

# BOOK 1 – ETHICAL AND PROFESSIONAL STANDARDS, QUANTITATIVE METHODS, AND ECONOMICS

---

|                                                                        |     |
|------------------------------------------------------------------------|-----|
| Readings and Learning Outcome Statements .....                         | 6   |
| Study Session 1 – Ethical and Professional Standards .....             | 14  |
| Study Session 2 – Ethical and Professional Standards: Application..... | 113 |
| Self-Test – Ethical and Professional Standards.....                    | 131 |
| Study Session 3 – Quantitative Methods for Valuation .....             | 141 |
| Self-Test – Quantitative Methods for Valuation.....                    | 258 |
| Study Session 4 – Economics for Valuation .....                        | 262 |
| Self-Test – Economics for Valuation.....                               | 356 |
| Formulas.....                                                          | 359 |
| Appendices .....                                                       | 363 |
| Index .....                                                            | 372 |

LEVEL 2 BOOK 1: ETHICAL AND PROFESSIONAL STANDARDS, QUANTITATIVE METHODS,  
AND ECONOMICS

©2009 Kaplan, Inc. All rights reserved.

Published in September 2009 by Kaplan Schweser.

Printed in the United States of America.

ISBN: 1-4277-9462-6

PPN: 4550-0112

If this book does not have the hologram with the Kaplan Schweser logo on the back cover, it was distributed without permission of Kaplan Schweser, a Division of Kaplan, Inc., and is in direct violation of global copyright laws. Your assistance in pursuing potential violators of this law is greatly appreciated.

Required CFA Institute® disclaimer: "CFA® and Chartered Financial Analyst® are trademarks owned by CFA Institute. CFA Institute (formerly the Association for Investment Management and Research) does not endorse, promote, review, or warrant the accuracy of the products or services offered by Kaplan Schweser."

Certain materials contained within this text are the copyrighted property of CFA Institute. The following is the copyright disclosure for these materials: "Copyright, 2010, CFA Institute. Reproduced and republished from 2010 Learning Outcome Statements, Level 1, 2, and 3 questions from CFA® Program Materials, CFA Institute Standards of Professional Conduct, and CFA Institute's Global Investment Performance Standards with permission from CFA Institute. All Rights Reserved."

These materials may not be copied without written permission from the author. The unauthorized duplication of these notes is a violation of global copyright laws and the CFA Institute Code of Ethics. Your assistance in pursuing potential violators of this law is greatly appreciated.

Disclaimer: The Schweser Notes should be used in conjunction with the original readings as set forth by CFA Institute in their 2010 CFA Level 2 Study Guide. The information contained in these Notes covers topics contained in the readings referenced by CFA Institute and is believed to be accurate. However, their accuracy cannot be guaranteed nor is any warranty conveyed as to your ultimate exam success. The authors of the referenced readings have not endorsed or sponsored these Notes.

# WELCOME TO THE 2010 SCHWESERNOTES™

---

Thank you for trusting Kaplan Schweser to help you reach your goals. We are all very pleased to be able to help you prepare for the Level 2 CFA Exam. In this introduction, I want to explain the resources included with the SchweserNotes™, suggest how you can best use Schweser materials to prepare for the exam, and direct you toward other educational resources you will find helpful as you study for the exam.

Besides the SchweserNotes themselves, there are many educational resources available at Schweser.com. Just log in using the individual username and password that you received when you purchased the SchweserNotes, and go to Online Access Home.

## **SchweserNotes™**

Five volumes that include complete coverage of all 18 Study Sessions and all Learning Outcome Statements (LOS) with examples, Concept Checkers (multiple-choice questions for every reading), and Challenge Problems for many readings to help you master the material and check your progress. At the end of each topic area, we include a Self-test. Self-test questions are created to be exam-like in format and difficulty in order for you to evaluate how well your study of each topic has prepared you for the actual exam. The Level 2 SchweserNotes Package also includes a sixth volume, the Level 1 Refresher, a review of important Level 1 material.

## **Practice Exams Volume 1**

Three full (120-question, 6-hour) Level 2 practice exams to help you prepare for the exam itself as well as to better target your final review efforts.

## **Schweser Library**

We have created reference videos, some of which are available to all SchweserNotes purchasers. Schweser Library volumes range from 20 to 60 minutes in length and cover such topics as: "Introduction to Item Sets," "Hypothesis Testing," "Foreign Exchange Basics," "Ratio Analysis," and "Forward Contracts." The full Schweser Library is included with our 16-week live and online classes and with our video class series.

## **Online Schweser Study Planner**

Use your Online Access to tell us when you will start and what days of the week you can study. The online Schweser Study Planner will create a study plan just for you, breaking each study session into daily and weekly tasks to keep you on track and help you monitor your progress through the curriculum.

## **Additional Resources**

Purchasers of the Essential Prep or Premium Packages also receive access to our Instructor-led Office Hours. Office Hours allow you to get your questions about the curriculum answered in real time and to see others' questions (and instructor answers) as well. Office Hours is a text-based live interactive online chat with our team of Level 2 experts. Archives of previous Office Hours sessions can be sorted by topic or date and are posted shortly after each session.

The Level 2 CFA exam is a formidable challenge (68 readings and 450+ Learning Outcome Statements), and you must devote considerable time and effort to be properly prepared. There is no shortcut! You must learn the material, know the terminology and techniques, understand the concepts, and be able to answer (70% of) 120 questions quickly and correctly. Fifteen to 20 hours per week for 20 weeks is probably a good estimate of the study time required on average, but some candidates will need more or less time, depending on their individual backgrounds and experience.

To help you master this material and be well prepared for the CFA Exam, we offer several other educational resources, including:

### **Live Weekly Classroom Programs**

We offer weekly classroom programs around the world. Please check at Schweser.com for locations, dates, and availability.

### **16-Week Online Classes**

Our 16-Week Online Classes are available at New York Time (6:30–9:30 pm) or London Time (6:00–9:00 pm). The approximate schedule for the 16-Week Online Classes (3-hour sessions) is as follows:

| <u>Class #</u>                          | <u>Class #</u>                                   |
|-----------------------------------------|--------------------------------------------------|
| 1) Exam Intro/Ethical Standards SS 1, 2 | 9) Equity SS 10, 11                              |
| 2) Quantitative Methods SS 3            | 10) Equity SS 11, 12                             |
| 3) Economics for Valuation SS 4         | 11) Alternative Asset Valuation SS 13            |
| 4) Financial Reporting & Analysis SS 5  | 12) Fixed Income SS 14                           |
| 5) Financial Reporting & Analysis SS 6  | 13) Fixed Income SS 15                           |
| 6) Financial Reporting & Analysis SS 7  | 14) Derivatives SS 16, 17                        |
| 7) Corporate Finance SS 8               | 15) Derivatives & Portfolio Management SS 17, 18 |
| 8) Corporate Finance & Equity SS 9, 10  | 16) Portfolio Management SS 18                   |

Archived classes are available for viewing at any time throughout the season. Candidates enrolled in the 16-Week Online Classes also have full access to supplemental on-demand video instruction in the Schweser Library and an e-mail address to use to send questions to the instructor at any time.

### **Intensive Review**

Whether you are a self-study student or use a Schweser instruction alternative, attending an Intensive Review Seminar as part of your final preparation can make all the difference. We have several options for final review of the core curriculum material at each level. We offer live classroom 3-Day Intensive Review Seminars in many cities around the United States, an online on-demand archive of the Chicago Intensive 3-Day Review Seminar, 5-day review programs in Dallas and many western European cities, and our flagship 7-day residence program, WindsorWeek®, in Windsor, Ontario, Canada. Please visit us at Schweser.com for details and a complete listing of intensive review options.

### **Practice Questions**

In order to retain what you learn, it is important that you quiz yourself often. We offer CD, download, and online versions of the SchweserPro™ QBank, which contains thousands of Level 2 practice questions, item sets, and explanations. Quizzes are available for each LOS, Reading, or Study Session. Build your own exams by specifying the topics and the number of questions you choose.

### **Practice Exams**

Schweser offers six full 6-hour practice exams. Practice Exams Volume 1 and Volume 2 each contain three full 120-question exams. These are important tools for gaining the speed and skills you will need to pass the exam. Each book contains answers with full explanations for self-grading and evaluation. By entering your answers at Schweser.com, you can use our Performance Tracker to find out how you have performed compared to other Schweser Level 2 candidates.

### **Mock Exam and Multimedia Tutorial**

On May 22, 2010, the Schweser Mock Exam will be offered live in many cities around the world and as an online exam as well. The optional Multimedia Tutorial provides extended explanation and topic tutorials to get you exam-ready in areas where you miss questions on the Mock Exam.

### **How to Succeed**

There are no shortcuts; depend on the fact that CFA Institute will test you in a way that will reveal how well you know the Level 2 curriculum. You should begin early and stick to your study plan. You should first read the SchweserNotes and complete the Concept Checkers and Challenge Problems for each reading. You should prepare for and attend a live class, an online class, or a study group each week. You should take quizzes often using SchweserPro Qbank and go back to review previous readings and Study Sessions as well. At the end of each topic area you should take the self-test to check your progress. You should finish the overall curriculum at least two weeks (preferably four weeks) before the Level 2 exam so that you have sufficient time for Practice Exams and for further review of those topics that you have not yet mastered.

I would like to thank Kevin Rygg, CFA Content Specialist, Stephanie Downey, Editorial Project Manager, and Jeff Faas, Lead Editor, for their contributions to the 2010 Level 2 SchweserNotes for the CFA Exam.

Best regards,

*Doug Van Eaton*

Dr. Doug Van Eaton, CFA  
SVP and Head of CFA Education

Kaplan Schweser

# READINGS AND LEARNING OUTCOME STATEMENTS

---

## READINGS

*The following material is a review of the Ethical and Professional Standards, Quantitative Methods, and Economics principles designed to address the learning outcome statements set forth by CFA Institute.*

### STUDY SESSION 1

#### Reading Assignments

*Ethical and Professional Standards and Quantitative Methods*, CFA Program Curriculum, Volume 1, Level 2 (CFA Institute, 2010)

- |    |                                                      |          |
|----|------------------------------------------------------|----------|
| 1. | Code of Ethics and Standards of Professional Conduct | page 14  |
| 2. | Guidance for Standards I–VII                         | page 14  |
| 3. | CFA Institute Soft Dollar Standards                  | page 94  |
| 4. | CFA Institute Research Objectivity Standards         | page 104 |

### STUDY SESSION 2

#### Reading Assignments

*Ethical and Professional Standards and Quantitative Methods*, CFA Program Curriculum, Volume 1, Level 2 (CFA Institute, 2010)

- |     |                                               |          |
|-----|-----------------------------------------------|----------|
| 5.  | The Glenarm Company                           | page 113 |
| 6.  | Preston Partners                              | page 115 |
| 7.  | Super Selection                               | page 118 |
| 8.  | Trade Allocation: Fair Dealing and Disclosure | page 121 |
| 9.  | Changing Investment Objectives                | page 123 |
| 10. | Prudence in Perspective                       | page 124 |

### STUDY SESSION 3

#### Reading Assignments

*Ethical and Professional Standards and Quantitative Methods*, CFA Program Curriculum, Volume 1, Level 2 (CFA Institute, 2010)

- |     |                                                       |          |
|-----|-------------------------------------------------------|----------|
| 11. | Correlation and Regression                            | page 141 |
| 12. | Multiple Regression and Issues in Regression Analysis | page 175 |
| 13. | Time-Series Analysis                                  | page 221 |

## STUDY SESSION 4

### Reading Assignments

*Economics*, CFA Program Curriculum, Volume 1, Level 2 (CFA Institute, 2010)

|     |                                                         |          |
|-----|---------------------------------------------------------|----------|
| 14. | Economic Growth                                         | page 262 |
| 15. | Regulation and Antitrust Policy in a Globalized Economy | page 280 |
| 16. | Trading with the World                                  | page 287 |
| 17. | The Exchange Rate and the Balance of Payments           | page 298 |
| 18. | Currency Exchange Rates                                 | page 309 |
| 19. | Foreign Exchange Parity Relations                       | page 329 |
| 20. | Measuring Economic Activity                             | page 350 |

### LEARNING OUTCOME STATEMENTS (LOS)

*The CFA Institute Learning Outcome Statements are listed below. These are repeated in each topic review; however, the order may have been changed in order to get a better fit with the flow of the review.*

## STUDY SESSION 1

*The topical coverage corresponds with the following CFA Institute assigned reading:*

### 1. Code of Ethics and Standards of Professional Conduct

The candidate should be able to:

- state the six components of the Code of Ethics and the seven Standards of Professional Conduct. (page 14)
- explain the ethical responsibilities required by the Code and Standards. (page 14)

*The topical coverage corresponds with the following CFA Institute assigned reading:*

### 2. Guidance for Standards I–VII

The candidate should be able to:

- demonstrate a thorough knowledge of the Code of Ethics and Standards of Professional Conduct by applying the Code and Standards to specific situations. (page 19)
- recommend practices and procedures designed to prevent violations of the Code of Ethics and Standards of Professional Conduct. (page 19)

*The topical coverage corresponds with the following CFA Institute assigned reading:*

### 3. CFA Institute Soft Dollar Standards

The candidate should be able to:

- define soft-dollar arrangements and state the general principles of the Soft Dollar Standards. (page 94)
- critique company soft-dollar practices and policies. (page 95)
- determine whether a product or service qualifies as “permissible research” that can be purchased with client brokerage. (page 98)

*The topical coverage corresponds with the following CFA Institute assigned reading:*

**4. CFA Institute Research Objectivity Standards**

The candidate should be able to:

- a. explain the objectives of the Research Objectivity Standards. (page 104)
- b. critique company policies and practices related to research objectivity and distinguish between changes required and changes recommended for compliance with the Research Objectivity Standards. (page 104)

## STUDY SESSION 2

*The topical coverage corresponds with the following CFA Institute assigned reading:*

**5. The Glenarm Company**

**6. Preston Partners**

**7. Super Selection**

For each of these cases, the candidate should be able to:

- a. critique the practices and policies presented. (pages 113, 115, 118)
- b. explain the appropriate action to take in response to conduct that violates the CFA Institute Code of Ethics and Standards of Professional Conduct. (pages 113, 115, 118)

*The topical coverage corresponds with the following CFA Institute assigned reading:*

**8. Trade Allocation: Fair Dealing and Disclosure**

The candidate should be able to:

- a. critique trade allocation practices and determine whether there is compliance with the CFA Institute Standards of Professional Conduct addressing fair dealing and client loyalty. (page 121)
- b. discuss appropriate actions to take in response to trade allocation practices that do not adequately respect client interests. (page 122)

*The topical coverage corresponds with the following CFA Institute assigned reading:*

**9. Changing Investment Objectives**

The candidate should be able to:

- a. critique the disclosure of investment objectives and basic policies and determine whether they comply with the CFA Institute Standards of Professional Conduct. (page 123)
- b. discuss appropriate actions needed to ensure adequate disclosure of the investment process. (page 123)

*The topical coverage corresponds with the following CFA Institute assigned reading:*

**10. Prudence in Perspective**

The candidate should be able to:

- a. explain the basic principles of the new Prudent Investor Rule. (page 124)
- b. explain the general fiduciary standards to which a trustee must adhere. (page 125)
- c. differentiate between the old Prudent Man Rule and the new Prudent Investor Rule. (page 126)
- d. explain the key factors that a trustee should consider when investing and managing trust assets. (page 126)



## STUDY SESSION 3

*The topical coverage corresponds with the following CFA Institute assigned reading:*

### 11. Correlation and Regression

The candidate should be able to:

- a. calculate and interpret a sample covariance and a sample correlation coefficient, and interpret a scatter plot. (page 141)
- b. explain the limitations to correlation analysis, including outliers and spurious correlation. (page 145)
- c. formulate a test of the hypothesis that the population correlation coefficient equals zero and determine whether the hypothesis is rejected at a given level of significance. (page 146)
- d. differentiate between the dependent and independent variables in a linear regression. (page 147)
- e. explain the assumptions underlying linear regression and interpret the regression coefficients. (page 148)
- f. calculate and interpret the standard error of estimate, the coefficient of determination, and a confidence interval for a regression coefficient. (page 152)
- g. formulate a null and alternative hypothesis about a population value of a regression coefficient, select the appropriate test statistic, and determine whether the null hypothesis is rejected at a given level of significance. (page 154)
- h. calculate a predicted value for the dependent variable, given an estimated regression model and a value for the independent variable and calculate and interpret a confidence interval for the predicted value of a dependent variable. (page 155)
- i. describe the use of analysis of variance (ANOVA) in regression analysis, interpret ANOVA results, and calculate and interpret an  $F$ -statistic. (page 157)
- j. discuss the limitations of regression analysis. (page 162)

*The topical coverage corresponds with the following CFA Institute assigned reading:*

### 12. Multiple Regression and Issues in Regression Analysis

The candidate should be able to:

- a. formulate a multiple regression equation to describe the relation between a dependent variable and several independent variables, determine the statistical significance of each independent variable, and interpret the estimated coefficients and their  $p$ -values. (page 176)
- b. formulate a null and an alternative hypothesis about the population value of a regression coefficient, calculate the value of the test statistic, determine whether to reject the null hypothesis at a given level of significance by using a one-tailed or two-tailed test, and interpret the results of the test. (page 178)
- c. calculate and interpret 1) a confidence interval for the population value of a regression coefficient and 2) a predicted value for the dependent variable, given an estimated regression model and assumed values for the independent variables. (page 182)
- d. explain the assumptions of a multiple regression model. (page 184)
- e. calculate and interpret the  $F$ -statistic and discuss how it is used in regression analysis; define, distinguish between, and interpret the  $R^2$  and adjusted  $R^2$  in multiple regression; and infer how well a regression model explains the dependent variable by analyzing the output of the regression equation and an ANOVA table. (page 184)

- f. formulate a multiple regression equation by using dummy variables to represent qualitative factors and interpret the coefficients and regression results. (page 193)
- g. discuss the types of heteroskedasticity and the effects of heteroskedasticity and serial correlation on statistical inference. (page 196)
- h. describe multicollinearity and discuss its causes and effects in regression analysis. (page 203)
- i. discuss the effects of model misspecification on the results of a regression analysis and explain how to avoid the common forms of misspecification. (page 205)
- j. discuss models with qualitative dependent variables. (page 209)
- k. interpret the economic meaning of the results of multiple regression analysis and critique a regression model and its results. (page 209)

*The topical coverage corresponds with the following CFA Institute assigned reading:*

**13. Time-Series Analysis**

The candidate should be able to:

- a. calculate and evaluate the predicted trend value for a time series, modeled as either a linear trend or a log-linear trend, given the estimated trend coefficients. (page 221)
- b. discuss the factors that determine whether a linear or a log-linear trend should be used with a particular time series and evaluate the limitations of trend models. (page 227)
- c. explain the requirement for a time series to be covariance stationary and discuss the significance of a series not being stationary. (page 236)
- d. discuss the structure of an autoregressive (AR) model of order  $p$ , calculate one- and two-period-ahead forecasts given the estimated coefficients, and explain how autocorrelations of the residuals can be used to test whether the autoregressive model fits the time series. (page 228)
- e. explain mean reversion and calculate a mean-reverting level. (page 237)
- f. contrast in-sample and out-of-sample forecasts and compare the forecasting accuracy of different time-series models based on the root mean squared error criterion. (page 234)
- g. discuss the instability of coefficients of time-series models. (page 235)
- h. describe the characteristics of random walk processes and contrast them to covariance stationary processes. (page 238)
- i. discuss the implications of unit roots for time-series analysis, explain when unit roots are likely to occur and how to test for them, and demonstrate how a time series with a unit root can be transformed so it can be analyzed with an AR model. (page 239)
- j. discuss the steps of the unit root test for nonstationarity and explain the relation of the test to autoregressive time-series models. (page 239)
- k. discuss how to test and correct for seasonality in a time-series model and calculate and interpret a forecasted value using an AR model with a seasonal lag. (page 231)
- l. explain autoregressive conditional heteroskedasticity (ARCH) and discuss how ARCH models can be applied to predict the variance of a time series. (page 245)
- m. explain how time-series variables should be analyzed for nonstationarity and/or cointegration before use in a linear regression. (page 243)
- n. select and justify the choice of a particular time-series model from a group of models. (page 246)

## STUDY SESSION 4

*The topical coverage corresponds with the following CFA Institute assigned reading:*

### 14. Economic Growth

The candidate should be able to:

- a. define the sources of economic growth and discuss the preconditions for economic growth. (page 263)
- b. discuss how the one-third rule can be used to explain the contributions of labor and technological change to growth in labor productivity. (page 264)
- c. discuss how faster economic growth can be achieved by increasing the growth of physical capital, technological advances, and investment in human capital. (page 267)
- d. compare and contrast classical growth theory, neoclassical growth theory, and new growth theory. (page 267)

*The topical coverage corresponds with the following CFA Institute assigned reading:*

### 15. Regulation and Antitrust Policy in a Globalized Economy

The candidate should be able to:

- a. explain the rationale for government regulation in the form of 1) economic regulation of natural monopolies and 2) social regulation of nonmonopolistic industries. (page 280)
- b. discuss the potential benefits and possible negative side effects of social regulation. (page 282)
- c. differentiate between the capture hypothesis and the share-the-gains, share-the-pains theory of regulator behavior. (page 282)

*The topical coverage corresponds with the following CFA Institute assigned reading:*

### 16. Trading with the World

The candidate should be able to:

- a. explain comparative advantage and how countries can gain from international trade. (page 287)
- b. compare and contrast tariffs, nontariff barriers, quotas, and voluntary export restraints. (page 290)
- c. critique the arguments for trade restrictions. (page 292)

*The topical coverage corresponds with the following CFA Institute assigned reading:*

### 17. The Exchange Rate and the Balance of Payments

The candidate should be able to:

- a. define an exchange rate and differentiate between the nominal exchange rate and the real exchange rate. (page 298)
- b. explain the factors that influence supply and demand in the foreign exchange market. (page 299)
- c. discuss how the supply and demand for a currency changes the exchange rate. (page 301)
- d. differentiate between interest rate parity and purchasing power parity. (page 302)
- e. describe the balance of payments accounts. (page 303)
- f. describe the following exchange rate policies: flexible exchange rates, fixed exchange rates, and crawling pegs. (page 304)

*The topical coverage corresponds with the following CFA Institute assigned reading:*

**18. Currency Exchange Rates**

The candidate should be able to:

- a. define direct and indirect methods of foreign exchange quotations and convert direct (indirect) foreign exchange quotations into indirect (direct) foreign exchange quotations. (page 309)
- b. calculate and interpret the spread on a foreign currency quotation and explain how spreads on foreign currency quotations can differ as a result of market conditions, bank/dealer positions, and trading volume. (page 311)
- c. calculate and interpret currency cross rates, given two spot exchange quotations involving three currencies. (page 312)
- d. calculate the profit on a triangular arbitrage opportunity, given the bid-ask quotations for the currencies of three countries involved in the arbitrage. (page 314)
- e. distinguish between the spot and forward markets for foreign exchange. (page 315)
- f. calculate and interpret the spread on a forward foreign currency quotation and explain how spreads on forward foreign currency quotations can differ as a result of market conditions, bank/dealer positions, trading volume, and maturity/length of contract. (page 316)
- g. calculate and interpret a forward discount or premium and express it as an annualized rate. (page 317)
- h. explain interest rate parity and illustrate covered interest arbitrage. (page 318)
- i. distinguish between spot and forward transactions, calculate the annualized forward premium/discount for a given currency, and infer whether the currency is “strong” or “weak.” (page 320)

*The topical coverage corresponds with the following CFA Institute assigned reading:*

**19. Foreign Exchange Parity Relations**

The candidate should be able to:

- a. explain how exchange rates are determined in a flexible (or floating) exchange rate system. (page 329)
- b. explain the role of each component of the balance of payments accounts. (page 329)
- c. explain how current account deficits or surpluses and financial account deficits or surpluses affect an economy. (page 330)
- d. describe the factors that cause a nation’s currency to appreciate or depreciate. (page 330)
- e. explain how monetary and fiscal policies affect the exchange rate and balance of payments components. (page 331)
- f. describe a fixed exchange rate and a pegged exchange rate system. (page 332)
- g. define and discuss absolute purchasing power parity and relative purchasing power parity. (page 333)
- h. calculate the end-of-period exchange rate implied by purchasing power parity, given the beginning-of-period exchange rate and the inflation rates. (page 333)
- i. define and discuss the international Fisher relation. (page 335)
- j. calculate the real interest rate, given interest rates and inflation rates and the assumption that the international Fisher relation holds. (page 335)
- k. calculate the international Fisher relation, and its linear approximation, between interest rates and expected inflation rates. (page 335)

- l. define and discuss the theory of uncovered interest rate parity and explain the theory's relation to other exchange rate parity theories. (page 337)
- m. calculate the expected change in the exchange rate, given interest rates and the assumption that uncovered interest rate parity holds. (page 337)
- n. discuss the foreign exchange expectation relation between the forward exchange rate and the expected exchange rate. (page 339)

*The topical coverage corresponds with the following CFA Institute assigned reading:*

**20. Measuring Economic Activity**

The candidate should be able to:

- a. distinguish between the different measures of economic activity and their components. (page 350)
- b. differentiate between GDP at market prices and GDP at factor cost and explain the adjustments made. (page 352)
- c. differentiate between current and constant prices and describe the GDP deflator. (page 352)

---

The following is a review of the Ethical and Professional Standards principles designed to address the learning outcome statements set forth by CFA Institute®. This topic is also covered in:

# CFA INSTITUTE CODE OF ETHICS AND STANDARDS OF PROFESSIONAL CONDUCT AND “GUIDANCE” FOR STANDARDS I–VII

Study Session 1

---

## EXAM FOCUS

In addition to reading this review of the ethics material, we strongly recommend that all candidates for the CFA® examination *purchase* their own copy of the *Standards of Practice Handbook* 9th Edition (2005) and read it multiple times. As a registered candidate, it is your responsibility to own an original copy of the *Code and Standards* and to comply with the *Code and Standards*.



*Professor's Note: The 9th edition of the Standards of Practice Handbook is now in effect. There are significant revisions, restructurings, additions, and deletions to the previous edition that you should be aware of.*

---

**LOS 1.a: State the six components of the Code of Ethics and the seven Standards of Professional Conduct.**

**LOS 1.b: Explain the ethical responsibilities required by the Code and Standards.**

---

## Code of Ethics

Members of CFA Institute [including Chartered Financial Analyst® (CFA®) charterholders] and candidates for the CFA designation (“Members and Candidates”) must:<sup>1</sup>

- Act with integrity, competence, diligence, respect, and in an ethical manner with the public, clients, prospective clients, employers, employees, colleagues in the investment profession, and other participants in the global capital markets.
- Place the integrity of the investment profession and the interests of clients above their own personal interests.
- Use reasonable care and exercise independent professional judgment when conducting investment analysis, making investment recommendations, taking investment actions, and engaging in other professional activities.
- Practice and encourage others to practice in a professional and ethical manner that will reflect credit on themselves and the profession.
- Promote the integrity of, and uphold the rules governing, capital markets.

---

1. Copyright 2005, CFA Institute. Reproduced and republished from “The Code of Ethics,” from *Standards of Practice Handbook*, 9th ed., 2005, with permission from CFA Institute. All rights reserved.

- Maintain and improve their professional competence and strive to maintain and improve the competence of other investment professionals.

The Standards of Professional Conduct are organized into seven standards:

- I. Professionalism
- II. Integrity of Capital Markets
- III. Duties to Clients
- IV. Duties to Employers
- V. Investment Analysis, Recommendations, and Action
- VI. Conflicts of Interest
- VII. Responsibilities as a CFA Institute Member or CFA Candidate

## **I. PROFESSIONALISM**

- A. **Knowledge of the Law.** Members and Candidates must understand and comply with all applicable laws, rules, and regulations (including the CFA Institute Code of Ethics and Standards of Professional Conduct) of any government, regulatory organization, licensing agency, or professional association governing their professional activities. In the event of conflict, Members and Candidates must comply with the more strict law, rule, or regulation. Members and Candidates must not knowingly participate or assist in any violation of laws, rules, or regulations and must disassociate themselves from any such violation.
- B. **Independence and Objectivity.** Members and Candidates must use reasonable care and judgment to achieve and maintain independence and objectivity in their professional activities. Members and Candidates must not offer, solicit, or accept any gift, benefit, compensation, or consideration that reasonably could be expected to compromise their own or another's independence and objectivity.
- C. **Misrepresentation.** Members and Candidates must not knowingly make any misrepresentations relating to investment analysis, recommendations, actions, or other professional activities.
- D. **Misconduct.** Members and Candidates must not engage in any professional conduct involving dishonesty, fraud, or deceit or commit any act that reflects adversely on their professional reputation, integrity, or competence.

## **II. INTEGRITY OF CAPITAL MARKETS**

- A. **Material Nonpublic Information.** Members and Candidates who possess material nonpublic information that could affect the value of an investment must not act or cause others to act on the information.
- B. **Market Manipulation.** Members and Candidates must not engage in practices that distort prices or artificially inflate trading volume with the intent to mislead market participants.

### III. DUTIES TO CLIENTS

- A. **Loyalty, Prudence, and Care.** Members and Candidates have a duty of loyalty to their clients and must act with reasonable care and exercise prudent judgment. Members and Candidates must act for the benefit of their clients and place their clients' interests before their employer's or their own interests. In relationships with clients, Members and Candidates must determine applicable fiduciary duty and must comply with such duty to persons and interests to whom it is owed.
- B. **Fair Dealing.** Members and Candidates must deal fairly and objectively with all clients when providing investment analysis, making investment recommendations, taking investment action, or engaging in other professional activities.
- C. **Suitability.**
1. When Members and Candidates are in an advisory relationship with a client, they must:
    - a. Make a reasonable inquiry into a client's or prospective clients' investment experience, risk and return objectives, and financial constraints prior to making any investment recommendation or taking investment action and must reassess and update this information regularly.
    - b. Determine that an investment is suitable to the client's financial situation and consistent with the client's written objectives, mandates, and constraints before making an investment recommendation or taking investment action.
    - c. Judge the suitability of investments in the context of the client's total portfolio.
  2. When Members and Candidates are responsible for managing a portfolio to a specific mandate, strategy, or style, they must make only investment recommendations or take investment actions that are consistent with the stated objectives and constraints of the portfolio.
- D. **Performance Presentation.** When communicating investment performance information, Members or Candidates must make reasonable efforts to ensure that it is fair, accurate, and complete.
- E. **Preservation of Confidentiality.** Members and Candidates must keep information about current, former, and prospective clients confidential unless:
1. The information concerns illegal activities on the part of the client or prospective client,
  2. Disclosure is required by law, or
  3. The client or prospective client permits disclosure of the information.



#### IV. DUTIES TO EMPLOYERS

- A. **Loyalty.** In matters related to their employment, Members and Candidates must act for the benefit of their employer and not deprive their employer of the advantage of their skills and abilities, divulge confidential information, or otherwise cause harm to their employer.
- B. **Additional Compensation Arrangements.** Members and Candidates must not accept gifts, benefits, compensation, or consideration that competes with, or might reasonably be expected to create a conflict of interest with, their employer's interest unless they obtain written consent from all parties involved.
- C. **Responsibilities of Supervisors.** Members and Candidates must make reasonable efforts to detect and prevent violations of applicable laws, rules, regulations, and the Code and Standards by anyone subject to their supervision or authority.

#### V. INVESTMENT ANALYSIS, RECOMMENDATIONS, AND ACTION

- A. **Diligence and Reasonable Basis.** Members and Candidates must:
  - 1. Exercise diligence, independence, and thoroughness in analyzing investments, making investment recommendations, and taking investment actions.
  - 2. Have a reasonable and adequate basis, supported by appropriate research and investigation, for any investment analysis, recommendation, or action.
- B. **Communication with Clients and Prospective Clients.** Members and Candidates must:
  - 1. Disclose to clients and prospective clients the basic format and general principles of the investment processes used to analyze investments, select securities, and construct portfolios and must promptly disclose any changes that might materially affect those processes.
  - 2. Use reasonable judgment in identifying which factors are important to their investment analyses, recommendations, or actions and include those factors in communications with clients and prospective clients.
  - 3. Distinguish between fact and opinion in the presentation of investment analysis and recommendations.
- C. **Record Retention.** Members and Candidates must develop and maintain appropriate records to support their investment analysis, recommendations, actions, and other investment related communications with clients and prospective clients.

**VI. CONFLICTS OF INTEREST**

- A. **Disclosure of Conflicts.** Members and Candidates must make full and fair disclosure of all matters that could reasonably be expected to impair their independence and objectivity or interfere with respective duties to their clients, prospective clients, and employer. Members and Candidates must ensure that such disclosures are prominent, are delivered in plain language, and communicate the relevant information effectively.
- B. **Priority of Transactions.** Investment transactions for clients and employers must have priority over investment transactions in which a Member or Candidate is the beneficial owner.
- C. **Referral Fees.** Members and Candidates must disclose to their employer, clients, and prospective clients, as appropriate, any compensation, consideration, or benefit received by, or paid to, others for the recommendation of products or services.

**VII. RESPONSIBILITIES AS A CFA INSTITUTE MEMBER OR CFA CANDIDATE**

- A. **Conduct as Members and Candidates in the CFA Program.** Members and Candidates must not engage in any conduct that compromises the reputation or integrity of CFA Institute or the CFA designation or the integrity, validity, or security of the CFA examinations.
- B. **Reference to CFA Institute, the CFA Designation, and the CFA Program.** When referring to CFA Institute, CFA Institute membership, the CFA designation, or candidacy in the CFA Program, Members and Candidates must not misrepresent or exaggerate the meaning or implications of membership in CFA Institute, holding the CFA designation, or candidacy in the CFA Program.

## STANDARDS OF PROFESSIONAL CONDUCT: GUIDANCE, COMPLIANCE, AND EXAMPLES

---

LOS 2.a: Demonstrate a thorough knowledge of the Code of Ethics and Standards of Professional Conduct by applying the Code and Standards to specific situations.

LOS 2.b: Recommend practices and procedures designed to prevent violations of the Code of Ethics and Standards of Professional Conduct.

---



*Professor's Note: While we use the term "members" in the following discussion, note that all of the standards apply to candidates as well.*

### I. PROFESSIONALISM

**I(A) Knowledge of the Law.** Members must understand and comply with laws, rules, regulations, and Code and Standards of any authority governing their activities. In the event of a conflict, follow the more strict law, rule, or regulation. Do not knowingly participate or assist in violations, and *dissociate from any known violation*.

#### *Guidance—Code and Standards vs. Local Law*

Members must know the laws and regulations relating to their professional activities in all countries in which they conduct business. Members must comply with applicable laws and regulations relating to their professional activity. Do not violate Code or Standards even if the activity is otherwise legal. Always adhere to the most strict rules and requirements (law or CFA Institute Standards) that apply.

#### *Guidance—Participation or Association With Violations by Others*

Members should dissociate, or separate themselves, from any ongoing client or employee activity that is illegal or unethical, even if it involves leaving an employer (an extreme case). While a member may confront the involved individual first, he must approach his supervisor or compliance department. Inaction with continued association may be construed as knowing participation.

#### *Recommended Procedures for Compliance—Members*

- Members should have procedures to keep up with changes in applicable laws, rules, and regulations.
- Compliance procedures should be reviewed on an ongoing basis to assure that they address current law, CFA Institute Standards, and regulations.
- Members should maintain current reference materials for employees to access in order to keep up to date on laws, rules, and regulations.

- Members should seek advice of counsel or their compliance department when in doubt.
- Members should document any violations when they disassociate themselves from prohibited activity and encourage their employers to bring an end to such activity.
- There is no requirement under the Standards to report violations to governmental authorities, but this may be advisable in some circumstances and required by law in others.

#### *Recommended Procedures for Compliance—Firms*

Members should encourage their firms to:

- Develop and/or adopt a code of ethics.
- Make available to employees information that highlights applicable laws and regulations.
- Establish written procedures for reporting suspected violation of laws, regulations, or company policies.

#### *Application of Standard I(A) Knowledge of the Law<sup>2</sup>*

##### **Example 1:**

Michael Allen works for a brokerage firm and is responsible for an underwriting of securities. A company official gives Allen information indicating that the financial statements Allen filed with the regulator overstate the issuer's earnings. Allen seeks the advice of the brokerage firm's general counsel, who states that it would be difficult for the regulator to prove that Allen has been involved in any wrongdoing.

##### **Comment:**

Although it is recommended that members and candidates seek the advice of legal counsel, the reliance on such advice does not absolve a member or candidate from the requirement to comply with the law or regulation. Allen should report this situation to his supervisor, seek an independent legal opinion, and determine whether the regulator should be notified of the error.

##### **Example 2:**

Kamisha Washington's firm advertises its past performance record by showing the 10-year return of a composite of its client accounts. However, Washington discovers that the composite omits the performance of accounts that have left the firm during the 10-year period and that this omission has led to an inflated performance figure. Washington is asked to use promotional material that includes the erroneous performance number when soliciting business for the firm.

##### **Comment:**

Misrepresenting performance is a violation of the Code and Standards. Although she did not calculate the performance herself, Washington would be assisting in violating this

2. Selected Examples and Comments. Copyright 2005, CFA Institute. Reproduced and republished from *Standards of Practice Handbook*, 9th ed., 2005, with permission from CFA Institute. All Rights Reserved.

standard if she were to use the inflated performance number when soliciting clients. She must dissociate herself from the activity. She can bring the misleading number to the attention of the person responsible for calculating performance, her supervisor, or the compliance department at her firm. If her firm is unwilling to recalculate performance, she must refrain from using the misleading promotional material and should notify the firm of her reasons. If the firm insists that she use the material, she should consider whether her obligation to dissociate from the activity would require her to seek other employment.

### Example 3:

An employee of an investment bank is working on an underwriting and finds out the issuer has altered their financial statements to hide operating losses in one division. These misstated data are included in a preliminary prospectus that has already been released.

### Comment:

The employee should report the problem to his supervisors. If the firm doesn't get the misstatement fixed, the employee should dissociate from the underwriting and further, seek legal advice about whether he should undertake additional reporting or other actions.

### Example 4:

Laura Jameson is a U.S. citizen, works for an investment adviser based in the United States, and works in a country where investment managers are prohibited from participating in IPOs for their own accounts.

### Comment:

Jameson must comply with the strictest requirements among U.S. law (where her firm is based), the CFA Institute Code and Standards, and the laws of the country where she is doing business. In this case that means she must not participate in any IPOs for her personal account.

**I(B) Independence and Objectivity.** Use reasonable care to exercise independence and objectivity in professional activities. Members and Candidates are not to offer, solicit, or accept any gift, benefit, compensation, or consideration that would compromise either their own or someone else's independence and objectivity.



*Professor's Note: Gifts, benefits, and other consideration are prohibited if given in an attempt to influence Members or Candidates.*

### *Guidance*

Do not let the investment process be influenced by any external sources. Modest gifts are permitted. Allocation of shares in oversubscribed IPOs to personal accounts is NOT permitted. Distinguish between gifts from clients and gifts from entities seeking influence to the detriment of the client. Gifts must be disclosed to the member's employer in any case.

### *Guidance—Investment Banking Relationships*

Do not be pressured by sell-side firms to issue favorable research on current or prospective investment banking clients. It is appropriate to have analysts work with investment bankers in "road shows" only when the conflicts are adequately and effectively managed and disclosed. Be sure there are effective "firewalls" between research/investment management and investment banking activities.

### *Guidance—Public Companies*

Analysts should not be pressured to issue favorable research by the companies they follow. Do not confine research to discussions with company management, but rather use a variety of sources, including suppliers, customers, and competitors.

### *Guidance—Buy-Side Clients*

Buy-side clients may try to pressure sell-side analysts. Portfolio managers may have large positions in a particular security, and a rating downgrade may have an effect on the portfolio performance. As a portfolio manager, there is a responsibility to respect and foster intellectual honesty of sell-side research.

### *Guidance—Issuer-Paid Research*

Remember that this type of research is fraught with potential conflicts. Analysts' compensation for preparing such research should be limited, and the preference is for a flat fee, without regard to conclusions or the report's recommendations.

### *Recommended Procedures for Compliance*

- Protect the integrity of opinions—make sure they are unbiased.
- Create a restricted list and distribute only factual information about companies on the list.
- Restrict special cost arrangements—pay for one's own commercial transportation and hotel; limit use of corporate aircraft to cases in which commercial transportation is not available.
- Limit gifts—token items only. Customary, business-related entertainment is okay as long as its purpose is not to influence a member's professional independence or objectivity.
- Restrict employee investments in equity IPOs and private placements.

- Review procedures—have effective supervisory and review procedures.
- Firms should have formal written policies on independence and objectivity of research.

*Application of Standard I(B) Independence and Objectivity*

**Example 1:**

Steven Taylor, a mining analyst with Bronson Brokers, is invited by Precision Metals to join a group of his peers in a tour of mining facilities in several western U.S. states. The company arranges for chartered group flights from site to site and for accommodations in Spartan Motels, the only chain with accommodations near the mines, for three nights. Taylor allows Precision Metals to pick up his tab, as do the other analysts, with one exception—John Adams, an employee of a large trust company who insists on following his company's policy and paying for his hotel room himself.

**Comment:**

The policy of Adams' company complies closely with Standard I(B) by avoiding even the appearance of a conflict of interest, but Taylor and the other analysts were not necessarily violating Standard I(B). In general, when allowing companies to pay for travel and/or accommodations under these circumstances, members and candidates must use their judgment, keeping in mind that such arrangements must not impinge on a member or candidate's independence and objectivity. In this example, the trip was strictly for business and Taylor was not accepting irrelevant or lavish hospitality. The itinerary required chartered flights, for which analysts were not expected to pay. The accommodations were modest. These arrangements are not unusual and did not violate Standard I(B) so long as Taylor's independence and objectivity were not compromised. In the final analysis, members and candidates should consider both whether they can remain objective and whether their integrity might be perceived by their clients to have been compromised.

**Example 2:**

Walter Fritz is an equity analyst with Hilton Brokerage who covers the mining industry. He has concluded that the stock of Metals & Mining is overpriced at its current level, but he is concerned that a negative research report will hurt the good relationship between Metals & Mining and the investment banking division of his firm. In fact, a senior manager of Hilton Brokerage has just sent him a copy of a proposal his firm has made to Metals & Mining to underwrite a debt offering. Fritz needs to produce a report right away and is concerned about issuing a less-than-favorable rating.

**Comment:**

Fritz's analysis of Metals & Mining must be objective and based solely on consideration of company fundamentals. Any pressure from other divisions of his firm is inappropriate. This conflict could have been eliminated if, in anticipation of the offering, Hilton Brokerage had placed Metals & Mining on a restricted list for its sales force.

**Example 3:**

Tom Wayne is the investment manager of the Franklin City Employees Pension Plan. He recently completed a successful search for firms to manage the foreign equity allocation of the plan's diversified portfolio. He followed the plan's standard procedure of seeking presentations from a number of qualified firms and recommended that his board select Penguin Advisors because of its experience, well-defined investment strategy, and performance record, which was compiled and verified in accordance with the CFA Institute Global Investment Performance Standards. Following the plan selection of Penguin, a reporter from the Franklin City Record called to ask if there was any connection between the action and the fact that Penguin was one of the sponsors of an "investment fact-finding trip to Asia" that Wayne made earlier in the year. The trip was one of several conducted by the Pension Investment Academy, which had arranged the itinerary of meetings with economic, government, and corporate officials in major cities in several Asian countries. The Pension Investment Academy obtains support for the cost of these trips from a number of investment managers including Penguin Advisors; the Academy then pays the travel expenses of the various pension plan managers on the trip and provides all meals and accommodations. The president of Penguin Advisors was one of the travelers on the trip.

**Comment:**

Although Wayne can probably put to good use the knowledge he gained from the trip in selecting portfolio managers and in other areas of managing the pension plan, his recommendation of Penguin Advisors may be tainted by the possible conflict incurred when he participated in a trip paid partly for by Penguin Advisors and when he was in the daily company of the president of Penguin Advisors. To avoid violating Standard I(B), Wayne's basic expenses for travel and accommodations should have been paid by his employer or the pension plan; contact with the president of Penguin Advisors should have been limited to informational or educational events only; and the trip, the organizer, and the sponsor should have been made a matter of public record. Even if his actions were not in violation of Standard I(B), Wayne should have been sensitive to the public perception of the trip when reported in the newspaper and the extent to which the subjective elements of his decision might have been affected by the familiarity that the daily contact of such a trip would encourage. This advantage would probably not be shared by competing firms.

**Example 4:**

An analyst in the corporate finance department promises a client that her firm will provide full research coverage of the issuing company after the offering.

**Comment:**

This is not a violation, but she cannot promise favorable research coverage. Research must be objective and independent.

**Example 5:**

An employee's boss tells him to assume coverage of a stock and maintain a buy rating.



**Comment:**

Research opinions and recommendations must be objective and independently arrived at. Following the boss' instructions would be a violation if the analyst determined a buy rating is inappropriate.

**Example 6:**

A money manager receives a gift of significant value from a client as a reward for good performance over the prior period and informs her employer of the gift.

**Comment:**

No violation here since the gift is from a client and is not based on performance going forward, but the gift must be disclosed to her employer. If the gift were contingent on future performance, the money manager must obtain permission from the employer. The reason for both the disclosure and permission requirements is that the employer must ensure that the money manager does not give advantage to the client giving or offering additional compensation to the detriment of other clients.

**Example 7:**

An analyst enters into a contract to write a research report on a company, paid for by that company, for a flat fee plus a bonus based on attracting new investors to the security.

**Comment:**

This is a violation because the compensation structure makes total compensation depend on the conclusions of the report (a favorable report will attract investors and increase compensation). Accepting the job for a flat fee that does not depend on the report's conclusions or its impact on share price is permitted, with proper disclosure of the fact that the report is funded by the subject company.

**1(C) Misrepresentation:** Do not misrepresent facts regarding investment analysis, recommendations, actions, or other professional activities.

**Guidance**

Trust is a foundation in the investment profession. Do not make any misrepresentations or give false impressions. This includes oral and electronic communications. Misrepresentations include guaranteeing investment performance and plagiarism. Plagiarism encompasses using someone else's work (reports, forecasts, charts, graphs, and spreadsheet models) without giving them credit.

**Recommended Procedures for Compliance**

A good way to avoid misrepresentation is for firms to provide employees who deal with clients or prospects a written list of the firm's available services and a description of the firm's qualifications. Employee qualifications should be accurately presented as well.

To avoid plagiarism, maintain records of all materials used to generate reports or other firm products and properly cite sources (quotes and summaries) in work products. Information from recognized financial and statistical reporting services need not be cited.

### *Application of Standard I(C) Misrepresentations*

#### **Example 1:**

Allison Rogers is a partner in the firm of Rogers and Black, a small firm offering investment advisory services. She assures a prospective client who has just inherited \$1 million that “we can perform all the financial and investment services you need.” Rogers and Black is well equipped to provide investment advice but, in fact, cannot provide asset allocation assistance or a full array of financial and investment services.

#### **Comment:**

Rogers has violated Standard I(C) by orally misrepresenting the services her firm can perform for the prospective client. She must limit herself to describing the range of investment advisory services Rogers and Black can provide and offer to help the client obtain elsewhere the financial and investment services that her firm cannot provide.

#### **Example 2:**

Anthony McGuire is an issuer-paid analyst hired by publicly traded companies to electronically promote their stocks. McGuire creates a Web site that promotes his research efforts as a seemingly independent analyst. McGuire posts a profile and a strong buy recommendation for each company on the Web site indicating that the stock is expected to increase in value. He does not disclose the contractual relationships with the companies he covers on his Web site, in the research reports he issues, or in the statements he makes about the companies on Internet chat rooms.

#### **Comment:**

McGuire has violated Standard I(C) because the Internet site and e-mails are misleading to potential investors. Even if the recommendations are valid and supported with thorough research, his omissions regarding the true relationship between himself and the companies he covers constitute a misrepresentation. McGuire has also violated Standard VI(C) by not disclosing the existence of an arrangement with the companies through which he receives compensation in exchange for his services.

#### **Example 3:**

Claude Browning, a quantitative analyst for Double Alpha, Inc., returns in great excitement from a seminar. In that seminar, Jack Jorrely, a well-publicized quantitative analyst at a national brokerage firm, discussed one of his new models in great detail, and Browning is intrigued by the new concepts. He proceeds to test this model, making some minor mechanical changes but retaining the concept, until he produces some very positive results. Browning quickly announces to his supervisors at Double Alpha that he has discovered a new model and that clients and prospective clients alike should be informed of this positive finding as ongoing proof of Double Alpha's continuing innovation and ability to add value.

**Comment:**

Although Browning tested Jorrely's model on his own and even slightly modified it, he must still acknowledge the original source of the idea. Browning can certainly take credit for the final, practical results; he can also support his conclusions with his own test. The credit for the innovative thinking, however, must be awarded to Jorrely.

**Example 4:**

Gary Ostrowski runs a small, two-person investment management firm. Ostrowski's firm subscribes to a service from a large investment research firm that provides research reports that can be repackaged as in-house research from smaller firms. Ostrowski's firm distributes these reports to clients as its own work.

**Comment:**

Gary Ostrowski can rely on third-party research that has a reasonable and adequate basis, but he cannot imply that he is the author of the report. Otherwise, Ostrowski would misrepresent the extent of his work in a way that would mislead the firm's clients or prospective clients.

**Example 5:**

A member makes an error in preparing marketing materials and misstates the amount of assets his firm has under management.

**Comment:**

The member must attempt to stop distribution of the erroneous material as soon as the error is known. Simply making the error unintentionally is not a violation, but continuing to distribute material known to contain a significant misstatement of fact would be.

**Example 6:**

The marketing department states in sales literature that an analyst has received an MBA degree, but he has not. The analyst and other members of the firm have distributed this document for years.

**Comment:**

The analyst has violated the Standards as he should have known of this misrepresentation after having distributed and used the materials over a period of years.

**Example 7:**

A member describes an interest-only collateralized mortgage obligation as guaranteed by the U.S. government since it is a claim against the cash flows of a pool of guaranteed mortgages, although the payment stream and the market value of the security are not guaranteed.

**Comment:**

This is a violation because of the misrepresentation.

**Example 8:**

A member describes a bank CD as “guaranteed.”

**Comment:**

This is not a violation as long as the limits of the guarantee provided by the Federal Deposit Insurance Corporation are not exceeded and the nature of the guarantee is clearly explained to clients.

**Example 9:**

A member uses definitions he found online for such terms as variance and coefficient of variation in preparing marketing material.

**Comment:**

Even though these are standard terms, using the work of others word-for-word is plagiarism.

**Example 10:**

A candidate reads about a research paper in a financial publication and includes the information in a research report, citing the original research report but not the financial publication.

**Comment:**

To the extent that the candidate used information and interpretation from the financial publication without citing it, the candidate is in violation of the Standard. The candidate should either obtain the report and reference it directly or, if he relies solely on the financial publication, should cite both sources.

**I(D) Misconduct.** Do not engage in any professional conduct which involves dishonesty, fraud, or deceit. Do not do anything that reflects poorly on one's integrity, good reputation, trustworthiness, or professional competence.

**Guidance**

CFA Institute discourages unethical behavior in all aspects of members' and candidates' lives. Do not abuse CFA Institute's Professional Conduct Program by seeking enforcement of this Standard to settle personal, political, or other disputes that are not related to professional ethics.

### *Recommended Procedures for Compliance*

Firms are encouraged to adopt these policies and procedures:

- Develop and adopt a code of ethics and make clear that unethical behavior will not be tolerated.
- Give employees a list of potential violations and sanctions, including dismissal.
- Check references of potential employees.

### *Application of Standard I(D) Misconduct*

#### **Example 1:**

Simon Sasserman is a trust investment officer at a bank in a small affluent town. He enjoys lunching every day with friends at the country club, where his clients have observed him having numerous drinks. Back at work after lunch, he clearly is intoxicated while making investment decisions. His colleagues make a point of handling any business with Sasserman in the morning because they distrust his judgment after lunch.

#### **Comment:**

Sasserman's excessive drinking at lunch and subsequent intoxication at work constitute a violation of Standard I(D) because this conduct has raised questions about his professionalism and competence. His behavior thus reflects poorly on him, his employer, and the investment industry.

#### **Example 2:**

Carmen Garcia manages a mutual fund dedicated to socially responsible investing. She is also an environmental activist. As the result of her participation at nonviolent protests, Garcia has been arrested on numerous occasions for trespassing on the property of a large petrochemical plant that is accused of damaging the environment.

#### **Comment:**

Generally, Standard I(D) is not meant to cover legal transgressions resulting from acts of civil disobedience in support of personal beliefs because such conduct does not reflect poorly on the member or candidate's professional reputation, integrity, or competence.

#### **Example 3:**

A member intentionally includes a receipt that is not his in his expenses for a company trip.

#### **Comment:**

Since this act involves deceit and fraud and reflects on the member's integrity and honesty, it is a violation.

**Example 4:**

A member tells a client that he can get her a good deal on a car through his father-in-law, but instead gets her a poor deal and accepts part of the commission on the car purchase.

**Comment:**

The member has been dishonest and misrepresented the facts of the situation and has, therefore, violated the Standard.

## II. INTEGRITY OF CAPITAL MARKETS

**II(A) Material Nonpublic Information.** Members and Candidates in possession of nonpublic information that could affect an investment's value must not act or induce someone else to act on the information.



*Professor's Note: This Standard prohibits any conduct that will damage the integrity of the markets. It states that Members and Candidates must not act or cause others to act on material nonpublic information until that same information is made public. It does not matter whether the information is obtained in breach of a duty, is misappropriated, or relates to a tender offer.*

### *Guidance*

Information is "material" if its disclosure would impact the price of a security or if reasonable investors would want the information before making an investment decision. Ambiguous information, as far as its likely effect on price, may not be considered material. Information is "nonpublic" until it has been made available to the marketplace. An analyst conference call is not public disclosure. Selectively disclosing information by corporations creates the potential for insider-trading violations.

### *Guidance—Mosaic Theory*

There is no violation when a perceptive analyst reaches an investment conclusion about a corporate action or event through an analysis of public information together with items of nonmaterial, nonpublic information.

### *Recommended Procedures for Compliance*

Make reasonable efforts to achieve public dissemination of the information. Encourage firms to adopt procedures to prevent misuse of material nonpublic information. Use a "firewall" within the firm, with elements including:

- Substantial control of relevant interdepartmental communications, through a clearance area such as the compliance or legal department.
- Review employee trades—maintain "watch," "restricted," and "rumor" lists.

- Monitor and restrict proprietary trading while a firm is in possession of material nonpublic information.

Prohibition of all proprietary trading while a firm is in possession of material nonpublic information may be inappropriate because it may send a signal to the market. In these cases, firms should take the contra side of only unsolicited customer trades.

### *Application of Standard II(A) Material Nonpublic Information*

#### **Example 1:**

Josephine Walsh is riding an elevator up to her office when she overhears the chief financial officer (CFO) for the Swan Furniture Company tell the president of Swan that he has just calculated the company's earnings for the past quarter and they have unexpectedly and significantly dropped. The CFO adds that this drop will not be released to the public until next week. Walsh immediately calls her broker and tells him to sell her Swan stock.

#### **Comment:**

Walsh has sufficient information to determine that the information is both material and nonpublic. By trading on the inside information, she has violated Standard II(A).

#### **Example 2:**

Samuel Peter, an analyst with Scotland and Pierce Incorporated, is assisting his firm with a secondary offering for Bright Ideas Lamp Company. Peter participates, via telephone conference call, in a meeting with Scotland and Pierce investment banking employees and Bright Ideas' CEO. Peter is advised that the company's earnings projections for the next year have significantly dropped. Throughout the telephone conference call, several Scotland and Pierce salespeople and portfolio managers walk in and out of Peter's office, where the telephone call is taking place. As a result, they are aware of the drop in projected earnings for Bright Ideas. Before the conference call is concluded, the salespeople trade the stock of the company on behalf of the firm's clients and other firm personnel trade the stock in a firm proprietary account and in employee personal accounts.

#### **Comment:**

Peter violated Standard II(A) because he failed to prevent the transfer and misuse of material nonpublic information to others in his firm. Peter's firm should have adopted information barriers to prevent the communication of nonpublic information between departments of the firm. The salespeople and portfolio managers who traded on the information have also violated Standard II(A) by trading on inside information.

#### **Example 3:**

Elizabeth Levenson is based in Taipei and covers the Taiwanese market for her firm, which is based in Singapore. She is invited to meet the finance director of a manufacturing company along with the other ten largest shareholders of the company. During the meeting, the finance director states that the company expects its workforce

to strike next Friday, which will cripple productivity and distribution. Can Levenson use this information as a basis to change her rating on the company from “buy” to “sell”?

**Comment:**

Levenson must first determine whether the material information is public. If the company has not made this information public (a small-group forum does not qualify as a method of public dissemination), she cannot use the information according to Standard II(A).

**Example 4:**

Jagdish Teja is a buy-side analyst covering the furniture industry. Looking for an attractive company to recommend as a buy, he analyzed several furniture makers by studying their financial reports and visiting their operations. He also talked to some designers and retailers to find out which furniture styles are trendy and popular. Although none of the companies that he analyzed turned out to be a clear buy, he discovered that one of them, Swan Furniture Company (SFC), might be in trouble. Swan's extravagant new designs were introduced at substantial costs. Even though these designs initially attracted attention, in the long run, the public is buying more conservative furniture from other makers. Based on that and on P&L analysis, Teja believes that Swan's next-quarter earnings will drop substantially. He then issues a sell recommendation for SFC. Immediately after receiving that recommendation, investment managers start reducing the stock in their portfolios.

**Comment:**

Information on quarterly earnings figures is material and nonpublic. However, Teja arrived at his conclusion about the earnings drop based on public information and on pieces of nonmaterial nonpublic information (such as opinions of designers and retailers). Therefore, trading based on Teja's correct conclusion is not prohibited by Standard II(A).

**Example 5:**

A member's dentist, who is an active investor, tells the member that based on his research he believes that Acme, Inc., will be bought out in the near future by a larger firm in the industry. The member investigates and purchases shares of Acme.

**Comment:**

There is no violation here because the dentist had no inside information but has reached the conclusion on his own. The information here is not material because there is no reason to suspect that an investor would wish to know what the member's dentist thought before investing in shares of Acme.

**Example 6:**

A member received an advance copy of a stock recommendation that will appear in a widely read national newspaper column the next day, and purchases the stock.



**Comment:**

A recommendation in a widely read newspaper column will likely cause the stock price to rise, so this is material non-public information. The member has violated the Standard.

**Example 7:**

A member is having lunch with a portfolio manager from a mutual fund who is known for his stock-picking ability and often influences market prices when his stock purchases and sales are disclosed. The manager tells the member that he is selling all his shares in Able, Inc., the next day. The member shorts the stock.

**Comment:**

The fact that the fund will sell its shares of Able is material because news of it will likely cause the shares to fall in price. Since this is also not currently public information, the member has violated the Standard by acting on the information.

**Example 8:**

A broker who is a member receives the sell order for the Able Inc. shares from the portfolio manager in the above example. The broker sells his shares of Able prior to entering the sell order for the fund, but since his personal holdings are small compared to the stock's trading volume, his trade does not affect the price.

**Comment:**

The broker has acted on material non-public information (the fund's sale of shares) and has violated the Standard.



*Professor's Note: The member also violated Standard VI(B) - Priority of Transactions by front-running the client trade with a trade in his own account. Had the member sold his shares after executing the fund trade, he still would be violating Standard II(A) by acting on his knowledge of the fund trade, which would still not be public information at that point.*

**II(B) Market Manipulation.** Do not engage in any practices intended to mislead market participants through distorted prices or artificially inflated trading volume.



*Professor's Note: This Standard requires Members and Candidates to uphold market integrity by banning practices that distort security prices or trading volume with the intent to deceive.*

**Guidance**

This Standard applies to transactions that deceive the market by distorting the price-setting mechanism of financial instruments or by securing a controlling position to

manipulate the price of a related derivative and/or the asset itself. Spreading false rumors is also prohibited.

### *Application of Standard II(B) Market Manipulation*

#### **Example 1:**

Matthew Murphy is an analyst at Divisadero Securities & Co., which has a significant number of hedge funds among its most important brokerage clients. Two trading days before the publication of the quarter-end report, Murphy alerts his sales force that he is about to issue a research report on Wirewolf Semiconductor, which will include his opinion that:

- quarterly revenues are likely to fall short of management's guidance,
- earnings will be as much as 5 cents per share (or more than 10%) below consensus, and
- Wirewolf's highly respected chief financial officer may be about to join another company.

Knowing that Wirewolf had already entered its declared quarter-end "quiet period" before reporting earnings (and thus would be reluctant to respond to rumors, etc.), Murphy times the release of his research report specifically to sensationalize the negative aspects of the message to create significant downward pressure on Wirewolf's stock to the distinct advantage of Divisadero's hedge fund clients. The report's conclusions are based on speculation, not on fact. The next day, the research report is broadcast to all of Divisadero's clients and to the usual newswire services.

Before Wirewolf's investor relations department can assess its damage on the final trading day of the quarter and refute Murphy's report, its stock opens trading sharply lower, allowing Divisadero's clients to cover their short positions at substantial gains.

#### **Comment:**

Murphy violated Standard II(B) by trying to create artificial price volatility designed to have material impact on the price of an issuer's stock. Moreover, by lacking an adequate basis for the recommendation, Murphy also violated Standard V(A).

#### **Example 2:**

Sergei Gonchar is the chairman of the ACME Futures Exchange, which seeks to launch a new bond futures contract. In order to convince investors, traders, arbitrageurs, hedgers, and so on, to use its contract, the exchange attempts to demonstrate that it has the best liquidity. To do so, it enters into agreements with members so that they commit to a substantial minimum trading volume on the new contract over a specific period in exchange for substantial reductions on their regular commissions.

#### **Comment:**

Formal liquidity on a market is determined by the obligations set on market makers, but the actual liquidity of a market is better estimated by the actual trading volume and bid-ask spreads. Attempts to mislead participants on the actual liquidity of the market constitute a violation of Standard II(B). In this example, investors have been

intentionally misled to believe they chose the most liquid instrument for some specific purpose and could eventually see the actual liquidity of the contract dry up suddenly after the term of the agreement if the “pump-priming” strategy fails. If ACME fully discloses its agreement with members to boost transactions over some initial launch period, it does not violate Standard II(B). ACME’s intent is not to harm investors but on the contrary to give them a better service. For that purpose, it may engage in a liquidity-pumping strategy, but it must be disclosed.

**Example 3:**

A member is seeking to sell a large position in a fairly illiquid stock from a fund he manages. He buys and sells shares of the stock between that fund and another he also manages to create an appearance of activity and stock price appreciation so that the sale of the whole position will have less market impact and he will realize a better return for the fund’s shareholders.

**Comment:**

The trading activity is meant to mislead market participants and is, therefore, a violation of the Standard. The fact that his fund shareholders gain by this action does not change the fact that it is a violation.

**Example 4:**

A member posts false information about a firm on Internet bulletin boards and stock chat facilities in an attempt to cause the firm’s stock to increase in price.

**Comment:**

This is a violation of the Standard.

### III. DUTIES TO CLIENTS

**III(A) Loyalty, Prudence, and Care.** Members must always act for the benefit of clients and place clients’ interests before their employer’s or their own interests. Members must be loyal to clients, use reasonable care, exercise prudent judgment, and determine and comply with their applicable fiduciary duty to clients.



*Professor’s Note: This Standard requires that members and candidates understand and comply with their actual fiduciary duty. There is also a minimum level of conduct—reasonable care and prudent judgment must be exercised in all circumstances.*

**Guidance**

Client interests always come first.

- Exercise the prudence, care, skill, and diligence under the circumstances that a person acting in a like capacity and familiar with such matters would use.

- Manage pools of client assets in accordance with the terms of the governing documents, such as trust documents or investment management agreements.
- Make investment decisions in the context of the total portfolio.
- Vote proxies in an informed and responsible manner. Due to cost benefit considerations, it may not be necessary to vote all proxies.
- Client brokerage, or “soft dollars” or “soft commissions” must be used to benefit the client.

#### *Recommended Procedures of Compliance*

Submit to clients, at least quarterly, itemized statements showing all securities in custody and all debits, credits, and transactions.

Encourage firms to address these topics when drafting policies and procedures regarding fiduciary duty:

- Follow applicable rules and laws.
- Establish investment objectives of client. Consider suitability of portfolio relative to client’s needs and circumstances, the investment’s basic characteristics, or the basic characteristics of the total portfolio.
- Diversify.
- Deal fairly with all clients in regards to investment actions.
- Disclose conflicts.
- Disclose compensation arrangements.
- Vote proxies in the best interest of clients and ultimate beneficiaries.
- Maintain confidentiality.
- Seek best execution.
- Place client interests first.

#### *Application of Standard III(A) Loyalty, Prudence, and Care*

##### **Example 1:**

First Country Bank serves as trustee for the Miller Company’s pension plan. Miller is the target of a hostile takeover attempt by Newton, Inc. In attempting to ward off Newton, Miller’s managers persuade Julian Wiley, an investment manager at First Country Bank, to purchase Miller common stock in the open market for the employee pension plan. Miller’s officials indicate that such action would be favorably received and would probably result in other accounts being placed with the bank. Although Wiley believes the stock to be overvalued and would not ordinarily buy it, he purchases the stock to support Miller’s managers, to maintain the company’s good favor, and to realize additional new business. The heavy stock purchases cause Miller’s market price to rise to such a level that Newton retracts its takeover bid.

##### **Comment:**

Standard III(A) requires that a member or candidate, in evaluating a takeover bid, act prudently and solely in the interests of plan participants and beneficiaries. To meet this requirement, a member or candidate must carefully evaluate the long-term prospects of the company against the short-term prospects presented by the takeover offer and by the ability to invest elsewhere. In this instance, Wiley, acting on behalf of his employer, the

trustee, clearly violated Standard III(A) by using the profit-sharing plan to perpetuate existing management, perhaps to the detriment of plan participants and the company's shareholders, and to benefit himself. Wiley's responsibilities to the plan participants and beneficiaries should take precedence over any ties to corporate managers and self-interest. A duty exists to examine such a takeover offer on its own merits and to make an independent decision. The guiding principle is the appropriateness of the investment decision to the pension plan, not whether the decision benefits Wiley or the company that hired him.

**Example 2:**

Emilie Rome is a trust officer for Paget Trust Company. Rome's supervisor is responsible for reviewing Rome's trust account transactions and her monthly reports of personal stock transactions. Rome has been using Nathan Gray, a broker, almost exclusively for trust account brokerage transactions. Where Gray makes a market in stocks, he has been giving Rome a lower price for personal purchases and a higher price for sales than he gives to Rome's trust accounts and other investors.

**Comment:**

Rome is violating her duty of loyalty to the bank's trust accounts by using Gray for brokerage transactions simply because Gray trades Rome's personal account on favorable terms.

**Example 3:**

A member uses a broker for client-account trades that has relatively high prices and average research and execution. In return, the broker pays for the rent and other overhead expenses for the member's firm.

**Comment:**

This is a violation of the Standard since the member used client brokerage for services that do not benefit clients and failed to get the best price and execution for his clients.

**Example 4:**

In return for receiving account management business from Broker X, a member directs trades to Broker X on the accounts referred to her by Broker X as well as on other accounts as an incentive to Broker X to send her more account business.

**Comment:**

This is a violation if Broker X does not offer the best price and execution or if the practice of directing trades to Broker X is not disclosed to clients. The obligation to seek best price and execution is always required unless clients provide a written statement that the member is not to seek best price and execution and that they are aware of the impact of this decision on their accounts.

**Example 5:**

A member does more trades in client accounts than are necessary to accomplish client goals because she desires to increase her commission income.

**Comment:**

The member is using client assets (brokerage fees) to benefit herself and has violated the Standard.

**III(B) Fair Dealing.** Members must deal fairly and objectively with all clients and prospects when providing investment analysis, making investment recommendations, taking investment action, or in other professional activities.

**Guidance**

Do not discriminate against any clients when disseminating recommendations or taking investment action. Fairly does not mean equally. In the normal course of business, there will be differences in the time e-mails, faxes, etc. are received by different clients. Different service levels are okay, but they must not negatively affect or disadvantage any clients. Disclose the different service levels to all clients and prospects, and make premium levels of service available to all who wish to pay for them.

**Guidance—Investment Recommendations**

Give all clients a fair opportunity to act upon every recommendation. Clients who are unaware of a change in a recommendation should be advised before the order is accepted.

**Guidance—Investment Actions**

Treat clients fairly in light of their investment objectives and circumstances. Treat both individual and institutional clients in a fair and impartial manner. Members and Candidates should not take advantage of their position in the industry to disadvantage clients (e.g., in the context of IPOs).

**Recommended Procedures for Compliance**

Encourage firms to establish compliance procedures requiring proper dissemination of investment recommendations and fair treatment of all customers and clients. Consider these points when establishing fair dealing compliance procedures:

- Limit the number of people who are aware that a change in recommendation will be made.
- Shorten the time frame between decision and dissemination.

- Publish personnel guidelines for pre-dissemination—have in place guidelines prohibiting personnel who have prior knowledge of a recommendation from discussing it or taking action on the pending recommendation.
- Simultaneous dissemination.
- Maintain list of clients and holdings—use to ensure that all holders are treated fairly.
- Develop written trade allocation procedures—ensure fairness to clients, timely and efficient order execution, and accuracy of client positions.
- Disclose trade allocation procedures.
- Establish systematic account review—to ensure that no client is given preferred treatment and that investment actions are consistent with the account's objectives.
- Disclose available levels of service.

### *Application of Standard III(B) Fair Dealing*

#### **Example 1:**

Bradley Ames, a well-known and respected analyst, follows the computer industry. In the course of his research, he finds that a small, relatively unknown company whose shares are traded over the counter has just signed significant contracts with some of the companies he follows. After a considerable amount of investigation, Ames decides to write a research report on the company and recommend purchase. While the report is being reviewed by the company for factual accuracy, Ames schedules a luncheon with several of his best clients to discuss the company. At the luncheon, he mentions the purchase recommendation scheduled to be sent early the following week to all the firm's clients.

#### **Comment:**

Ames violated Standard III(B) by disseminating the purchase recommendation to the clients with whom he had lunch a week before the recommendation was sent to all clients.

#### **Example 2:**

Spencer Rivers, president of XYZ Corporation, moves his company's growth-oriented pension fund to a particular bank primarily because of the excellent investment performance achieved by the bank's commingled fund for the prior 5-year period. A few years later, Rivers compares the results of his pension fund with those of the bank's commingled fund. He is startled to learn that, even though the two accounts have the same investment objectives and similar portfolios, his company's pension fund has significantly underperformed the bank's commingled fund. Questioning this result at his next meeting with the pension fund's manager, Rivers is told that, as a matter of policy, when a new security is placed on the recommended list, Morgan Jackson, the pension fund manager, first purchases the security for the commingled account and then purchases it on a pro rata basis for all other pension fund accounts. Similarly, when a sale is recommended, the security is sold first from the commingled account and then sold on a pro rata basis from all other accounts. Rivers also learns that if the bank cannot get enough shares (especially the hot issues) to be meaningful to all the accounts, its policy is to place the new issues only in the commingled account.

Seeing that Rivers is neither satisfied nor pleased by the explanation, Jackson quickly adds that nondiscretionary pension accounts and personal trust accounts have a lower priority on purchase and sale recommendations than discretionary pension fund accounts. Furthermore, Jackson states, the company's pension fund had the opportunity to invest up to 5% in the commingled fund.

**Comment:**

The bank's policy did not treat all customers fairly, and Jackson violated her duty to her clients by giving priority to the growth-oriented commingled fund over all other funds and to discretionary accounts over nondiscretionary accounts. Jackson must execute orders on a systematic basis that is fair to all clients. In addition, trade allocation procedures should be disclosed to all clients from the beginning. Of course, in this case, disclosure of the bank's policy would not change the fact that the policy is unfair.

**Example 3:**

A member gets options for his part in an IPO from the subject firm. The IPO is oversubscribed and the member fills his own and other individuals' orders, but has to reduce allocations to his institutional clients.

**Comment:**

The member has violated the Standard. He must disclose to his employer and to his clients that he has accepted options for putting together the IPO. He should not take any shares of a hot IPO for himself and should have distributed his allocated shares of the IPO to all clients in proportion to their original order amounts.

**Example 4:**

A member is delayed in allocating some trades to client accounts. When she allocates the trades, she puts some positions that have appreciated in a preferred client's account and puts trades that have not done as well in other client accounts.

**Comment:**

This is a violation of the Standard. The member should have allocated the trades to specific accounts prior to the trades or should have allocated the trades proportionally to suitable accounts in a timely fashion.



**III(C) SUITABILITY**

1. When in an advisory relationship with client or prospect, Members and Candidates must:
  - a. Make reasonable inquiry into clients' investment experience, risk and return objectives, and constraints prior to making any recommendations or taking investment action. Reassess information and update regularly.
  - b. Be sure investments are suitable to a client's financial situation and consistent with client objectives before making recommendation or taking investment action.
  - c. Make sure investments are suitable in the context of a client's total portfolio.
2. When managing a portfolio, investment recommendations and actions must be consistent with stated portfolio objectives and constraints.



*Professor's Note: "Regular updates" to client information should be done at least annually. Suitability is based on a total-portfolio perspective.*

**Guidance**

In advisory relationships, be sure to gather client information at the beginning of the relationship, in the form of an investment policy statement (IPS). Consider client's needs and circumstances and thus the risk tolerance. Consider whether or not the use of leverage is suitable for the client.

If a member is responsible for managing a fund to an index or other stated mandate, be sure investments are consistent with the stated mandate.

**Recommended Procedures for Compliance**

Members should:

- Put the needs and circumstances of each client and the client's investment objectives into a written IPS for each client.
- Consider the type of client and whether there are separate beneficiaries, investor objectives (return and risk), investor constraints (liquidity needs, expected cash flows, time, tax, and regulatory and legal circumstances), and performance measurement benchmarks.
- Review investor's objectives and constraints at least annually to reflect any changes in client circumstances, as well as prior to material changes in recommendations or decisions.

### *Application of Standard III(C) Suitability*

#### **Example 1:**

Ann Walters, an investment adviser, suggests to Brian Crosby, a risk-averse client, that covered call options be used in his equity portfolio. The purpose would be to enhance Crosby's income and partially offset any untimely depreciation in value should the stock market or other circumstances affect his holdings unfavorably. Walters educates Crosby about all possible outcomes, including the risk of incurring an added tax liability if a stock rises in price and is called away and, conversely, the risk of his holdings losing protection on the downside if prices drop sharply.

#### **Comment:**

When determining suitability of an investment, the primary focus should be on the characteristics of the client's entire portfolio, not on an issue-by-issue analysis. The basic characteristics of the entire portfolio will largely determine whether the investment recommendations are taking client factors into account. Therefore, the most important aspects of a particular investment will be those that will affect the characteristics of the total portfolio. In this case, Walters properly considered the investment in the context of the entire portfolio and thoroughly explained the investment to the client.

#### **Example 2:**

Max Gubler, CIO of a property/casualty insurance subsidiary of a large financial conglomerate, wants to better diversify the company's investment portfolio and increase its returns. The company's investment policy statement (IPS) provides for highly liquid investments, such as large caps, governments, and supra-nationals, as well as corporate bonds with a minimum credit rating of AA—and maturity of no more than five years. In a recent presentation, a venture capital group offered very attractive prospective returns on some of their private equity funds providing seed capital. An exit strategy is already contemplated but investors will first have to observe a minimum 3-year lock-up period, with a subsequent ladder exit option for a maximum of one third of shares per year. Gubler does not want to miss this opportunity and after an extensive analysis and optimization of this asset class with the company's current portfolio, he invests 4% in this seed fund, leaving the portfolio's total equity exposure still well below its upper limit.

#### **Comment:**

Gubler violates Standards III(A) and III(C). His new investment locks up part of the company's assets for at least three and for up to as many as five years and possibly beyond. Since the IPS requires investments in highly liquid investments and describes accepted asset classes, private equity investments with a lock-up period certainly do not qualify. Even without such lock-up periods, an asset class with only an occasional, and thus implicitly illiquid, market may not be suitable. Although an IPS typically describes objectives and constraints in great detail, the manager must make every effort to understand the client's business and circumstances. Doing so should also enable the manager to recognize, understand, and discuss with the client other factors that may be or may become material in the investment management process.

**Example 3:**

A member gives a client account a significant allocation to non-dividend paying high risk securities, even though the client has low risk tolerance and modest return objectives.

**Comment:**

This is a violation of the Standard.

**Example 4:**

A member puts a security into a fund she manages that does not fit the mandate of the fund and is not a permitted investment according to the fund's disclosures.

**Comment:**

This, too, is a violation of the Standard.

**III(D) Performance Presentation.** Presentations of investment performance information must be fair, accurate, and complete.

*Guidance*

Members must avoid misstating performance or misleading clients/prospects about investment performance of themselves or their firms, should not misrepresent past performance or reasonably expected performance, and should not state or imply the ability to achieve a rate of return similar to that achieved in the past.

*Recommended Procedures for Compliance*

Encourage firms to adhere to Global Investment Performance Standards. Obligations under this Standard may also be met by:

- Considering the sophistication of the audience to whom a performance presentation is addressed.
- Presenting performance of weighted composite of similar portfolios rather than a single account.
- Including terminated accounts as part of historical performance.
- Including all appropriate disclosures to fully explain results (e.g., model results included, gross or net of fees, etc.).
- Maintaining data and records used to calculate the performance being presented.

*Application of Standard III(D) Performance Presentation***Example 1:**

Kyle Taylor of Taylor Trust Company, noting the performance of Taylor's common trust fund for the past two years, states in the brochure sent to his potential clients that "You can expect steady 25% annual compound growth of the value of your investments over the year." Taylor Trust's common trust fund did increase at the rate of 25% per annum for the past year which mirrored the increase of the entire market. The fund, however, never averaged that growth for more than one year, and the average rate of growth of all of its trust accounts for five years was 5% per annum.

**Comment:**

Taylor's brochure is in violation of Standard III(D). Taylor should have disclosed that the 25% growth occurred in only one year. Additionally, Taylor did not include client accounts other than those in the firm's common trust fund. A general claim of firm performance should take into account the performance of all categories of accounts. Finally, by stating that clients can expect a steady 25% annual compound growth rate, Taylor also violated Standard I(C), which prohibits statements of assurances or guarantees regarding an investment.

**Example 2:**

Aaron McCoy is vice president and managing partner of the equity investment group of Mastermind Financial Advisors, a new business. Mastermind recruited McCoy because he had a proven 6-year track record with G&P Financial. In developing Mastermind's advertising and marketing campaign, McCoy prepared an advertisement that included the equity investment performance he achieved at G&P Financial. The advertisement for Mastermind did not identify the equity performance as being earned while at G&P. The advertisement was distributed to existing clients and prospective clients of Mastermind.

**Comment:**

McCoy violated Standard III(D) by distributing an advertisement that contained material misrepresentations regarding the historical performance of Mastermind. Standard III(D) requires that members and candidates make every reasonable effort to ensure that performance information is a fair, accurate, and complete representation of an individual or firm's performance. As a general matter, this standard does not prohibit showing past performance of funds managed at a prior firm as part of a performance track record so long as it is accompanied by appropriate disclosures detailing where the performance comes from and the person's specific role in achieving that performance. If McCoy chooses to use his past performance from G&P in Mastermind's advertising, he should make full disclosure as to the source of the historical performance.

**Example 3:**

A member puts simulated results of an investment strategy in a sales brochure without disclosing that the results are not actual performance numbers.

**Comment:**

The member has violated the Standard.

**Example 4:**

In materials for prospective clients, a member uses performance figures for a large-cap growth composite she has created by choosing accounts that have done relatively well and including some accounts with significant mid-cap exposure.

**Comment:**

This is a violation of the Standard as the member has attempted to mislead clients and has misrepresented her performance.

**III(E) Preservation of Confidentiality.** All information about current and former clients and prospects must be kept confidential unless it pertains to illegal activities, disclosure is required by law, or the client or prospect gives permission for the information to be disclosed.



*Professor's Note: This Standard covers all client information, not just information concerning matters within the scope of the relationship. Also note that the language specifically includes not only clients, but prospects and former clients as well. Confidentiality regarding employer information is covered in Standard IV.*

**Guidance**

If illegal activities by a client are involved, members may have an obligation to report the activities to authorities. The confidentiality Standard extends to former clients as well.

The requirements of this Standard are not intended to prevent Members and Candidates from cooperating with a CFA Institute Professional Conduct Program (PCP) investigation.

**Recommended Procedures for Compliance**

Members should avoid disclosing information received from a client except to authorized co-workers who are also working for the client.

**Application of Standard III(E) Preservation of Confidentiality**

**Example 1:**

Susan Connor, a financial analyst employed by Johnson Investment Counselors, Inc., provides investment advice to the trustees of City Medical Center. The trustees have

given her a number of internal reports concerning City Medical's needs for physical plant renovation and expansion. They have asked Connor to recommend investments that would generate capital appreciation in endowment funds to meet projected capital expenditures. Connor is approached by a local business man, Thomas Kasey, who is considering a substantial contribution either to City Medical Center or to another local hospital. Kasey wants to find out the building plans of both institutions before making a decision, but he does not want to speak to the trustees.

**Comment:**

The trustees gave Connor the internal reports so she could advise them on how to manage their endowment funds. Because the information in the reports is clearly both confidential and within the scope of the confidential relationship, Standard III(E) requires that Connor refuse to divulge information to Kasey.

**Example 2:**

David Bradford manages money for a family-owned real estate development corporation. He also manages the individual portfolios of several of the family members and officers of the corporation, including the chief financial officer (CFO). Based on the financial records from the corporation, as well as some questionable practices of the CFO that he has observed, Bradford believes that the CFO is embezzling money from the corporation and putting it into his personal investment account.

**Comment:**

Bradford should check with his firm's compliance department as well as outside counsel to determine whether applicable securities regulations require reporting the CFO's financial records.

**Example 3:**

A member has learned from his client that one of his goals is to give more of his portfolio income to charity. The member tells this to a friend who is on the board of a worthy charity and suggests that he should contact the client about a donation.

**Comment:**

The member has violated the Standard by disclosing information he has learned from the client in the course of their business relationship.

**Example 4:**

A member learns that a pension account client is violating the law with respect to charges to the pension fund.

**Comment:**

The member must bring this to the attention of her supervisor and try to end the illegal activity. Failing this, the member should seek legal advice about any disclosure she should make to legal or regulatory authorities and dissociate herself from any continuing association with the pension account.

## IV. DUTIES TO EMPLOYERS

**IV(A) Loyalty.** In matters related to their employment, Members and Candidates must act for the benefit of their employer and not deprive their employer of the advantage of their skills and abilities, divulge confidential information, or otherwise cause harm to their employer.



*Professor's Note: Always act in the employer's best interests and do not deprive the employer of any of Member's/Candidate's skills or abilities. Also protect confidential information. The phrase "in matters related to employment" means that Members/Candidates are not required to subordinate important personal and family obligations to their job.*

### *Guidance*

Members must not engage in any activities which would injure the firm, deprive it of profit, or deprive it of the advantage of employees' skills and abilities. Always place client interests above interests of employer. There is no requirement that the employee put employer interests ahead of family and other personal obligations; it is expected that employers and employees will discuss such matters and balance these obligations with work obligations.

### *Guidance—Independent Practice*

Independent practice for compensation is allowed if a notification is provided to the employer fully describing all aspects of the services, including compensation, duration, and the nature of the activities *and* if the employer consents to all terms of the proposed independent practice before it begins.

### *Guidance—Leaving an Employer*

Members must continue to act in their employer's best interests until resignation is effective. Activities which may constitute a violation include:

- Misappropriation of trade secrets.
- Misuse of confidential information.
- Soliciting employer's clients prior to leaving.
- Self-dealing.
- Misappropriation of client lists.

Once an employee has left a firm, simple knowledge of names and existence of former clients is generally not confidential. Also there is no prohibition on the use of experience or knowledge gained while with a former employer.

*Guidance—Whistleblowing*

There may be isolated cases where a duty to one's employer may be violated in order to protect clients or the integrity of the market, and not for personal gain.

*Guidance—Nature of Employment*

The applicability of this Standard is based on the nature of the employment—employee versus independent contractor. If Members and Candidates are independent contractors, they still have a duty to abide by the terms of the agreement.

*Application of Standard IV(A) Loyalty*

**Example 1:**

James Hightower has been employed by Jason Investment Management Corporation for 15 years. He began as an analyst but assumed increasing responsibilities and is now a senior portfolio manager and a member of the firm's investment policy committee. Hightower has decided to leave Jason Investment and start his own investment management business. He has been careful not to tell any of Jason's clients that he is leaving, because he does not want to be accused of breaching his duty to Jason by soliciting Jason's clients before his departure. Hightower is planning to copy and take with him the following documents and information he developed or worked on while at Jason: (1) the client list, with addresses, telephone numbers, and other pertinent client information; (2) client account statements; (3) sample marketing presentations to prospective clients containing Jason's performance record; (4) Jason's recommended list of securities; (5) computer models to determine asset allocations for accounts with different objectives; (6) computer models for stock selection; and (7) personal computer spreadsheets for Hightower's major corporate recommendations which he developed when he was an analyst.

**Comment:**

Except with the consent of their employer, departing employees may not take employer property, which includes books, records, reports, and other materials, and may not interfere with their employer's business opportunities. Taking any employer records, even those the member or candidate prepared, violates Standard IV(A).

**Example 2:**

Dennis Elliot has hired Sam Chisolm who previously worked for a competing firm. Chisolm left his former firm after 18 years of employment. When Chisolm begins working for Elliot, he wants to contact his former clients because he knows them well and is certain that many will follow him to his new employer. Is Chisolm in violation of the Standard IV(A) if he contacts his former clients?

**Comment:**

Because client records are the property of the firm, contacting former clients for any reason through the use of client lists or other information taken from a former employer



without permission would be a violation of Standard IV(A). In addition, the nature and extent of the contact with former clients may be governed by the terms of any non-compete agreement signed by the employee and the former employer that covers contact with former clients after employment.

But simple knowledge of the name and existence of former clients is not confidential information, just as skills or experience that an employee obtains while employed is not “confidential” or “privileged” information. The Code and Standards do not impose a prohibition on the use of experience or knowledge gained at one employer from being used at another employer. The Code and Standards also do not prohibit former employees from contacting clients of their previous firm, absent a non-compete agreement. Members and candidates are free to use public information about their former firm after departing to contact former clients without violating Standard IV(A).

In the absence of a non-compete agreement, as long as Chisolm maintains his duty of loyalty to his employer before joining Elliot’s firm, and does not take steps to solicit clients until he has left his former firm, and does not make use of material from his former employer without its permission after he has left, he would not be in violation of the Code and Standards.

**Example 3:**

Several employees are planning to depart their current employer within a few weeks to form a new firm, and have been careful to not engage in any activities that would conflict with their duty to their current employer. They have just learned that one of their employer’s clients has undertaken a request for proposal (RFP) to review and possibly hire a new investment consultant. The RFP has been sent to the employer and all of its competitors. The group believes that the new entity to be formed would be qualified to respond to the RFP and eligible for the business. The RFP submission period is likely to conclude before the employees’ resignations are effective. Is it permissible for the group of departing employees to respond to the RFP under their anticipated new firm?

**Comment:**

A group of employees responding to an RFP that their employer is also responding to would lead to direct competition between the employees and the employer. Such conduct would violate Standard IV(A) unless the group of employees received permission from their employer as well as the entity sending out the RFP.

**Example 4:**

A member solicits clients and prospects of his current employer to open accounts at the new firm he will be joining shortly.

**Comment:**

It is a violation of the Standard to solicit the firm’s clients and prospects while he is still employed by the firm.

**Example 5:**

Two employees discuss joining with others in an employee-led buyout of their employer's emerging markets investment management business.

**Comment:**

There is no violation here. Their employer can decide how to respond to any buyout offer. If such a buyout takes place, clients should be informed of the nature of the changes in a timely manner.

**Example 6:**

A member is writing a research report on a company as a contract worker for Employer A (using Employer A's premises and materials) with the understanding that Employer A does not claim exclusive rights to the outcome of her research. As she is finishing the report, she is offered a full-time job by Employer B and sends Employer B a copy of a draft of her report for publication.

**Comment:**

She has violated the Standard by not giving Employer A the first rights to act on her research. She must also be careful not to take any materials used in preparing the report from Employer A's premises.

**Example 7:**

A member helps develop software for a firm while acting as an unpaid intern and takes the software, without permission, with her when she takes a full-time job at another firm.

**Comment:**

She is considered an employee of the firm and has violated the Standard by taking her employer's property without permission.

**Example 8:**

A member prepares to leave his employer and open his own firm by registering with the SEC, renting an office, and buying office equipment.

**Comment:**

As long as these preparations have not interfered with the performance of his current job, there has been no violation. The solicitation of firm clients and prospects prior to leaving his employer would, however, be a violation of the Standard.

**Example 9:**

A member is a full-time employee of an investment management firm and wants to accept a paid position as town mayor without asking his employer's permission.

**Comment:**

Since the member serving as mayor does not conflict with his employer's business interests, as long as the time commitment does not preclude performing his expected job functions well, there is no violation.

**Example 10:**

A member, who has left one employer, uses public sources to get the phone numbers of previous clients and solicits their business for her new employer.

**Comment:**

As long as there is no agreement in force between the member and his previous employer that prohibits such solicitation, there is no violation of the Standards.

**IV(B) Additional Compensation Arrangements.** No gifts, benefits, compensation, or consideration are to be accepted which may create a conflict of interest with the employer's interest unless written consent is received from all parties.



*Professor's Note: "Compensation" includes "gifts, benefits, compensation, or consideration."*

**Guidance**

Compensation includes direct and indirect compensation from a client and other benefits received from third parties. Written consent from a member's employer includes e-mail communication.

***Recommended Procedures for Compliance***

Make an immediate written report to employer detailing proposed compensation and services, if additional to that provided by employer.

***Application of Standard IV(B) Additional Compensation Arrangements***

**Example 1:**

Geoff Whitman, a portfolio analyst for Adams Trust Company, manages the account of Carol Cochran, a client. Whitman is paid a salary by his employer, and Cochran pays the trust company a standard fee based on the market value of assets in her portfolio. Cochran proposes to Whitman that "any year that my portfolio achieves at least a 15% return before taxes, you and your wife can fly to Monaco at my expense and use my condominium during the third week of January. Whitman does not inform his employer of the arrangement and vacations in Monaco the following January as Cochran's guest.

**Comment:**

Whitman violated Standard IV(B) by failing to inform his employer in writing of this supplemental, contingent compensation arrangement. The nature of the arrangement could have resulted in partiality to Cochran's account, which could have detracted from Whitman's performance with respect to other accounts he handles for Adams Trust. Whitman must obtain the consent of his employer to accept such a supplemental benefit.

**Example 2:**

A member is on the board of directors of a company whose shares he purchases for client accounts. As a member of the board he receives the company's product at no charge.

**Comment:**

Since receiving the company's product constitutes compensation for his service, he is in violation of the Standard if he does not disclose this additional compensation to his employer.

**IV(C) Responsibilities of Supervisors:** All Members and Candidates must make reasonable efforts to detect and prevent violations of laws, rules, regulations, and the Code and Standards by any person under their supervision or authority.



*Professor's Note: The focus is on establishing and implementing reasonable compliance procedures in order to meet this Standard.*

**Guidance**

Members must take steps to prevent employees from violating laws, rules, regulations, or the Code and Standards and make reasonable efforts to detect violations.

**Guidance—Compliance Procedures**

Understand that an adequate compliance system must meet industry standards, regulatory requirements, and the requirements of the Code and Standards. Members with supervisory responsibilities have an obligation to bring an inadequate compliance system to the attention of firm's management and recommend corrective action. While investigating a possible breach of compliance procedures, it is appropriate to limit the suspected employee's activities.

**Recommended Procedures for Compliance**

A member should recommend that his employer adopt a code of ethics. Employers should not commingle compliance procedures with the firm's code of ethics—this can

dilute the goal of reinforcing one's ethical obligations. Members should encourage employers to provide their code of ethics to clients.

Adequate compliance procedures should:

- Be clearly written.
- Be easy to understand.
- Designate a compliance officer with authority clearly defined.
- Have a system of checks and balances.
- Outline the scope of procedures.
- Outline what conduct is permitted.
- Contain procedures for reporting violations and sanctions.

Once the compliance program is instituted, the supervisor should:

- Distribute it to the proper personnel.
- Update it as needed.
- Continually educate staff regarding procedures.
- Issue reminders as necessary.
- Require professional conduct evaluations.
- Review employee actions to monitor compliance and identify violations.
- Enforce procedures once a violation occurs.

If there is a violation, respond promptly and conduct a thorough investigation while placing limitations on the wrongdoer's activities.

#### *Application of Standard IV(C) Responsibilities of Supervisors*

##### **Example 1:**

Jane Mattock, senior vice president and head of the research department of H&V, Inc., a regional brokerage firm, has decided to change her recommendation for Timber Products from buy to sell. In line with H&V's procedures, she orally advises certain other H&V executives of her proposed actions before the report is prepared for publication. As a result of his conversation with Mattock, Dieter Frampton, one of the executives of H&V accountable to Mattock, immediately sells Timber's stock from his own account and from certain discretionary client accounts. In addition, other personnel inform certain institutional customers of the changed recommendation before it is printed and disseminated to all H&V customers who have received previous Timber reports.

##### **Comment:**

Mattock failed to supervise reasonably and adequately the actions of those accountable to her. She did not prevent or establish reasonable procedures designed to prevent dissemination of or trading on the information by those who knew of her changed recommendation. She must ensure that her firm has procedures for reviewing or recording trading in the stock of any corporation that has been the subject of an unpublished change in recommendation. Adequate procedures would have informed the subordinates of their duties and detected sales by Frampton and selected customers.

**Example 2:**

Deion Miller is the research director for Jamestown Investment Programs. The portfolio managers have become critical of Miller and his staff because the Jamestown portfolios do not include any stock that has been the subject of a merger or tender offer. Georgia Ginn, a member of Miller's staff, tells Miller that she has been studying a local company, Excelsior, Inc., and recommends its purchase. Ginn adds that the company has been widely rumored to be the subject of a merger study by a well-known conglomerate and discussions between them are under way. At Miller's request, Ginn prepares a memo recommending the stock. Miller passes along Ginn's memo to the portfolio managers prior to leaving for vacation, noting that he has not reviewed the memo. As a result of the memo, the portfolio managers buy Excelsior stock immediately. The day Miller returns to the office, Miller learns that Ginn's only sources for the report were her brother, who is an acquisitions analyst with Acme Industries and the "well-known conglomerate" and that the merger discussions were planned but not held.

**Comment:**

Miller violated Standard IV(C) by not exercising reasonable supervision when he disseminated the memo without checking to ensure that Ginn had a reasonable and adequate basis for her recommendations and that Ginn was not relying on material nonpublic information.

**Example 3:**

A member responsible for compliance by the firm's trading desk notices a high level of trading activity in a stock that is not on the firm's recommended list. Most of this trading is being done by a trainee and the member does not investigate this trading.

**Comment:**

This is a violation of the member's responsibilities as supervisor. She must take steps to monitor the activities of traders in training as well as investigate the reason for the heavy trading of the security by her firm's trading desk.

## V. INVESTMENT ANALYSIS, RECOMMENDATIONS, AND ACTION

### V(A) Diligence and Reasonable Basis

1. When analyzing investments, making recommendations, and taking investment actions use diligence, independence, and thoroughness.
2. Investment analysis, recommendations, and actions should have a reasonable and adequate basis, supported by research and investigation.

**Guidance**

The application of this Standard depends on the investment philosophy adhered to, members' and candidates' roles in the investment decision-making process, and the

resources and support provided by employers. These factors dictate the degree of diligence, thoroughness of research, and the proper level of investigation required.

#### *Guidance—Using Secondary Research or Third-Party Research*

See that the research is sound. Examples of criteria to use to evaluate:

- Review assumptions used.
- How rigorous was the analysis?
- How timely is the research?
- Evaluate objectivity and independence of the recommendations.

#### *Guidance—Group Research and Decision Making*

Even if a member does not agree with the independent and objective view of the group, he does not necessarily have to decline to be identified with the report, as long as there is a reasonable and adequate basis.

#### *Recommended Procedures for Compliance*

Members should encourage their firms to consider these policies and procedures supporting this Standard:

- Have a policy requiring that research reports and recommendations have a basis that can be substantiated as reasonable and adequate.
- Have detailed, written guidance for proper research and due diligence.
- Have measurable criteria for judging the quality of research.

#### *Application of Standard V(A) Diligence and Reasonable Basis*

##### **Example 1:**

Helen Hawke manages the corporate finance department of Sarkozi Securities, Ltd. The firm is anticipating that the government will soon close a tax loophole that currently allows oil and gas exploration companies to pass on drilling expenses to holders of a certain class of shares. Because market demand for this tax-advantaged class of stock is currently high, Sarkozi convinces several companies to undertake new equity financings at once before the loophole closes. Time is of the essence, but Sarkozi lacks sufficient resources to conduct adequate research on all the prospective issuing companies. Hawke decides to estimate the IPO prices based on the relative size of each company and to justify the pricing later when her staff has time.

##### **Comment:**

Sarkozi should have taken on only the work that it could adequately handle. By categorizing the issuers as to general size, Hawke has bypassed researching all the other relevant aspects that should be considered when pricing new issues and thus has not performed sufficient due diligence. Such an omission can result in investors purchasing shares at prices that have no actual basis. Hawke has violated Standard V(A).

**Example 2:**

Evelyn Mastakis is a junior analyst asked by her firm to write a research report predicting the expected interest rate for residential mortgages over the next six months. Mastakis submits her report to the fixed-income investment committee of her firm for review, as required by firm procedures. Although some committee members support Mastakis's conclusion, the majority of the committee disagrees with her conclusion and the report is significantly changed to indicate that interest rates are likely to increase more than originally predicted by Mastakis.

**Comment:**

The results of research are not always clear, and different people may have different opinions based on the same factual evidence. In this case, the majority of the committee may have valid reasons for issuing a report that differs from the analyst's original research. The firm can issue a report different from the original report of the analyst as long as there is a reasonable or adequate basis for its conclusions. Generally, analysts must write research reports that reflect their own opinion and can ask the firm not to put their name on reports that ultimately differ from that opinion. When the work is a group effort, however, not all members of the team may agree with all aspects of the report. Ultimately, members and candidates can ask to have their names removed from the report, but if they are satisfied that the process has produced results or conclusions that have a reasonable or adequate basis, members or candidates do not have to dissociate from the report even when they do not agree with its contents. The member or candidate should document the difference of opinion and any request to remove his or her name from the report.

**Example 3:**

A member makes a presentation for an offering his firm is underwriting, using maximum production levels as his estimate in order to justify the price of the shares he is recommending for purchase.

**Comment:**

Using the maximum possible production without acknowledging that this is not the expected level of production (or without presenting a range of possible outcomes and their relative probabilities) does not provide a reasonable basis for the purchase recommendation and is a violation of the Standard.

**Example 4:**

A member posts buy recommendations in an internet chat room based on "conventional wisdom" and what the public is currently buying.

**Comment:**

A recommendation that is not based on independent and diligent research into the subject company is a violation of the Standard.



**Example 5:**

A member is a principal in a small investment firm that bases its securities recommendations on third-party research that it purchases.

**Comment:**

This is not a violation as long as the member's firm periodically checks the purchased research to determine that it has met and still meets the criteria of objectivity and reasonableness required by the Standard.

**V(B) Communication With Clients and Prospective Clients**

1. Disclose to clients and prospects basic format and general principles of investment processes used to analyze and select securities and construct portfolios. Promptly disclose any process changes.
2. Use reasonable judgment in identifying relevant factors important to investment analyses, recommendations, or actions, and include factors when communicating with clients and prospects.
3. Investment analyses and recommendations should clearly differentiate facts from opinions.

**Guidance**

Proper communication with clients is critical to provide quality financial services. Members must distinguish between opinions and facts and always include the basic characteristics of the security being analyzed in a research report.

Members must illustrate to clients and prospects the investment decision-making process utilized. The suitability of each investment is important in the context of the entire portfolio.

All means of communication are included here, not just research reports.

**Recommended Procedures for Compliance**

Selection of relevant factors in a report can be a judgment call, so be sure to maintain records indicating the nature of the research, and be able to supply additional information if it is requested by the client or other users of the report.

*Application of Standard V(B) Communication with Clients and Prospective Clients***Example 1:**

Sarah Williamson, director of marketing for Country Technicians, Inc., is convinced that she has found the perfect formula for increasing Country Technician's income and diversifying its product base. Williamson plans to build on Country Technician's reputation as a leading money manager by marketing an exclusive and expensive investment advice letter to high-net-worth individuals. One hitch in the plan is the complexity of Country Technician's investment system—a combination of technical trading rules (based on historical price and volume fluctuations) and portfolio-construction rules designed to minimize risk. To simplify the newsletter, she decides to include only each week's top-five buy and sell recommendations and to leave out details of the valuation models and the portfolio-structuring scheme.

**Comment:**

Williamson's plans for the newsletter violate Standard V(B) because she does not intend to include all the relevant factors behind the investment advice. Williamson need not describe the investment system in detail in order to implement the advice effectively, but clients must be informed of Country Technician's basic process and logic. Without understanding the basis for a recommendation, clients cannot possibly understand its limitations or its inherent risks.

**Example 2:**

Richard Dox is a mining analyst for East Bank Securities. He has just finished his report on Boisy Bay Minerals. Included in his report is his own assessment of the geological extent of mineral reserves likely to be found on the company's land. Dox completed this calculation based on the core samples from the company's latest drilling. According to Dox's calculations, the company has in excess of 500,000 ounces of gold on the property. Dox concludes his research report as follows: "Based on the fact that the company has 500,000 ounces of gold to be mined, I recommend a strong BUY."

**Comment:**

If Dox issues the report as written, he will violate Standard V(B). His calculation of the total gold reserves for the property is an opinion, not a fact. Opinion must be distinguished from fact in research reports.

**Example 3:**

May & Associates is an aggressive growth manager that has represented itself since its inception as a specialist at investing in small-capitalization domestic stocks. One of May's selection criteria is a maximum capitalization of \$250 million for any given company. After a string of successful years of superior relative performance, May expanded its client base significantly, to the point at which assets under management now exceed \$3 billion. For liquidity purposes, May's chief investment officer (CIO) decides to lift the maximum permissible market-cap ceiling to \$500 million and change the firm's sales and marketing literature accordingly to inform prospective clients and third-party consultants.

**Comment:**

Although May's CIO is correct about informing potentially interested parties as to the change in investment process, he must also notify May's existing clients. Among the latter group might be a number of clients who not only retained May as a small-cap manager but also retained mid-cap and large-cap specialists in a multiple-manager approach. Such clients could regard May's change of criteria as a style change that could distort their overall asset allocations.

**Example 4:**

Rather than lifting the ceiling for its universe from \$250 million to \$500 million, May & Associates extends its small-cap universe to include a number of non-U.S. companies.

**Comment:**

Standard V(B) requires that May's CIO advise May's clients of this change because the firm may have been retained by some clients specifically for its prowess at investing in domestic small-cap stocks. Other variations requiring client notification include introducing derivatives to emulate a certain market sector or relaxing various other constraints, such as portfolio beta. In all such cases, members and candidates must disclose changes to all interested parties.

**Example 5:**

A member sends a report to his investment management firm's clients describing a strategy his firm offers in terms of the high returns it will generate in the event interest rate volatility decreases. The report does not provide details of the strategy because they are deemed proprietary. The report does not consider the possible returns if interest rate volatility actually increases.

**Comment:**

This is a violation on two counts. The basic nature of the strategy must be disclosed including the extent to which leverage is used to generate the high returns when volatility falls. Further, the report must include how the strategy will perform if volatility rises as well as if it falls.

**Example 6:**

A member's firm changes from its old equity selection model which is based on price-sales ratios to a new model based on several factors including future earnings growth rates, but does not inform clients of this change.

**Comment:**

This is a violation because members must inform their clients of any significant change in their investment process. Here, the introduction of forecast data on earnings growth can be viewed as a significant change since the old single-variable model was based on reported rather than forecast data.

**Example 7:**

A member's firm, in response to poor results relative to its stated benchmark, decides to structure portfolios to passively track the benchmark and does not inform clients.

**Comment:**

This is a significant change in the investment process and must be communicated to clients.

**Example 8:**

At a firm where individual portfolio managers have been responsible for security selection, a new policy is implemented whereby only stocks on an approved list constructed by the firm's senior managers may be purchased in client accounts. A member who is a portfolio manager does not inform his clients.

**Comment:**

This is a violation of the Standard because it represents a significant change in the investment process.



*Professor's Note: Remember, the argument that clients "won't care" about a process change can be turned around to "there's no reason NOT to disclose the change."*

**V(C) Record Retention.** Maintain all records supporting analysis, recommendations, actions, and all other investment-related communications with clients and prospects.

**Guidance**

Members must maintain research records that support the reasons for the analyst's conclusions and any investment actions taken. Such records are the property of the firm. If no other regulatory standards are in place, CFA Institute recommends at least a 7-year holding period.

**Recommended Procedures for Compliance**

This record-keeping requirement generally is the firm's responsibility.

**Application of Standard V(C) Record Retention****Example 1:**

One of Nikolas Lindstrom's clients is upset by the negative investment returns in his equity portfolio. The investment policy statement for the client requires that the portfolio manager follow a benchmark-oriented approach. The benchmark for

the client included a 35% investment allocation in the technology sector, which the client acknowledged was appropriate. Over the past three years, the portion put into the segment of technology stocks suffered severe losses. The client complains to the investment manager that so much money was allocated to this sector.

**Comment:**

For Lindstrom, it is important to have appropriate records to show that over the past three years the percentage of technology stocks in the benchmark index was 35%. Therefore, the amount of money invested in the technology sector was appropriate according to the investment policy statement. Lindstrom should also have the investment policy statement for the client stating that the benchmark was appropriate for the client's investment objectives. He should also have records indicating that the investment had been explained appropriately to the client and that the investment policy statement was updated on a regular basis.

**Example 2:**

A member bases his research reports on interviews, his own analysis, and industry reports from third parties on his industry and related industries.

**Comment:**

The member must keep records of all the information that went into the research on which his reports and recommendations are based.

**Example 3:**

A member mails investment research and promotional materials to prospects. If the prospects fail to become customers within one year, their names and information concerning documents sent them are purged from the firm's database.

**Comment:**

This communication is investment-related, so the recipient name and other relevant information should be retained for at least seven years for future reference.

## VI. CONFLICTS OF INTEREST

**VI(A) Disclosure of Conflicts.** Members and Candidates must make full and fair disclosure of all matters which may impair their independence or objectivity or interfere with their duties to employer, clients and prospects. Disclosures must be prominent, in plain language, and effectively communicate the information.



*Professor's Note: Emphasis in this Standard is on meaningful disclosure—prominent and in plain language.*

*Guidance*

Members must fully disclose to clients, prospects, and their employers all actual and potential conflicts of interest in order to protect investors and employers. These disclosures must be clearly stated.

*Guidance—Disclosure to Clients*

The requirement that all potential areas of conflict be disclosed allows clients and prospects to judge motives and potential biases for themselves. Disclosure of broker/dealer market-making activities would be included here. Board service is another area of potential conflict.

The most common conflict which requires disclosure is actual ownership of stock in companies that the member recommends or that clients hold.

*Guidance—Disclosure of Conflicts to Employers*

Members must give the employer enough information to judge the impact of the conflict. Take reasonable steps to avoid conflicts, and report them promptly if they occur.

*Recommended Procedures of Compliance*

Any special compensation arrangements, bonus programs, commissions, and incentives should be disclosed.

*Application of Standard VI(A) Disclosure of Conflicts***Example 1:**

Hunter Weiss is a research analyst with Farmington Company, a broker and investment banking firm. Farmington's merger and acquisition department has represented Vimco, a conglomerate, in all of its acquisitions for 20 years. From time to time, Farmington officers sit on the boards of directors of various Vimco subsidiaries. Weiss is writing a research report on Vimco.

**Comment:**

Weiss must disclose in his research report Farmington's special relationship with Vimco. Broker/dealer management of and participation in public offerings must be disclosed in research reports. Because the position of underwriter to a company presents a special past and potential future relationship with a company that is the subject of investment advice, it threatens the independence and objectivity of the report and must be disclosed.

**Example 2:**

Samantha Dyson, a portfolio manager for Thomas Investment Counsel, Inc., specializes in managing defined-benefit pension plan accounts, all of which are in the accumulative phase and have long-term investment objectives. A year ago, Dyson's employer, in an attempt to motivate and retain key investment professionals, introduced a bonus compensation system that rewards portfolio managers on the basis of quarterly performance relative to their peers and certain benchmark indexes. Dyson changes her investment strategy and purchases several high-beta stocks for client portfolios in an attempt to improve short-term performance. These purchases are seemingly contrary to the client investment policy statement. Now, an officer of Griffin Corporation, one of Dyson's pension fund clients, asks why Griffin Corporation's portfolio seems to be dominated by high-beta stocks of companies that often appear among the most actively traded issues. No change in objective or strategy has been recommended by Dyson during the year.

**Comment:**

Dyson violated Standard VI(A) by failing to inform her clients of the changes in her compensation arrangement with her employer that created a conflict of interest. Firms may pay employees on the basis of performance, but pressure by Thomas Investment Counsel to achieve short-term performance goals is in basic conflict with the objectives of Dyson's accounts.

**Example 3:**

Bruce Smith covers East European equities for Marlborough investments, an investment management firm with a strong presence in emerging markets. While on a business trip to Russia, Smith learns that investing in Russian equity directly is difficult but that equity-linked notes that replicate the performance of the underlying Russian equity can be purchased from a New York-based investment bank. Believing that his firm would not be interested in such a security, Smith purchases a note linked to a Russian telecommunications company for his own account without informing Marlborough. A month later, Smith decides that the firm should consider investing in Russian equities using equity-linked notes, and he prepares a write-up on the market that concludes with a recommendation to purchase several of the notes. One note recommended is linked to the same Russian telecom company that Smith holds in his personal account.

**Comment:**

Smith violated Standard VI(A) by failing to disclose his ownership of the note linked to the Russian telecom company. Smith is required by the standard to disclose the investment opportunity to his employer and look to his company's policies on personal trading to determine whether it was proper for him to purchase the note for his own account. By purchasing the note, Smith may or may not have impaired his ability to make an unbiased and objective assessment of the appropriateness of the derivative instrument for his firm, but Smith's failure to disclose the purchase to his employer impaired his employer's ability to render an opinion regarding whether the ownership of a security constituted a conflict of interest that might have affected future recommendations. Once he recommended the notes to his firm, Smith compounded

his problems by not disclosing that he owned the notes in his personal account—a clear conflict of interest.

**Example 4:**

An investment management partnership sells a significant stake to a firm that is publicly traded. The partnership has added the firm's stock to its recommended list and approved its commercial paper for cash management accounts.

**Comment:**

Members are required to disclose such a change in firm ownership to all clients. Further, any transactions in client accounts involving the securities of the public firm, and any recommendations concerning the public firm's securities, must include a disclosure of the business relation between it and the partnership.

**Example 5:**

A member provides clients with research about a company's stock, and his wife inherits a significant amount of stock in the company.

**Comment:**

The member must disclose this potential conflict to his employer and in any subsequent reports or recommendations he authors. His employer may prudently choose to reassign the stock.

**Example 6:**

A member's investment banking firm receives a significant number of options as partial compensation for bringing a firm public. The member will profit personally from a portion of these options as well.

**Comment:**

In any research report on the public firm's securities the member must disclose the fact that these options exist and include their number and the expiration date(s). Since he will profit personally from these, he must also disclose the extent of his participation in these options.

**Example 7:**

A member accepts an offer from a stock promoter who will provide additional compensation when the member sells Acme stock to his clients. He does not inform his clients or his employer.

**Comment:**

The member is in violation of the Standard because he must disclose this additional compensation to those clients to whom he recommends the stock and to his employer. Both have a right to determine for themselves the extent to which this additional compensation might affect the member's objectivity.



**Example 8:**

A member who is a portfolio manager for a small investment management firm serving individuals accepts a job as a trustee of an endowment fund that has over €1.5 billion in assets and does not disclose this to her employer.

**Comment:**

This is a significant position that may require a substantial portion of the member's time and may involve decisions on security selection and trading. The member is in violation of the Standard by not disclosing this involvement to her employer and by not discussing it with her employer before accepting the position.

**VI(B) Priority of Transactions:** Investment transactions for clients and employers must have priority over those in which a Member or Candidate is a beneficial owner.



*Professor's Note: Transactions for clients and employers always have priority over personal transactions.*

**Guidance**

Client transactions take priority over personal transactions and over transactions made on behalf of the member's firm. Personal transactions include situations where the member is a "beneficial owner." Personal transactions may be undertaken only after clients and the member's employer have had an adequate opportunity to act on a recommendation. Note that family-member accounts that are client accounts should be treated just like any client account; they should not be disadvantaged.

**Recommended Procedures for Compliance**

All firms should have in place basic procedures that address conflicts created by personal investing. The following areas should be included:

- Limited participation in equity IPOs. Members can avoid these conflicts by not participating in IPOs.
- Restrictions on private placements. Strict limits should be placed on employee acquisition of these securities and proper supervisory procedures should be in place. Participation in these investments raises conflict of interest issues, similar to IPOs.
- Establish blackout/restricted periods. Employees involved in investment decision-making should have blackout periods prior to trading for clients—no "front running" (i.e., purchase or sale of securities in advance of anticipated client or employer purchases and sales). The size of the firm and the type of security should help dictate how severe the blackout requirement should be.
- Reporting requirements. Supervisors should establish reporting procedures, including duplicate trade confirmations, disclosure of personal holdings/beneficial ownership positions, and pre-clearance procedures.

- Disclosure of policies. When requested, members must fully disclose to investors their firm's personal trading policies.

### *Application of Standard VI(B) Priority of Transactions*

#### **Example 1:**

Erin Toffler, a portfolio manager at Esposito Investments, manages the retirement account established with the firm by her parents. Whenever IPOs become available, she first allocates shares to all her other clients for whom the investment is appropriate; only then does she place any remaining portion in her parents' account, if the issue is appropriate for them. She has adopted this procedure so that no one can accuse her of favoring her parents.

#### **Comment:**

Toffler has breached her duty to her parents by treating them differently from her other accounts simply because of the family relationship. As fee-paying clients of Esposito Investments, Toffler's parents are entitled to the same treatment as any other client of the firm. If Toffler has beneficial ownership in the account, however, and Esposito Investments has preclearance and reporting requirements for personal transactions, she may have to preclear the trades and report the transactions to Esposito.

#### **Example 2:**

A brokerage's insurance analyst, Denise Wilson, makes a closed-circuit report to her firm's branches around the country. During the broadcast, she includes negative comments about a major company within the industry. The following day, Wilson's report is printed and distributed to the sales force and public customers. The report recommends that both short-term traders and intermediate investors take profits by selling that company's stocks. Several minutes after the broadcast, Ellen Riley, head of the firm's trading department, closes out a long call position in the stock. Shortly thereafter, Riley establishes a sizable "put" position in the stock. Riley claims she took this action to facilitate anticipated sales by institutional clients.

#### **Comment:**

Riley expected that both the stock and option markets would respond to the "sell" recommendation, but she did not give customers an opportunity to buy or sell in the options market before the firm itself did. By taking action before the report was disseminated, Riley's firm could have depressed the price of the "calls" and increased the price of the "puts." The firm could have avoided a conflict of interest if it had waited to trade for its own account until its clients had an opportunity to receive and assimilate Wilson's recommendations. As it is, Riley's actions violated Standard VI(B).

#### **Example 3:**

A member who is a research analyst does not recommend a stock to his employer because he wants to purchase it quickly for his personal account.

**Comment:**

He has violated the priority of transactions by withholding this information from his employer and seeking to profit personally at his employer's expense. The member has likely violated his duty to his employer under Standard IV(A) - Loyalty as well.

**Example 4:**

A member who manages a fund gets hot IPO shares for her husband's account from syndicate firms even when the fund is unable to get shares.

**Comment:**

The member has violated the Standard by this action. She must act in the interest of the shareholders of the fund and place allocated shares there first. She must also inform her employer of her participation in these offerings through her beneficial interest in her husband's account(s).

**Example 5:**

A member allows an employee to continue his duties without having signed a required report of his personal trading activity over the last three months. The employee, a CFA candidate, has been purchasing securities for his own account just before firm buy recommendations have been released.

**Comment:**

The employee has violated the Standard. The member has also violated Standard IV(C)—Responsibilities of Supervisors by allowing the employee to continue in his regular duties.

**Example 6:**

A member reveals a sell rating on some securities in a broadcast to all of her firm's brokers. The changed rating is sent to clients the next day. Shortly after revealing the change to her firm's brokers and prior to dissemination to clients, she buys puts on the stock for her firm's account.

**Comment:**

The member did not give clients adequate opportunity to act on the change in recommendation before buying the puts for her firm's account.

**VI(C) Referral Fees:** Members and Candidates must disclose to their employers, clients, and prospects any compensation consideration or benefit received by, or paid to, others for recommendations of products and services.

*Guidance*

Members must inform employers, clients, and prospects of any benefit received for referrals of customers and clients, allowing them to evaluate the full cost of the service as well as any potential impartiality. All types of consideration must be disclosed.

*Application of Standard VI(C) Referral Fees***Example 1:**

Brady Securities, Inc., a broker/dealer, has established a referral arrangement with Lewis Brothers, Ltd., an investment counseling firm. Under this arrangement, Brady Securities refers all prospective tax-exempt accounts, including pension, profit-sharing, and endowment accounts, to Lewis Brothers. In return, Lewis Brothers makes available to Brady Securities on a regular basis the security recommendations and reports of its research staff, which registered representatives of Brady Securities use in serving customers. In addition, Lewis Brothers conducts monthly economic and market reviews for Brady Securities personnel and directs all stock commission business generated by referral account to Brady Securities. Willard White, a partner in Lewis Brothers, calculates that the incremental costs involved in functioning as the research department of Brady Securities amount to \$20,000 annually. Referrals from Brady Securities last year resulted in fee income of \$200,000, and directing all stock trades through Brady Securities resulted in additional costs to Lewis Brothers' clients of \$10,000.

Diane Branch, the chief financial officer of Maxwell, Inc., contacts White and says that she is seeking an investment manager for Maxwell's profit-sharing plan. She adds, "My friend Harold Hill at Brady Securities recommended your firm without qualification, and that's good enough for me. Do we have a deal?" White accepts the new account but does not disclose his firm's referral arrangement with Brady Securities.

**Comment:**

White violated Standard VI(C) by failing to inform the prospective customer of the referral fee payable in services and commissions for an indefinite period to Brady Securities. Such disclosure could have caused Branch to reassess Hill's recommendation and make a more critical evaluation of Lewis Brothers' services.

**Example 2:**

James Handley works for the Trust Department of Central Trust Bank. He receives compensation for each referral he makes to Central Trust's brokerage and personal financial management department that results in a sale. He refers several of his clients to the personal financial management department but does not disclose the arrangement within Central trust to his clients.

**Comment:**

Handley has violated Standard V(C) by not disclosing the referral arrangement at Central Trust Bank to his clients. The Standard does not distinguish between referral fees paid by a third party for referring clients to the third party and internal compensation

arrangements paid within the firm to attract new business to a subsidiary. Members and candidates must disclose all such referral fees. Therefore, Handley would be required to disclose, at the time of referral, any referral fee agreement in place between Central Trust Bank's departments. The disclosure should include the nature and the value of the benefit and should be made in writing.

### Example 3:

Yeshao Wen is a portfolio manager for a bank. He receives additional monetary compensation from his employer when he is successful in assisting in the sales process and generation of assets under management. The assets in question will be invested in proprietary product offerings such as affiliate company mutual funds.

### Comment:

Standard VI(C) is meant to address instances where the investment advice provided by a member or candidate appears to be objective and independent but in fact is influenced by an unseen referral arrangement. It is not meant to cover compensation by employers to employees for generating new business when it would be obvious to potential clients that the employees are "referring" potential clients to the services of their employers.

If Wen is selling the bank's investment management services in general, he does not need to disclose to potential clients that he will receive a bonus for finding new clients and acquiring new assets under management for the bank. Potential clients are likely aware that it would be financially beneficial both to the portfolio manager and the manager's firm for the portfolio manager to sell the services of the firm and attract new clients. Therefore, sales efforts attempting to attract new investment management clients need not disclose this fact.

However, in this example, the assets will be managed in "proprietary product offerings" of the manager's company (for example, an in-house mutual fund) and Wen will receive additional compensation for selling firm products. Some sophisticated investors may realize that it would be financially beneficial to the portfolio manager and the manager's firm if the investor buys the product offerings of the firm.

Best practice, however, dictates that the portfolio manager must disclose to clients that they are compensated for referring clients to firm products. Such disclosure will meet the purpose of Standard VI(C), which is to allow investors to determine whether there is any partiality on the part of the portfolio manager when making investment advice.

## VII. RESPONSIBILITIES AS A CFA INSTITUTE MEMBER OR CFA CANDIDATE

**VII(A) Conduct as Members and Candidates in the CFA Program.** Members and Candidates must not engage in conduct that compromises the reputation or integrity of CFA Institute or the CFA designation or the integrity, validity, or security of the CFA exams.



*Professor's Note: The Standard is intended to cover conduct such as cheating on the CFA exam or otherwise violating rules of CFA Institute or the CFA program. It is not intended to prevent anyone from expressing any opinions or beliefs concerning CFA Institute or the CFA program.*

Members must not engage in any activity that undermines the integrity of the CFA charter. This Standard applies to conduct which includes:

- Cheating on the CFA exam or any exam.
- Not following rules and policies of the CFA program.
- Giving confidential information on the CFA program to Candidates or the public.
- Improperly using the designation to further personal and professional goals.
- Misrepresenting information on the Professional Conduct Statement (PCS) or the CFA Institute Professional Development Program.

Members and candidates are not precluded from expressing their opinions regarding the exam program or CFA Institute.

***Application of Standard VII(A) Conduct as Members and Candidates in the CFA Program***

**Example 1:**

Ashlie Hocking is writing Level 2 of the CFA examination in London. After completing the exam, she immediately attempts to contact her friend in Sydney, Australia, to tip him off to specific questions on the exam.

**Comment:**

Hocking has violated Standard VII(A) by attempting to give her friend an unfair advantage, thereby compromising the integrity of the CFA examination process.

**Example 2:**

Jose Ramirez is an investment-relations consultant for several small companies that are seeking greater exposure to investors. He is also the program chair for the CFA Institute society in the city where he works. To the exclusion of other companies, Ramirez only schedules companies that are his clients to make presentations to the society.

**Comment:**

Ramirez, by using his volunteer position at CFA Institute to benefit himself and his clients, compromises the reputation and integrity of CFA Institute, and, thus, violates Standard VII(A).

**Example 3:**

A member who is an exam grader discusses with friends the guideline answer for and relative candidate performance on a specific question he graded on the CFA exam.

**Comment:**

He has violated his Grader's Agreement and also the Standard by compromising the integrity of the CFA exam.

**Example 4:**

A candidate does not stop writing when asked to by the proctor at the CFA exam.

**Comment:**

By taking additional time compared to other candidates this candidate has violated the Standard, compromising the integrity of the exam process.

**Example 5:**

A member who is a volunteer on a CFA Institute committee tells her clients that what she learns through her committee work will allow her to better serve their interests.

**Comment:**

She has violated the Standard by using her CFA committee position to benefit herself personally and to any extent her 'inside' knowledge has benefited her clients.

**VII(B) Reference to CFA Institute, the CFA Designation, and the CFA Program.**

Members and Candidates must not misrepresent or exaggerate the meaning or implications of membership in CFA Institute, holding the CFA designation, or candidacy in the program.



*Professor's Note: This Standard prohibits Candidates from engaging in any conduct that may "misrepresent or exaggerate the meaning or implications of membership in CFA Institute, holding the CFA designation, or candidacy in the CFA program." Candidates must not reference any "partial" designation since this also misrepresents or exaggerates credentials.*

**Guidance**

Members must not make promotional promises or guarantees tied to the CFA designation. Do not:

- Over-promise individual competence.
- Over-promise investment results in the future (i.e., higher performance, less risk, etc.).

*Guidance—CFA Institute Membership*

Members must satisfy these requirements to maintain membership:

- Sign PCS annually.
- Pay annual CFA Institute membership dues.

If they fail to do this, they are no longer active members.

*Guidance—Using the CFA Designation*

Do not misrepresent or exaggerate the meaning of the designation.

*Guidance—Referencing Candidacy in the CFA Program*

There is no partial designation. It is acceptable to state that a Candidate successfully completed the program in three years, if in fact they did, but claiming superior ability because of this is not permitted.

*Guidance—Proper Usage of the CFA Marks*

The Chartered Financial Analyst and CFA marks must always be used either after a charterholder's name or as adjectives, but not as nouns, in written and oral communications.

*Recommended Procedures for Compliance*

Make sure that members' and candidates' firms are aware of the proper references to a member's CFA designation or candidacy, as this is a common error.

*Application of Standard VII(B) Reference to CFA Institute, the CFA Designation, and the CFA Program***Example 1:**

An advertisement for AZ Investment Advisors states that all the firm's principals are CFA charterholders and all passed the three examinations on their first attempt. The advertisement prominently links this fact to the notion that AZ's mutual funds have achieved superior performance.

**Comment:**

AZ may state that all principals passed the three examinations on the first try as long as this statement is true and is not linked to performance or does not imply superior ability. Implying that (1) CFA charterholders achieve better investment results and (2) those who pass the exams on the first try may be more successful than those who do not violates Standard VII(B).



**Example 2:**

Five years after receiving his CFA charter, Louis Vasseur resigns his position as an investment analyst and spends the next two years traveling abroad. Because he is not actively engaged in the investment profession, he does not file a completed Professional Conduct Statement with CFA Institute and does not pay his CFA Institute membership dues. At the conclusion of his travels, Vasseur becomes a self-employed analyst, accepting assignments as an independent contractor. Without reinstating his CFA Institute membership by filing his Professional Conduct Statement and paying his dues, he prints business cards that display “CFA” after his name.

**Comment:**

Vasseur has violated Standard VII(B) because Vasseur’s right to use the CFA designation was suspended when he failed to file his Professional Conduct Statement and stopped paying dues. Therefore, he no longer is able to state or imply that he is an active CFA charterholder. When Vasseur files his Professional Conduct Statement and resumes paying CFA Institute dues to activate his membership, he will be eligible to use the CFA designation upon satisfactory completion of CFA Institute reinstatement procedures.

**Example 3:**

A member still uses the initials CFA after his name even though his membership has been suspended for not paying dues and for not submitting a personal conduct statement as required.

**Comment:**

This is a violation of the Standard.

**Example 4:**

A member puts the CFA logo on his letterhead, his business cards, and the company letterhead.

**Comment:**

By putting the logo on the company letterhead (rather than the letterhead or business card of an individual who is a CFA charterholder), the member has violated the Standard.

## KEY CONCEPTS

### LOS 1.a, b

Members of CFA Institute [including Chartered Financial Analyst® (CFA®) charterholders] and candidates for the CFA designation (“Members and Candidates”) must:<sup>3</sup>

- Act with integrity, competence, diligence, respect, and in an ethical manner with the public, clients, prospective clients, employers, employees, colleagues in the investment profession, and other participants in the global capital markets.
- Place the integrity of the investment profession and the interests of clients above their own personal interests.
- Use reasonable care and exercise independent professional judgment when conducting investment analysis, making investment recommendations, taking investment actions, and engaging in other professional activities.
- Practice and encourage others to practice in a professional and ethical manner that will reflect credit on themselves and the profession.
- Promote the integrity of, and uphold the rules governing, capital markets.
- Maintain and improve their professional competence and strive to maintain and improve the competence of other investment professionals.

The Standards of Professional Conduct are organized into seven standards:

- I. Professionalism
- II. Integrity of Capital Markets
- III. Duties to Clients
- IV. Duties to Employers
- V. Investment Analysis, Recommendations, and Action
- VI. Conflicts of Interest
- VII. Responsibilities as a CFA Institute Member or CFA Candidate

3. Copyright 2005, CFA Institute. Reproduced and republished from “The Code of Ethics,” from Standards of Practice Handbook, 9th ed., 2005, with permission from CFA Institute. All rights reserved.

## CONCEPT CHECKERS



*Professor's Note: On the actual Level 2 exam, and in all of our self-tests and practice exams, the questions will have 3 choices. However, by including 4 choices here, as is also done in parts of the source curriculum, we are able to test your comprehension of the material more completely.*

1. Jamie Hutchins, CFA, is a portfolio manager for CNV Investments, Inc. Over the years, Hutchins has made several poor personal investments that have led to financial distress and personal bankruptcy. Hutchins feels that her business partner, John Smith, is mostly to blame for her situation since “he did not invest enough money in her investment opportunities and caused them to fail.” Hutchins reports Smith to CFA Institute claiming Smith violated the Code and Standards relating to misconduct. Which of the following statements is *most accurate*?
  - A. Neither Hutchins nor Smith violated the Code and Standards.
  - B. By reporting Smith to CFA Institute, Hutchins has misused the Professional Conduct Program, thus violating the Code and Standards.
  - C. Hutchins’ bankruptcy reflects poorly on her professional reputation and thus violates the Code and Standards.
  - D. Smith’s lack of investment in Hutchins’ opportunities violated the priority of transactions, and he was appropriately reported to CFA Institute.
2. While working on a new underwriting project, Jean Brayman, CFA, has just received information from her client that leads her to believe that the firm’s financial statements in the registration statement overstate the firm’s financial position. Brayman should:
  - A. report her finding to the appropriate governmental regulatory authority.
  - B. immediately dissociate herself from the underwriting in writing to the client.
  - C. seek advice from her firm’s compliance department as to the appropriate action to take.
  - D. inform the client of the problem and issue a press release correcting the statements.
3. Karen Jones, CFA, is an outside director for Valley Manufacturing. At a directors’ meeting, Jones finds out that Valley Manufacturing has made several contributions to foreign politicians that she suspects were illegal. Jones checks with her firm’s legal counsel and determines that the contributions were indeed illegal. At the next board meeting Jones urges the board to disclose the contributions. The board, however, votes not to make a disclosure. Jones should:
  - A. protest the board’s actions in writing to the executive officer of Valley.
  - B. resign from the board and seek legal counsel as to her legal disclosure requirements.
  - C. inform her supervisor of her discovery and cease attending meetings until the matter is resolved.
  - D. resign from the board, sell any stock she owns in the firm, and issue a press release explaining her actions.

4. Carrie Carlson, CFA, is a citizen of Emerging Market Country (EMC) with no securities laws governing the use of inside information. Carlson has clients in Emerging Market Country and in Neighboring Country (NC), which has a few poorly defined laws governing the use of inside information. Should Carlson have inside information on a publicly traded security, she:
  - A. can inform her clients in EMC, but not NC.
  - B. can only trade for her own account when she has inside information.
  - C. can use the information for her NC clients to the extent permitted by the laws of NC.
  - D. cannot use the information to trade in either EMC or NC.
  
5. In order to dispel the myth that emerging market stocks are illiquid investments, Green Brothers, a “long only” emerging market fund manager, has two of its subsidiaries simultaneously buy and sell emerging market stocks. In its marketing literature, Green Brothers cites the overall emerging market volume as evidence of the market’s liquidity. As a result of its actions, more investors participate in the emerging markets fund. Which of the following is *most accurate*? Green Brothers:
  - A. did not violate the Code and Standards.
  - B. violated the Code and Standards by failing to consider the suitability of emerging market investments.
  - C. violated the Code and Standards by manipulating the volume in the emerging securities markets.
  - D. would not have violated the Code and Standards if the subsidiaries traded only stocks not included in the fund.
  
6. Over the past two days, Lorraine Quigley, CFA and manager of a hedge fund, has been purchasing large quantities of Craeger Industrial Products’ common stock while at the same time shorting put options on the same stock. Quigley did not notify her clients of the trades although they are aware of the fund’s general strategy to generate returns. Which of the following statements is *most accurate*? Quigley:
  - A. did not violate the Code and Standards.
  - B. violated the Code and Standards by manipulating the prices of publicly traded securities.
  - C. violated the Code and Standards by failing to disclose the transactions to clients before they occurred.
  - D. violated the Code and Standards by failing to establish a reasonable and adequate basis before making the trades.
  
7. Which of the following statements is *least accurate*? A member or candidate:
  - A. can be considered to have effectively participated in a violation by having knowledge of the violation and not taking steps to disassociate themselves from the activity.
  - B. is held responsible for participating in illegal acts in instances where violation of the law is evident to those who know or should know the law.
  - C. when confronted with potentially illegal activities, should consult with her supervisor and her employer’s counsel.
  - D. must report evidence of legal violations to the appropriate governmental or regulatory organization.

8. Paula Osgood, CFA, is promoting her new money management firm by issuing an advertisement. Which of these items is *least likely* to be in conflict with the professional designation Standard? The advertisement states that:
- A. she passed three exams covering ethics, financial statement analysis, asset valuation, and portfolio management and that she is a member of the local society. Osgood signs the advertisement followed by the letters CFA in oversized and bold strike letters.
  - B. she passed three exams totaling over 18 hours within the minimum period of one and a half years. Knowledge tested included ethics, financial statement analysis, asset valuation, and portfolio management. In addition, she is a member of the local society.
  - C. because of her extensive CFA training she will be able to achieve better investment results than non-CFA managers since she is one of very few professionals to have been awarded this designation.
  - D. she is one of very few professionals to have been awarded this designation and that she is a member of the local society. She signs the advertisement followed by the letters CFA in oversized and bold strike letters.
9. Melvin Byrne, CFA, manages a portfolio for James Martin, a very wealthy client. Martin's portfolio is well diversified with a slight tilt toward capital appreciation. Martin requires very little income from the portfolio. Recently Martin's brother, Cliff, has become a client of Byrne. Byrne proceeds to invest Cliff's portfolio in a similar manner to James' portfolio based on the fact that both brothers have a similar lifestyle and are only two years apart in age. Which of the following statements is *most accurate*? Byrne:
- A. violated the Code and Standards by deviating from his investment mandate related to James' portfolio.
  - B. violated the Code and Standards by knowingly creating a conflict of interest between James' and Cliff's portfolio.
  - C. violated the Code and Standards by failing to determine Cliff's objectives and constraints prior to investing his portfolio.
  - D. did not violate the Code and Standards.
10. In which of the following is the analyst *least likely* to have committed plagiarism?
- A. Julie Long takes performance projections and charts from a company she is researching, combines them with her own analysis, and publishes them under her own name.
  - B. Bill Cooper finds a statistical table in the Federal Reserve Bulletin that supports the work he has done in his industry analysis and has his secretary include the table as part of his report without citing the source.
  - C. Jan Niedfeldt gets a call from one of her fellow analysts stating that the analyst's research shows that XYZ Company is a buy. Niedfeldt calls up her major clients and tells them that her research shows XYZ is a buy.
  - D. To speed up an acquisition project, Jim Zijacek's boss gives him a report from another firm also working on the project and tells Zijacek to print the report on company letterhead, sign it, and mail it out to the stockholders.

11. Jessica Ellis, CFA, manages an international stock portfolio for a group of wealthy investors with similar investment objectives. According to the investment policy statement, the portfolio is to pursue an aggressive growth strategy while maintaining sufficient international diversification. The fund is prohibited from using leverage. Ellis has just received a request from all of the group of investors to purchase for the fund a large position in German bonds which they believe to be significantly undervalued. Which of the following actions should Ellis take to avoid violating the Code and Standards?
  - A. Purchase the bonds since it was requested by the clients to whom Ellis has a fiduciary duty.
  - B. Inform the investors that she is unable to make the purchase since it is inconsistent with the international stock portfolio's investment mandate.
  - C. Purchase the bonds only after receiving a written consent statement signed by each portfolio investor stating that they are aware that the investment is not suitable for the portfolio.
  - D. Change the investment policy statement to reflect an investment strategy that would allow the bond purchase and then purchase the undervalued bonds for the portfolio.
  
12. In a marketing brochure, DNR Asset Managers presents the performance of several composite portfolios managed according to similar investment strategies. In constructing composites, the firm excludes individual portfolios with less than \$1 million in assets, excludes terminated portfolios, and includes simulated results. DNR includes the following disclosure in the brochure: "Past performance is no guarantee of future results. Composites exclude portfolios under \$1 million in assets and include results from simulated model portfolios with similar strategies." DNR's brochure:
  - A. does not violate the Code and Standards.
  - B. violates the Code and Standards by failing to include terminated portfolios in the performance presentation.
  - C. violates the Code and Standards by excluding portfolios under \$1 million from the composite performance presentations.
  - D. violates the Code and Standards by including simulated results of model portfolios even with a disclosure in the presentation.
  
13. Connie Fletcher, CFA, works for a small money management firm that specializes in pension accounts. Recently, a friend asked her to act as an unpaid volunteer manager for the city's street sweep pension fund. As part of the position, the city would grant Fletcher a free parking space in front of her downtown office. Fletcher is considering the offer. Before she accepts she should:
  - A. do nothing since this is a volunteer position.
  - B. inform her current clients in writing and discuss the offer with her employer.
  - C. inform her current clients in writing, get their permission, and discuss the offer with her employer.
  - D. disclose the details of the volunteer position to her employer and obtain written permission from her employer.

14. Which of the following statements about an investment supervisor's responsibilities is *least accurate*? A supervisor:
- A. is expected to know what constitutes an adequate compliance system.
  - B. should bring an inadequate compliance system to the attention of management and recommend corrective action.
  - C. is responsible for instructing those to whom he has delegated authority about methods to detect and prevent violations of the law and standards.
  - D. need only report employee violations of the Code and Standards to upper management and provide a written warning to the employee to cease such activities.
15. Robert Blair, CFA, Director of Research, has had an ongoing battle with management about the adequacy of the firm's compliance system. Recently, it has come to Blair's attention that the firm's compliance procedures are inadequate in that they are not being monitored or carefully followed. What should Blair do?
- A. Resign from the firm unless the compliance system is strengthened and followed.
  - B. Send his superior a memo outlining the problem. This will discharge his obligation under the Code.
  - C. Take no action since his job is supervision and not policy making.
  - D. Decline in writing to continue to accept supervisory responsibility until reasonable compliance procedures are adopted.
16. Ahmed Jamal, CFA, head of research for Valley Brokers, decided it was time to change his recommendation on D&R Company from buy to sell. He orally announced his decision during the Monday staff meeting and said his written report would be finished and disseminated to Valley's customers by the middle of next week. As a result of this announcement, Doris Smith, one of Jamal's subordinates, immediately sold her personal shares in D&R, and Martin Temple told his largest institutional customers of the change the following day. Which Standards have *most likely* been violated?
- A. Jamal violated Standard IV(C) Responsibilities of Supervisors; and Smith violated Standard II(A) Material Nonpublic Information.
  - B. Jamal violated Standard IV(C) Responsibilities of Supervisors; Smith violated Standard II(A) Material Nonpublic Information; and Temple violated Standard VI(B) Priority of Transactions.
  - C. Jamal violated Standard IV(C) Responsibilities of Supervisors; Smith violated Standard VI(B) Priority of Transactions; and Temple violated Standard III(B) Fair Dealing.
  - D. Smith violated Standard VI(B) Priority of Transactions; and Temple violated Standard III(B) Fair Dealing.

17. Jack Schleifer, CFA, is an analyst for Brown Investment Managers (BIM). Schleifer has recently accepted an invitation to visit the facilities of ChemCo, a producer of chemical compounds used in a variety of industries. ChemCo offers to pay for Schleifer's accommodations in a penthouse suite at a luxury hotel and allow Schleifer to use the firm's private jet to travel to its three facilities located in New York, Hong Kong, and London. In addition, ChemCo offers two tickets to a formal high-society dinner in New York and a small desk clock with the ChemCo logo. Schleifer declines to use ChemCo's corporate jet and to let the firm pay for his accommodations but accepts the clock and the tickets to the dinner (which he discloses to his employer) since he will be able to market his firm's mutual funds to other guests at the dinner. Has Schleifer violated any CFA Institute Standards of Professional Conduct?
- Yes.
  - No, since he is using the gifts accepted to benefit his employer's interests.
  - No, since the gifts he accepted were fully disclosed in writing to his employer.
  - No, since the gifts that he accepted were of nominal value and he declined to accept the hotel accommodations and the use of ChemCo's jet.
18. Based on the Standards of Professional Conduct, a financial analyst is required to do all the following EXCEPT:
- disclose the fact that his firm is the underwriter for securities issued by a company he covers.
  - report to his employer the receipt of gifts and additional compensation from clients.
  - pay for chartered transportation and lodging while visiting a company's remotely located facilities.
  - pay for commercial transportation and lodging while visiting a company's headquarters.
19. Beth Anderson, CFA, is a portfolio manager for several wealthy clients including Reuben Carlyle. Anderson manages Carlyle's personal portfolio of stock and bond investments. Carlyle recently told Anderson that he is under investigation by the IRS for tax evasion related to his business, Carlyle Concrete (CC). After learning about the investigation, Anderson proceeds to inform a friend at a local investment bank so that they may withdraw their proposal to take CC public. Which of the following is *most accurate*? Anderson:
- violated the Code and Standards by failing to immediately terminate the client relationship with Carlyle.
  - violated the Code and Standards by failing to maintain the confidentiality of her client's information.
  - violated the Code and Standards by failing to detect and report the tax evasion to the proper authorities.
  - did not violate the Code and Standards since the information she conveyed pertained to illegal activities on the part of her client.



20. Gail Stefano, CFA, an analyst for a U.S. brokerage firm that serves U.S. investors, researches public utilities in South American emerging markets. Stefano makes the following statement in a recent report: "Based on the fact that the South American utilities sector has seen rapid growth in new service orders, we expect that most companies in the sector will be able to convert the revenue increases into significant profits. We also believe the trend will continue for the next three to five years." The report goes on to describe the major risks of investing in this market, in particular the political and exchange rate instability associated with South American countries. Stefano's report:
- A. has not violated the Code and Standards.
  - B. violated the Code and Standards by failing to properly distinguish factual information from opinions.
  - C. violated the Code and Standards by recommending an investment which would not be suitable for all of its clients.
  - D. violated the Code and Standards by failing to properly identify details related to the operations of South American utilities.
21. All of the following violate Standard III(B) Fair Dealing, **EXCEPT**:
- A. before disseminating a change in the analyst's buy recommendation, the analyst calls his best clients and tells them about the change.
  - B. a firm makes investment recommendations and also manages a mutual fund. The firm routinely begins trading for the fund's account ten minutes before announcing recommendation changes to client accounts.
  - C. after releasing the general recommendation to all clients, an analyst calls the firm's largest institutional clients to discuss the recommendation in more detail.
  - D. a portfolio manager allocates IPO shares to her brother's fee-based retirement account only after allocating shares to all other accounts.
22. Which of the following is *least likely* to constitute a violation of Standard VI(B) Priority of Transactions?
- A. Failure by an analyst to make or change a recommendation until he trades for his own account.
  - B. An analyst trades for her son's trust account on the same day her firm changes its buy/sell recommendation.
  - C. An analyst takes a position in a stock she recommended one week after the recommendation was made public.
  - D. An analyst trades for the firm's account before handling client trades.

23. Jamie Olson, CFA, has just started work as a trainee with Neuvo Management Corp., a small regional money management firm started six months ago. She has been told to make a few cold calls and round up some new clients. In which of the following statements is Olson *least likely* to have violated the Standards of Practice?
- A. "Sure, we can perform all the financial and investment services you need. We've consistently outperformed the market indexes and will continue to do so under our current management."
  - B. "Sure, we can assist you with all the financial and investment services you need. If we don't provide the service in-house, we have arrangements with other full-service firms that I would be happy to tell you about."
  - C. "Believe me, I've been at this game long enough to know what I'm talking about. I personally guarantee this investment. It's a sure winner."
  - D. "Our firm has a long history of successful performance for our clients. While we can't guarantee future results, we do believe we will continue to benefit our clients."
24. Mary Herbst, CFA, a pension fund manager at GBH Investments, is reviewing some of FreeTime, Inc.'s pension fund activities over the past years. Which of the following actions related to FreeTime, Inc.'s pension fund is *least likely* to be a breach of her fiduciary duties?
- A. Paying higher-than-average brokerage fees to obtain research materials used in the management of other funds by the investment group.
  - B. Trading with selected brokers so that the brokers will recommend GBH's managers to potential clients.
  - C. Substantially increasing the risk of the fund in order to minimize FreeTime, Inc.'s future contributions.
  - D. Selectively choosing brokers for the quality of research provided for managing FreeTime's pension.
25. Kevin Minter, CFA, is an investment analyst at Bradley & Company, a small money management firm. Minter keeps detailed records and documentation of relevant research pertaining to his investment recommendations. Because of the limited physical and electronic storage space, however, three days after issuing a recommendation, Minter shreds hard copy documentation and deletes all electronic files except for the recommendation itself. There is no regulatory requirement to maintain records for any specified time period. Which of the following statements is *most accurate*? Minter:
- A. has not violated the Code and Standards.
  - B. violated the Code and Standards because he did not maintain hard copy and electronic documentation supporting all of his current recommendations.
  - C. violated the Code and Standards because he did not maintain hard copy or electronic documentation supporting his recommendations for seven years.
  - D. violated the Code and Standards because he did not maintain hard copy and electronic documentation supporting all of his recommendations.

26. Eugene Nieder, CFA, has just accepted a new job as a quantitative analyst for Paschal Investments, LLP. Nieder developed a complex model while working for his previous employer and plans to recreate the model for Paschal. Nieder did not make copies of the model or any supporting documents since his employer refused to grant him permission to do so. Nieder will recreate the model from memory. Which of the following statements is *most accurate*?
- A. Nieder can recreate the model without violating the Code and Standards as long as he also generates supporting documentation.
  - B. Nieder can recreate the model without violating the Code and Standards as long as he obtains permission to do so from his former employer.
  - C. Nieder can recreate the model without violating the Code and Standards without documentation if the model is modified from its original form.
  - D. Nieder cannot recreate the model without violating the Code and Standards because it is the property of his former employer.
27. As part of an agreement with Baker Brokerage, Hern Investment Company, a money manager for individual clients, provides monthly emerging market overviews in exchange for prospective client referrals and European equity research from Baker. Clients and prospects of Hern are not made aware of the agreement, but clients unanimously rave about the high quality of the research provided by Baker. As a result of the research, many non-discretionary clients have earned substantial returns on their portfolios. Managers at Hern have also used the research to earn outstanding returns for the firm's discretionary portfolios. Which of the following statements is *most accurate*? Hern:
- A. has not violated the Code and Standards.
  - B. has violated the Code and Standards by using third-party research in discretionary accounts.
  - C. has violated the Code and Standards by failing to disclose the referrals made by Baker.
  - D. has violated the Code and Standards by failing to communicate the basic investment characteristics to discretionary clients.

28. Frist Investments, Inc., has just hired Michael Pulin to manage institutional portfolios, most of which are pension related. Pulin has just taken the Level 3 CFA exam and is awaiting his results. Pulin has over 15 years of investment management experience with individual clients but has never managed an institutional portfolio. Pulin joined the CFA Institute as an affiliate member two years ago and is in good standing with the organization. Which of the following statements would be *most appropriate* for Frist to use in advertising Pulin as a new member of the firm? Pulin:
- A. has many years of investment experience which, along with his participation in the CFA program, will allow him to deliver superior investment performance relative to other managers.
  - B. is a CFA Level 3 and passed the first two exams on the first attempt. He is an affiliate member of the CFA Institute. We expect him to become a regular member if he passes the Level 3 examination.
  - C. will be a CFA once he passes the Level 3 CFA exam. He has vast amounts of practical experience as well as an enhanced understanding of the investment process as a result of his participation in the CFA program.
  - D. is a Level 3 CFA candidate and has many years of excellent performance in the investment management industry. Pulin is an affiliate member of the CFA Institute and will be eligible to become a CFA charterholder and regular member if he passes the Level 3 CFA exam.
29. Before joining Mitsui Ltd. as an analyst covering the electrical equipment manufacturing industry, Pam Servais, CFA, worked for Internet Security Systems (ISS) where she had access to nonpublic information. While at ISS, Servais learned of a severe environmental problem at two firms handling boron-based components. It is common knowledge that seven firms in the industry worldwide use the same boron handling technique. The two firms for which Servais has knowledge announced the problem last week and had immediate stock price declines of 11% and 17%, respectively. The other five firms have not made an announcement. Servais issues a report citing these facts and recommending Mitsui clients sell shares of the remaining five firms. Servais' issuance of this recommendation:
- A. is not a violation of CFA Institute Standards.
  - B. is a violation of CFA Institute Standards insofar as she has failed to deal fairly and objectively with all clients.
  - C. is a violation of CFA Institute Standards insofar as it fails to distinguish between opinion and fact.
  - D. constitutes a violation of the Standard pertaining to the use of material nonpublic information.

30. Zanuatu, an island nation, does not have any regulations precluding the use of nonpublic information. Alfredo Romero has a friend and fellow CFA charterholder there with whom he has shared nonpublic information regarding firms outside of his industry. The information concerns several firms' internal earnings and cash flow projections. The friend may:
- A. trade on the information under the laws of Zanuatu, which govern her behavior.
  - B. not trade on the information under CFA Institute Standards, which govern her behavior.
  - C. not trade on the information under the laws of Zanuatu, which govern her behavior.
  - D. trade on the information under CFA Institute Standards since the firms concerned are outside of Romero's industry.
31. Samantha Donovan, CFA, is an exam proctor for the Level 2 CFA exam. The day before the exam is to be administered, Donovan faxes a copy of one of the questions to two friends, James Smythe and Lynn Yeats, who are Level 2 candidates in the CFA program. Donovan, Smythe, and Yeats had planned the distribution of an exam question months in advance. Smythe used the fax to prepare for the exam. Yeats, however, had second thoughts and threw the fax away without looking at its contents. Which of the following statements is *most accurate*?
- A. Donovan violated the Code and Standards but Yeats did not.
  - B. Yeats violated the Code and Standards but Smythe did not.
  - C. Donovan violated the Code and Standards but Smythe did not.
  - D. Donovan and Yeats both violated the Code and Standards.
32. Julia Green, CFA, has friends from her previous employer who have suggested that she agree to receive nonpublic information anonymously from them via an Internet chat room. In this way, she receives news about an exciting new product being developed by a firm in Singapore that has the potential to double the firm's revenue. The firm has not previously revealed any information regarding the product to the public. According to the Code and Standards, this information is:
- A. not material and may be traded upon.
  - B. both material and nonpublic and may not be traded upon in Singapore, but may be traded on elsewhere.
  - C. both material and nonpublic and may not be traded upon in any jurisdiction.
  - D. public by virtue of its release in the chat room and may be traded upon.

33. Sally Albright, CFA, works full time for Frank & Company, an investment management firm, as a fixed-income security analyst. Albright has been asked by a business contact at KDG Enterprises to accept some analytical work from KDG on a consulting basis. The work would entail investigating potential distressed debt investments in the small-cap market. Albright should:
- accept the work as long as she obtains consent to all the terms of the engagement from Frank & Company.
  - not accept the work as it violates the Code and Standards by creating a conflict of interest.
  - accept the work so long as she obtains written consent from KDG.
  - not accept the work since this will likely expose her to material nonpublic information in violation of the Code and Standards.
34. William Bixby, CFA, oversees a mid-cap fund that is required to invest in a minimum of 40 and a maximum of 60 different issues. Bixby uses a quantitative approach to actively manage the assets. In promotional materials, he states that “through our complex quantitative approach, securities are selected that have similar exposures to a number of risk factors that are found in the S&P 500 Index. Thus, the fund is designed to track the performance of the S&P 500 Index but will receive a return premium of between 2% and 4% according to our model’s risk-return measures.” This statement is:
- permissible since the assertion is supported by modern portfolio theory and estimates from the firms’ model.
  - not permissible since Bixby is misrepresenting the services that she and/or her firm are capable of performing.
  - not permissible since Bixby is misrepresenting the investment performance she and/or her firm can reasonably expect to achieve.
  - permissible since the statement describes the basic characteristics of the fund’s risk and return objectives.
35. Josef Karloff, CFA, acts as liaison between Pinnacle Financial (an investment management firm) and Summit, Inc. (an investment banking boutique specializing in penny stocks). When Summit underwrites an IPO, Karloff routinely has Pinnacle issue vague statements implying that the firm has cash flows, financial resources, and growth prospects that are far better than is the case in reality. This action is:
- permissible under CFA Institute Standards.
  - a violation of the Standard concerning fair dealing.
  - a violation of the Standard concerning responsibilities of supervisors.
  - a violation of the Standard concerning professional misconduct.
36. Shane Matthews, CFA, is a principal at Carlson Brothers, a leading regional investment bank specializing in initial public offerings of small to mid-sized biotech firms. Just before many of the IPOs are offered to the general public, Matthews arranges for 10% of the shares of the firm going public to be distributed to management at 75% of the expected IPO price. This action is:
- permissible under CFA Institute Standards.
  - a violation of the Standard concerning professionalism.
  - a violation of the Standard concerning disclosure of conflicts of interest.
  - a violation of the Standard concerning suitability.

37. Will Hunter, CFA, is a portfolio manager at NV Asset Managers in Baltimore, which specializes in managing labor union pension fund accounts. A friend of Hunter's who is an investment banker asks Hunter to purchase shares in their new IPOs in order to support the price long enough for insiders to liquidate their holdings. Hunter realizes that the price of the shares will almost certainly fall dramatically after his buying support ceases. NV management "strongly suggests" that Hunter "not rock the boat" and honor the investment banker's request since NV has had a long-standing relationship with the investment bank. Hunter agrees to make the purchases. Hunter has:
- A. not violated the Code and Standards.
  - B. violated the Code and Standards by failing to report fair, accurate, and complete data to his clients.
  - C. violated the Code and Standards by attempting to distort natural market forces.
  - D. violated the Code and Standards by failing to place orders in the appropriate transaction priority.
38. Neiman Investment Co. receives brokerage business from Pick Asset Management in exchange for referring prospective clients to Pick. Pick advises pension clients—in writing at the time the relationship is established—of the nature of its arrangement with Neiman. With regard to this practice, Pick has:
- A. fully complied with the Code and Standards.
  - B. violated the Code and Standards by failing to preserve the confidentiality of the agreement with Neiman.
  - C. violated the Code and Standards by inappropriately negotiating an agreement that creates a conflict of interest.
  - D. violated the Code and Standards by inappropriately delegating its fiduciary responsibilities to Neiman.
39. Fred Johnson, CFA, a financial analyst and avid windsurfer, has begun an investment survey of the water sports leisure industry. His brother sells windsurfing gear in Tampa and tells him that Swordfish9 is the "hottest windsurfing rig on the market and will be highly profitable for Swordfish Enterprises." Johnson had never heard of Swordfish previously but after testing the board himself became very excited about the Swordfish9 and issued an investment recommendation of "buy" on Swordfish Enterprises. As a result of issuing the recommendation, Johnson has:
- A. not violated the Code and Standards.
  - B. violated the Code and Standards by failing to establish a reasonable and adequate basis.
  - C. violated the Code and Standards concerning professionalism by placing recreational interests ahead of his fiduciary duty to his clients.
  - D. violated the Code and Standards by failing to consider the suitability of the investment for his clients.

40. Daniel Lyons, CFA, is an analyst for a French firm that sells investment research to European companies. Lyons' aunt owns 30,000 shares of French National Bank (FNB). She informs Lyons that as a part of her estate planning she has created a trust in his name into which she has placed 2,000 shares of FNB. The trust is structured so that Lyons will not receive control of the assets for two years, at which time his aunt will also gift her current home to Lyons and move into a retirement community. Lyons is due to update his research coverage of FNB next week. Lyons should:
- A. advise his superiors that he is no longer able to issue research recommendations on FNB.
  - B. update the report without notification since the shares are held in trust and are beyond his direct control.
  - C. disclose the situation to his employer and, if then asked to prepare a report, also disclose the situation in the report.
  - D. disclose the situation to his employer and then prepare the report with no disclosure.



## ANSWERS – CONCEPT CHECKERS

1. B Hutchins' personal bankruptcy may reflect poorly on her professional reputation if it resulted from fraudulent or deceitful business activities. There is no indication of this, however, and the bankruptcy is thus not a violation. Smith has not violated the Code and Standards by refusing to invest with Hutchins in what turned out to be bad investment opportunities. By reporting Smith to CFA Institute for a violation, Hutchins has misused the Professional Conduct Program to settle a dispute unrelated to professional ethics and has thus violated Standard I(D), Misconduct.
2. C According to Standard I(A), informing her supervisor or firm's compliance department is appropriate. Dissociating herself would be premature. She should report her suspicions to a supervisory person and attempt to remedy the situation.
3. B According to Standard I(A), since she has taken steps to stop the illegal activities and the board has ignored her, Jones must dissociate from the board and seek legal advice as to what other actions would be appropriate in this instance. She may need to inform legal or regulatory authorities of the illegal activities.
4. D According to Standard II(A), members and candidates are under no circumstances allowed to use inside information to trade securities. Carlson must abide by the Code and Standards, which is the most strict regulation in the scenario.
5. C The intent of Green Brothers' actions is to manipulate market liquidity in order to attract investment to its own funds. The increased trading activity was not based on market fundamentals or an actual trading strategy to benefit investors. It was merely an attempt to mislead market participants in order to increase assets under Green Brothers' management. The action violates Standard II(B) Market Manipulation.
6. A Quigley's trades are most likely an attempt to take advantage of an arbitrage opportunity that exists between Craeger's common stock and its put options. She is not manipulating the prices of securities in an attempt to mislead market participants, which would violate Standard II (A). She is pursuing a legitimate investment strategy. Participants in her hedge fund are aware of the fund's investment strategy, and thus Quigley did not violate the Code and Standards by not disclosing this specific set of trades in advance of trading.
7. D According to Standard I(A), in some instances reporting a legal violation to governmental or regulatory officials may be appropriate, but this isn't always necessary, and it isn't required under Standard I(A).
8. B According to Standard VII(B), any explanation of the designation in print form should be a concise description of the requirements or of CFA Institute. The other statements contain violations of Standard VII(B), in particular the presentation of the letters CFA. Also, she may not imply superior performance as a result of being a CFA charterholder.
9. C Standard III(C) requires that before taking investment action, members and candidates must make a reasonable inquiry into a client's or prospect's investment objectives and constraints as well as their prior investment experience. Byrne cannot assume that because the brothers have similar lifestyles and are close in age, they should have similarly managed portfolios. Byrne should have interviewed Cliff directly before investing his portfolio.
10. B According to Standard I(C), a recognized statistical reporting service used as a source of factual data need not be cited.

11. B According to Standard III(C), Ellis must consider the suitability of each new investment (as well as the current holdings) in light of the portfolio mandate. Ellis must only make investments that are in accordance with the portfolio's investment policy statement. Therefore, Ellis should not purchase the unsuitable bonds as requested by her clients.
12. B By failing to include terminated portfolios in the performance presentation, the performance will have an inherent upward bias, making results appear better than they truly are. By excluding the terminated portfolios, DNR misleads its potential investors and thus violates Standard III(D) Performance Presentation. Presentation of simulated performance results is permitted as long as the firm provides full and complete disclosure.
13. D According to Standard IV(A), members and candidates are expected to act for the benefit of the employer and not deprive the employer of their skills. Fletcher is performing work similar to the services that her employer provides for a fee. Although the position is a volunteer position, Fletcher will receive compensation in the form of a free parking space. In light of the circumstances, Fletcher must disclose the details of the position and get written permission before accepting the volunteer position.
14. D According to Standard IV(C), reporting the violation and warning the employee to cease activities that violate the law or the Code and Standards are not enough. The supervisor must take steps (such as limiting employee activity or increasing the level of employee monitoring) to prevent further violations while he conducts an investigation.
15. D According to Standard IV(C), because he is aware that the firm's compliance procedures are not being monitored and followed and because he has repeatedly tried to get company management to correct the situation, Blair should decline supervisory responsibility until adequate procedures to detect and prevent violations of laws, regulations, and the Code and Standards are adopted and followed. If he does not do so, he will be in violation of the Code and Standards.
16. C Jamal failed to properly supervise employees and provide adequate procedures and policies to prevent employee violations. Smith should not have traded her own account ahead of client accounts. Temple should not have disclosed the recommendation change selectively but should have informed his clients fairly and objectively. No inside information was used in the question.
17. A Standard I(B) requires that members and candidates reject offers of gifts or compensation that could compromise their independence or objectivity. Schleifer has appropriately rejected the offer of the hotel accommodations and the use of ChemCo's jet. He may accept the desk clock since this gift is of nominal value and is unlikely to compromise his independence and objectivity. Schleifer cannot accept the tickets to the dinner, however. Since it is a formal high-society dinner, the tickets are most likely expensive or hard to come by. Even though he has disclosed the gift to his employer and he plans to use the dinner as a marketing opportunity for his firm, the gift itself may influence Schliefer's future research in favor of ChemCo. Allowing such potential influence is a violation of Standard I(B).
18. C Standard I(B) requires that an analyst maintain his independence and objectivity by having his firm pay for ordinary travel expenses to visit companies that are the subject of research. However, in some cases, such as remotely located facilities, the company may pay for modest accommodations and chartered flights as long as the transportation and lodging is not lavish and is not intended to exert influence over the analyst.

19. B Anderson must maintain the confidentiality of client information according to Standard III(E). Confidentiality may be broken in instances involving illegal activities on the part of the client, but the client's information shall be relayed to proper authorities. Anderson did not have the right to inform the investment bank of her client's investigation.
20. A Historical growth can be cited as a fact since it actually happened. Stefano states that her firm expects further growth and profitability which is an opinion. She does not claim that these are facts. In addition, Stefano identifies relevant factors and highlights in particular the most significant risks of investing in South American utilities. She has fully complied with Standard V(B) Communication With Clients and Prospective Clients. Under the Standard, it is not necessary to include every detail about a potential investment in a report. Members and candidates are expected to use their judgment and identify the most important factors to include.
21. C This is not necessarily a violation. Firms can offer different levels of service to clients as long as this is disclosed to all clients. The largest institutional clients would likely be paying higher fees for a greater level of service. Also note that the analyst's brother's account in answer D should be treated similarly to any other client account.
22. C One week is likely an acceptable waiting period.
23. B Standard I(C)—in the other choices, Olson misrepresents the services that she or her firm are capable of performing, her qualifications, her academic or professional credentials, or the firm's credentials. The firm is small and most likely cannot perform all investment services the client may require. The firm cannot guarantee future outperformance of the market indexes. Olson hasn't been in the business for a long time, as she claims, and cannot guarantee the performance of any investment. The firm doesn't have a long history (only six months).
24. D Standard III(A)—Herbst is acting as a fiduciary for the pension plan beneficiaries. She may pay higher-than-average brokerage fees so long as doing so benefits the pension beneficiaries, not other clients. Trading with selected brokers solely to gain referrals is not likely to be in the pension beneficiaries' best interest since it does not take into account other important factors for selecting brokerage firms. Minimizing contributions benefits the plan sponsor, not the plan beneficiaries to whom the fiduciary duty is owed. Choosing brokers based on quality of services provided is reasonable.
25. C Minter is required by Standard V(C) to maintain hard copy *or* electronic documentation of the research and data supporting current investment recommendations for more than three days. In cases where there is no regulatory guidance on an appropriate length of time, the Standard recommends keeping documentation for seven years.
26. A Nieder must not take models or documents from his previous employer without explicit permission to do so [Standard IV(A)]. He is allowed, however, to reproduce the model from memory but must recreate the supporting documentation to maintain compliance with Standard V(C) Record Retention.
27. C According to Standard VI(C) Referral Fees, Hern must disclose the referral arrangement between itself and Baker so that potential clients can judge the true cost of Hern's services and assess whether there is any partiality inherent in the recommendation of services.

28. **D** Standard VII(B) governs acceptable methods of referencing the CFA Institute, CFA designation, and CFA Program. Candidates may reference their candidacy if they are enrolled for or waiting for the results of a CFA exam. Pulin may also reference his membership status with the CFA Institute as well as his remaining eligibility requirements to become a CFA charterholder.
29. **A** There is no indication that Servais has inside information pertaining to the situation at the five firms in question—only the two firms that have already gone public with the information. It is common knowledge that the other five firms follow the same bond handling procedures. She is, therefore, in compliance with Standard V(A) concerning the use of material nonpublic information in the issuance of the investment recommendation.
30. **B** Even though the laws of Zanuatu would not preclude trading on the information, as a CFA Charterholder the friend is bound by the CFA Institute Code and Standards. Standard II(A) prohibits the use of material nonpublic information, and the friend may not trade the stocks about which she has such information under any circumstances.
31. **D** In this situation, Donovan, Smythe, and Yeats all violated Standard VII(A) Conduct as Members and Candidates in the CFA Program. The Standard prohibits conduct that compromises the integrity, validity, or security of the CFA exams. Donovan clearly breached the exam security. Smythe and Yeats both compromised the integrity of the exams by planning to use the actual exam question to gain an advantage over other candidates. Even though Yeats did not ultimately use the information to study for the exam, she participated in a scheme to cheat on the CFA exam.
32. **C** The furtive release of such information to a limited circle via an internet chat room does not cause the information to be public. The information is also clearly material. Therefore Green is not allowed to trade on the information under Standard II(A).
33. **A** Albright is entitled to accept work for which she receives outside compensation as long as the appropriate consent is obtained. Under Standard IV(A), such consent must be obtained from her employer prior to beginning the work.
34. **C** It is not reasonable for Bixby to expect a 40-to-60 stock mid-cap portfolio to track the entire S&P 500 Index, which is a large-cap index. He should know that there will be periods of wide variance between the performance of the portfolio and the S&P 500 Index. There is no assurance that a premium of 2% to 4% will consistently be obtained. Bixby is in violation of Standard III(D) since he has made an implicit guarantee of the fund's expected performance.
35. **D** Since the statements are vague, we have no direct evidence that a violation of securities law has occurred. However, under Standard I(C), members and candidates are prohibited from engaging in activities involving false or misleading statements. Karloff's action is a clear attempt to deceive the investing public regarding the value of Summit IPOs.
36. **B** Members and candidates are required to maintain knowledge of and comply with the applicable securities laws governing their professional activities. This type of securities fraud would almost certainly be against the law in most jurisdictions. Matthews's actions, therefore, are in violation of Standard I(A), which require knowledge of and adherence to applicable laws. He has also violated Standard I(D), which prohibits professional misconduct involving fraud and other acts that reflect poorly on the professional's reputation.

37. C NV management is asking Hunter to violate Standard II(B), which prohibits taking actions that are designed to distort prices or artificially increase trading volume. The intent of Hunter's actions is to mislead market participants and allow corporate insiders to take advantage of the artificially high prices.
38. A There is no violation of the CFA Institute Standards regarding this matter. The referral arrangement is fully disclosed to clients before they agree to do business with Pick. Therefore clients can fully assess how the agreement will affect their account before hiring Pick as their asset manager.
39. B Johnson has apparently let his recreational passion cloud his judgment. This is not to say that Swordfish Enterprises is not or will not be an excellent investment. However, if he had never heard of the firm previously, issuing an investment recommendation without conducting a thorough financial investigation indicates a failure to exercise diligence and also indicates that he lacks a reasonable and adequate basis for his recommendation. He is in violation of Standard V(A).
40. C Even though the shares are held in trust, this could still be construed as a conflict of interest. Lyons is obligated under Standard VI(A) to inform his employer of the potential conflict. If he is then authorized to issue investment recommendations on the security in question, the existence of a potential conflict must be disclosed in the report.

# CFA INSTITUTE SOFT DOLLAR STANDARDS

Study Session 1

---

## EXAM FOCUS

“Soft dollars” (or “client brokerage”) refers to investment research, products and services, and cash credits given to the investment manager by brokers in return for client business. The soft dollar credit is the client’s asset because he pays the commission. Fiduciaries owe their clients two basic duties: to act in the clients’ best interest and to disclose conflicts of interest. The cardinal rule is that soft dollars are an asset of the client and may not be used for any purpose that does not benefit that client. The Soft Dollar Standards are voluntary, but firms that claim compliance must meet all of the requirements.

---

**LOS 3.a: Define soft-dollar arrangements and state the general principles of the Soft Dollar Standards.**

---

*Soft dollar arrangement* refers to the research and other benefits provided to the client or the client’s investment manager by the broker for directing the trade to the broker.

## SOME DEFINITIONS

- *Soft dollars* refer to commissions generated on both agency and principal trades.
- An *agency trade* is a transaction that involves the payment of a commission.
- A *principal trade* is a transaction that involves a discount or a spread.
- *Soft dollar practices* involve the use of client brokerage by an investment manager to obtain certain products and services to aid the manager in the investment decision making process.
- *Brokerage* refers to the amount given to a broker as payment for execution services.
- *Research* includes both *proprietary* (generated by the broker) and *third-party* research (purchased by the broker). Research must directly assist the investment manager in the investment decision-making process and not in the management of the firm itself. Research that can be used for both the investment management process and management is called *mixed use* research.
- *Client-directed brokerage* is an arrangement under which the client tells the manager to execute trades under its account with a specific broker. In exchange, the client receives a benefit in addition to the execution services.

## GENERAL PRINCIPLES OF THE SOFT DOLLAR STANDARDS

The two key principles of the Soft Dollar Standards are:

1. Brokerage is the property of the client.
2. Investment managers have a duty to obtain best execution, minimize transactions costs, and use client brokerage to benefit clients.

CFA Institute Soft Dollar Standards are intended to ensure:

- Complete disclosure of the investment manager's use of soft dollars and client brokerage.
- Consistent presentation of data so all parties can clearly understand brokerage practices.
- Uniform disclosure and record keeping so the client clearly understands how the investment manager is using client brokerage.
- Consistently high ethical industry standards.

The investment manager should consider that:

- The manager is a fiduciary and as such must disclose all details relating to benefits received through a client's brokerage.
- Third-party and proprietary research are to be treated similarly when examining soft dollar arrangements since the research received is paid for with client brokerage.
- Any research purchased with client brokerage must directly assist the investment manager in the investment process and not in the overall management of the firm.
- If there is ever any question as to whether the research assists in the investment process, it should be paid for with investment manager assets.

---

### LOS 3.b: Critique company soft-dollar practices and policies.

---

#### I. General

*Required:*

- Soft dollar practices must benefit the client and must place the clients' interests above the investment manager's interests.
- Allocation of client brokerage should not be based on the amount of client referrals the investment manager receives from a broker.
- Regarding mutual funds, the investment manager's client is the fund. The fund's board should set policies regarding broker selection.

#### II. Relationships With Clients

*Required:*

- Disclose to the client that the manager may participate in soft dollar arrangements involving the client's account prior to participating in such arrangements.

*Recommended:*

- It is permissible to use client brokerage from agency trades to obtain research which may not directly benefit the client. Over time, however, the client should receive a benefit from the research.
- As long as no fiduciary regulations apply, it is permissible to use client brokerage obtained from principal trades to benefit other client accounts, as long as this is disclosed to the client and prior consent is received.

**III. Selection of Brokers**

Proper broker selection is a key area where the investment manager can add value for the client. Failure to obtain best execution will hurt performance.

*Required:*

- Consider trade execution capabilities when selecting brokers.

*Recommended:*

- When evaluating best execution, consider the broker's financial responsibility, responsiveness, brokerage rate or spread involved, and range of services provided.

**IV. Evaluation of Research***Required:*

To be able to use client brokerage to pay for research, these criteria must be followed:

- Research must meet the definition. Research is defined as services and products provided by a broker whose primary use directly assists the investment manager in the investment decision making process, and not in the management of the firm.
- Research must benefit the client.
- The basis for the determination must be documented.
- In the case of principal trades not subject to other fiduciary regulations, the research may benefit other client accounts, as long as disclosure is made to the client and prior permission is received.
- If the criteria regarding client brokerage associated with principal trades is not met, the investment manager must pay for the research.
- In the case of mixed use research, make a reasonable allocation of the cost of the research based on its expected usage. Only portions that are used by the investment manager in the investment decision making process can be paid with client brokerage. Mixed use research allocation must be reevaluated annually.

**V. Client-Directed Brokerage**

Brokerage is an asset of the client, so the practice of client-directed brokerage does not violate the investment manager's duty.



***Required:***

- Do not use brokerage from another client to pay for products or services purchased under any client directed brokerage agreement.

***Recommended:***

- The investment manager should disclose the duty to seek best execution.
- Disclose to the client that the arrangement may adversely affect the manager's ability to obtain best execution and receive adequate research for the client.
- The investment manager should structure the arrangements so that they do not require the commitment of a certain portion of client brokerage to a single broker. The arrangement should ensure that commissions are negotiated and that there is an emphasis on best execution.

## **VI. Disclosure**

***Required:***

- Investment managers must disclose in plain language their soft dollar policies. Principal trades must be addressed.
- Investment managers must disclose the types of research received through proprietary or third party research, the extent of its use, and whether an affiliated broker is involved.
- To claim compliance with Soft Dollar Standards, the client must receive a statement that soft dollar practices conform to these standards, and the statement must be provided at least annually.
- Investment managers must disclose in writing that more information concerning soft dollar arrangements is available on request.
- Additional information provided upon request may include a description of what the firm obtained through its soft dollar arrangements, the brokers who provided services, and total commissions generated for the client's account.

***Recommended:***

- As requested by the client, provide a description of the product or service obtained through client brokerage generated by the client's account.
- Provide the total amount of brokerage paid from all accounts over which the investment manager has discretion.

## **VII. Record Keeping**

***Required:***

The investment manager must maintain records that:

- Meet legal and regulatory requirements.
- Are needed to supply timely information to clients consistent with the disclosure requirements.
- Document any arrangements that obligate the investment manager to generate a specific amount of brokerage.

- Document arrangements with clients regarding soft dollar or client-directed brokerage.
- Document any broker arrangements.
- Document the basis for allocations when using client brokerage for mixed use services and products.
- Show how services and products obtained via soft dollars assist the investment manager in the investment decision making process.
- Show compliance with the CFA Institute Soft Dollar Standards, and identify the personnel responsible.
- Include copies of client disclosures and authorizations.

---

**LOS 3.c: Determine whether a product or service qualifies as “permissible research” that can be purchased with client brokerage.**

---

CFA Institute Soft Dollar Standards set forth a 3-level analysis to assist the investment manager in the determination of whether a product or service is permissible research that can be purchased with client brokerage.

**Level 1 – Define the Product/Service:** Define it in detail, including multiple components. *For example, a computer work station may be classified as a qualifying product, but the electricity to run the equipment would not.*

**Level 2 – Determine Usage:** Determine the primary use of the product or service. *For example, does the Bloomberg service received directly assist in the investment decision-making process, or is it there just to provide an “overall benefit to the firm”?*

**Level 3 – Mixed Use Analysis:** This step must be completed only if the product or service is classified as “research” based on the Level 1 and Level 2 analysis above. This Level 3 analysis is the investment manager’s allocation of the portion of the product or service which directly assists in the investment decision-making process. *For example, if the Bloomberg service is used 50% of the time to “determine market and industry trends as part of the investment manager’s investment decision-making process,” then half of the expense can be paid from client brokerage.*

## KEY CONCEPTS

### LOS 3.a

Brokerage is the property of the client. Investment managers have a duty to obtain best execution, minimize transactions costs, and use client brokerage to benefit clients.

Soft Dollars refer to commissions generated on both agency (payment of a commission) and principal trades (discount or a spread).

Soft dollar practices involve the use of client brokerage by an investment manager to obtain certain products and services to aid the manager in the investment decision making process.

Research includes both proprietary (generated by the broker) and third-party research (purchased by the broker). Research must directly assist the investment manager in the investment decision-making process and not in the management of the firm itself. Research that can be used for both the investment management process and management is called mixed use research.

The Soft Dollar Standards are intended to ensure the following:

- Complete disclosure of the investment manager's use of soft dollars and client brokerage.
- Consistent presentation of data so all parties can clearly understand brokerage practices.
- Uniform disclosure and record keeping so the client clearly understands how the investment manager is using client brokerage.
- Consistently high ethical industry standards.

The investment manager should consider that:

- The manager is a fiduciary and as such must disclose all details relating to benefits received through a client's brokerage.
- Third-party and proprietary research are to be treated similarly when examining soft dollar arrangements since the research received is paid for with client brokerage.
- Any research purchased with client brokerage must directly assist the investment manager in the investment process and not in the overall management of the firm.
- If there is ever any question as to whether the research assists in the investment process, it should be paid for with investment manager assets.

### LOS 3.b

Client-directed brokerage is permissible provided that the manager does not use brokerage from another client to pay for products or services purchased under any client directed brokerage agreement.

Disclosure requirements address clarity, discussion of principal trades, types/sources of research, annual updates, and additional information on request.

Record-keeping requirements address the following:

- Legal / regulatory items, timeliness, and broker arrangements.
- Obligations to generate a specific amount of brokerage.
- Mixed use services / products, and client-specific disclosures/ authorizations / arrangements (including soft dollar or client-directed brokerage).
- Connection among services / products and the investment process.
- Record of compliance with the CFA Institute Soft Dollar Standards and the personnel responsible.

### LOS 3.c

The CFA Institute's 3-level analysis guides the determination of whether a product or service can be purchased with client brokerage. The three levels are:

- Define the Product/Service.
- Determine (Primary) Usage.
- Mixed Use Analysis.

**CONCEPT CHECKERS**

1. In regards to CFA Institute Soft Dollar Standards, broker selection is a key area of the investment manager's ability to add value to client portfolios. Which of the following is a requirement in selecting and evaluating brokers? The investment manager must consider:
  - A. the broker's financial responsibility.
  - B. if the broker is capable of providing best execution.
  - C. the range of services provided or offered.
2. CFA Institute Soft Dollar Standards focus heavily on whether a product or service constitutes "research" that can be paid for with soft dollars (client brokerage) and whether that same product or service provides lawful and proper assistance to the investment manager in carrying out his investment decision making responsibilities. Which of the following statements regarding permissible or allowable "research" is *most accurate*?
  - A. The product or service should directly assist the investment manager in his investment decision-making process and in the management of the investment firm.
  - B. Determining what is permissible "research" is subject to specific rules.
  - C. CFA Institute recommends performing a three level analysis to assist the investment manager in deciding whether a product or service is "research."
3. Which of these disclosures is recommended but not required under CFA Institute Soft Dollar Standards?
  - A. More information concerning the firm's soft dollar standards is available upon request.
  - B. The total amount of brokerage paid from all accounts over which the investment manager has discretion.
  - C. A statement provided annually to the client that soft dollar practices of the firm conform to CFA Institute Soft Dollar Standards.

4. Western Investment Inc. manages investment accounts for individual investors and employee benefit plans subject to ERISA. In addition the firm manages an institutional hedge fund and a money market fund registered with the SEC as an investment company. Western has claimed compliance with the CFA Institute Soft Dollar Standards. The firm executes trades with a number of broker-dealers, who provide various products and services for the firm's use in exchange for client brokerage.

Among the products and services provided by one of the broker-dealers is:

- Office equipment, including desks, photocopiers, and fax machines.
- A subscription to the Bloomberg service, which is used only to provide clients visiting the office with access to security prices and other financial information.

Is Western in compliance with the Soft Dollar Standards based on its treatment of the office equipment and Bloomberg service?

- A. Both are permitted.
- B. One is permitted, the other is not permitted.
- C. Neither is permitted.

5. Soft dollar practices most precisely refers to:
  - A. commissions generated on agency trades.
  - B. firms which are in compliance with the CFA Institute's Soft Dollar Standards.
  - C. a manager's use of client brokerage to obtain certain products and services to aid the manager in the investment decision making process.
6. An investment firm which is currently in compliance with the CFA Institute's Soft Dollar Standards performs an analysis to determine whether recent services provided by a new broker can be purchased with client brokerage. Which of the following is the firm *least likely* to do as part of this analysis?
  - A. Create detailed definitions of the multiple components of the service.
  - B. Determine the service use by research / non-research.
  - C. Disclose the types of research received through proprietary or third party research.

## ANSWERS – CONCEPT CHECKERS

1. B The other choices are all recommendations but not requirements. Best execution is the most critical consideration.
2. C Choice A is incorrect because aid in management of the overall firm is not permissible. Choice B is incorrect because determining what is permissible research is not subject to specific and identifiable rules.
3. B It is not required under the Soft Dollar Standards to disclose the amount of brokerage paid from all accounts. The other disclosures are required.
4. C The office equipment does not satisfy the Soft Dollar Standards definition of research because it does not aid directly in the investment decision-making process. The Bloomberg service also does not satisfy the Soft Dollar Standards because of the way the firm uses the services: it is provided as a service to clients and does not directly assist the investment manager in the investment decision-making process.
5. C Soft dollar practices refer to a manager's use of client brokerage to obtain certain products and services to aid the manager in the investment decision making process. Soft dollars refer to commissions generated on agency trades and principal trades. There is no official term to describe firms which are in compliance with the CFA Institute's Soft Dollar Standards.
6. C The CFA Institute's 3-level analysis guides the determination of whether a product or service can be purchased with client brokerage. The three levels are:
  - Define the Product/Service
  - Determine (Primary) Usage
  - Mixed Use Analysis

---

The following is a review of the Ethical and Professional Standards principles designed to address the learning outcome statements set forth by CFA Institute®. This topic is also covered in:

# CFA INSTITUTE RESEARCH OBJECTIVITY STANDARDS

Study Session 1

---

## EXAM FOCUS

The objectives of CFA Institute's Research Objectivity Standards are to provide specific, measurable standards for managing and disclosing conflicts of interest that may interfere with an analyst's ability to conduct independent research and make objective recommendations.

These standards are intended to be a universal guide for all investment firms by providing ethical standards and practices regarding full and fair disclosure of any conflicts or potential conflicts relating to the firm's research. The goal is objectivity and independence.

---

### LOS 4.a: Explain the objectives of the Research Objectivity Standards.

---

When designing policies and procedures for a firm, strive to achieve these objectives while implementing the CFA Institute Research Objectivity Standards:

- A. Prepare research, make recommendations, take investment actions, and develop policies, procedures, and disclosures that put client interests before employees' and the firm's interests.
  - B. Facilitate full, fair, meaningful, and specific disclosures to clients and prospects of possible and actual conflicts of interest of the firm and its employees.
  - C. Promote the use of effective policies and procedures that minimize possible conflicts that may adversely affect independence and objectivity of research.
  - D. Support self-regulation by adhering to specific, measurable standards to promote objective and independent research.
  - E. Provide a work environment conducive to ethical behavior and adherence to the *Code and Standards*.
- 

### LOS 4.b: Critique company policies and practices related to research objectivity and distinguish between changes required and changes recommended for compliance with the Research Objectivity Standards.

---

## IMPORTANT DEFINITIONS

**Covered employee.** A firm employee who:

- Conducts research, writes research reports, and/or makes investment recommendations.



- Takes investment action on the client's behalf or is involved in the decision-making process.
- May benefit, either personally or professionally, from her ability to influence research reports or investment recommendations.

**Immediate family.** Anyone who lives with (i.e., has the same principal residence as) the analyst or manager.

**Investment manager.** Any employee who conducts investment research and/or takes investment action for client accounts or the firm's accounts, *whether or not the person has the title of "investment manager."*

**Public appearance.** Any forum in which the analyst or manager makes investment recommendations or offers opinions, including seminars, public speaking engagements, interactive electronic forums, and any kind of media interview.

**Research analyst.** Any employee who is primarily responsible for any part of the process of developing a research report, *whether or not the person has the title of "research analyst."*

**Subject company.** Company whose securities are covered by a research report or recommendation.

## REQUIREMENTS AND RECOMMENDED COMPLIANCE PROCEDURES

### 1.0 Research Objectivity Policy

#### *Requirements:*

The firm must have:

- A formal written independence and objectivity of research policy that it distributes to clients, prospective clients, and employees.
- Supervisory procedures in place to make sure employees comply with the policy.
- A senior officer who attests annually to clients and prospective clients that the firm has complied with the policy.

#### *Recommended Compliance Procedures:*

- Identify and describe covered employees—those conducting and writing research and making recommendations, including anyone who would benefit from his ability to influence the recommendations.
- Specify whether covered employees are subject to a code of ethics and standards of professional conduct. Fully disclose any conflicts of interest.
- Any policy should clearly identify the factors on which research analysts' compensation is based.
- Policy should also include terms regarding how research reports may be purchased by clients.

## 2.0 Public Appearances

### *Requirements:*

Covered employees who make public appearances to discuss research or investment recommendations must disclose any personal and firm conflicts of interest.

### *Recommended Compliance Procedures:*

- Be sure that the audience can make informed judgments and that they consider the investment in the context of their entire portfolio.
- Covered employees making public appearances should always be prepared to disclose all conflicts.
- Firms should require covered employees to disclose all investment banking relationships or whether the analyst has participated in marketing activities for the subject company.
- All supporting research reports should be provided at a reasonable cost. (Note: The Standards don't define "reasonable.")

## 3.0 Reasonable and Adequate Basis

### *Requirements:*

Research reports and investment recommendations must have a reasonable and adequate basis. Either a single employee or a committee must be charged with reviewing and approving all research reports and investment recommendations.

### *Recommended Compliance Procedures:*

- Firms must provide guidance on what constitutes reasonable and adequate basis for a specific recommendation.
- Offer to provide supporting data to clients, and disclose the current market price of the security.

## 4.0 Investment Banking

### *Requirements:*

Firms with investment banking operations must have in place policies and procedures that:

- Separate research analysts from the investment banking department.
- Make sure analysts don't report to, and are not supervised by, investment banking personnel.
- Prevent the investment banking department from reviewing, revising, or approving research reports and investment recommendations.

***Recommended Compliance Procedures:***

- Firms must prohibit any communication between research and investment banking or corporate finance prior to the publication of a research report.
- Investment banking/corporate finance personnel may review reports only to verify factual information or to identify possible conflicts.
- Firms should have quiet periods for IPOs and secondary offerings of sufficient length to ensure that research reports and recommendations are not based on inside information obtained by the analyst through investment banking/corporate finance sources.
- It is recommended that analysts not be allowed to participate in marketing “road shows.”

## **5.0 Research Analyst Compensation**

***Requirements:***

Compensation for research analysts should be directly related to the quality of the research and recommendations provided by the analyst and not directly linked to investment banking or corporate finance activities.

***Recommended Compliance Procedures:***

- Compensation systems should be based on measurable criteria consistently applied to all research analysts.
- Ideally there should be no link between analyst compensation and investment banking and corporate finance activities, but firms should disclose to what extent analyst compensation depends upon investment banking revenues.

## **6.0 Relationships With Subject Companies**

***Requirements:***

Analysts must not allow the subject company, prior to publication, to see any part of the research report that might signal the analyst’s recommendation or rating, or make any promises concerning a specific recommendation or rating.

***Recommended Compliance Procedures:***

- Firms should have policies and procedures governing analysts’ relationship with subject companies, specifically relating to material gifts, company-sponsored trips, etc.
- There should be efforts made to check facts contained in the research report before publication.
- The compliance and legal departments should receive a report draft before it is shared with the subject company. Any subsequent changes should be carefully documented.

## 7.0 Personal Investments and Trading

### *Requirements:*

The firm must institute policies and procedures that:

- Address the personal trading of covered employees.
- Ensure covered employees do not share information with anyone who could use that information to trade ahead (i.e., front running) of client trades.
- Ensure covered employees and immediate family members can't trade ahead of client trades.
- Prohibit covered employees and immediate family members from trading contrary to the firm's recommendations, except under cases of extreme financial hardship.
- Prohibit covered employees and immediate family members from participating in IPOs of subject companies or companies in the industry the employee covers.

### *Recommended Compliance Procedures:*

- Always place interests of clients ahead of personal and firm interests.
- Obtain approval from the compliance and legal departments in advance of trading on any securities of subject companies in the industries assigned to the analyst.
- Firms should have procedures in place to prevent employees from trading ahead of investing client trades. Restricted periods should be in place at least 30 calendar days before and 5 calendar days after recommendations are made via research reports.
- It is permissible to allow the analyst to sell contrary to their recommendation in the case of extreme financial hardship.
- Firms should require covered employees to provide the compliance and legal departments with a complete list of personal holdings, including securities in which they have a beneficial interest.

## 8.0 Timeliness of Research Reports and Recommendations

### *Requirements:*

Regularly issue research reports on subject companies on a timely basis.

### *Recommended Compliance Procedures:*

- Firms should require regular updates to research and recommendations. Quarterly updates are preferred.
- If coverage of a company is discontinued, the analyst should issue a "final" research report.

## 9.0 Compliance and Enforcement

### *Requirements:*

Firms must enforce their policies and compliance procedures, assess disciplinary sanctions on employees who violate the policies, monitor the effectiveness of the compliance procedures, and maintain records of any internal audits of the policies.

***Recommended Compliance Procedures:***

- Firms should distribute to clients a list of activities which are violations and include disciplinary sanctions for such violations.

## **10.0 Disclosure**

***Requirements:***

The firm must disclose conflicts of interests related to covered employees or the firm as a whole.

***Recommended Compliance Procedures:***

- Disclosures should be complete, prominent, and easy to understand.
- Investment banking/corporate finance relationships should be disclosed.
- All conflicts of interest must be disclosed, including whether the firm makes a market in the subject company's security, whether it has managed a recent IPO or secondary offering, and whether any ownership position or covered employee's family is affiliated in any way with the subject company. Any material gifts from the subject company should also be disclosed.
- Disclose any statistical or quantitative basis for recommendations and ratings.
- Disclose valuation methods used to determine specific price targets and include any risk factors.

## **11.0 Rating System**

***Requirements:***

The firm must have a rating system that investors find useful for investment decisions and provides investors with information they can use to determine the suitability of specific investments for their own portfolio.

***Recommended Compliance Procedures:***

- Firms should avoid one-dimensional rating systems since they do not give investors enough information to make informed decisions.
- Rating systems should include the recommendation and rating categories, time horizon categories, and risk categories.
- Absolute (buy, hold, sell, etc.) or relative (market outperform, underperform, etc.) recommendation categories are permitted.
- A complete description of the firm's rating system should be provided to clients upon request.

**KEY CONCEPTS**

## LOS 4.a

When designing policies and procedures for a firm, strive to achieve these objectives while implementing the CFA Institute Research Objectivity Standards:

- Prepare research, make recommendations, take investment actions, and develop policies, procedures, and disclosures that put client interests before employees' and the firm's interests.
- Facilitate full, fair, meaningful, and specific disclosures to clients and prospects of possible and actual conflicts of interest of the firm and its employees.
- Promote the use of effective policies and procedures that minimize possible conflicts that may adversely affect independence and objectivity of research.
- Support self-regulation by adhering to specific, measurable standards to promote objective and independent research.
- Provide a work environment conducive to ethical behavior and adherence to the Code and Standards.

## LOS 4.b

Requirements and Recommended Compliance Procedures generally concern the following matters:

1. Research Objectivity Policy
2. Public Appearances
3. Reasonable and Adequate Basis
4. Investment Banking
5. Research Analyst Compensation
6. Relationships with Subject Companies
7. Personal Investments and Trading
8. Timeliness of Research Reports and Recommendations
9. Compliance and Enforcement
10. Disclosure
11. Rating System

## CONCEPT CHECKERS

1. Which of the following is *least likely* an objective for proper implementation of the Research Objectivity Standards?
  - A. Prepare research, make recommendations, take investment actions, and develop policies, procedures, and disclosures that place client interests before employees' and firm's interests.
  - B. Support the appropriate regulatory agency regulation by adhering to specific, measurable standards to promote objective and independent research.
  - C. Facilitate full and meaningful disclosures to clients and prospects of possible and actual conflicts of interest of the firm and its employees.
  
2. When presenting research and recommendations in a public forum, which of the following would be *least likely* to comply with the Research Objectivity Standards?
  - A. Firms should require employees to disclose any investment banking relationships or whether the analyst has participated in marketing activities for the subject firm.
  - B. Be sure that the audience can make informed judgments, and provide any supporting research at no cost.
  - C. Be sure that investors consider the investment in the context of their entire portfolio.
  
3. Warren Sun, an analyst with Myers and Bradley Partners, has completed a research report on ROS, Inc. In the report Sun has changed his recommendation from buy to hold. Sun sends the entire report to the compliance department and to ROS for review. ROS management suggests a few minor changes to some of the financial data. Sun provides to the compliance department a justification for these changes, and the compliance department approves the changes in advance of the release of the report.

Are the following actions taken by Sun consistent with the CFA Institute Research Objectivity Standards?

| Sending the report<br>to the subject company? | Making the changes<br>to the report? |
|-----------------------------------------------|--------------------------------------|
| A. Yes                                        | No                                   |
| B. No                                         | Yes                                  |
| C. No                                         | No                                   |

## ANSWERS – CONCEPT CHECKERS

1. **B** Self-regulation is an objective, as opposed to regulation by regulatory agencies. Remember that CFA Institute is a self-regulatory organization.
2. **B** Any supporting research should be provided at a reasonable cost. The rest of the statements are correct.
3. **B** The Research Objectivity Standards prohibit Sun from sending the entire report, including his recommendation, to ROS. He is allowed, however, to send the sections of the report containing facts that can be verified by ROS. He is allowed to change the facts presented in the report in response to feedback from ROS, and he has followed the recommended procedures for making those changes and having them approved by the compliance department.



---

The following is a review of the Ethical and Professional Standards principles designed to address the learning outcome statements set forth by CFA Institute®. This topic is also covered in:

# THE GLENARM COMPANY

Study Session 2

---

## EXAM FOCUS

The Glenarm case introduces you to the obligations CFA Institute members and CFA® charterholders and candidates have to their employers. This ethics case will give you a sense of the types of scenarios you are likely to encounter on the Level 2 exam. The particulars of this case are not important in terms of test questions. However, understanding how to analyze a case and having the ability to recommend procedures to bring an illustrative firm into compliance are crucial to your success on the ethics portion of the exam.

---

**LOS 5.a: Critique the practices and policies presented.**

**LOS 5.b: Explain the appropriate action to take in response to conduct that violates the CFA Institute Code of Ethics and Standards of Professional Conduct.**

---

## CASE OUTLINE

The main facts of the Glenarm case are as follows:

- Peter Sherman, CFA, was employed for five years with Pearl Investment Management as an emerging markets analyst. While he was at Pearl, he developed outside consulting positions with several Latin American companies. This outside consulting activity was disclosed to Pearl. Sherman recently switched firms and is now employed by the Glenarm Company.
- Glenarm is a small investment management firm that has been investigated, censured, and fined by the SEC for securities violations. Glenarm's partners are eager to repair the firm's reputation and hoped that hiring a CFA charterholder would help retain current clients and bring in new business.
- Prior to joining the firm, Glenarm asked Sherman to solicit current and prospective Pearl clients. Glenarm offered Sherman a large stake in the first-year investment management fees of any Pearl clients that Sherman could bring to Glenarm.
- While still employed at Pearl, Sherman visited socially with several Pearl clients in an attempt to woo them away from Pearl. He also contacted potential Pearl clients that Pearl has been actively soliciting. He even contacted some clients that Pearl had rejected.
- As he left Pearl, Sherman took the following items with him to his new job:
  - ♦ Pearl marketing presentations.
  - ♦ Computer stock selection models that he developed.
  - ♦ Research materials.
  - ♦ News articles on firms that he had been following.
  - ♦ A list of research ideas that were rejected by Pearl.

## CASE RESULTS

### Standard IV(A) Duties to Employers: Loyalty

Violations of Standard IV(A) include:

- It is acceptable for Sherman to contact prospects that Pearl decided not to pursue, because of a particular size or investment objective, while he is still employed at Pearl.
- Unless the employer consents, departing employees may not misappropriate property. All of the items Sherman took are the property of Pearl, and there is a violation.



*Professor's Note: Members and Candidates must always act for the benefit of the employer. By taking confidential information, and soliciting clients and prospects to benefit Glenarm, Sherman has harmed his old employer, Pearl, and is in violation of his duty of loyalty. Sherman must act in the "old" employer's best interest while still employed there.*

Actions required to prevent these violations include:

- Sherman should not solicit Pearl's clients or prospects until he leaves Pearl's employment.
- Sherman should not have taken Pearl property.

### Standard IV(B) Duties to Employers: Additional Compensation Arrangements.

Violations of Standard IV(B) include:

- Sherman did not disclose his consulting arrangements to Glenarm.

Actions required to prevent these violations include:

- Sherman should disclose his consulting arrangements to Glenarm.

### Standard VI(A) Disclosure of Conflicts, and Standard I(B) Independence and Objectivity

Violations of Standards VI(A) and I(B) include:

- The consulting arrangements had the potential to affect Sherman's independence and objectivity.
- Disclosures must be prominent and delivered in plain language.

Actions required to prevent these violations include:

- Sherman must disclose all details about outside compensation to Glenarm and obtain written permission from Glenarm in advance of entering into any such arrangements.

---

The following is a review of the Ethical and Professional Standards principles designed to address the learning outcome statements set forth by CFA Institute®. This topic is also covered in:

# PRESTON PARTNERS

Study Session 2

---

## EXAM FOCUS

The Preston Partners case emphasizes the violations that can occur when allocating block trades to clients. This ethics case will give you a sense of the types of scenarios you are likely to encounter on the Level 2 exam. The particulars of this case are not important in terms of test questions. However, understanding how to analyze a case and having the ability to recommend procedures to bring an illustrative firm into compliance are crucial to your success on the ethics portion of the exam.

---

LOS 6.a: Critique the practices and policies presented.

LOS 6.b: Explain the appropriate action to take in response to conduct that violates the CFA Institute Code of Ethics and Standards of Professional Conduct.

---

## CASE OUTLINE

The following statements summarize the main facts of the Preston Partners case:

- Sheldon Preston, CFA, is president of Preston Partners. Preston Partners is a mid-size investment management firm that specializes in managing large-cap portfolios for individuals and pension funds. CFA Institute's Code and Standards have been adopted as part of Preston's compliance manual.
- Preston wrote the firm's compliance manual but did a cursory job because he was in a hurry. A copy of the manual was provided to all employees upon joining the firm.
- During his daily review of Preston Partner trades, Preston found that Gerald Smithson, CFA, had added the stocks of Utah BioChemical Co. and Norgood PLC to all his clients' portfolios.
- Preston Partners manages Utah BioChemical's pension fund. In addition, the president and CEO of Utah BioChemical, Arne Okapuu, has Smithson manage his personal portfolio. Smithson and Okapuu have had a long-term business relationship.
- Smithson was vacationing in London and had seen Okapuu and the chairman of Norgood talking at a restaurant. Smithson contacted an analyst that he knew in London, Andrew Jones, and requested information on Norgood. Jones's latest research report had placed a "hold" recommendation on Norgood stock.
- Norgood is an aggressive investment and Utah BioChemical is a conservative investment.
- Smithson performed a complete analysis of the biotech industry, Norgood, and Utah BioChemical. Based on his analysis and the fact that he saw Okapuu and Norgood's chairman talking, he deduced that a merger between the two firms was possible.

- Smithson ordered block trades of 50,000 shares for each firm. The firm's compliance manual was vague on the proper allocation of shares from a block trade. Smithson decided to allocate shares based on the size of the client's account, with the largest clients receiving their shares first at the most favorable prices. Also, the needs and constraints of Smithson's clients vary widely.
- Utah BioChemical and Norgood announced that they were merging. The share price of both firms increased by 40%.

### CASE RESULTS

In researching and making client investment decisions, Smithson complied with Standard V(A) – Diligence and Reasonable Basis. Furthermore, Smithson did not possess or act on insider information. What he learned was assembled through the “mosaic” theory.

However, Smithson did not comply with portions of the Standards relating to suitability of investments for clients and trade allocations. Preston failed to properly exercise his supervisory responsibility.

### Standard III(C) Duties to Clients: Suitability

Violations of Standard III(C) include:

- Smithson should have considered clients' individual risk tolerances, needs, circumstances, and goals; he should have also better matched clients with investments. Norgood is too volatile for many clients' accounts.

Actions required to prevent this violation include:

- Be sure that Smithson's clients have written investment objectives and policy statements.
- For accounts which contain unsuitable investments, the shares should be sold, and Preston Partners should reimburse any loss.

### Standard III(B) Duties to Clients: Fair Dealing

Violations of Standard III(B) include:

- The firm had no clear procedures for allocating block trades to client accounts. Large accounts were favored, disadvantaging smaller accounts.

Actions required to prevent this violation include:

- Detailed guidelines covering block trades must be prepared, emphasizing fairness to clients, timely executions, and accuracy.

## Standard IV(C) Duties to Employers: Responsibilities of Supervisors

Violations of Standard IV(C) include:

- The senior management at Preston Partners should have made reasonable efforts to identify and prevent violations of applicable laws, rules, and regulations. A compliance program should have been in place.
- Supervisors and managers have the responsibility of training, distributing a policies and procedures manual, and providing refresher courses.

Actions required to prevent these violations include:

- Preston must have proper procedures established that would have prevented violations such as those that occurred.
- A compliance officer should be designated.

---

The following is a review of the Ethical and Professional Standards principles designed to address the learning outcome statements set forth by CFA Institute®. This topic is also covered in:

# SUPER SELECTION

Study Session 2

---

## EXAM FOCUS

The Super Selection case emphasizes the fiduciary duty that members have to their clients. This ethics case will give you a sense of the types of scenarios you are likely to encounter on the Level 2 exam. The particulars of this case are not important in terms of test questions. However, understanding how to analyze a case and having the ability to recommend procedures to bring an illustrative firm into compliance are crucial to your success on the ethics portion of the exam.

---

LOS 7.a: Critique the practices and policies presented.

LOS 7.b: Explain the appropriate action to take in response to conduct that violates the CFA Institute Code of Ethics and Standards of Professional Conduct.

---

## CASE OUTLINE

The main facts of the Super Selection case are as follows:

- Patricia Cuff is the CFO and compliance officer for Super Selection Investment Advisors. Cuff is also a member of CFA Institute. CFA Institute's Standards of Practice have been incorporated into Super Selection's compliance manual.
- Karen Trader is a portfolio manager with Super Selection. She has recently purchased shares of Atlantis Medical Devices (AMD) for all of her clients' portfolios. AMD is a rapidly growing biotech firm.
- Trader's friend, Josey James, is president of AMD. James has been providing advice to Trader regarding the viability of certain biotech firms over the past few years. Trader has taken advantage of this advice for both her personal account and her client's portfolios. In many cases, she has placed personal trades before trading for her clients. Trader's personal brokerage statements had not been submitted to Cuff until recently.
- Several years ago, James asked Trader to serve as an outside director for AMD. She was paid with AMD stock options that at the time had no value. AMD earnings and sales are up and AMD directors recently voted to take the firm public via an initial public offering. AMD also began paying directors \$5,000 per year. Trader stands to gain considerably by exercising her stock options.
- By the time the offering was to go public, the initial public offering (IPO) market had soured considerably. James called Trader to ask if she could commit to the purchase of a block of AMD shares for her client accounts. Trader had previously determined that AMD shares were not a good investment for her clients—but she changed her mind on the recommendation of James and purchased a considerable amount of AMD stock for her clients.

## CASE RESULTS

Several Code and Standard violations are evident relating to Karen Trader's involvement with an outside firm. Although she is not a CFA charterholder or member, she is bound by the CFA Institute Code and Standards to the extent that they are a part of her own company's compliance procedures.

### Standard IV(C) Duties to Employers: Responsibilities of Supervisors

The presumption is that Cuff is the "supervisor" and thus must comply with this standard. Cuff has the responsibility to take steps to prevent violations, and as compliance officer she should see that the firm's compliance procedures are adhered to by employees. Any violations must be addressed.

Actions required to prevent these violations include:

- Cuff must take prompt action to correct violations by reporting the violations to the appropriate members of senior management.
- Cuff is a compliance officer and must monitor Trader's personal trades and impose sanctions when necessary.
- If the senior management does not back up Cuff, other options include disclosing the incident to the Board, to the regulators, and even resigning from the firm.

### Standard VI(A) Disclosure of Conflicts

Violations of Standard VI(A) include:

- Trader failed to disclose ownership of AMD stock options and also the compensation she received as a director of AMD.

Actions required to prevent this violation include:

- As a supervisor, Cuff must take action to ensure disclosure and, if necessary, by limiting behavior and imposing sanctions.

### Standard V(A) Diligence and Reasonable Basis

Violations of Standard V(A) include:

- Trader determined AMD was not a suitable security for her clients. Trader was pressured by James and reversed positions; thus the AMD stock was purchased.

Actions required to prevent this violation include:

- Trader should have conducted due diligence and thorough research before making an investment decision for clients' accounts. Any change in opinion must have a reasonable basis. Trader must also inform clients of any AMD conflicts such as directorship and stock options.
- The compliance officer, Cuff, should review investment actions taken for clients at least annually.

### **Standard III(A) Duties to Clients: Loyalty, Prudence and Care**

Violations of Standard III(A) include:

- The fiduciary duty to clients was violated. Remember that client interests always come first.

Actions required to prevent this violation include:

- Trader should have taken any investment action for the sole benefit of her clients. Cuff must completely investigate Trader's activities to determine other fiduciary breaches. Following any fiduciary breaches, wrongdoers must have their activities limited.

### **Standard III(C) Duties to Clients: Suitability**

Violations of Standard III(C) include:

- AMD stock was purchased for clients without considering client needs and circumstances.

Actions required to prevent this violation include:

- Trader should have considered clients' needs and circumstances instead of taking actions that benefited her personally.
- The compliance officer should establish at least an annual review to compare suitability of investment actions with investment policy statements.

### **Standard VI(B) – Priority of Transactions**

Violations of Standard VI(B) include:

- Trader violated this Standard by trading personally prior to client trades.

Actions required to prevent this violation include:

- By not reporting trades and brokerage accounts, Trader failed to follow her firm's procedures. The compliance officer needs to fully investigate Trader's transactions and recommend proper sanctions.



---

The following is a review of the Ethical and Professional Standards principles designed to address the learning outcome statements set forth by CFA Institute®. This topic is also covered in:

# TRADE ALLOCATION: FAIR DEALING AND DISCLOSURE

Study Session 2

---

## EXAM FOCUS

This topic review provides a brief summary of trade allocation procedures as recently updated by CFA Institute. The CFA Institute Code and Standards speak directly to the issue of trade allocation procedures since allocating trades among clients is an example of taking investment action. Under CFA Institute Standard III(B) Duties to Clients – Fair Dealing, “Members and Candidates must deal fairly and objectively with all clients when providing investment analysis, making investment recommendations, taking investment action, or engaging in other professional activities.”

---

**LOS 8.a: Critique trade allocation practices and determine whether there is compliance with the CFA Institute Standards of Professional Conduct addressing fair dealing and client loyalty.**

---

The allocation of client trades on an *ad hoc* basis lends itself to two fundamental fairness problems:

- The allocation of trades may be based on *compensation arrangements*.
- The allocation of trades may be based on *client relationships* with the firm.

As far as compensation arrangements are concerned, an *ad hoc* allocation procedure gives rise to the temptation to allocate a disproportionate share of profitable trades to performance-based fee accounts. In addition to violating Standard III(B) – Duties to Clients: Fair Dealing, this is a clear violation of Standard III(A) – Duties to Clients: Loyalty, Prudence, and Care (which covers fiduciary duty) since this has the effect of increasing fees paid to the investment adviser at the expense of asset-based fee accounts.

As far as the client relationship with the firm is concerned, an *ad hoc* allocation procedure gives rise to the temptation to allocate a disproportionate share of profitable trades to favored clients. In addition to violating the fair dealing standard, this is again a clear violation of Standard III(A) – Duties to Clients: Loyalty, Prudence, and Care, which states that members owe a duty of loyalty to clients and requires them to put clients’ interests above their own. Conflicts of interest should be avoided. Giving certain clients special access to attractive IPOs with the intent to receive future investment banking business or more fees creates a conflict and breaches the duty to clients.

**LOS 8.b: Discuss appropriate actions to take in response to trade allocation practices that do not adequately respect client interests.**

---

Appropriate responses to inadequate trade allocation practices include the following:

- Get advanced indication of client interest regarding any new issues.
- Distribute new issues by client, not by portfolio manager.
- Have in place a fair and objective method for trade allocation, such as pro rata or a similar system.
- Be fair to clients regarding both execution of trades and price.
- Execute orders in a timely and efficient manner.
- Keep records and periodically review them to ensure that all clients are being treated equitably.

---

The following is a review of the Ethical and Professional Standards principles designed to address the learning outcome statements set forth by CFA Institute®. This topic is also covered in:

# CHANGING INVESTMENT OBJECTIVES

Study Session 2

---

## EXAM FOCUS

This topic review provides a brief summary of CFA Institute Standard III(C) Duties to Clients: Suitability. When entering into an advisory relationship with a client, the investment manager must inquire about the client's investing experience and investment objectives and constraints before taking any investment actions or making any recommendations. The actions and recommendations must be suitable to the client's situation and must be judged in the context of the entire portfolio. If the investment manager is managing a portfolio according to a specific style or mandate, the recommendations and investment actions must be consistent with the stated objectives and constraints of the specific portfolio.

---

LOS 9.a: Critique the disclosure of investment objectives and basic policies and determine whether they comply with the CFA Institute Standards of Professional Conduct.

---

In the case of pooled client funds such as mutual funds, it is particularly important that the portfolio manager's recommendations and investment actions be consistent with the stated objectives and constraints of the fund. The security selection and portfolio construction processes are typically described in the fund's prospectus. *These processes are the key elements upon which the determination of appropriateness and suitability may be determined.* A material deviation from these processes, in the absence of approval from clients, constitutes a violation of CFA Institute Standard III(C) – Duties to Clients: Suitability. *The investment must fit within the mandate or within the realm of investments that are allowed according to the fund's disclosures.*

---

LOS 9.b: Discuss appropriate actions needed to ensure adequate disclosure of the investment process.

---

In order to remain in compliance with CFA Institute Standards, a portfolio manager must:

- Determine the client's financial situation, investment objectives, and level of investing expertise.
- Adequately disclose the basic security selection and portfolio construction processes.
- Conduct regular internal checks for compliance with these processes.
- Stick to the stated investment strategy if managing to a specific mandate or strategy.
- Notify investors and potential investors of any potential change in the security selection and portfolio construction processes and secure documentation of authorization for proposed changes.

---

The following is a review of the Ethical and Professional Standards principles designed to address the learning outcome statements set forth by CFA Institute®. This topic is also covered in:

# PRUDENCE IN PERSPECTIVE

Study Session 2

---

## EXAM FOCUS

The new Prudent Investor Rule incorporates the principles of portfolio theory (think “diversification”), total return analysis (versus the *old* school of thought that capital preservation was the only concern), and management’s ability to delegate investment duties. As you read this topic review, note the many similarities between the new Rule and the CFA Institute Standards of Professional Conduct—you’ll find the two sets of principles to be quite consistent. You may see this material tested in conjunction with the portfolio management process material in Study Session 18.

---

## WARM-UP: THE OLD PRUDENT MAN RULE

Until recently, the old *Prudent Man Rule* was the accepted legal statute that applied to fiduciary trust law in the U.S. The Prudent Man Rule originated from Justice Putnam’s ruling in the *Harvard College v. Amory* case in 1830. Despite its appealing flexibility, the Prudent Man Rule failed to attain wide acceptance outside of Massachusetts until the 1940s. Prior to that time, most states had adopted “legal list” statutes that described appropriate investments for trustees. After the collapse of the bond markets during the Depression, there was general disaffection with legal lists and a trend toward the Prudent Man Rule.

The Prudent Man Rule states that:

In acquiring, investing, reinvesting, exchanging, retaining, selling, and managing property for the benefit of another, a fiduciary shall exercise the judgment and care, under the circumstances then prevailing, which men of prudence, discretion, and intelligence exercise in the management of their own affairs, not in regard to speculation but in regard to the permanent disposition of their funds, considering the probable income as well as the probable safety of their capital.

---

## LOS 10.a: Explain the basic principles of the new Prudent Investor Rule.

---

### Basic Investment Principles

Because the old Rule severely limited trustees’ abilities to manage portfolios to the best of their abilities, the American Law Institute in 1992 offered a definitive commentary called the **Prudent Investor Rule**. The substance of the *new* Rule is to change the

mindset that certain types of investments are prohibited. There are five basic principles to the new Prudent Investor Rule:

1. Diversification is expected of portfolio managers as a method of reducing risk.
2. Trustees must base an investment's appropriateness on its risk/return profile: how it contributes to the overall risk of the portfolio.
3. Excessive trading (churning) as well as excessive fees and other transactions costs that are not warranted by the portfolio risk/return objectives should be avoided.
4. Current income for the trust must be balanced against the need for growth.
5. Trustees are allowed to delegate investment authority. In fact, this is a duty if the trustee does not have the required level of expertise.

---

**LOS 10.b: Explain the general fiduciary standards to which a trustee must adhere.**

---

A trustee must exercise *care*, *skill*, *caution*, *loyalty*, and *impartiality* when managing trust assets. The loyalty and impartiality standards are carried over from the old Rule to the new Rule. The definitions of care, skill, and caution have changed significantly.

- *Care* means the trustees must do their homework by gathering pertinent information to use in their investment decisions. This could include seeking advice. A higher level of care is required under the new Rule.
- *Skill* means that if the trustee does not have the relevant investment knowledge, he or she has a duty to seek out such advice. Note the difference in this standard versus the old Rule. The old Rule forbade such delegation. Also, if you have the necessary skill set, you have a duty to use it. Here again, the requirement for skill is higher. Before, you as a trustee needed to have all the answers.
- *Caution* must be used to balance the need for current income with the need to guard against inflation. In addition, a *total return* approach to money management should be employed. Principal growth (not just maintaining purchasing power) could indeed be a goal in certain circumstances. Caution under the old Rule *really* meant caution—don't lose any money, which meant don't even think about growth!
- *Loyalty* requires the trustee to avoid conflicts of interest by always acting exclusively in the best interest of beneficiaries. This standard remains fairly constant under both rules.
- *Impartiality* requires that the trustee act "in a fair and reasonable manner" when handling the conflicting interests of beneficiaries (i.e., remaindermen interests versus current income beneficiaries). Impartiality standards also carry over from the old Rule to the new Rule.

The adherence to these standards is required of the trustee at the time of the investment decision. For example, the trustees of Enron's pension assets may have believed at the time that they acted according to the aforementioned standards. However, it is clear to see today that the decisions they made were not appropriate. We must not judge decisions *ex post facto* under the new standards.

---

### LOS 10.c: Differentiate between the old Prudent Man Rule and the new Prudent Investor Rule.

---

The new Prudent Investor Rule makes five key changes to the traditional rules governing investment trust management.

- *Use of total return.* The new Rule measures reasonable portfolio return as total return (income plus capital growth). It also emphasizes that the trustee's duty is to not only preserve the purchasing power of the trust but in certain cases to realize principal growth in excess of inflation.
- *Risk management.* Under the new Rule the trustee has the obligation to assess the risk and return objectives of the trust beneficiaries and manage the trust in a prudent manner consistent with those objectives, rather than to avoid all risk.
- *Evaluation in a portfolio context.* While the new Rule calls for the avoidance of undue speculation and risk, it also encourages trustees to view risk in a portfolio context. For example, stock options are risky when held in isolation but can actually reduce portfolio risk when held as part of a properly structured portfolio. Protective put options are an example of this type of strategy.
- *Security restrictions.* No securities are "off-limits" because of their riskiness when held in isolation. For example, under the old Rule options were not allowed, but under the new Rule they are, as long as the manager takes the portfolio perspective to analyzing risk.
- *Delegation of duty.* The *old* Rule did not permit trustees to delegate investment authority. In fact, investing in mutual funds or even index funds was deemed improper. The *new* Rule goes so far as to say that it may be the *duty* of a trustee (this is stronger language than just authority) to delegate, just as a prudent investor would.



*Professor's Note: These principles are consistent with the guidelines outlined in the topic review of the portfolio management process in Study Session #18, where the LOS ask you to explain the importance of the portfolio perspective and define investment objectives and constraints.*

---

### LOS 10.d: Explain the key factors that a trustee should consider when investing and managing trust assets.

---

The new Prudent Investor Rule includes eight key factors that the trustee should consider when investing and managing trust assets:

- Economic conditions.
- Effects of inflation and deflation.
- Impact of investment decisions on the beneficiary's tax liability.
- How each individual investment contributes to the risk and return of the overall portfolio.
- Expected total return from capital appreciation and income.
- Other resources of the beneficiary.
- The beneficiary's liquidity, income, and capital preservation requirements.
- Whether any assets have a special relationship to the requirements of the beneficiary or the trust.

## KEY CONCEPTS

### LOS 10.a

The five basic principles of the new Prudent Investor Rule are:

- Diversification is expected of portfolio managers as a method of reducing risk.
- Trustees must base an investment's appropriateness on its risk/return profile in a portfolio context.
- Excessive trading (churning), as well as excessive fees and other transactions costs that are not warranted by the portfolio risk/return objectives, should be avoided.
- Current income for the trust must be balanced against the need for growth.
- Trustees are allowed (and may be required under certain circumstances) to delegate investment authority.

### LOS 10.b

The general fiduciary standards that a trustee must adhere to are care, skill, caution, loyalty, and impartiality. The adherence to these standards is required of the trustee at the time of the investment decision.

### LOS 10.c

The new Prudent Investor Rule differs from the old Prudent Man Rule in a number of areas:

- Total return is emphasized rather than preservation of purchasing power.
- Risk must be consistent with expected return objectives; under the old Rule risk was avoided.
- The investments are evaluated from a risk-return perspective in a portfolio context, not individually.
- No securities are "off-limits" because they are risky on a stand-alone basis.
- Delegation of duties is encouraged rather than prohibited.

### LOS 10.d

Key factors the trustee should consider include general economic conditions (including inflation and deflation), total expected return and the risk-return trade-off of the portfolio, and the unique needs of the beneficiary, including the tax situation, other resources available to the beneficiary, liquidity, income and capital preservation requirements, and unique assets with a special relationship to the beneficiary.

## CONCEPT CHECKERS

1. Which of the following statements regarding the old Prudent Man Rule is *most accurate*?
  - A. The delegation of investment authority to a third party was acceptable.
  - B. Trustees were to consider the safety of invested assets as well as income potential.
  - C. Each investment was considered in the context of its contribution to the entire portfolio.
  
2. Which of the following statements is *least likely* to be a basic principle of the new Prudent Investor Rule?
  - A. Current income for the trust must be balanced against the need for growth.
  - B. Trustees must base appropriateness of risk on an investment's risk/return profile.
  - C. Trustees may not delegate investment authority, except in unusual circumstances.
  
3. In which way are the old Prudent Man Rule and the new Prudent Investor Rule *similar*? Both rules:
  - A. forbid entire classes of securities.
  - B. instruct trustees to act in a fair and reasonable manner.
  - C. stipulate that a total return approach to money management should be employed.

Use the following information to answer Question 4.

Stanley Bostwick, CFA, is a portfolio manager at Cornerstone Trust Company. He has asked Susan Sarahson, a newly hired analyst and Level 2 CFA candidate, to research the differences between the old Prudent Man Rule and the new Prudent Investor Rule. Sarahson conducts her research, meets with Bostwick, and makes the following statements:

*Statement 1:* "The old Rule allows the delegation of authority and the new rule doesn't."

*Statement 2:* "The old Rule considers each investment on its own merits, and the new Rule takes a total portfolio approach."

*Statement 3:* "The old Rule allows for plain vanilla derivative instruments, and the new Rule allows for more exotic derivative instruments."

4. Bostwick has some familiarity with both rules and, after some further consideration, agrees with Sarahson concerning statements #1 and #2, but disagrees with her concerning statement #3. Which of the following statements is *most accurate*?
  - A. He was correct to agree with her concerning statement #1.
  - B. He was correct to agree with her concerning statement #2.
  - C. He was incorrect to disagree with her concerning statement #3.



5. The new Prudent Investor Rule includes eight key factors that the trustee should consider when investing and managing trust assets. Which of the following is *least likely* to be one of these eight key factors?
  - A. Economic conditions.
  - B. Effect of deflation.
  - C. Impact of investment decisions on the beneficiary's personal beliefs and ethical principles.
  
6. The new Prudent Investor Rule includes eight key factors that the trustee should consider when investing and managing trust assets. Which of the following is *least likely* to be one of these eight key factors?
  - A. Expected total return from capital appreciation and income.
  - B. The non-systematic risk present in individual investments.
  - C. Whether any assets have a special relationship to the requirements of the beneficiary or the trust.
  
7. The new Prudent Investor specifies five fiduciary standards that the trustee must adhere to. Which of the following is *least likely* to be one of these factors?
  - A. Skill.
  - B. Caution.
  - C. Feasibility.

## ANSWERS – CONCEPT CHECKERS

1. B Delegation of authority was not permitted under the old Rule. The trustee was required to consider each investment individually and not in a portfolio context. The old Rule has been replaced by the new Prudent Investor Rule.
2. C Trustees are allowed to delegate authority and may, under certain circumstances, be required to delegate authority to perform their fiduciary duty to their clients.
3. B Trustees are instructed to act “in a fair and reasonable manner” under the impartiality standards of both rules.
4. B Only statement #2 is true, so Bostwick was correct to agree with her concerning that statement. The other statements are false, so Bostwick was not correct to agree with her concerning statement #1, but he was correct to disagree with her concerning statement #3.

Statement #1 is false because the old Rule did not allow for the delegation of duty; the new Rule requires it if the manager does not have the relevant investment knowledge. Statement #3 is false because the old Rule did not allow the investment in securities deemed “imprudent,” like derivative instruments, while the new Rule allows them as part of the total portfolio approach.

5. C The impact of investment decisions on the beneficiary’s *tax liability* is a factor the new rule requires. It may be reasonable to consider the beneficiary’s personal beliefs and ethical principles, but this is *not* part of the Prudent Investor Rule.
6. B The key point of the Prudent Investor Rule is to consider risk in a portfolio context, rather than the non-systematic risk present in individual investments.
7. C Feasibility is not part of the Prudent Investor Rule. The fiduciary standards are care, skill, caution, loyalty, and impartiality.

## SELF-TEST: ETHICAL AND PROFESSIONAL STANDARDS



*Professor's Note: Remember that the Level 2 exam consists of all item set format questions; that is, a vignette presenting the relevant information followed by six multiple choice questions on that topic. For an accurate gauge of your preparedness, allow 18 minutes per item set (54 minutes total) for this self-test.*

### Item Set #1

Lewis Smithers, CFA, is the lead portfolio manager for Fundamental Investments Corp., a money manager serving several hundred wealthy individual investors. He spent his morning reading several articles on Phoenix-based Pineda Canyon Development in real estate industry publications. He concluded that while Pineda is a majority owner of several developers with huge portfolios of mountainside real estate perfect for the development of ski resorts, the company lacks the cash to build the resorts.

While lunching at his club, Smithers ran into Judith Carson, an old college friend he hadn't seen in months. Carson is managing partner of a land-speculation endeavor that owns thousands of acres of prime real estate. During the course of their conversation, Carson asked Smithers to invest in the partnership, which was about to buy a land developer and its acreage near Sassy River.

When Smithers returned to the office after lunch, he found an e-mail from Liam O'Toole, his largest client, who is knowledgeable about and likes to invest in real estate. O'Toole, who in the past did business with money manager Big Ideas International, had read in Big Ideas' prospect newsletter that a large Arizona developer was close to a deal to sell property in the Sassy River Valley. The article did not identify the parties to the transaction but did reveal the acreage of the land and the proposed sale price. O'Toole wanted to know if Smithers had heard about this deal and if he could get O'Toole a piece of it in exchange for a week at O'Toole's condo in St. Thomas.

Smithers suspected Pineda was the seller and Carson's real estate partnership was the buyer. Seeking to verify this, Smithers called Carson and asked if the partnership's big deal involved Pineda Canyon Development. Carson responded by saying she could neither confirm nor deny that a transaction with Pineda or any other specific company was in the works. A couple of days later, however, Smithers observed Carson and two of her business partners having dinner with Pineda executives. Smithers checked public records and discovered that Pineda was the majority shareholder in the only major development company with significant land ownership in the Sassy River Valley. Smithers concluded that Carson's firm was about to purchase the Sassy River developer from Pineda.

That afternoon, Smithers prepared a purchase recommendation for Pineda stock. He cited the expected sale of Sassy River Valley land for enough cash to fund both the construction of several ski resorts and retire some high interest notes. Smithers worked up some revenue and profit numbers, detailed the location of the property, and submitted a report for approval by the company president.

1. In preparing his recommendation to purchase Pineda, Smithers violated:
  - A. none of the standards.
  - B. Standard III(A) Loyalty, Prudence, and Care with regard to Carson's information.
  - C. Standard II(A) Material Nonpublic Information with regard to Carson's statements.
2. Immediately after submitting his purchase recommendation to his boss, Smithers takes three actions. Which of the following actions is *least likely* a violation of the Code and Standards?
  - A. Immediately downgrading two ski equipment manufacturers based only on "trends in the industry."
  - B. Advising a colleague in Fundamental's bond department of this new information regarding Pineda's debt.
  - C. Giving Carson the names and summary financial information of O'Toole and two other clients as possible limited partners.
3. Fundamental's president, Dana Aaronson, is so impressed with Smithers' report that she sends it to the fulfillment department for printing and faxing five minutes after receiving it from Smithers' supervisor, who has read and approved the report. In her handling of the report, *how many* of the following standards has Aaronson violated?
  - I(B) Independence and Objectivity.
  - IV(C) Responsibilities of Supervisors.
  - V(A) Diligence and Reasonable Basis.
  - II(A) Material Nonpublic Information.
  - A. One.
  - B. Two.
  - C. None.
4. With regard to his information-gathering activities and the creation of his report, did Smithers or anyone else violate Standard III(A) Loyalty, Prudence, and Care?
  - A. No one violated the Standard.
  - B. O'Toole's disclosure of the Big Ideas newsletter to Smithers is a violation of the Standard.
  - C. Carson's discussion with Smithers about the partnership's plans is a violation of the Standard.
5. Because O'Toole brought the information about the real estate deal to Smithers' attention, Smithers purchased Pineda stock for O'Toole immediately after submitting his report to management. The purchase was *most likely* to violate:
  - A. Standard III(B) regarding fair dealing.
  - B. Standard III(C) regarding suitability of investments.
  - C. Standard IV(B) regarding additional compensation arrangements.

6. The Pineda report has been dispatched by e-mail, fax, or mail to every client. The purchase will be announced in one day, not enough time to disseminate Smithers' research to clients with no e-mail or fax capability. Fundamental's trading manager, Bill Johnson, is considering various directives regarding the trading of Pineda stock. Which of the following instructions for portfolio managers is *best*?
- A. Make no trades until the written reports are delivered to every client in 48 hours.
  - B. Do not execute any pending sell order for Pineda stock until the client has been informed of the rating change.
  - C. Purchase Pineda stock for all discretionary portfolios, then call nondiscretionary clients to seek permission to purchase the stock.

## Item Set #2

Gerard Cutty, CFA, a technology-stock analyst and money manager at Unique Investments, has been hearing rumors for months that Simpson Semiconductor was near a breakthrough on a next-generation telecommunications microchip. Simpson is best known on the street for its expert design engineers, perennially shaky balance sheet, and extremely volatile stock.

One morning, as he is listening to a recorded *Barron's* interview with Simpson's CEO, who is also a CFA charterholder, he learns that Simpson has struck a licensing agreement with Simak Foundry, a privately held chip fabricator in Malaysia. Then he reads in *The Asian Wall Street Journal* that a Malaysian bank has loaned \$500 million to Simak for construction of a new plant.

Cutty owns an apartment in Paris which is leased to Gladys Catcher, CFA. The lease is about to expire and Cutty and Catcher are currently in the process of renegotiating the terms of the lease. Cutty has other potential tenants for the apartment who are willing to pay more than what Catcher is currently paying, so he would like to negotiate a significant increase in the monthly payments.

Catcher works for a Paris public relations firm that handles accounts for a lot of Asian technology companies. Cutty calls Catcher, and after learning that her firm handled the Simak account, he asks what she knows about the Simak loan. Catcher says Simak has inked a deal with a big U.S. firm to make a new kind of microchip. She refuses to identify the firm but does provide some impressive performance numbers for the new chip.

After conducting a detailed patent search using the chip performance figures as a guide, Cutty learns that a Simpson engineer has filed for a series of patents related to the new technology over the past 18 months, and confirms Catcher's information on the performance of the new chip.

Cutty works up some revenue and market-share projections, then concludes that if the new technology works, it could triple the company's profits over the next three years. He writes up a research report on Simpson, detailing the licensing deal, specs on the new chip, and his opinion about the company's growth potential. Cutty then raises his rating on Simpson from neutral to high-risk buy.

Mary Wabb, lead portfolio manager for Unique Investments, calls Cutty into her office after reviewing the analyst's report. Wabb asks Cutty about his sources and methodology, and Cutty explains his thinking process. She then thanks Cutty for his good work and tells him he will receive Unique's World Series tickets this year. After Cutty leaves, Wabb makes minor edits to the report and sends it to the fulfillment department for inclusion in the daily e-mail report and weekly printed report for clients and prospects. Then Wabb instructs the trading desk to purchase Simpson stock for all client accounts after the reports have been issued.

The day after Cutty's report is released, rival analyst Sue Ellen Slusher, CFA, publishes her own analysis of Simpson Semiconductor. She cites Cutty's report specifically, quoting him directly and rebutting his conclusions point by point with her own research, criticizing his lack of thoroughness and questioning his abilities as an analyst and his academic and professional credentials. Specifically, she says that she's a better analyst than he is because "he earned his charter way back in 1986, when the CFA® exam was a lot easier to pass than it is today, but I earned my charter last year." Slusher writes that after talking with executives at Werfel Wafers, she believes Simpson infringed on Werfel's patent and will never reap the profits from the new technology.

7. In the production of his research report, Cutty violated:
  - A. Standard V(A) Diligence and Reasonable Basis.
  - B. Standard II(A) Material Nonpublic Information.
  - C. None of the standards.
8. Which of the following statements is *most accurate* regarding potential violations of Standard III(A) Loyalty, Prudence, and Care in this scenario?
  - A. Neither Cutty, Catcher, nor Simpson violated the Standard.
  - B. Catcher violated the Standard by revealing information about her client, Simak.
  - C. Simpson's CEO violated the Standard by discussing his company's licensing agreement.
9. Which of the following statements, if found in Cutty's report without clarification, would *most likely* violate Standard V(B) Communications With Clients and Prospective Clients?
  - A. Simpson's sales have faltered in recent years, but I believe the new technology will bring back the days of 25% revenue growth.
  - B. The new technology could boost Simpson's cash flows considerably and provide flexibility to clean up the balance sheet.
  - C. After a few phone calls and an analysis of the relevant information from our internal database, I concluded that Simpson's new technology was more than just a rumor.
10. Which of Wabb's actions *most likely* violated the Code and Standards? Her:
  - A. newsletter instructions violated Standard III(B) Fair Dealing.
  - B. trading instructions violated Standard III(C) Suitability.
  - C. awarding of World Series tickets to Cutty violated Standard IV(B) Additional Compensation Arrangements.

11. Which of the following actions could Cutty have taken while researching his report on Simpson *without* violating CFA Institute Standards of Professional Conduct?
  - A. Not saving the results of the patent search.
  - B. Ignoring a rival analyst's report on a Simpson competitor with a similar technology.
  - C. Using statements from the Standard & Poor's report on Simpson without verifying them.
12. According to CFA Institute Standards of Professional Conduct, Slusher violated:
  - A. Standard VII(B) Reference to CFA Institute, the CFA Designation, and the CFA Program because of her criticism of Cutty's credentials.
  - B. Standard V(A) Diligence and Reasonable Basis because her conclusions differed from Cutty's.
  - C. Standard I(B) Independence and Objectivity because of her criticism of Cutty's research report and conclusions.

### Item Set #3

MH Securities is a subsidiary of MH Group, a large Korean conglomerate, and has recently established offices in the United States and Canada. MH plans to target Korean-Americans and Canadians for its services which include selling the firm's research services as well as Korean equities, bonds, and won-denominated certificates of deposit (CD). Chan-Heung Lee, CFA, has been hired to develop, implement, and oversee MH's compliance activities. Since there are very few compliance procedures in place, Lee will have to build the entire compliance framework. His objective is to conform to the CFA Institute Code and Standards. As one of his first steps, Lee decides to interview several MH employees to determine what formal and informal policies and procedures currently exist at the firm. Lee calls meetings with Jamie Jin, Nadine Yu, and Mark Larson, each of whom is a CFA charterholder.

Jamie Jin has recently been hired as an investment officer by MH. Jin informs Lee during their meeting that her previous employer, Rearguard Funds, has agreed to pay her a 25 basis point commission plus an annual bonus for all Rearguard Funds she sells to MH clients. Jin is unsure whether she will even use any Rearguard products with her new clients but agrees to the arrangement in case a client specifically requests a Rearguard product. Since the likelihood of actually receiving any compensation from Rearguard seems remote, Jamie has not previously disclosed the arrangement to MH.

In his meeting with Nadine Yu, an equity analyst at MH, Lee discovers that Yu has recently and abruptly changed her investment recommendation on Korean won-denominated bonds from buy to sell. She has prepared a research report to this effect and provides a copy to Lee in accordance with one of the firm's few existing compliance procedures. Her change of opinion is based upon nonpublic information provided to her in confidence by a friend on the monetary board at the Bank of Korea. While Lee is surprised at the abrupt change in the recommendation, he does not question the rationale and allows the report to be issued. Having received approval for her investment recommendation, Yu simultaneously releases the report to her individual and institutional research service subscribers as well as to MH's portfolio managers.

Lee's final meeting is with a new hire, Mark Larson, who has recently agreed to go to work for MH starting at the beginning of the next month. Lee is meeting with Larson to discuss new clients that Larson is expected to bring to MH. Larson, without providing details, assures Lee that he will have no problem increasing MH's client base. Prior to leaving his current employer, Affinity Advisors, Larson contacts 25 prospects by calling them, using public records and not Affinity's records, on Saturday mornings from his home. Of the prospects, ten individuals had previously been rejected as being too small for Affinity, but they still meet MH standards. The other 15 individuals remained viable prospects for Affinity. After learning of their status with Affinity, Larson suggests that all 25 prospects consider directing their business to him and his new firm, MH.

Lee's meetings with Jin, Yu, and Larson help him formulate compliance procedures. Lee decides that he will develop a written compliance manual which will be distributed to all of the firm's employees. The manual will delineate procedures for reporting violations and sanctions, describe the supervision hierarchy and each supervisor's duties, and outline the steps to monitor and evaluate the compliance program. Lee also designates Jin as the employee with ultimate responsibility for the compliance procedures and their enforcement.

13. Since there are currently no compliance procedures in place, Lee should:
  - A. develop procedures that are in accordance with the CFA Institute Code and Standards as compliance situations arise.
  - B. implement a comprehensive set of compliance procedures immediately and verify their conformance with the CFA Institute Code and Standards as circumstances dictate.
  - C. determine what constitutes adequate compliance procedures under the CFA Institute Code and Standards, then implement such procedures immediately.
14. Prior to her meeting with Lee, did Jin's decision regarding the disclosure of the arrangement with Rearguard Funds violate any CFA Institute Standards of Professional Conduct?
  - A. Yes.
  - B. No, since she disclosed the arrangement with Rearguard to Lee in their meeting.
  - C. No, since prior to the meeting with Lee, MH did not have any compliance procedures requiring such a disclosure.
15. With regard to Yu's recommendation that investors sell Korean bonds, did Lee and Yu violate any CFA Institute Standards of Professional Conduct?

|    |            |           |
|----|------------|-----------|
|    | <u>Lee</u> | <u>Yu</u> |
| A. | No         | No        |
| B. | Yes        | Yes       |
| C. | No         | Yes       |
16. With respect to the release of Yu's investment recommendation, did Yu violate any CFA Institute Standards of Professional Conduct?
  - A. No.
  - B. Yes. Yu should have released the recommendation to the individual clients first.
  - C. Yes. Yu should have released the recommendation to the individual and institutional clients first.



17. In soliciting the list of 10 previously rejected prospects and the list of 15 viable prospects, did Larson violate any CFA Institute Standards of Professional Conduct?

10 previously-rejected prospects

15 viable prospects

- |        |     |
|--------|-----|
| A. No  | No  |
| B. Yes | Yes |
| C. No  | Yes |

18. Does the compliance program developed by Lee after his meetings with MH employees comply with CFA Institute Standards of Professional Conduct?

- A. Yes.
- B. No. Authority to enforce the compliance program should rest with the compliance officer.
- C. No. Assigning supervisory duties takes away the responsibility of all supervisors to detect all violations of the compliance procedures.

## SELF-TEST ANSWERS: ETHICAL AND PROFESSIONAL STANDARDS

### Item Set #1

1. A Smithers has assembled both material public and nonmaterial nonpublic information as the basis for his recommendation. By putting all of the information together, Smithers has utilized the mosaic theory to come to a conclusion of material nonpublic nature without actually using material nonpublic information. Therefore, he did not violate Standard II(A). Carson is not Smithers' client, and Smithers owes Carson no fiduciary responsibility under Standard III(A). Smithers had no reason to believe Carson would misrepresent anything about the situation.
2. B Sharing information between the stock and bond divisions within a single company does not violate any fiduciary duties. It is possible that by not sharing the information, Smithers could violate a fiduciary duty to Fundamental's bond-investing clients. Immediately downgrading the ski equipment manufacturers implies the downgrades were issued solely because of a new deal for Pineda, an act that violates Standard V(A) Diligence and Reasonable Basis. Giving client financial information to a competitor would definitely violate III(E), Preservation of Confidentiality.
3. C Nothing in Aaronson's conduct implies any violation of the independence and objectivity Standard, nor the Standard regarding use of material nonpublic information. As president of the firm, Aaronson is NOT responsible for making sure that each analyst has a reasonable basis for every recommendation. Aaronson is entitled to rely on reasonable procedures to detect and prevent such violations. Therefore, she has not violated any of the four listed standards.
4. A Standard III(A) Loyalty, Prudence, and Care requires members and candidates act for the benefit of their clients and comply with applicable fiduciary duties. O'Toole has no fiduciary duty to Big Ideas and can share the information with anyone he wishes. As managing partner, Carson is presumably authorized to speak for the partnership and attempt to bring in new-investors. She has a fiduciary duty to the limited partners, but revealing the purchase plans to Smithers did not violate that duty as the deal had already been struck, and the information would not affect the purchase price. No actions in the scenario reflect a breach of fiduciary duty.
5. A O'Toole is an experienced real estate investor, and Pineda is probably a good fit for him. And because O'Toole is Smithers' biggest client, it can be assumed that Smithers has worked with O'Toole extensively and is familiar with his investment needs and preferences. As such, the purchase most likely satisfies Standard III(C) Suitability. Smithers did not violate Standard IV(B) Additional Compensation Arrangements because he did not accept O'Toole's offer, nor did he do what O'Toole asked in return for the condo, which was to get O'Toole a piece of the deal. By favoring O'Toole over other clients, however, Smithers violates the fair dealing Standard and his fiduciary duty to other clients besides O'Toole. Smithers should not have purchased stock in Pineda for O'Toole until the report had been disseminated to all clients with an interest in the investment.

6. **B** The fair dealing Standard requires brokers to inform clients of any pending rating changes. If the clients still want to sell Pineda, then Fundamental must sell it for them. Purchasing Pineda stock for all discretionary portfolios violates the Standard III(C) Suitability, as the stock may not be suitable for all account holders. Waiting to make buys until everyone has received a mailed report sounds fair, but it violates the firm's fiduciary duty to discretionary clients and those who can be reached by phone, fax, or e-mail before the merger announcement is made. In addition, Standard III(B) Fair Dealing requires fair dissemination of recommendations, not "equal" dissemination, which is not always practical.

## Item Set #2

7. **C** Cutty's use of someone with whom he does personal business as a source could be perceived by some as a conflict of interest. However, there seems to be no ill intent, and Cutty corroborated Catcher's information from an additional source (the patent search). The research reports Standard requires that the analyst use reasonable judgment and distinguish between fact and opinion—Cutty did that. Cutty's broad-based research also satisfies the requirements of the reasonable basis Standard. None of the nonpublic information Cutty picked up was likely to be considered material by itself, and his conclusions about Simpson are an example of the mosaic theory.
8. **A** Cutty owes no fiduciary duty to Catcher. Simpson's CEO did not reveal material information, but as CEO he likely would not have been violating a fiduciary duty even if he had. Catcher is in public relations, and her job is to discuss her clients' business with third parties. As such, she is authorized to release information—Standard III(A).
9. **C** While Cutty clearly states that his opinion is based on his own conclusions rather than verifiable facts, he violates Standard V(B) by not providing details about the evaluation process, which was quite complicated. Therefore, choice C is not an adequate description of the process, and a violation of the Standard. Cutty's use of "I believe" and "could" suggest the statements about sales and cash flows are his opinions. Therefore, choices A and B are not violations.
10. **B** Since Simpson is a risky stock, it is probably not suitable for all clients, and a blanket purchase order violates Standard III(C) Suitability. Wabb's instructions for the fulfillment department meet the requirements of Standard III(B) Fair Dealing, as the Standard does not require that everyone be notified at the same time, only that the dissemination of information is handled fairly. In this case, everyone with e-mail will get the information at the same time, and those without e-mail will get it later, but at the same time as their low-tech peers. The additional compensation Standard applies to compensation that doesn't come from the employer, and the World Series tickets did indeed come from the employer.
11. **C** Members are in compliance with Standard V(A) Diligence and Reasonable Basis if they depend on the research of others they know to be competent and diligent. S&P qualifies as such a source. Standard V(C) Record Retention requires analysts to maintain records supporting their actions, so Cutty must save the results of the patent search. A rival's report about a competitor with similar technology could have a material effect on Cutty's financial model for Simpson and must be considered.
12. **A** Slusher's claim that her credentials are superior to Cutty's because she earned her charter more recently is a violation of Standard VII(B) Reference to CFA Institute, the CFA Designation, and the CFA Program. Slusher did not plagiarize Cutty's work because she cited him as the author. Just because Slusher disagrees with, and criticizes, Cutty's well-researched opinion does not mean she lacks basis for her own analysis, or has violated the independence and objectivity standard.

Item Set #3

13. C In order to best conform to the CFA Institute Code and Standards, Lee should first define what constitutes adequate standards. According to Standard IV(C) Responsibilities of Supervisors, “adequate” procedures are those designed to meet industry standards, regulatory requirements, the requirements of the Code and Standards, and the circumstances of the firm.” Once this has been done he should implement the procedures immediately.
14. A In order to be in compliance with Standard IV(E) Jin must disclose all additional compensation arrangements, in writing, to her employer. It does not matter whether Rearguard actually pays her a commission on the funds or whether the firm previously had such a policy. In addition, the relationship with Rearguard creates a potential conflict of interest between Jin and her clients since she may be tempted to increase her income by recommending Rearguard Funds that are inappropriate for her clients’ needs. Standard VI(A) Disclosure of Conflicts, requires disclosure of such conflicts to clients and prospects. There is no indication that Jin has made such a disclosure.
15. B Yu is in violation of Standard II(A) Material Nonpublic Information, as she has used material nonpublic information in her investment recommendations. She is forbidden to act upon such information. Lee, the firm’s compliance officer, has violated Standard IV(C) Responsibilities of Supervisors, in the discharge of his responsibility as a supervisor. Given the abrupt change in the recommendation, Lee should have attempted to determine if there was a reasonable basis for the dramatic shift in opinion.
16. A According to Standard III(B) Fair Dealing, members and candidates must ensure that all clients are treated equitably with regard to investment recommendations and investment actions. Because MH has clients that subscribe to their research service but do not pay for portfolio management services and the firm has clients that pay for discretionary portfolio management, investment recommendations must be communicated to research subscribers and the firm’s portfolio managers simultaneously in order to ensure that all clients have equal opportunity to trade on the firm’s research without being disadvantaged because of the type of service the client receives.
17. C According to Standard IV(A) Loyalty to Employer, Larson must not solicit current or prospective Affinity clients prior to his leaving. Larson is allowed to solicit prospects that have been rejected by Affinity as long as he does so on his own time, does not use Affinity’s client lists, and his actions do not impair his performance at work. His solicitation of prospects who are still viable for Affinity is a clear violation of duty to his employer under Standard IV(A).
18. B According to Standard IV(C) Responsibilities of Supervisors, the responsibility to implement procedures and the authority to enforce the procedures should both reside with the compliance officer (in this case Lee, rather than Jin, who is an investment officer).

# CORRELATION AND REGRESSION

Study Session 3

---

## EXAM FOCUS

This introduction to regression analysis begins with the calculation of sample covariance and sample correlation. You should be able to calculate both of these measures and to test the significance of an estimated correlation coefficient. A simple linear regression involves two random variables, an independent and a dependent variable. Candidates should be able to construct a simple regression model (equation), state the assumptions under which such a (linear) model is valid, and discuss the limitations of a simple regression model. Given the estimated model parameters (coefficients), you should be able to use the model to predict the dependent variable using an assumed value of the independent variable. Finally, you may be required to interpret an ANOVA table and test the significance of estimated regression coefficients. Note that an *F*-test, in the context of a simple regression, is equivalent to a *t*-test of the significance of the estimated slope coefficient.

---



*Professor's Note: For more details on hypothesis testing and simple linear regression, please see the online Schweser Library.*

---

## LOS 11.a: Calculate and interpret a sample covariance and a sample correlation coefficient and interpret a scatter plot.

---

The **covariance** between two random variables is a statistical measure of the degree to which the two variables move together. The covariance captures the linear relationship between one variable and another. A positive covariance indicates that the variables tend to move together; a negative covariance indicates that the variables tend to move in opposite directions.

The **sample covariance** is calculated as:

$$\text{cov}_{XY} = \frac{\sum_{i=1}^n (X_i - \bar{X})(Y_i - \bar{Y})}{n - 1}$$

where:

$n$  = sample size

$X_i$  =  $i$ th observation on variable  $X$

$\bar{X}$  = mean of the variable  $X$  observations

$Y_i$  =  $i$ th observation on variable  $Y$

$\bar{Y}$  = mean of the variable  $Y$  observations

The actual value of the covariance is not very meaningful because its measurement is extremely sensitive to the scale of the two variables. Also, the covariance may range from

negative to positive infinity, and it is presented in terms of squared units (e.g., percent squared). For these reasons, we take the additional step of calculating the correlation coefficient, which converts the covariance into a measure that is easier to interpret.

**SAMPLE CORRELATION COEFFICIENT**

The **correlation coefficient**,  $r$ , is a measure of the strength of the linear relationship (correlation) between two variables. The correlation coefficient has no unit of measurement; it is a “pure” measure of the tendency of two variables to move together.

The **sample correlation coefficient** for two variables,  $X$  and  $Y$ , is calculated as:

$$r_{XY} = \frac{\text{covariance of X and Y}}{(\text{sample standard deviation of X})(\text{sample standard deviation of Y})} = \frac{\text{cov}_{XY}}{(s_X)(s_Y)}$$

The correlation coefficient is bounded by positive and negative one (i.e.,  $-1 \leq r \leq +1$ ), where a correlation coefficient of +1 indicates that changes in the variables are perfectly positively correlated (i.e., they go up and down together, in lock-step). In contrast, if the correlation coefficient is -1, the changes in the variables are perfectly negatively correlated.

Figure 1 provides the data for two variables,  $X$  and  $Y$ , and shows the calculation of the correlation between  $X$  and  $Y$ .

**Figure 1: Procedure for Computing Correlation**

| Obs.                        | X   | Y   | $X - \bar{X}$ | $(X - \bar{X})^2$               | $Y - \bar{Y}$ | $(Y - \bar{Y})^2$ | $(X - \bar{X})(Y - \bar{Y})$ |
|-----------------------------|-----|-----|---------------|---------------------------------|---------------|-------------------|------------------------------|
| 1                           | 12  | 50  | -1.50         | 2.25                            | 8.40          | 70.56             | -12.60                       |
| 2                           | 13  | 54  | -0.50         | 0.25                            | 12.40         | 153.76            | -6.20                        |
| 3                           | 10  | 48  | -3.50         | 12.25                           | 6.40          | 40.96             | -22.40                       |
| 4                           | 9   | 47  | -4.50         | 20.25                           | 5.40          | 29.16             | -24.30                       |
| 5                           | 20  | 70  | 6.50          | 42.25                           | 28.40         | 806.56            | 184.60                       |
| 6                           | 7   | 20  | -6.50         | 42.25                           | -21.60        | 466.56            | 140.40                       |
| 7                           | 4   | 15  | -9.50         | 90.25                           | -26.60        | 707.56            | 252.70                       |
| 8                           | 22  | 40  | 8.50          | 72.25                           | -1.60         | 2.56              | -13.60                       |
| 9                           | 15  | 35  | 1.50          | 2.25                            | -6.60         | 43.56             | -9.90                        |
| 10                          | 23  | 37  | 9.50          | 90.25                           | -4.60         | 21.16             | -43.70                       |
| Sum                         | 135 | 416 | 0.00          | 374.50                          | 0.00          | 2,342.40          | 445.00                       |
| $\bar{X} = 135 / 10 = 13.5$ |     |     |               | $s_X^2 = 374.5 / 9 = 41.611$    |               |                   |                              |
| $\bar{Y} = 416 / 10 = 41.6$ |     |     |               | $s_Y^2 = 2,342.4 / 9 = 260.267$ |               |                   |                              |

Using the information in Figure 1, the sample correlation coefficient for variables  $X$  and  $Y$  may be calculated as:

$$r_{XY} = \frac{\frac{445}{9}}{\sqrt{41.611}\sqrt{260.267}} = \frac{49.444}{(6.451)(16.133)} = 0.475$$

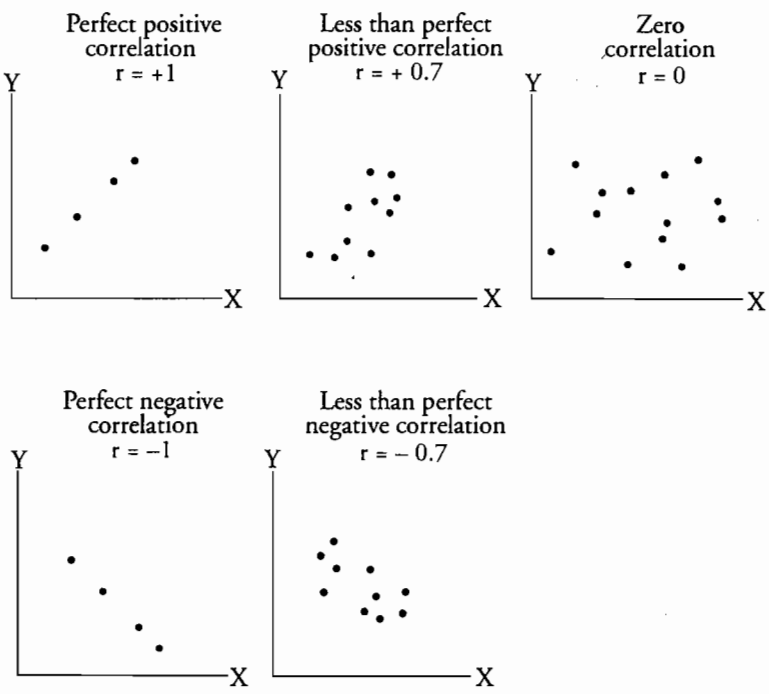
The interpretation of the possible correlation values is summarized in Figure 2.

**Figure 2: Interpretation of Correlation Coefficients**

| <i>Correlation Coefficient (<math>r</math>)</i> | <i>Interpretation</i>          |
|-------------------------------------------------|--------------------------------|
| $r = +1$                                        | perfect positive correlation   |
| $0 < r < +1$                                    | a positive linear relationship |
| $r = 0$                                         | no linear relationship         |
| $-1 < r < 0$                                    | a negative linear relationship |
| $r = -1$                                        | perfect negative correlation   |

A scatter plot is a collection of points on a graph where each point represents the values of two variables (i.e., an  $X/Y$  pair). Figure 3 shows several scatter plots for the two random variables  $X$  and  $Y$  and the corresponding interpretation of correlation. As shown, an upward-sweeping scatter plot indicates a positive correlation between the two variables, while a downward sweeping plot implies a negative correlation. Also illustrated in Figure 3 is that as we move from left to right in the rows of scatter plots, the extent of the linear relationship between the two variables deteriorates, and the correlation gets closer to zero. Note that for  $r = 1$  and  $r = -1$  the data points lie exactly on a line, but the slope of that line is not necessarily  $+1$  or  $-1$ .

Figure 3: Interpretations of Correlation



INTERPRETING A SCATTER PLOT

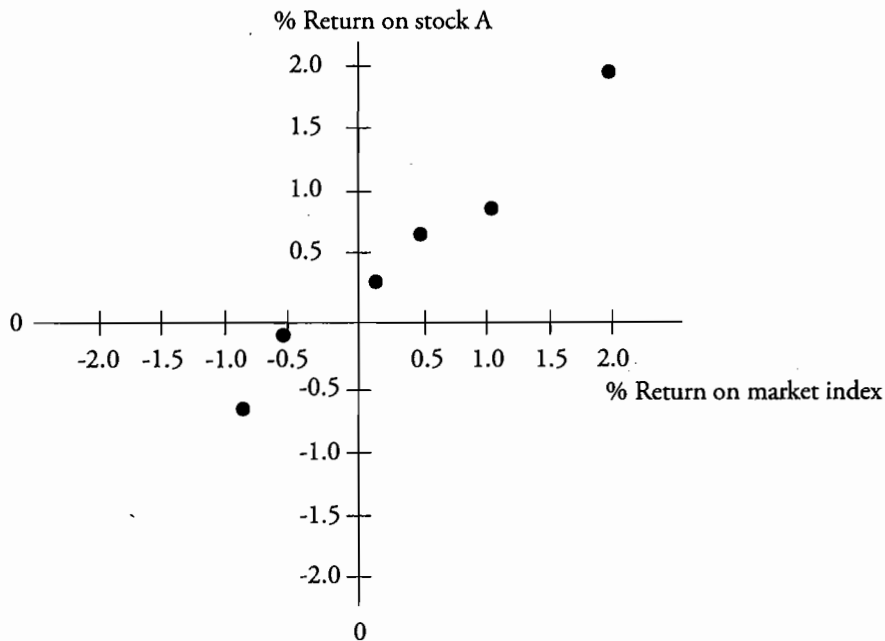
Suppose we wish to graphically represent the data for the returns on Stock A and returns on a market index over the last six months, shown in Figure 4. Figure 5 shows the data graphically with the returns on Stock A on the Y-axis and the returns on the market index on the X-axis. Each point of the scatter plot in Figure 5 represents one month of the six in our sample. The rightmost point in the scatter plot is for the month of March, a 2.0% return on the market index and a 1.8% return on Stock A.

Figure 4: Monthly Returns Data

| <i>Month</i> | <i>Return on Stock A</i> | <i>Return on Market Index</i> |
|--------------|--------------------------|-------------------------------|
| Jan          | +0.8%                    | +1.2%                         |
| Feb          | +0.6%                    | +0.5%                         |
| Mar          | +1.8%                    | +2.0%                         |
| Apr          | −0.7%                    | −0.9%                         |
| May          | +0.3%                    | +0.2%                         |
| June         | −0.1%                    | −0.5%                         |



**Figure 5: A Scatter Plot of Returns**



Notice that returns on Stock A appear to be positively correlated with the market index returns.

**LOS 11.b: Explain the limitations to correlation analysis, including outliers and spurious correlation.**

Limitations to correlation analysis include the impact of outliers, the potential for spurious correlation, and nonlinear relationships.

**Outliers**

Computed correlation coefficients, as well as other sample statistics, may be affected by outliers. Outliers represent a few extreme values for sample observations. Relative to the rest of the sample data, the value of an outlier may be extraordinarily large or small. Outliers can result in apparent statistical evidence that a significant relationship exists when, in fact, there is none, or that there is no relationship when, in fact, there is a relationship.

**Spurious Correlation**

Spurious correlation refers to the appearance of a causal linear relationship when, in fact, there is no relation. Certain data items may be highly correlated purely by chance. For example, suppose that you compute the correlation coefficient for historical stock prices and snowfall totals in Minnesota and get a statistically significant relationship—especially for the month of January. Obviously there is no economic explanation for this relationship, so this would be considered a spurious correlation.

## Nonlinear Relationships

Correlation measures the *linear* relationship between two variables. That's why in the first panel of Figure 3 that the data points lie perfectly on a straight line when the two variables are perfectly positively correlated. For example,  $Y = 6 - 3X$  is a linear relationship. However, two variables could have a *nonlinear* relationship such as  $Y = (3X - 6)^2$  and the correlation coefficient would be close to zero. Therefore another limitation of correlation analysis is that it does not capture strong nonlinear relationships between variables.

---

**LOS 11.c: Formulate a test of the hypothesis that the population correlation coefficient equals zero and determine whether the hypothesis is rejected at a given level of significance.**

---

As indicated earlier, the closer the correlation coefficient is to plus or minus one, the stronger the correlation. With the exception of these extremes (i.e.,  $r = \pm 1.0$ ), we cannot really speak of the strength of the relationship indicated by the correlation coefficient without a statistical test of significance.

For our purposes, we want *to test whether the correlation between the population of two variables is equal to zero*. Using the lower case Greek letter rho ( $\rho$ ) to represent the population parameter, the appropriate null and alternative hypotheses can be structured as a two-tailed test as follows:

$$H_0: \rho = 0 \text{ versus } H_a: \rho \neq 0$$

Assuming that the two populations are normally distributed, we can use a *t*-test to determine whether the null hypothesis should be rejected. The test statistic is computed using the sample correlation,  $r$ , with  $n - 2$  degrees of freedom (*df*):

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$

To make a decision, the calculated test statistic is compared with the critical *t*-value for the appropriate degrees of freedom and level of significance. Bearing in mind that we are conducting a two-tailed test, the decision rule can be stated as:

$$\text{Reject } H_0 \text{ if } +t_{\text{critical}} < t, \text{ or } t < -t_{\text{critical}}$$

**Example: Test of significance for the correlation coefficient**

Using the information from the table in Figure 1, determine if the sample correlation is significant at the 5% level of significance.

**Answer:**

The hypotheses are structured as  $H_0 : \rho = 0$  versus  $H_a : \rho \neq 0$ .

For the sample data in Figure 1,  $n = 10$  and  $r = 0.475$ . Using this information, the test statistic can be computed as:

$$t = \frac{0.475\sqrt{8}}{\sqrt{1-0.475^2}} = \frac{1.3435}{0.88} = 1.527$$

The two-tailed critical  $t$ -values at a 5% level of significance with  $df = 10 - 2 = 8$  are found in the  $t$ -table to be  $\pm 2.306$ . (Look in the  $df = 8$  row and match that with the  $p = 0.05$  two-tailed level of significance column.)

Since  $-2.306 \leq 1.5267 \leq 2.306$  (i.e.,  $-t_{\text{critical}} \leq t \leq +t_{\text{critical}}$ ), the null cannot be rejected. We conclude that the correlation between variables  $X$  and  $Y$  is not significantly different than zero at a 5% significance level.

---

**LOS 11.d: Differentiate between the dependent and independent variables in a linear regression.**

---

The purpose of **simple linear regression** is to explain the variation in a dependent variable in terms of the variation in a single independent variable. Here, the term “variation” is interpreted as the degree to which a variable differs from its mean value. Don’t confuse variation with variance—they are related but are not the same.

- The **dependent variable** is the variable whose variation is explained by the independent variable. The dependent variable is also referred to as the *explained variable*, the *endogenous variable*, or the *predicted variable*.
- The **independent variable** is the variable used to explain the variation of the dependent variable. The independent variable is also referred to as the *explanatory variable*, the *exogenous variable*, or the *predicting variable*.

**Example: Dependent vs. independent variables**

Suppose that you want to predict stock returns with GDP growth. Which variable is the independent variable?

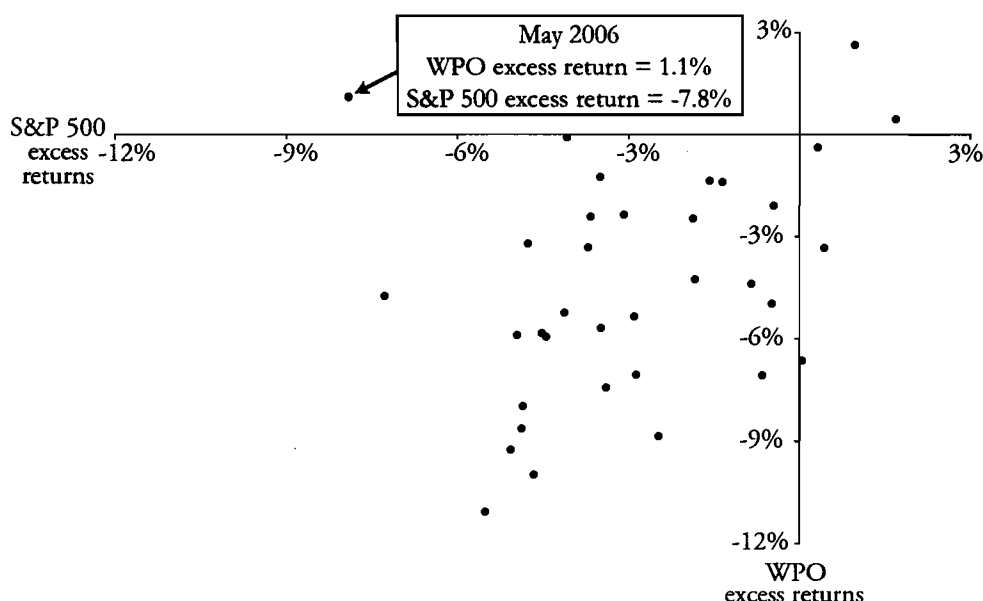
**Answer:**

Since GDP is going to be used as a predictor of stock returns, stock returns are being *explained* by GDP. Hence, stock returns are the dependent (explained) variable, and GDP is the independent (explanatory) variable.

Suppose we want to use excess returns on the S&P 500 (the independent variable) to explain the variation in excess returns on Washington Post (WPO) common stock (the dependent variable). Excess return is defined as the difference between the actual return and the return on 1-month Treasury bills.

We would start by creating a scatter plot with WPO excess returns on the vertical axis and S&P 500 excess returns on the horizontal axis. Monthly excess returns for both variables from June 2004 to May 2007 are plotted in Figure 6. For example, look at the point labeled May 2006. In that month the excess return on the S&P 500 was  $-7.8\%$  and the excess return on WPO common stock was  $1.1\%$ .

**Figure 6: Scatter Plot of WPO Excess Returns vs. S&P 500 Index Excess Returns**



Notice that it appears that the two variables are positively correlated: excess WPO returns tended to be positive (negative) in the same month that S&P 500 excess returns were positive (negative). Note that this is not the case for all the observations, however (including, for example, May 2006). In fact, the correlation between the two is approximately 0.40.

**LOS 11.e: Explain the assumptions underlying linear regression and interpret the regression coefficients.**

Linear regression requires a number of assumptions. As indicated in the following list, most of the major assumptions pertain to the regression model's residual term ( $\epsilon$ ).

- A linear relationship exists between the dependent and the independent variable.
- The independent variable is uncorrelated with the residuals.
- The expected value of the residual term is zero ( $E(\epsilon) = 0$ ).
- The variance of the residual term is constant for all observations ( $E(\epsilon_i^2) = \sigma_\epsilon^2$ ).

- The residual term is independently distributed; that is, the residual for one observation is not correlated with that of another observation  $(E(\varepsilon_i \varepsilon_j) = 0, j \neq i)$ .
- The residual term is normally distributed.

### SIMPLE LINEAR REGRESSION MODEL



*Professor's Note: We'll first calculate the regression coefficients and then interpret them. Note that the LOS does not ask you to calculate regression coefficients; we included that step so you can better understand the interpretation of the coefficients.*

The following linear regression model is used to describe the relationship between two variables,  $X$  and  $Y$ :

$$Y_i = b_0 + b_1 X_i + \varepsilon_i, i=1, \dots, n$$

where:

$Y_i$  =  $i$ th observation of the dependent variable,  $Y$

$X_i$  =  $i$ th observation of the independent variable,  $X$

$b_0$  = regression intercept term

$b_1$  = regression slope coefficient

$\varepsilon_i$  = the residual for the  $i$ th observation (also referred to as the disturbance term or error term)

Based on the regression model stated above, the regression process estimates an equation for a line through a scatter plot of the data that “best” explains the observed values for  $Y$  in terms of the observed values for  $X$ . The linear equation, often called the line of best fit, or regression line, takes the following form:

$$\hat{Y}_i = \hat{b}_0 + \hat{b}_1 X_i, i=1, \dots, n$$

where:

$\hat{Y}_i$  = the estimated value of  $Y_i$  given  $X_i$

$\hat{b}_0$  = the estimated intercept term

$\hat{b}_1$  = the estimated slope coefficient



*Professor's Note: The hat “^” above a variable or parameter indicates a predicted value.*

The regression line is just one of the many possible lines that can be drawn through the scatter plot of  $X$  and  $Y$ . In fact, the criteria used to estimate this line forms the very essence of linear regression. The regression line is the line for which the estimates of  $\hat{b}_0$  and  $\hat{b}_1$  are such that the sum of the squared differences (vertical distances) between the  $Y$ -values predicted by the regression equation ( $\hat{Y}_i = \hat{b}_0 + \hat{b}_1 X_i$ ) and actual  $Y$ -values,  $Y_i$ , is minimized. The sum of the squared vertical distances between the estimated and actual  $Y$ -values is referred to as the **sum of squared errors** (SSE).

Thus, the regression line is the line that minimizes the SSE. This explains why simple linear regression is frequently referred to as *ordinary least squares* (OLS) regression, and the values estimated by the estimated regression equation,  $\hat{Y}_i$ , are called least squares estimates.

The estimated slope coefficient ( $\hat{b}_1$ ) for the regression line describes the change in  $Y$  for a one unit change in  $X$ . It can be positive, negative, or zero, depending on the relationship between the regression variables. The slope term is calculated as:

$$\hat{b}_1 = \frac{\text{cov}_{XY}}{\sigma_X^2}$$



*Professor's Note: For the exam, know that the slope equals covariance divided by variance.*

The intercept term ( $\hat{b}_0$ ) is the line's intersection with the  $Y$ -axis at  $X = 0$ . It can be positive, negative, or zero. A property of the least squares method is that the intercept term may be expressed as:

$$\hat{b}_0 = \bar{Y} - \hat{b}_1 \bar{X}$$

where:

$\bar{Y}$  = the mean of  $Y$

$\bar{X}$  = the mean of  $X$

The intercept equation highlights the fact that the regression line passes through a point with coordinates equal to the mean of the independent and dependent variables (i.e., the point  $\bar{X}, \bar{Y}$ ).

#### Example: Computing the slope coefficient and intercept term

Compute the slope coefficient and intercept term for the WPO regression example using the following information:

$$\text{cov}(\text{S\&P 500}, \text{WPO}) = 0.000336 \quad \overline{\text{S\&P 500}} = -2.70\%$$

$$\text{var}(\text{S\&P 500}) = 0.000522 \quad \overline{\text{WPO}} = -4.05\%$$

**Answer:**

The slope coefficient is calculated as  $\hat{b}_1 = 0.000336/0.000522 = 0.64$ .

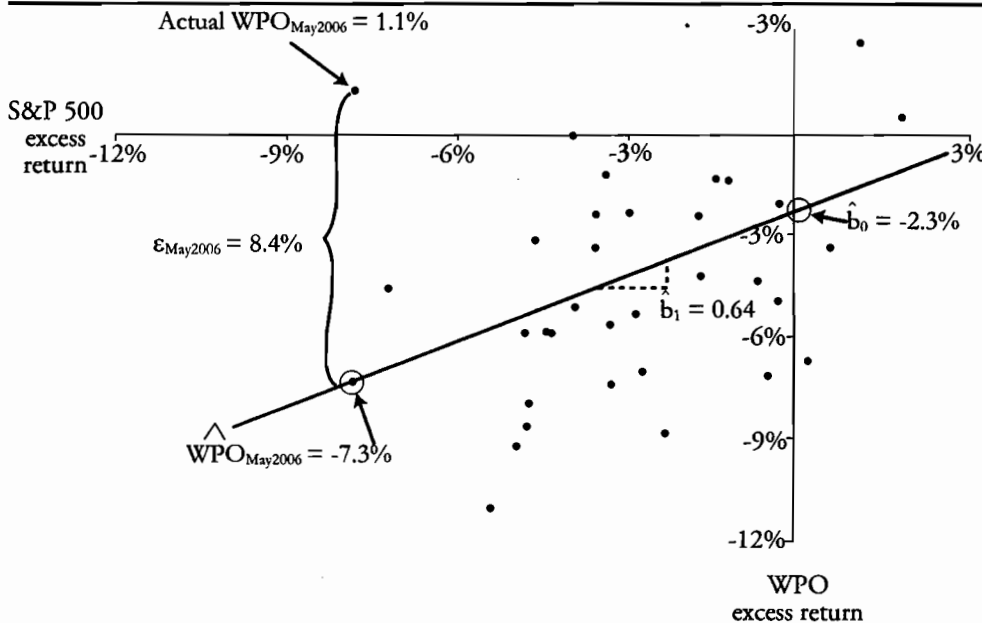
The intercept term is:

$$\hat{b}_0 = \overline{\text{WPO}} - \hat{b}_1 \overline{\text{S\&P 500}} = -4.05\% - 0.64(-2.70\%) = -2.3\%$$

The estimated regression line that minimizes the SSE in our WPO stock return example is shown in Figure 7.

This regression line has an intercept of  $-2.3\%$  and a slope of  $0.64$ . The model predicts that if the S&P 500 excess return is  $-7.8\%$  (what it was in May 2006), then the WPO excess return would be  $-2.3\% + (0.64)(-7.8\%) = -7.3\%$ . The residual for May 2006 is  $8.4\%$ , which is the difference between the actual WPO return ( $1.1\%$ ) and the predicted return ( $-7.3\%$ ).

**Figure 7: Estimated Regression Equation for WPO vs. S&P 500**



### INTERPRETING A REGRESSION COEFFICIENT

The estimated intercept represents the value of the dependent variable at the point of intersection of the regression line and the axis of the dependent variable (usually the vertical axis). In other words, the intercept is an estimate of the dependent variable when the independent variable takes on a value of zero.

We also mentioned earlier that the estimated slope coefficient is interpreted as the change in the dependent variable for a 1-unit change in the independent variable. For example, an estimated slope coefficient of 2 would indicate that the dependent variable will change two units for every 1-unit change in the independent variable.

#### Example: Interpreting regression coefficients

In the WPO regression example, the estimated slope coefficient was  $0.64$  and the estimated intercept term was  $-2.3\%$ . Interpret each coefficient estimate.

**Answer:**

The slope coefficient of 0.64 can be interpreted to mean that when excess S&P 500 returns increase (decrease) by 1%, WPO excess returns increase (decrease) by 0.64%.

The intercept term of -2.3% can be interpreted to mean that when the excess return on the S&P 500 is zero, the return on WPO stock is -2.3%.



*Professor's Note: As we will discuss in Study Session 18, the slope coefficient in a regression like this is called the stock's beta, and it measures the relative amount of systematic risk in WPO's returns. Notice that WPO is less risky than average, because its returns tend to increase or decrease by less than the change in the market returns. A stock with a beta of one would have an average level of systematic risk and a stock with a beta greater than one would have more than average systematic risk.*

*The intercept term in this regression is called the stock's ex-post alpha. It is a measure of excess risk-adjusted returns. A negative ex-post alpha means that WPO underperformed the S&P 500 on a risk-adjusted basis over the time period.*

Keep in mind, however, that any conclusions regarding the importance of an independent variable in explaining a dependent variable require determining the statistical significance of the slope coefficient. Simply looking at the magnitude of the slope coefficient does not address the issue of the importance of the variable. A hypothesis test must be conducted, or a confidence interval must be formed, to assess the importance of the variable.

---

**LOS 11.f: Calculate and interpret the standard error of estimate, the coefficient of determination, and a confidence interval for a regression coefficient.**

---

The **standard error of estimate (SEE)** measures the degree of variability of the actual  $Y$ -values relative to the estimated  $Y$ -values from a regression equation. The SEE gauges the "fit" of the regression line. *The smaller the standard error, the better the fit.*

The SEE is the standard deviation of the error terms in the regression. As such, SEE is also referred to as the standard error of the residual, or standard error of the regression.

In some regressions, the relationship between the independent and dependent variables is very strong (e.g., the relationship between 10-year Treasury bond yields and mortgage rates). In other cases, the relationship is much weaker (e.g., the relationship between stock returns and inflation). SEE will be low (relative to total variability) if the relationship is very strong and high if the relationship is weak.



## COEFFICIENT OF DETERMINATION ( $R^2$ )

The **coefficient of determination** ( $R^2$ ) is defined as the percentage of the total variation in the dependent variable explained by the independent variable. For example, an  $R^2$  of 0.63 indicates that the variation of the independent variable explains 63% of the variation in the dependent variable.



*Professor's Note: For simple linear regression (i.e., one independent variable), the coefficient of determination,  $R^2$ , may be computed by simply squaring the correlation coefficient,  $r$ . In other words,  $R^2 = r^2$ , for regression with one independent variable. This approach is not appropriate when more than one independent variable is used in the regression, as is the case with the multiple regression techniques presented in the next topic review.*

We will show you how to calculate the SEE and the  $R^2$  using an ANOVA table in LOS 11.i.

## REGRESSION COEFFICIENT CONFIDENCE INTERVAL

Hypothesis testing for a regression coefficient may use the confidence interval for the coefficient being tested. For instance, a frequently asked question is whether an estimated slope coefficient is statistically different from zero. In other words, the null hypothesis is  $H_0: b_1 = 0$  and the alternative hypothesis is  $H_a: b_1 \neq 0$ . If the confidence interval at the desired level of significance does not include zero, the null is rejected, and the coefficient is said to be statistically different from zero.

The confidence interval for the regression coefficient,  $b_1$ , is calculated as:

$$\hat{b}_1 \pm (t_c \times s_{\hat{b}_1}), \text{ or } \left[ \hat{b}_1 - (t_c \times s_{\hat{b}_1}) < b_1 < \hat{b}_1 + (t_c \times s_{\hat{b}_1}) \right]$$

In this expression,  $t_c$  is the critical two-tailed  $t$ -value for the selected confidence level with the appropriate number of degrees of freedom, which is equal to the number of sample observations minus 2 (i.e.,  $n - 2$ ).

The standard error of the regression coefficient is denoted as  $s_{\hat{b}_1}$ . It is a function of the SEE: as SEE rises,  $s_{\hat{b}_1}$  also increases, and the confidence interval widens. This makes sense because SEE measures the variability of the data about the regression line, and the more variable the data, the less confidence there is in the regression model to estimate a coefficient.



*Professor's Note: It is highly unlikely you will have to calculate  $s_{\hat{b}_1}$  on the exam. It is included in the output of all statistical software packages and should be given to you if you need it.*

Although the confidence interval for regression parameters looks slightly different than what you've seen at Level 1, it is precisely the same concept. All confidence intervals take the predicted value, then add and subtract the critical test statistic times the variability of the parameter estimate.

**Example: Calculating the confidence interval for a regression coefficient**

The estimated slope coefficient,  $b_1$ , from the WPO regression is 0.64 with a standard error equal to 0.26. Assuming that the sample had 36 observations, calculate the 95% confidence interval for  $b_1$ .

**Answer:**

The confidence interval for  $b_1$  is:

$$\hat{b}_1 \pm (t_c \times s_{\hat{b}_1}), \text{ or } \left[ \hat{b}_1 - (t_c \times s_{\hat{b}_1}) < b_1 < \hat{b}_1 + (t_c \times s_{\hat{b}_1}) \right]$$

The critical two-tail  $t$ -values are  $\pm 2.03$  (from the  $t$ -table with  $n - 2 = 34$  degrees of freedom). We can compute the 95% confidence interval as:

$$0.64 \pm (2.03)(0.26) = 0.64 \pm 0.53 = 0.11 \text{ to } 1.17$$

Since this confidence interval does not include zero, we can conclude that the slope coefficient is significantly different from zero.

---

**LOS 11.g: Formulate a null and alternative hypothesis about a population value of a regression coefficient, select the appropriate test statistic, and determine whether the null hypothesis is rejected at a given level of significance.**

---

A  $t$ -test may also be used to test the hypothesis that the true slope coefficient,  $b_1$ , is equal to some hypothesized value. Letting  $\hat{b}_1$  be the point estimate for  $b_1$ , the appropriate test statistic with  $n - 2$  degrees of freedom is:

$$t_{b_1} = \frac{\hat{b}_1 - b_1}{s_{\hat{b}_1}}$$

The decision rule for tests of significance for regression coefficients is:

Reject  $H_0$  if  $t > +t_{\text{critical}}$  or  $t < -t_{\text{critical}}$

Rejection of the null means that the slope coefficient is *different* from the hypothesized value of  $b_1$ .

To test whether an independent variable explains the variation in the dependent variable (i.e., it is statistically significant), the hypothesis that is tested is whether the true slope is zero ( $b_1 = 0$ ). The appropriate test structure for the null and alternative hypotheses is:

$$H_0: b_1 = 0 \text{ versus } H_a: b_1 \neq 0$$

**Example: Hypothesis test for significance of regression coefficients**

The estimated slope coefficient from the WPO example is 0.64 with a standard error equal to 0.26. Assuming that the sample has 36 observations, determine if the estimated slope coefficient is significantly different than zero at a 5% level of significance.

**Answer:**

The calculated test statistic is  $t = \frac{\hat{b}_1 - b_1}{s_{\hat{b}_1}} = \frac{0.64 - 0}{0.26} = 2.46$

The critical two-tailed  $t$ -values are  $\pm 2.03$  (from the  $t$ -table with  $df = 36 - 2 = 34$ ). Since  $t > t_{\text{critical}}$  (i.e.,  $2.46 > 2.03$ ), we reject the null hypothesis and conclude that the slope is different from zero. Note that the  $t$ -test and the confidence interval lead to the same conclusion to reject the null hypothesis and conclude that the slope coefficient is statistically significant.

---

LOS 11.h: Calculate a predicted value for the dependent variable, given an estimated regression model and a value for the independent variable and calculate and interpret a confidence interval for the predicted value of a dependent variable.

---

**Predicted values** are values of the dependent variable based on the estimated regression coefficients and a prediction about the value of the independent variable. They are the values that are *predicted* by the regression equation, given an estimate of the independent variable.

For a simple regression, the predicted (or forecast) value of  $Y$  is:

$$\hat{Y} = \hat{b}_0 + \hat{b}_1 X_p$$

where:

$\hat{Y}$  = predicted value of the dependent variable

$X_p$  = forecasted value of the independent variable

### Example: Predicting the dependent variable

Given the WPO regression equation:

$$\widehat{WPO} = -2.3\% + (0.64)(\widehat{S\&P\ 500})$$

Calculate the predicted value of WPO excess returns if forecasted S&P 500 excess returns are 10%.

**Answer:**

The predicted value for WPO excess returns is determined as follows:

$$\widehat{WPO} = -2.3\% + (0.64)(10\%) = 4.1\%$$

## CONFIDENCE INTERVALS FOR PREDICTED VALUES

Confidence intervals for the predicted value of a dependent variable are calculated in a manner similar to the confidence interval for the regression coefficients. The equation for the confidence interval for a predicted value of  $Y$  is:

$$\hat{Y} \pm (t_c \times s_f) \Rightarrow [\hat{Y} - (t_c \times s_f) < Y < \hat{Y} + (t_c \times s_f)]$$

where:

$t_c$  = the two-tailed critical  $t$ -value at the desired level of significance with  $df = n - 2$

$s_f$  = the standard error of the forecast

The challenge with computing a confidence interval for a predicted value is calculating  $s_f$ . It's highly unlikely that you will have to calculate the standard error of the forecast (it will probably be provided if you need to compute a confidence interval for the dependent variable). However, if you do need to calculate  $s_f$ , it can be done with the following formula for the variance of the forecast:

$$s_f^2 = SEE^2 \left[ 1 + \frac{1}{n} + \frac{(X - \bar{X})^2}{(n-1)s_x^2} \right]$$

where:

$SEE^2$  = variance of the residuals = the square of the standard error of estimate

$s_x^2$  = variance of the independent variable

$X$  = value of the independent variable for which the forecast was made

### Example: Confidence interval for a predicted value

Calculate a 95% prediction interval on the predicted value of WPO from the previous example. Assume the standard error of the forecast is 3.67, and the forecasted value of S&P 500 excess returns is 10%.

Answer:

The predicted value for WPO is:

$$\widehat{WPO} = -2.3\% + (0.64)(10\%) = 4.1\%$$

The 5% two-tailed critical  $t$ -value with 34 degrees of freedom is 2.03. The prediction interval at the 95% confidence level is:

$$\widehat{WPO} \pm (t_c \times s_f) \Rightarrow [4.1\% \pm (2.03 \times 3.67\%)] = 4.1\% \pm 7.5\%$$

or

$$-3.4\% \text{ to } 11.6\%$$

This range can be interpreted as, given a forecasted value for S&P 500 excess returns of 10%, we can be 95% confident that the WPO excess returns will be between -3.4% and 11.6%.

---

**LOS 11.i: Describe the use of analysis of variance (ANOVA) in regression analysis, interpret ANOVA results, and calculate and interpret an  $F$ -statistic.**

---

Analysis of variance (ANOVA) is a statistical procedure for analyzing the total variability of a data set. Let's define some terms before we move on to ANOVA tables.

- **Total sum of squares (SST)** *measures the total variation* in the dependent variable. SST is equal to the sum of the squared differences between the actual  $Y$ -values and the mean of  $Y$ :

$$SST = \sum_{i=1}^n (Y_i - \bar{Y})^2$$

- **Regression sum of squares (RSS)** *measures the variation in the dependent variable explained by the independent variable*. RSS is the sum of the squared distances between the predicted  $Y$ -values and the mean of  $Y$ .

$$RSS = \sum_{i=1}^n (\hat{Y}_i - \bar{Y})^2$$

- **Sum of squared errors (SSE)** *measures the unexplained variation* in the dependent variable. It's also known as the sum of squared residuals or the residual sum of squares. SSE is the sum of the squared vertical distances between the actual  $Y$ -values and the predicted  $Y$ -values on the regression line.

$$SSE = \sum_{i=1}^n (Y_i - \hat{Y}_i)^2$$



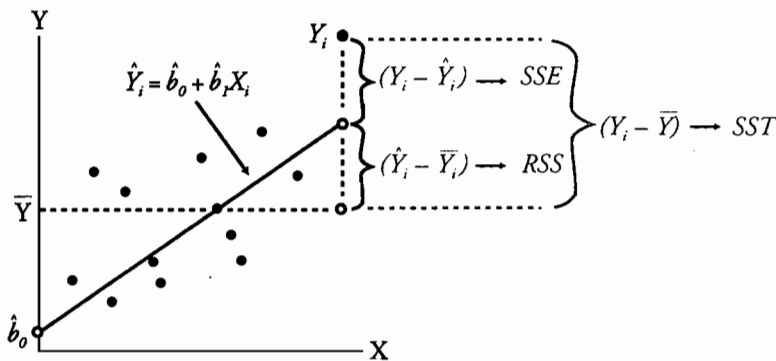
*Professor's Note: You don't have to memorize the formulas for the sums of squares. You do need to know what they measure and how you use them to construct an ANOVA table.*

Thus, total variation = explained variation + unexplained variation, or:

$$SST = RSS + SSE$$

Figure 8 illustrates how the total variation in the dependent variable (SST) is composed of RSS and SSE.

Figure 8: Components of the Total Variation



The output of the ANOVA procedure is an ANOVA table, which is a summary of the variation in the dependent variable. ANOVA tables are included in the regression output of many statistical software packages. You can think of the ANOVA table as the source of the data for the computation of many of the regression concepts discussed in this topic review. A generic ANOVA table for a simple linear regression (one independent variable) is presented in Figure 9.

Figure 9: ANOVA Table

| Source of Variation    | Degrees of Freedom | Sum of Squares | Mean Sum of Squares                         |
|------------------------|--------------------|----------------|---------------------------------------------|
| Regression (explained) | 1                  | RSS            | $MSR = \frac{RSS}{k} = \frac{RSS}{1} = RSS$ |
| Error (unexplained)    | $n - 2$            | SSE            | $MSE = \frac{SSE}{n - 2}$                   |
| Total                  | $n - 1$            | SST            |                                             |



*Professor's Note:  $k$  is the number of slope parameters estimated and  $n$  is the number of observations. In general, the regression  $df = k$  and the error  $df = (n - k - 1)$ . Since we are limited to simple linear regressions in this topic review (one independent variable) we use  $k = 1$  for the regression  $df$  and  $n - 1 - 1 = n - 2$  for the error  $df$ .*

The mean regression sum of squares (MSR) and mean squared error (MSE) are simply calculated as the appropriate sum of squares divided by its degrees of freedom.

### Calculating $R^2$ and SEE

The  $R^2$  and the standard error of estimate (SEE) can also be calculated directly from the ANOVA table as we discussed in LOS 11.f. The  $R^2$  is the percentage of the total variation in the dependent variable explained by the independent variable:

$$R^2 = \frac{\text{total variation (SST)} - \text{unexplained variation (SSE)}}{\text{total variation (SST)}}$$

$$= \frac{\text{explained variation (RSS)}}{\text{total variation (SST)}}$$

The SEE is the standard deviation of the regression error terms, and is equal to the square root of the mean squared error (MSE):

$$SEE = \sqrt{MSE} = \sqrt{\frac{SSE}{n - 2}}$$



*Professor's Note: Make sure you recognize the distinction between the sum of squared errors (SSE) and the standard error of estimate (SEE). SSE is the sum of the squared residuals, while SEE is the standard deviation of the residuals.*

### Example: Using the ANOVA table

Complete the ANOVA table for the WPO regression example and calculate the  $R^2$  and the standard error of estimate (SEE).

**Partial ANOVA Table For WPO Regression Example**

| Source of Variation    | Degrees of Freedom | Sum of Squares | Mean Sum of Squares |
|------------------------|--------------------|----------------|---------------------|
| Regression (explained) | ?                  | 0.00756        | ?                   |
| Error (unexplained)    | ?                  | 0.04064        | ?                   |
| Total                  | ?                  | ?              | ?                   |

**Answer:**

Recall that the data included three years of monthly return observations, so the total number of observations ( $n$ ) is 36.

**Completed ANOVA Table For WPO Regression Example**

| Source of Variation    | Degrees of Freedom | Sum of Squares | Mean Sum of Squares |
|------------------------|--------------------|----------------|---------------------|
| Regression (explained) | 1                  | 0.0076         | 0.0076              |
| Error (unexplained)    | 34                 | 0.0406         | 0.0012              |
| Total                  | 35                 | 0.0482         |                     |

$$R^2 = \frac{\text{explained variation (RSS)}}{\text{total variation (SST)}} = \frac{0.0076}{0.0482} = 0.158$$

$$SEE = \sqrt{MSE} = \sqrt{0.0012} = 0.035$$

### THE $F$ -STATISTIC

An  $F$ -test assesses how well a set of independent variables, as a group, explains the variation in the dependent variable. In multiple regression, the  $F$ -statistic is used to test whether *at least one* independent variable in a set of independent variables explains a significant portion of the variation of the dependent variable. We will discuss the use of the  $F$ -test in multiple regression with more than one independent variable in the next topic review.

The  $F$ -statistic is calculated as:

$$F = \frac{MSR}{MSE} = \frac{RSS/k}{SSE/(n-k-1)}$$

where:

MSR = mean regression sum of squares

MSE = mean squared error

**Important:** This is always a one-tailed test!

In multiple regression, the  $F$ -statistic tests *all* independent variables as a group.

### The $F$ -Statistic With One Independent Variable

For simple linear regression, there is only one independent variable, so the  $F$ -test tests the same hypothesis as the  $t$ -test for statistical significance of the slope coefficient:

$$H_0: b_1 = 0 \text{ versus } H_a: b_1 \neq 0$$



To determine whether  $b_1$  is statistically significant using the  $F$ -test, the calculated  $F$ -statistic is compared with the critical  $F$ -value,  $F_c$ , at the appropriate level of significance. The degrees of freedom for the numerator and denominator with one independent variable are:

$$df_{\text{numerator}} = k = 1$$

$$df_{\text{denominator}} = n - k - 1 = n - 2$$

where:

$n$  = number of observations

The decision rule for the  $F$ -test is:

Decision rule: reject  $H_0$  if  $F > F_c$

Rejection of the null hypothesis at a stated level of significance indicates that the independent variable is significantly different than zero, which is interpreted to mean that it makes a significant contribution to the explanation of the dependent variable. In simple linear regression, it tells us the same thing as the  $t$ -test of the slope coefficient ( $t_{b_1}$ ). In fact, in simple linear regression with one independent variable,  $F = t_{b_1}^2$ .

#### Example: Calculating and interpreting the $F$ -statistic

Use the completed ANOVA table from the previous example to calculate and interpret the  $F$ -statistic. Test the null hypothesis at the 5% significance level that the slope coefficient is equal to 0.

**Answer:**

$$F = \frac{MSR}{MSE} = \frac{0.0076}{0.0012} = 6.33$$

$$df_{\text{numerator}} = k = 1$$

$$df_{\text{denominator}} = n - k - 1 = 36 - 1 - 1 = 34$$

The null and alternative hypotheses are:  $H_0: b_1 = 0$  versus  $H_a: b_1 \neq 0$ . The critical  $F$ -value for 1 and 34 degrees of freedom at a 5% significance level is approximately 4.1. Remember, it's a one-tail test, so we use the 5%  $F$ -table! Therefore we can reject the null hypothesis and conclude that the slope coefficient is significantly different than zero. Recall from the earlier examples that we also rejected the null hypothesis using the  $t$ -statistic and that the 95% confidence interval did not include 0. Note that here,  $t^2 = 2.46^2 \approx F = 6.33$ . The difference is due to rounding of the  $t$ -statistic to two decimal places.



*Professor's Note: The bottom line is that the F-test is not as useful when we only have one independent variable because it tells us the same thing as the t-test of the slope coefficient. Make sure you know that fact for the exam, and then concentrate on the application of the F-test in multiple regression.*

---

**LOS 11.j: Discuss the limitations of regression analysis.**

---

**Limitations of regression analysis** include the following:

- Linear relationships can change over time. This means that the estimation equation based on data from a specific time period may not be relevant for forecasts or predictions in another time period. This is referred to as *parameter instability*.
- Even if the regression model accurately reflects the historical relationship between the two variables, its usefulness in investment analysis will be limited if other market participants are also aware of and act on this evidence.
- If the assumptions underlying regression analysis do not hold, the interpretation and tests of hypotheses may not be valid. For example, if the data is *heteroskedastic* (non-constant variance of the error terms) or exhibits *autocorrelation* (error terms are not independent), regression results may be invalid. We will discuss these issues in more detail in the next topic review.

## KEY CONCEPTS

### LOS 11.a

A scatter plot is a collection of points on a graph where each point represents the values of two variables (i.e., an X/Y pair).

The sample covariance,  $\text{cov}_{XY}$ , measures the linear relationship between two random

variables and is calculated as:

$$\frac{\sum_{i=1}^N (X_i - \bar{X})(Y_i - \bar{Y})}{n-1}$$

Sample correlation is a measure of the relationship between two variables:

$$r_{XY} = \frac{\text{cov}_{XY}}{(s_X)(s_Y)}, \text{ which takes on values from } -1.0 \text{ to } +1.0$$

### LOS 11.b

There are three limitations of correlation analysis.

- Outliers, or values that are unusually large or small, may influence the results of regression and the estimate of the correlation coefficient.
- Spurious correlation means that there may appear to be a relationship between two variables when, in fact, there is none.
- Correlation only measures linear relationships, but not nonlinear ones.

### LOS 11.c

A *t*-test is used to determine if a correlation coefficient, *r*, is statistically significant:

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$

Significance is supported if the test statistic is less than  $-t_{\text{critical}}$  or greater than  $t_{\text{critical}}$  with  $n - 2$  degrees of freedom.

### LOS 11.d

Linear regression provides an estimate of the linear relationship between an independent variable (the explanatory variable) and a dependent variable (the predicted variable).

The general form of a simple linear regression model is  $Y_i = b_0 + b_1X_i + \epsilon_i$ .

- $Y_i$  and  $X_i$  are the *i*th observations of the dependent and independent variable, respectively.
- $b_0$  = intercept.
- $b_1$  = slope coefficient.
- $\epsilon_i$  = residual error for the *i*th observation.

## LOS 11.e

Assumptions made with simple linear regression include:

- A linear relationship exists between the dependent and the independent variable.
- The independent variable is uncorrelated with the residuals.
- The expected value of the residual term is zero ( $E(\varepsilon) = 0$ ).
- The variance of the residual term is constant for all observations ( $E(\varepsilon_i^2) = \sigma_\varepsilon^2$ ).
- The residual term is independently distributed; that is, the residual for one observation is not correlated with that of another observation ( $E(\varepsilon_i \varepsilon_j) = 0, j \neq i$ ).

The estimated intercept,  $\hat{b}_0$ , represents the value of the dependent variable at the point of intersection of the regression line and the axis of the dependent variable (usually the vertical axis). The estimated slope coefficient,  $\hat{b}_1$ , is interpreted as the change in the dependent variable for a one-unit change in the independent variable.

## LOS 11.f

The confidence interval for the regression coefficient,  $b_1$ , is calculated as:

$$\hat{b}_1 \pm (t_c \times s_{\hat{b}_1}), \text{ or } \left[ \hat{b}_1 - (t_c \times s_{\hat{b}_1}) < b_1 < \hat{b}_1 + (t_c \times s_{\hat{b}_1}) \right]$$

## LOS 11.g

A  $t$ -test with  $n - 2$  degrees of freedom is used to conduct hypothesis tests of the estimated regression parameters.

$$t = \frac{\hat{b}_1 - b_1}{s_{\hat{b}_1}}$$

## LOS 11.h

A predicted value of the dependent variable,  $\hat{Y}$ , is determined by inserting the predicted value of the independent variable,  $X_p$ , in the regression equation and calculating

$$\hat{Y}_p = \hat{b}_0 + \hat{b}_1 X_p.$$

The confidence interval for a predicted  $Y$ -value is  $\left[ \hat{Y} - (t_c \times s_f) < Y < \hat{Y} + (t_c \times s_f) \right]$ , where  $s_f$  is the standard error of the forecast.

## LOS 11.i

ANOVA Table for Simple Linear Regression ( $k = 1$ )

| Source of Variation    | Degrees of Freedom | Sum of Squares | Mean Sum of Squares                         |
|------------------------|--------------------|----------------|---------------------------------------------|
| Regression (explained) | 1                  | RSS            | $MSR = \frac{RSS}{k} = \frac{RSS}{1} = RSS$ |
| Error (unexplained)    | $n - 2$            | SSE            | $MSE = \frac{SSE}{n - 2}$                   |
| Total                  | $n - 1$            | SST            |                                             |

The standard error of the estimate in a simple linear regression is calculated as:

$$SEE = \sqrt{\frac{SSE}{n-2}}$$

The coefficient of determination,  $R^2$ , is the proportion of the total variation of the dependent variable explained by the regression:

$$R^2 = \frac{RSS}{SST} = \frac{SST - SSE}{SST}$$

In multiple regression (next topic review) the  $F$ -test tests the statistical significance of all of the independent variables.

In simple linear regression, because there is only one independent variable ( $k=1$ ), the  $F$ -test tests the same null hypothesis as testing the statistical significance of  $b_1$ , using the  $t$ -test:  $H_0 : b_1 = 0$  vs.  $H_u : b_1 \neq 0$ . With only one independent variable,  $F$  is calculated as:

$$F\text{-stat} = \frac{MSR}{MSE} \text{ with 1 and } n-2 \text{ degrees of freedom}$$

In fact, in simple linear regression  $F = t_{b_1}^2$ .

#### LOS 11.j

The limitations of regression analysis include the following:

- Parameter instability (especially when dealing with economic and financial variables).
- The limited usefulness of regression models in identifying profitable investment strategies based on publicly available information.
- The possibility of violating the assumptions underlying regression analysis (heteroskedasticity and autocorrelation).

## CONCEPT CHECKERS

Use the following data to answer Questions 1 through 3.

An analyst is given the data in the following table for a regression of the annual sales for Company XYZ, a maker of paper products, on paper product industry sales.

### Regression Output

| <i>Parameters</i>      | <i>Coefficient</i> | <i>Standard Error of the Coefficient</i> |
|------------------------|--------------------|------------------------------------------|
| Intercept              | -94.88             | 32.97                                    |
| Slope (industry sales) | 0.2796             | 0.0363                                   |

The correlation between company and industry sales is 0.9757. The regression was based on five observations.

1. Which of the following is *closest* to the value and reports the *most likely* interpretation of the  $R^2$  for this regression? The  $R^2$  is:
  - A. 0.048, indicating that the variability of industry sales explains about 4.8% of the variability of company sales.
  - B. 0.952, indicating that the variability of industry sales explains about 95.2% of the variability of company sales.
  - C. 0.952, indicating that the variability of company sales explains about 95.2% of the variability of industry sales.
2. Based on the regression results, XYZ Company's market share of any increase in industry sales is expected to be *closest* to:
  - A. 4%.
  - B. 28%.
  - C. 45%.
3. The analyst determines that the  $t$ -statistic is 7.72 and that the correlation coefficient is not significant (using 95% confidence). Is the analyst correct?
  - A. Yes.
  - B. No, because the test statistic is 60.93.
  - C. No, because the correlation coefficient is significantly different from zero (using 95% confidence).

Use the following information to answer Questions 4 and 5.

A study was conducted by the British Department of Transportation to estimate urban travel time between locations in London, England. Data was collected for motorcycles and passenger cars. Simple linear regression was conducted using data sets for both types of vehicles, where  $Y$  = urban travel time in minutes and  $X$  = distance between locations in kilometers. The following results were obtained:

| <i>Regression Results for Travel Times Between Distances in London</i> |                          |               |
|------------------------------------------------------------------------|--------------------------|---------------|
| Passenger cars:                                                        | $\hat{Y} = 1.85 + 3.86X$ | $R^2 = 0.758$ |
| Motorcycles:                                                           | $\hat{Y} = 2.50 + 1.93X$ | $R^2 = 0.676$ |

4. The estimated increase in travel time for a motorcycle commuter planning to move 8 km farther from his workplace in London is *closest* to:
  - A. 31 minutes.
  - B. 15 minutes.
  - C. 0.154 hours.
5. Based on the regression results, which model is more reliable?
  - A. The passenger car model because  $3.86 > 1.93$ .
  - B. The motorcycle model because  $1.93 < 3.86$ .
  - C. The passenger car model because  $0.758 > 0.676$ .
6. Which of the following is not a necessary assumption of simple linear regression analysis?
  - A. The residuals are normally distributed.
  - B. There is a constant variance of the error term.
  - C. The dependent variable is uncorrelated with the residuals.
7. Which of the following statements regarding simple linear regression is *most accurate*?
  - A. If the units of the independent variable are tons instead of pounds the estimated slope coefficient will be 2,000 times larger.
  - B. If the slope of the regression line is +1, the variables are perfectly positively correlated.
  - C. If a researcher knows the sum of squared errors, the number of observations, and the standard error of estimate he can calculate the coefficient of determination for the regression.
8. What is the *most appropriate* interpretation of a slope coefficient estimate equal to 10.0?
  - A. The predicted value of the dependent variable when the independent variable is zero is 10.0.
  - B. For every one unit change in the independent variable the model predicts that the dependent variable will change by 10 units.
  - C. For every one unit change in the independent variable the model predicts that the dependent variable will change by 0.1 units.

9. What is the appropriate alternative hypothesis to test the statistical significance of the intercept term in the following regression?

$$Y = a_1 + a_2(X) + \varepsilon$$

- A.  $H_A: a_1 \neq 0$ .
  - B.  $H_A: a_1 > 0$ .
  - C.  $H_A: a_2 \neq 0$ .
10. Consider the following statement: In a simple linear regression, the appropriate degrees of freedom for the critical  $t$ -value used to calculate a confidence interval around both a parameter estimate and a predicted  $Y$ -value is the same as the number of observations minus two. The statement is:
- A. justified.
  - B. not justified, because the appropriate of degrees of freedom used to calculate a confidence interval around a parameter estimate is the number of observations.
  - C. not justified, because the appropriate of degrees of freedom used to calculate a confidence interval around a predicted  $Y$ -value is the number of observations.
11. The variation in the dependent variable explained by the independent variable is measured by the:
- A. mean squared error.
  - B. sum of squared errors.
  - C. regression sum of squares.



## CHALLENGE PROBLEMS

Use the following information for Questions 12 through 17.

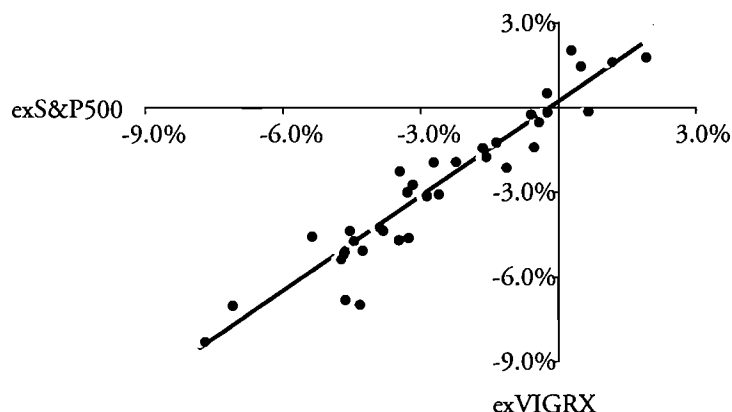
Bill Coldplay, CFA, is analyzing the performance of the Vanguard Growth Index Fund (VIGRX) over the past three years. The fund employs a passive management investment approach designed to track the performance of the MSCI US Prime Market Growth index, a broadly diversified index of growth stocks of large U.S. companies.

Coldplay estimates a regression using excess monthly returns on VIGRX (exVIGRX) as the dependent variable and excess monthly returns on the S&P 500 index (exS&P) as the independent variable. The data are expressed in decimal terms (e.g., 0.03, not 3%).

$$\text{exVIGRX}_t = b_0 + b_1(\text{exS\&P}_t) + \varepsilon_t$$

A scatter plot of excess returns for both return series from June 2004 to May 2007 are shown in the following figure.

Analysis of Large Cap Growth Fund



Results from that analysis are presented in the following figures.

### Estimated Coefficients

| <i>Coefficient</i> | <i>Coefficient Estimate</i> | <i>Standard Error</i> |
|--------------------|-----------------------------|-----------------------|
| $b_0$              | 0.0023                      | 0.0022                |
| $b_1$              | 1.1163                      | 0.0624                |

### Partial ANOVA Table

| <i>Source of Variation</i> | <i>Sum of Squares</i> |
|----------------------------|-----------------------|
| Regression (explained)     | 0.0228                |
| Error (unexplained)        | 0.0024                |

12. The 90% confidence interval for  $b_0$  is *closest* to:  
 A.  $-0.0014$  to  $+0.0060$ .  
 B.  $-0.0006$  to  $+0.0052$ .  
 C.  $+0.0001$  to  $+0.0045$ .
13. Are the intercept term and the slope coefficient statistically significantly different from zero at the 5% significance level?
- | <u>Intercept term significant?</u> | <u>Slope coefficient significant?</u> |
|------------------------------------|---------------------------------------|
| A. Yes                             | Yes                                   |
| B. Yes                             | No                                    |
| C. No                              | Yes                                   |
14. Coldplay would like to test the following hypothesis:  $H_0: b_1 \leq 1$  vs.  $H_1: b_1 > 1$  at the 1% significance level. The calculated  $t$ -statistic and the appropriate conclusion are:
- | <u>Calculated <math>t</math>-statistic</u> | <u>Appropriate conclusion</u> |
|--------------------------------------------|-------------------------------|
| A. 1.86                                    | Reject $H_0$                  |
| B. 1.86                                    | Fail to reject $H_0$          |
| C. 2.44                                    | Reject $H_0$                  |
15. Coldplay forecasts the excess return on the S&P 500 for June 2007 to be 5% and the 95% confidence interval for the predicted value of the excess return on VIGRX for June 2007 to be 3.9% to 7.7%. The standard error of the forecast is *closest* to:  
 A. 0.0080.  
 B. 0.0093.  
 C. 0.0111.
16. The  $R^2$  from the regression is *closest* to:  
 A. 0.095.  
 B. 0.295.  
 C. 0.905.
17. The standard error of estimate (SEE) is *closest* to:  
 A. 0.008.  
 B. 0.014.  
 C. 0.049.
18. Which of the following statements *least* accurately describes a limitation of correlation analysis?  
 A. Outliers may influence the results of regression.  
 B. Serial correlation means that there may appear to be a relationship between two or more variables when, in fact, there is none.  
 C. Correlation only measures linear relationships, but not nonlinear ones.
19. Regression analysis is *least likely* to be limited by:  
 A. parameter instability.  
 B. insufficient data.  
 C. violations of the assumptions underlying regression analysis.

20. Carla Preusser finds that the total assets under management by a popular hedge fund manager, and the number of lizards lying out in the sun in a nearby park, can be modeled as functions of time:  $f(t) = t^{1.8}$  and  $f(t) = t + 5$  respectively. The correlation between the two models is 0.98. Two potential problems with using the lizards to predict total assets include:
- A. spurious correlation and the non-linear relationship in the total assets function.
  - B. spurious correlation and the non-geometric relationship in the lizard function.
  - C. outliers and non-linear relationship in the total assets function.

## ANSWERS – CONCEPT CHECKERS

1. **B** The  $R^2$  is computed as the correlation squared:  $(0.9757)^2 = 0.952$ .

The interpretation of this  $R^2$  is that 95.2% of the variation in Company XYZ's sales is explained by the variation in industry sales. Answer C is incorrect because it is the independent variable (industry sales) that explains the variation in the dependent variable (company sales). This interpretation is based on the economic reasoning used in constructing the regression model.

2. **B** The slope coefficient of 0.2796 indicates that a \$1 million increase in industry sales will result in an increase in firm sales of approximately 28% (\$279,600) of that amount.
3. **C** The test of significance for the correlation coefficient is evaluated using the following  $t$ -statistic:

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}} = \frac{0.9757\sqrt{3}}{\sqrt{1-0.952}} = \frac{1.69}{0.219} = 7.72$$

From the  $t$ -table, we find that with  $df = 3$  and 95% significance, the two-tailed critical  $t$  values are  $\pm 3.182$  (recall that for the  $t$ -test the degrees of freedom =  $n - 2$ ). Since the computed  $t$  is greater than  $+3.182$ , the correlation coefficient is significantly different from zero.

4. **B** The slope coefficient is 1.93, indicating that each additional kilometer increases travel time by 1.93 minutes:
- $$1.93 \times 8 = 15.44$$
5. **C** The higher  $R^2$  for the passenger car model indicates that regression results are more reliable. Distance is a better predictor of travel time for cars. Perhaps the aggressiveness of the driver is a bigger factor in travel time for motorcycles than it is for autos.
6. **C** The model does not assume that the dependent variable is uncorrelated with the residuals. It does assume that the independent variable is uncorrelated with the residuals.
7. **A** If the independent variable is in pounds, the interpretation of the slope coefficient is the change in the dependent variable for a one pound change in the independent variable. If the independent variable is measured in tons (2,000 pounds) the slope coefficient is interpreted as the change in the dependent variable for a 2,000 pound change in the independent variable, which will be 2,000 times larger. The slope of the regression line is not a function of the correlation between the two variables. The researcher would need to know either the regression sum of squares or the total sum of squares, along with the sum of squared errors, in order to calculate the coefficient of determination.
8. **B** The slope coefficient is best interpreted as the predicted change in the dependent variable for a 1-unit change in the independent variable. If the slope coefficient estimate is 10.0 and the independent variable changes by one unit, the dependent variable will change by 10 units. The intercept term is best interpreted as the value of the dependent variable when the independent variable is equal to zero.

9. A In this regression,  $a_1$  is the intercept term. To test the statistical significance means to test the null hypothesis that  $a_1$  is equal to zero versus the alternative that it is not equal to zero.
10. A In simple linear regression the appropriate degrees of freedom for both confidence intervals is the number of observations in the sample ( $n$ ) minus two.
11. C The regression sum of squares measures the variation in the dependent variable explained by the independent variable (i.e., the explained variation). The sum of squared errors measures the variation in the dependent variable NOT explained by the independent variable. The mean squared error is equal to the sum of squared errors divided by its degrees of freedom.

## ANSWERS – CHALLENGE PROBLEMS

12. A Note that there are 36 monthly observations from June 2004 to May 2007, so  $n = 36$ . The critical two-tailed 10%  $t$ -value with 34 ( $n - 2 = 36 - 2 = 34$ ) degrees of freedom is approximately 1.69. Therefore the 90% confidence interval for  $b_0$  (the intercept term) is  $0.0023 \pm (0.0022)(1.69)$ , or  $-0.0014$  to  $+0.0060$ .
13. C The critical two-tailed 5%  $t$ -value with 34 degrees of freedom is approximately 2.03. The calculated  $t$ -statistics for the intercept term and slope coefficient are, respectively,  $0.0023/0.0022 = 1.05$  and  $1.1163/0.0624 = 17.9$ . Therefore the intercept term is not statistically different from zero at the 5% significance level, while the slope coefficient is.
14. B Notice that this is a one-tailed test. The critical one-tailed 1%  $t$ -value with 34 degrees of freedom is approximately 2.44. The calculated  $t$ -statistic for the slope coefficient is  $(1.1163 - 1)/0.0624 = 1.86$ . Therefore the slope coefficient is not statistically different from one at the 1% significance level and Coldplay should fail to reject the null hypothesis.
15. B This is a tricky question because you are given the confidence interval and its midpoint and asked to solve for the standard error of the forecast ( $s_f$ ). Remember to also convert the percentages to decimals. The critical two-tailed 5%  $t$ -value with 34 degrees of freedom is approximately 2.03. The midpoint, or predicted value is  $0.0023 + 1.1163 \times 0.05 = 0.058$ . Therefore,  $0.058 \pm (2.03)(s_f)$  is equivalent to 0.039 to 0.077 and solving for  $s_f$  yields  $s_f = 0.0093$ .
16. C SST is equal to the sum of RSS and SSE:  $0.0228 + 0.0024 = 0.0252$ .  $R^2 = \text{RSS}/\text{SST} = 0.0228/0.0252 = 0.905$ .
17. A Because  $n = 36$ , and the degrees of freedom for the sum of squared errors (SSE) is  $n - 2$  in simple linear regression, the degrees of freedom for SSE is 34 and the mean squared error is  $\text{SSE}/34$ . The standard error of estimate (SEE) is equal to the square root of the mean squared error:
 
$$\text{SEE} = \sqrt{\frac{0.0024}{34}} = 0.008$$
18. B The appearance of a relationship between two variables when there is none is spurious correlation. Outliers may influence the results of regression and the estimate of the correlation coefficient. Correlation only measures linear relationships properly.

- 19. **B** The insufficient availability of data is not likely to be much of a limitation for most financial and economic models; usually an abundance of data is available. The other choices are limitations of regression analysis.
- 20. **A** There is little to no chance that the relationship between total assets under management and lizards in a park is other than a coincidence. The correlation is spurious. The non-linear relationship in the total assets function makes correlation a poor choice of a measure.

# MULTIPLE REGRESSION AND ISSUES IN REGRESSION ANALYSIS

Study Session 3

---

## EXAM FOCUS

Multiple regression is the centerpiece of the quantitative methods topic at Level 2. It is a useful analysis tool that shows up throughout the Level 2 curriculum. Multiple regression is especially important for multifactor models in Study Sessions 10 (Equity), and 18 (Portfolio Management). It should be considered as highly probable to appear on the exam: be ready for it and you're on your way to Level 3!

You should know how to use a t-test to assess the significance of the individual regression parameters and an F-test to assess the effectiveness of the model as a whole in explaining the dependent variable. You should understand the effect that heteroskedasticity, serial correlation, and multicollinearity have on regression results, be able to detect the existence of each of these conditions, and recommend corrective actions. Also be able to identify the common model misspecifications.

Focus on interpretation of the regression equation and the test statistics. Remember that most of the test and descriptive statistics discussed (e.g., t-stat, F-stat, and R<sup>2</sup>) are provided in the output of statistical software. Hence, application and interpretation of these measurements are more likely than actual computations on the exam.

---

## WARM-UP: MULTIPLE REGRESSION BASICS

**Multiple regression** is regression analysis with more than one independent variable. It is used to quantify the influence of two or more independent variables on a dependent variable. For instance, simple (or univariate) linear regression explains the variation in stock returns in terms of the variation in systematic risk as measured by beta. With multiple regression, stock returns can be regressed against beta and against additional variables, such as firm size, equity, and industry classification, that might influence returns.

The general multiple linear regression model is:

$$Y_i = b_0 + b_1X_{1i} + b_2X_{2i} + \dots + b_kX_{ki} + \epsilon_i$$

where:

$Y_i$  =  $i$ th observation of the dependent variable  $Y$ ,  $i = 1, 2, \dots, n$

$X_j$  = independent variables,  $j = 1, 2, \dots, k$

$X_{ji}$  =  $i$ th observation of the  $j$ th independent variable

$b_0$  = intercept term

$b_j$  = slope coefficient for each of the independent variables

$\epsilon_i$  = error term for the  $i$ th observation

$n$  = number of observations

$k$  = number of independent variables

The multiple regression methodology estimates the intercept and slope coefficients such that the sum of the squared error terms,  $\sum_{i=1}^n \epsilon_i^2$ , is minimized. The result of this procedure is the following regression equation:

$$\hat{Y}_i = \hat{b}_0 + \hat{b}_1 X_{1i} + \hat{b}_2 X_{2i} + \dots + \hat{b}_k X_{ki}$$

where the “^” indicates an estimate for the corresponding regression coefficient

The residual,  $\hat{\epsilon}_i$ , is the difference between the observed value,  $Y_i$ , and the predicted value from the regression,  $\hat{Y}_i$ :

$$\hat{\epsilon}_i = Y_i - \hat{Y}_i = Y_i - (\hat{b}_0 + \hat{b}_1 X_{1i} + \hat{b}_2 X_{2i} + \dots + \hat{b}_k X_{ki})$$

---

**LOS 12.a:** Formulate a multiple regression equation to describe the relation between a dependent variable and several independent variables, determine the statistical significance of each independent variable, and interpret the estimated coefficients and their  $p$ -values.

---



*Professor's Note: Testing the statistical significance of the regression coefficients means conducting a  $t$ -test with a null hypothesis that the regression coefficient is equal to zero. Rather than cover that concept here, even though it is mentioned in LOS 12.a, we will cover it in detail in LOS 12.b as part of our general discussion of hypothesis testing. We will also defer a discussion of  $p$ -values to LOS 12.b.*

Let's illustrate multiple regression using research by Arnott and Asness (2003).<sup>1</sup> As part of their research the authors test the hypothesis that future 10-year real earnings growth in the S&P 500 (EG10) can be explained by the trailing dividend payout ratio of the stocks in the index (PR) and the yield curve slope (YCS). YCS is calculated as the difference between the 10-year T-bond yield and the 3-month T-bill yield at the start of the period. All three variables are measured in percent.

### Formulating the Multiple Regression Equation

The authors formulate the following regression equation using annual data from 1946 to 2001 (which results in 46 observations because the last observation is for 1991 and the dependent variable for the 1991 observation is the real earnings growth from 1991 to 2001):

$$EG10 = b_0 + b_1 PR + b_2 YCS + \epsilon$$

The results of this regression are shown in Figure 1.

---

1. Arnott, Robert D., and Clifford S. Asness. 2003. "Surprise! Higher Dividends = Higher Earnings Growth." *Financial Analysts Journal*, vol. 59, no. 1 (January/February): 70–87.



**Figure 1: Coefficient and Standard Error Estimates for Regression of EG10 on PR and YCS**

|           | <i>Coefficient</i> | <i>Standard Error</i> |
|-----------|--------------------|-----------------------|
| Intercept | –11.6%             | 1.657%                |
| PR        | 0.25               | 0.032                 |
| YCS       | 0.14               | 0.280                 |

### Interpreting the Multiple Regression Results

The interpretation of the estimated regression coefficients from a multiple regression is the same as in simple linear regression for the intercept term but significantly different for the slope coefficients:

- The **intercept term** is the value of the dependent variable when the independent variables are all equal to zero.
- Each slope coefficient is the estimated change in the dependent variable for a one-unit change in that independent variable, *holding the other independent variables constant*. That's why the slope coefficients in a multiple regression are sometimes called **partial slope coefficients**.

For example, in the real earnings growth example, we can make these interpretations:

- *Intercept term*: If the dividend payout ratio is zero and the slope of the yield curve is zero, we would expect the subsequent 10-year real earnings growth rate to be –11.6%.
- *PR coefficient*: If the payout ratio increases by 1%, we would expect the subsequent 10-year earnings growth rate to increase by 0.25%, *holding YCS constant*.
- *YCS coefficient*: If the yield curve slope increases by 1%, we would expect the subsequent 10-year earnings growth rate to increase by 0.14%, *holding PR constant*.

Let's discuss the interpretation of the multiple regression slope coefficients in more detail. Suppose we run a regression of the dependent variable  $Y$  on a single independent variable  $X_1$  and get the following result:

$$Y = 2.0 + 4.5X_1$$

The appropriate interpretation of the estimated slope coefficient is that if  $X_1$  increases by 1 unit, we would expect  $Y$  to increase by 4.5 units.

Now suppose we add a second independent variable  $X_2$  to the regression and get the following result:

$$Y = 1.0 + 2.5X_1 + 6.0X_2$$

Notice that the estimated slope coefficient for  $X_1$  changed from 4.5 to 2.5 when we added  $X_2$  to the regression. We would expect this to happen most of the time when a second variable is added to the regression, unless  $X_2$  is uncorrelated with  $X_1$ , because

if  $X_1$  increases by 1 unit then we would expect  $X_2$  to change as well. The multiple regression equation captures this relationship between  $X_1$  and  $X_2$  when predicting  $Y$ .

Now the interpretation of the estimated slope coefficient for  $X_1$  is that if  $X_1$  increases by 1 unit, we would expect  $Y$  to increase by 2.5 units, *holding  $X_2$  constant*.

---

**LOS 12.b: Formulate a null and an alternative hypothesis about the population value of a regression coefficient, calculate the value of the test statistic, determine whether to reject the null hypothesis at a given level of significance by using a one-tailed or two-tailed test, and interpret the results of the test.**

---

### Hypothesis Testing of Regression Coefficients

As with simple linear regression, the magnitude of the coefficients in a multiple regression tells us nothing about the importance of the independent variable in explaining the dependent variable. Thus, we must conduct hypothesis testing on the estimated slope coefficients to determine if the independent variables make a significant contribution to explaining the variation in the dependent variable.

The  $t$ -statistic used to test the significance of the individual coefficients in a multiple regression is calculated using the same formula that is used with simple linear regression:

$$t = \frac{\hat{b}_j - b_j}{s_{\hat{b}_j}} = \frac{\text{estimated regression coefficient} - \text{hypothesized value}}{\text{coefficient standard error of } b_j}$$

The  $t$ -statistic has  $n - k - 1$  degrees of freedom.



*Professor's Note: An easy way to remember the number of degrees of freedom for this test is to recognize that “ $k$ ” is the number of regression coefficients in the regression, and the “1” is for the intercept term. Therefore the degrees of freedom is the number of observations minus  $k$  minus 1.*

### Determining Statistical Significance

The most common hypothesis test done on the regression coefficients is to test statistical significance, which means testing the null hypothesis that the coefficient is zero versus the alternative that it is not:

$$\text{“testing statistical significance”} \Rightarrow H_0: b_j = 0 \text{ versus } H_a: b_j \neq 0$$

**Example: Testing the statistical significance of a regression coefficient**

Test the statistical significance of the independent variable PR in the real earnings growth example at the 10% significance level. The results of that regression are reproduced in the following figure.

**Coefficient and Standard Error Estimates for Regression of EG10 on PR and YCS**

|           | <i>Coefficient</i> | <i>Standard Error</i> |
|-----------|--------------------|-----------------------|
| Intercept | -11.6%             | 1.657%                |
| PR        | 0.25               | 0.032                 |
| YCS       | 0.14               | 0.280                 |

**Answer:**

We are testing the following hypothesis:

$$H_0: PR = 0 \text{ versus } H_a: PR \neq 0$$

The 10% two-tailed critical  $t$ -value with  $46 - 2 - 1 = 43$  degrees of freedom is approximately 1.68. We should reject the null hypothesis if the  $t$ -statistic is greater than 1.68 or less than -1.68.

The  $t$ -statistic is:

$$t = \frac{0.25}{0.032} = 7.8$$

Therefore, because the  $t$ -statistic of 7.8 is greater than the upper critical  $t$ -value of 1.68, we can reject the null hypothesis and conclude that the PR regression coefficient is statistically significantly different from zero at the 10% significance level.

**Interpreting  $p$ -Values**

The  $p$ -value is the smallest level of significance for which the null hypothesis can be rejected. An alternative method of doing hypothesis testing of the coefficients is to compare the  $p$ -value to the significance level:

- If the  $p$ -value is less than significance level, the null hypothesis can be rejected.
- If the  $p$ -value is greater than the significance level, the null hypothesis cannot be rejected.

**Example: Interpreting  $p$ -values**

Given the following regression results, determine which regression parameters for the independent variables are statistically significantly different from zero at the 1% significance level, assuming the sample size is 60.

| <i>Variable</i> | <i>Coefficient</i> | <i>Standard Error</i> | <i>t-Statistic</i> | <i>p-Value</i> |
|-----------------|--------------------|-----------------------|--------------------|----------------|
| Intercept       | 0.40               | 0.40                  | 1.0                | 0.3215         |
| X1              | 8.20               | 2.05                  | 4.0                | 0.0002         |
| X2              | 0.40               | 0.18                  | 2.2                | 0.0319         |
| X3              | -1.80              | 0.56                  | -3.2               | 0.0022         |

**Answer:**

The independent variable is statistically significant if the  $p$ -value is less than 1%, or 0.01. Therefore X1 and X3 are statistically significantly different from zero.

Figure 2 shows the results of the  $t$ -tests for each of the regression coefficients of our 10-year earnings growth example, including the  $p$ -values.

**Figure 2: Regression Results for Regression of EG10 on PR and YCS**

|           | <i>Coefficient</i> | <i>Standard Error</i> | <i>t-statistic</i> | <i>p-value</i> |
|-----------|--------------------|-----------------------|--------------------|----------------|
| Intercept | -11.6%             | 1.657%                | -7.0               | < 0.0001       |
| PR        | 0.25               | 0.032                 | 7.8                | < 0.0001       |
| YCS       | 0.14               | 0.280                 | 0.5                | 0.62           |

As we determined in a previous example, we can reject the null hypothesis and conclude that PR is statistically significant. We can also draw the same conclusion for the intercept term because -7.0 is less than the lower critical value of -1.68 (because it is a two-tailed test). However, we fail to reject the null hypothesis for YCS, so we cannot conclude that YCS has a statistically significant effect on the dependent variable, EG10, when PR is also included in the model. The  $p$ -values tell us exactly the same thing (as they always will): the intercept term and PR are statistically significant at the 10% level because their  $p$ -values are less than 0.10, while YCS is not statistically significant because its  $p$ -value is greater than 0.10.

## Other Tests of the Regression Coefficients

You should also be prepared to formulate one and two-tailed tests in which the null hypothesis is that the coefficient is equal to some value other than zero, or that it is greater than or less than some value.

### Example: Testing regression coefficients (two-tail test)

Using the data from Figure 2, test the null hypothesis that PR is equal to 0.20 versus the alternative that it is not equal to 0.20 using a 5% significance level.

**Answer:**

We are testing the following hypothesis:

$$H_0: PR = 0.20 \text{ versus } H_a: PR \neq 0.20$$

The 5% two-tailed critical  $t$ -value with  $46 - 2 - 1 = 43$  degrees of freedom is approximately 2.02. We should reject the null hypothesis if the  $t$ -statistic is greater than 2.02 or less than -2.02.

The  $t$ -statistic is:

$$t = \frac{0.25 - 0.20}{0.032} = 1.56$$

Therefore, because the  $t$ -statistic of 1.56 is between the upper and lower critical  $t$ -values of -2.02 and 2.02, we cannot reject the null hypothesis and must conclude that the PR regression coefficient is not statistically significantly different from 0.20 at the 5% significance level.

### Example: Testing regression coefficients (one-tailed test)

Using the data from Figure 2, test the null hypothesis that the intercept term is greater than or equal to -10.0% versus the alternative that it is less than -10.0% using a 1% significance level.

**Answer:**

We are testing the following hypothesis:

$$H_0: \text{Intercept} \geq -10.0\% \text{ versus } H_a: \text{Intercept} < -10.0\%$$

The 1% **one-tailed** critical  $t$ -value with  $46 - 2 - 1 = 43$  degrees of freedom is approximately 2.42. We should reject the null hypothesis if the  $t$ -statistic is less than -2.42.

The  $t$ -statistic is:

$$t = \frac{-11.6\% - (-10.0\%)}{1.657\%} = -0.96$$

Therefore, because the  $t$ -statistic of  $-0.96$  is not less than  $-2.42$ , we cannot reject the null hypothesis.

**LOS 12.c:** Calculate and interpret 1) a confidence interval for the population value of a regression coefficient and 2) a predicted value for the dependent variable, given an estimated regression model and assumed values for the independent variables.

### Confidence Intervals for a Regression Coefficient

The confidence interval for a regression coefficient in multiple regression is calculated and interpreted the same way as it is in simple linear regression. For example, a 95% confidence interval is constructed as follows:

$$\hat{b}_j \pm (t_c \times s_{\hat{b}_j})$$

or

estimated regression coefficient  $\pm$  (critical  $t$ -value)(coefficient standard error)

The critical  $t$ -value is a two-tailed value with  $n - k - 1$  degrees of freedom and a 5% significance level, where  $n$  is the number of observations and  $k$  is the number of independent variables.

#### Example: Calculating a confidence interval for a regression coefficient

Calculate the 90% confidence interval for the estimated coefficient for the independent variable PR in the real earnings growth example.

**Answer:**

The critical  $t$ -value is 1.68, the same as we used in testing the statistical significance at the 10% significance level (which is the same thing as a 90% confidence level). The estimated slope coefficient is 0.25 and the standard error is 0.032. The 90% confidence interval is:

$$0.25 \pm (1.68)(0.032) = 0.25 \pm 0.054 = 0.196 \text{ to } 0.304$$

*Professor's Note: Notice that because zero is not contained in the 90% confidence interval, we can conclude that the PR coefficient is statistically significant at the 10% level, the same conclusion we made when using the t-test in LOS 12.b. Constructing a confidence interval and conducting a t-test with a null hypothesis of "equal to zero" will always result in the same conclusion regarding the statistical significance of the regression coefficient.*

## PREDICTING THE DEPENDENT VARIABLE

We can use the regression equation to make predictions about the dependent variable based on forecasted values of the independent variables. The process is similar to forecasting with simple linear regression, only now we need predicted values for more than one independent variable. The predicted value of dependent variable  $Y$  is:

$$\hat{Y}_i = \hat{b}_0 + \hat{b}_1 \hat{X}_{1i} + \hat{b}_2 \hat{X}_{2i} + \dots + \hat{b}_k \hat{X}_{ki}$$

where:

$\hat{Y}_i$  = the predicted value of the dependent variable

$\hat{b}_j$  = the estimated slope coefficient for the  $j$ th independent variable

$\hat{X}_{ji}$  = the forecast of the  $j$ th independent variable,  $j = 1, 2, \dots, k$

*Professor's Note: The prediction of the dependent variable uses the estimated intercept and all of the estimated slope coefficients, regardless of whether the estimated coefficients are statistically significantly different from zero. For example, suppose you estimate the following regression equation:*

*$\hat{Y} = 6 + 2X_1 + 4X_2$ , and you determine that only the first independent variable ( $X_1$ ) is statistically significant (i.e., you rejected the null that  $b_1 = 0$ ). To predict  $Y$  given forecasts of  $X_1 = 0.6$  and  $X_2 = 0.8$ , you would use the complete model:  $\hat{Y} = 6 + (2 \times 0.6) + (4 \times 0.8) = 10.4$ . Alternatively, you could drop  $X_2$  and reestimate the model using just  $X_1$ , but remember that the coefficient on  $X_1$  will likely change.*

### Example: Calculating a predicted value for the dependent variable

An analyst would like to use the estimated regression equation from the previous example to calculate the predicted 10-year real earnings growth for the S&P 500, assuming the payout ratio of the index is 50%. He observes that the slope of the yield curve is currently 4%.

**Answer:**

$$\widehat{EG}_{10} = -11.6\% + 0.25(50\%) + 0.14(4\%) = 1.46\%$$

The model predicts a 1.46% real earnings growth rate for the S&P 500, assuming a 50% payout ratio, when the slope of the yield curve is 4%.

---

**LOS 12.d: Explain the assumptions of a multiple regression model.**


---

As with simple linear regression, most of the assumptions made with the multiple regression pertain to  $\epsilon$ , the model's error term:

- A linear relationship exists between the dependent and independent variables. In other words, the model on the first page of this topic review correctly describes the relationship.
  - The independent variables are not random, and there is no exact linear relation between any two or more independent variables.
  - The expected value of the error term, conditional on the independent variable, is zero [i.e.,  $E(\epsilon | X_1, X_2, \dots, X_k) = 0$ ].
  - The variance of the error terms is constant for all observations [i.e.,  $E(\epsilon_i^2) = \sigma_\epsilon^2$ ].
  - The error term for one observation is not correlated with that of another observation [i.e.,  $E(\epsilon_i \epsilon_j) = 0$ ,  $j \neq i$ ].
  - The error term is normally distributed.
- 

**LOS 12.e: Calculate and interpret the  $F$ -statistic and discuss how it is used in regression analysis; define, distinguish between, and interpret the  $R^2$  and adjusted  $R^2$  in multiple regression; and infer how well a regression model explains the dependent variable by analyzing the output of the regression equation and an ANOVA table.**

---

### THE $F$ -STATISTIC

An  $F$ -test assesses how well the set of independent variables, as a group, explains the variation in the dependent variable. That is, the  $F$ -statistic is used to test whether *at least one* of the independent variables explains a significant portion of the variation of the dependent variable.

For example, if there are four independent variables in the model, the hypotheses are structured as:

$$H_0: b_1 = b_2 = b_3 = b_4 = 0 \text{ versus } H_a: \text{at least one } b_j \neq 0$$



The  $F$ -statistic, which is always a one-tailed test, is calculated as:

$$F = \frac{MSR}{MSE} = \frac{RSS/k}{SSE/(n-k-1)}$$

where:

RSS = regression sum of squares

SSE = sum of squared errors

MSR = mean regression sum of squares

MSE = mean squared error



*Professor's Note: Recall from the previous topic review that the regression sum of squares and the sum of squared errors are found in an ANOVA table. We analyze an ANOVA table from a multiple regression later in this LOS.*

To determine whether at least one of the coefficients is statistically significant, the calculated  $F$ -statistic is compared with the **one-tailed** critical  $F$ -value,  $F_c$ , at the appropriate level of significance. The degrees of freedom for the numerator and denominator are:

$$df_{\text{numerator}} = k$$

$$df_{\text{denominator}} = n - k - 1$$

where:

$n$  = number of observations

$k$  = number of independent variables

The decision rule for the  $F$ -test is:

Decision rule: reject  $H_0$  if  $F$  (test-statistic)  $> F_c$  (critical value)

Rejection of the null hypothesis at a stated level of significance indicates that at least one of the coefficients is significantly different than zero, which is interpreted to mean that at least one of the independent variables in the regression model makes a significant contribution to the explanation of the dependent variable.



*Professor's Note: It may have occurred to you that an easier way to test all of the coefficients simultaneously is to just conduct all of the individual  $t$ -tests and see how many of them you can reject. This is the wrong approach, however, because if you set the significance level for each  $t$ -test at 5%, for example, the significance level from testing them all simultaneously is NOT 5%, but rather some higher percentage. Just remember to use the  $F$ -test on the exam if you are asked to test all of the coefficients simultaneously.*

**Example: Calculating and interpreting the  $F$ -statistic**

An analyst runs a regression of monthly value-stock returns on five independent variables over 60 months. The total sum of squares is 460, and the sum of squared errors is 170. Test the null hypothesis at the 5% significance level that all five of the independent variables are equal to zero.

**Answer:**

The null and alternative hypotheses are:

$$H_0: b_1 = b_2 = b_3 = b_4 = b_5 = 0 \text{ versus } H_a: \text{at least one } b_j \neq 0$$

$$RSS = SST - SSE = 460 - 170 = 290$$

$$MSR = \frac{290}{5} = 58.0$$

$$MSE = \frac{170}{60 - 5 - 1} = 3.15$$

$$F = \frac{58.0}{3.15} = 18.41$$

The critical  $F$ -value for 5 and 54 degrees of freedom at a 5% significance level is approximately 2.40. Remember, it's a **one-tailed** test, so we use the 5%  $F$ -table! Therefore we can reject the null hypothesis and conclude that at least one of the five independent variables is significantly different than zero.



*Professor's Note: When testing the hypothesis that all the regression coefficients are simultaneously equal to zero, the  $F$ -test is always a one-tailed test, despite the fact that it looks like it should be a two-tailed test because there is an equal sign in the null hypothesis. This is a common source of confusion among Level 2 candidates; make sure you don't make that mistake on the exam.*

**COEFFICIENT OF DETERMINATION,  $R^2$** 

In addition to an  $F$ -test, the multiple coefficient of determination,  $R^2$ , can be used to test the overall effectiveness of the entire set of independent variables in explaining the dependent variable. Its interpretation is similar to that for simple linear regression: the percentage of variation in the dependent variable that is *collectively* explained by all of the independent variables. For example, an  $R^2$  of 0.63 indicates that the model, as a whole, explains 63% of the variation in the dependent variable.

$R^2$  is also calculated the same way as in simple linear regression.

$$R^2 = \frac{\text{total variation} - \text{unexplained variation}}{\text{total variation}} = \frac{SST - SSE}{SST} = \frac{\text{explained variation}}{\text{total variation}} = \frac{RSS}{SST}$$

## Adjusted $R^2$

Unfortunately,  $R^2$  by itself *may not be a reliable measure of the explanatory power of the multiple regression model*. This is because  $R^2$  almost always increases as variables are added to the model, even if the marginal contribution of the new variables is not statistically significant. Consequently, a relatively high  $R^2$  may reflect the impact of a large set of independent variables rather than how well the set explains the dependent variable. This problem is often referred to as overestimating the regression.

To overcome the problem of overestimating the impact of additional variables on the explanatory power of a regression model, many researchers recommend adjusting  $R^2$  for the number of independent variables. The *adjusted  $R^2$*  value is expressed as:

$$R_a^2 = 1 - \left[ \left( \frac{n-1}{n-k-1} \right) \times (1 - R^2) \right]$$

where:

$n$  = number of observations

$k$  = number of independent variables

$R_a^2$  = adjusted  $R^2$

Whenever there is more than one independent variable,  $R_a^2$  is less than or equal to  $R^2$ . So while adding a new independent variable to the model will increase  $R^2$ , it may either *increase or decrease* the  $R_a^2$ . If the new variable has only a small effect on  $R^2$ , the value of  $R_a^2$  may decrease. In addition,  $R_a^2$  may be less than zero if the  $R^2$  is low enough.

### Example: Calculating $R^2$ and adjusted $R^2$

An analyst runs a regression of monthly value-stock returns on five independent variables over 60 months. The total sum of squares for the regression is 460, and the sum of squared errors is 170. Calculate the  $R^2$  and adjusted  $R^2$ .

**Answer:**

$$R^2 = \frac{460 - 170}{460} = 0.630 = 63.0\%$$

$$R_a^2 = 1 - \left[ \left( \frac{60-1}{60-5-1} \right) \times (1 - 0.63) \right] = 0.596 = 59.6\%$$

The  $R^2$  of 63% suggests that the five independent variables together explain 63% of the variation in monthly value-stock returns.

**Example: Interpreting adjusted  $R^2$** 

Suppose the analyst now adds four more independent variables to the regression, and the  $R^2$  increases to 65.0%. Identify which model the analyst would most likely prefer.

**Answer:**

With nine independent variables, even though the  $R^2$  has increased, from 63% to 65%, the adjusted  $R^2$  has decreased from 59.6% to 58.7%:

$$R_a^2 = 1 - \left[ \left( \frac{60-1}{60-9-1} \right) \times (1-0.65) \right] = 0.587 = 58.7\%$$

The analyst would prefer the first model because the adjusted  $R^2$  is higher and the model has five independent variables as opposed to nine.

**ANOVA TABLES**

**Analysis of variance (ANOVA)** is a statistical procedure that provides information on the explanatory power of a regression. We first discussed the use of ANOVA tables in the previous topic review of simple linear regression. Once again, the interpretation is the same in multiple regression.

The results of the ANOVA procedure are presented in an ANOVA table, which accompanies the output of a multiple regression program. An example of a generic ANOVA table is presented in Figure 3.

**Figure 3: ANOVA Table**

| <i>Source</i> | <i>df</i><br><i>(Degrees of Freedom)</i> | <i>SS</i><br><i>(Sum of Squares)</i> | <i>MS</i><br><i>(Mean Square= SS/df)</i> |
|---------------|------------------------------------------|--------------------------------------|------------------------------------------|
| Regression    | k                                        | RSS                                  | MSR                                      |
| Error         | n – k – 1                                | SSE                                  | MSE                                      |
| Total         | n – 1                                    | SST                                  |                                          |

The information in an ANOVA table is used to attribute the total variation of the dependent variable to one of two sources: the regression model or the residuals. This is indicated in the first column in the table, where the “source” of the variation is listed.

The information in an ANOVA table can be used to calculate  $R^2$ , the  $F$ -statistic, and the standard error of estimate (SEE). That is:

$$R^2 = \frac{RSS}{SST}$$

$$F = \frac{MSR}{MSE} \text{ with } k \text{ and } n - k - 1 \text{ degrees of freedom}$$

$$SEE = \sqrt{MSE}$$



*Professor's Note:  $R^2$ ,  $F$ , and  $SEE$  are provided along with the standard ANOVA table produced by most statistical software packages. On the exam, be prepared to fill in "missing data" from an ANOVA output.*

Let's look at an example to tie all of this together.

#### **Example: Using an ANOVA table with regression output**

In an attempt to estimate a regression equation that can be used to forecast BuildCo's future sales, 22 years of BuildCo's annual sales were regressed against two independent variables:

GDP = the level of gross domestic product

$\Delta I$  = changes in 30-year mortgage interest rates (expressed in percentage terms)

The output from a common statistical software package is contained in the following table.

## Regression Results for BuildCo Sales Data

|                                                  | <i>Coefficient</i> | <i>Standard Error</i> | <i>t-Statistic</i> | <i>p-Value</i> |
|--------------------------------------------------|--------------------|-----------------------|--------------------|----------------|
| Intercept                                        | 6.000              | 4.520                 | 1.327              | 0.20           |
| Level of gross domestic product (GDP)            | 0.004              | 0.003                 | ?                  | 0.20           |
| Changes in 30-year mortgage rates ( $\Delta I$ ) | -20.500            | 3.560                 | ?                  | < 0.001        |

| ANOVA      | <i>df</i> | <i>SS</i> | <i>MS</i> | <i>F</i> | <i>Significance F</i> |
|------------|-----------|-----------|-----------|----------|-----------------------|
| Regression | ?         | 236.30    | ?         | ?        | p < 0.005             |
| Error      | ?         | 116.11    | ?         |          |                       |
| Total      | ?         | ?         |           |          |                       |
| $R^2$      | ?         |           |           |          |                       |
| $R_a^2$    | ?         |           |           |          |                       |

Based on the output in the table, the regression equation can be stated as:

$$\widehat{\text{BuildCo Sales}} = 6.000 + 0.004(\text{GDP}) - 20.500(\Delta I)$$

Fill in the missing data and interpret the results of the regression at a 5% level of significance with respect to:

- The significance of the individual independent variables.
- The utility of the model as a whole.

**Answer:**

*Step 1:* Fill in the missing data.

The computed test statistics for the regression coefficients are:

$$t_{\text{GDP}} = \frac{0.004}{0.003} = 1.333$$

$$t_{\Delta I} = \frac{-20.500}{3.560} = -5.758$$

Degrees of freedom are:

$$\begin{aligned} df_{\text{regression}} &= k = 2 \\ df_{\text{error}} &= n - k - 1 = 22 - 2 - 1 = 19 \\ df_{\text{total}} &= n - 1 = 22 - 1 = 21 \end{aligned}$$

Other calculations:

$$SST = RSS + SSE = 236.30 + 116.11 = 352.41$$

$$MSR = \frac{RSS}{k} = \frac{236.30}{2} = 118.15$$

$$MSE = \frac{SSE}{n - k - 1} = \frac{116.11}{19} = 6.11$$

$$F = \frac{MSR}{MSE} = \frac{118.15}{6.11} = 19.34$$

$$R^2 = \frac{RSS}{SST} = \frac{236.30}{352.41} = 67.05\%$$

$$R_a^2 = 1 - \left( \frac{n-1}{n-k-1} \right) (1 - R^2) = 1 - \left( \frac{21}{19} \right) (1 - 0.6705) = 63.58\%$$

The following table shows what the complete ANOVA table looks like:

Regression Results for BuildCo Sales Data

|                                                  |  | <i>Coefficient</i> | <i>Standard Error</i> | <i>t-Statistic</i> | <i>p-Value</i> |
|--------------------------------------------------|--|--------------------|-----------------------|--------------------|----------------|
| Intercept                                        |  | 6.000              | 4.520                 | 1.327              | 0.20           |
| Level of gross domestic product (GDP)            |  | 0.004              | 0.003                 | 1.333              | 0.20           |
| Changes in 30-year mortgage rates ( $\Delta I$ ) |  | -20.500            | 3.560                 | -5.758             | < 0.001        |

| ANOVA      | <i>df</i> | <i>SS</i> | <i>MS</i> | <i>F</i> | <i>Significance F</i> |
|------------|-----------|-----------|-----------|----------|-----------------------|
| Regression | 2         | 236.30    | 118.15    | 19.34    | p < 0.005             |
| Error      | 19        | 116.11    | 6.11      |          |                       |
| Total      | 21        | 352.41    |           |          |                       |

|         |        |
|---------|--------|
| $R^2$   | 67.05% |
| $R_a^2$ | 63.58% |

*Step 2:* Determine the significance of the individual independent variables.

The contribution of the individual variables, as indicated by the significance of their slope coefficients, can be tested using  $t$ -tests. However, since the  $p$ -values are included with the regression output, as is usually the case, the level of significance can be observed directly. Just for practice, let's test for significance of the individual coefficients using  $t$ -tests and  $p$ -values.

- Using  $p$ -values. Only the  $p$ -value of the coefficient for  $\Delta I$  is less than the 5% level of significance, so we conclude that only  $\Delta I$  contributes significantly to the level of BuildCo's annual sales.
- Using  $t$ -statistics. The hypothesis test structure is:

$$H_0: b_j = 0 \text{ versus } H_a: b_j \neq 0$$

The critical two-tailed  $t$ -values with  $df = 19$  are  $\pm 2.093$ .

The decision rule is reject  $H_0$  if  $t_{b_j}$  is greater than 2.093 or less than  $-2.093$ .

Since  $t_{GDP} = 1.33$  does not fall in the rejection region, we cannot reject the null for GDP, and we conclude that the level of GDP does not make a statistically significant contribution to the variation in sales at the 5% level.

Since  $(t_{\Delta I} = -5.758) < (t_c = -2.093)$ , we conclude that changes in mortgage rates make a significant contribution to the variation in sales at the 5% level.



*Professor's Note: The use of  $p$ -values or  $t$ -tests will always result in the same conclusions about the statistical significance of the slope estimate (i.e., coefficients on the independent variables). On the exam, use the  $p$ -value if it is provided!*

*Step 3:* Determine the utility of the model as a whole.

The overall utility of the model can be generally assessed with the coefficient of determination,  $R^2$ . The  $R^2$  value indicates that GDP and  $\Delta I$  explain 67.05% of the variation in BuildCo's annual sales.

Tests of significance for the set of independent variables should be performed using the  $F$ -test. The hypotheses for the one-sided  $F$ -test can be structured as:

$$H_0: b_{\Delta I} = b_{GDP} = 0 \text{ versus } H_a: b_{\Delta I} \neq 0, \text{ or } b_{GDP} \neq 0$$

$F_c$  at the 5% significance level with  $df_{\text{numerator}} = 2$  and  $df_{\text{denominator}} = 19$  is 3.52. Remember, this is a one-tailed test.



The decision rule is reject  $H_0$  if  $F$  is greater than 3.52.

Since  $F > 3.52$ , the null hypothesis can be rejected and we can conclude that at least one of the independent variables significantly contributes to the dependent variable. That is, changes in mortgage rates *and* the level of GDP together explain a significant amount of the variation in BuildCo's annual sales at the 5% significance level. Notice that we could have reached this conclusion by observing that the ANOVA table reports that  $F$  is significant at a level less than 5%.

**LOS 12.f: Formulate a multiple regression equation by using dummy variables to represent qualitative factors and interpret the coefficients and regression results.**

Observations for most independent variables (e.g., firm size, level of GDP, and interest rates) can take on a wide range of values. However, there are occasions when the independent variable is binary in nature—it is either “on” or “off.” Independent variables that fall into this category are called *dummy variables* and are often used to quantify the impact of qualitative events.

Dummy variables are assigned a value of “0” or “1.” For example, in a time series regression of monthly stock returns, you could employ a “January” dummy variable that would take on the value of “1” if a stock return occurred in January and “0” if it occurred in any other month. The purpose of including the January dummy variable would be to see if stock returns in January were significantly different than stock returns in all other months of the year. Many “January Effect” anomaly studies employ this type of regression methodology.

The estimated regression coefficient for dummy variables indicates the difference in the dependent variable for the category represented by the dummy variable and the average value of the dependent variable for all classes except the dummy variable class. For example, testing the slope coefficient for the January dummy variable would indicate whether, and by how much, security returns are different in January as compared to the other months.

An *important consideration* when performing multiple regression with dummy variables is the choice of the number of dummy variables to include in the model. Whenever we want to distinguish between  $n$  classes, we must use  $n - 1$  dummy variables. Otherwise, the regression assumption of no exact linear relationship between independent variables would be violated.

### Interpreting the Coefficients in a Dummy Variable Regression

Consider the following regression equation for explaining quarterly EPS in terms of the quarter of their occurrence:

$$EPS_t = b_0 + b_1 Q_{1t} + b_2 Q_{2t} + b_3 Q_{3t} + \varepsilon_t$$

where:

$EPS_t$  = a quarterly observation of earnings per share

$Q_{1t}$  = 1 if period  $t$  is the first quarter,  $Q_{1t} = 0$  otherwise

$Q_{2t}$  = 1 if period  $t$  is the second quarter,  $Q_{2t} = 0$  otherwise

$Q_{3t}$  = 1 if period  $t$  is the third quarter,  $Q_{3t} = 0$  otherwise

The intercept term,  $b_0$ , represents the average value of *EPS* for the fourth quarter. The slope coefficient on each dummy variable estimates the *difference* in earnings per share (on average) between the respective quarter (i.e., quarter 1, 2, or 3) and the omitted quarter (the fourth quarter in this case). *Think of the omitted class as the reference point.*

For example, suppose we estimate the quarterly EPS regression model with ten years of data (40 quarterly observations) and find that  $b_0 = 1.25$ ,  $b_1 = 0.75$ ,  $b_2 = -0.20$ , and  $b_3 = 0.10$ :

$$\widehat{EPS}_t = 1.25 + 0.75Q_{1t} - 0.20Q_{2t} + 0.10Q_{3t}$$

We can use the equation to determine the average EPS in each quarter over the past ten years:

$$\text{average fourth quarter EPS} = 1.25$$

$$\text{average first quarter EPS} = 1.25 + 0.75 = 2.00$$

$$\text{average second quarter EPS} = 1.25 - 0.20 = 1.05$$

$$\text{average third quarter EPS} = 1.25 + 0.10 = 1.35$$

These are also the model's predictions of future EPS in each quarter of the following year. For example, to use the model to predict EPS in the first quarter of the next year, set  $\hat{Q}_1 = 1$ ,  $\hat{Q}_2 = 0$ , and  $\hat{Q}_3 = 0$ . Then  $\widehat{EPS}_{2010} = 1.25 + 0.75(1) - 0.20(0) + 0.10(0) = 2.00$ . This simple model uses average EPS for any specific quarter over the past ten years as the forecast of EPS in its respective quarter of the following year.

As with all multiple regression results, the  $F$ -statistic for the set of coefficients and the  $R^2$  should be evaluated to determine if the quarters, individually or collectively, contribute to the explanation of quarterly EPS.

We can also test whether the average EPS in each of the first three quarters is equal to the fourth quarter EPS (the omitted quarter) by testing the individual slope coefficients using the following null hypotheses:

$H_0: b_1 = 0$  tests whether fourth quarter EPS = first quarter EPS

$H_0: b_2 = 0$  tests whether fourth quarter EPS = second quarter EPS

$H_0: b_3 = 0$  tests whether fourth quarter EPS = third quarter EPS

The  $t$ -statistic for each test is equal to the coefficient divided by its standard error, and the critical  $t$ -value is a two-tailed value with  $n - k - 1 = 40 - 3 - 1 = 36$  degrees of freedom.

#### Example: Hypothesis testing with dummy variables

The standard error of the coefficient  $b_1$  is equal to 0.15 from the EPS regression model. Test whether first quarter EPS is equal to fourth quarter EPS at the 5% significance level.

**Answer:**

We are testing the following hypothesis:

$$H_0: b_1 = 0 \text{ vs. } H_A: b_1 \neq 0$$

The  $t$ -statistic is  $0.75/0.15 = 5.0$  and the two-tail 5% critical value with 36 degrees of freedom is approximately 2.03. Therefore we should reject the null and conclude that first quarter EPS is statistically significantly different than fourth quarter EPS at the 5% significance level.

#### Example of Regression Application with Dummy Variables

Mazumdar and Sengupta (2005)<sup>2</sup> provide a more complex example of an investment application of multiple regression using dummy variables. They determine that loan spreads relative to LIBOR on private debt contracts are negatively associated with measures of the quality of the company's financial disclosures.

The dependent variable (SPREAD) is the quoted spread in basis points over LIBOR on the first year of the loan. The independent variables include a number of quantitative variables, including, for example, average total disclosure score (DISC), standard deviation of daily stock returns (STDRETN), current ratio (CRATIO), and market to book ratio (MKBK). The authors also include three dummy variables in the regression:

- SECURE, which is equal to one if the loan is collateralized, and equal to zero otherwise.
- BID, which is equal to one if the loan contained the option to price the loan relative to a different index, and equal to zero otherwise.
- RESTRUC, which is equal to one if the loan was a result of corporate restructuring, and equal to zero otherwise.

2. Mazumdar, S. and P. Sengupta. 2005. "Disclosure of the Loan Spread on Private Debt." *Financial Analysts Journal*, vol. 61, no. 3 (May/June): 83–95.

In the model both SECURE and RESTRUC are positive and statistically significantly different from zero, while BID is not. The proper interpretation is that the loan spreads on private debt contracts are higher for collateralized loans than for uncollateralized loans, and higher for loans used for corporate restructuring than for loans used for other purposes, *after controlling for the other independent variables in the model*.

### WARM-UP: WHY MULTIPLE REGRESSION ISN'T AS EASY AS IT LOOKS

Regression analysis relies on the assumptions listed in LOS 12.d. When these assumptions are violated, the inferences drawn from the model are questionable. There are three primary assumption violations that you will encounter: (1) heteroskedasticity, (2) serial correlation (i.e., autocorrelation), and (3) multicollinearity.

On exam day, you must be able to answer the following four questions about each of the three assumption violations:

- What is it?
- What is its effect on regression analysis?
- How do we detect it?
- How do we correct for it?

Recall that the calculated test statistic for the estimated regression coefficient on the  $j$ th independent variable is:

$$t = \frac{\hat{b}_j - b_j}{s_{\hat{b}_j}}$$

Note that the denominator in the test statistic equation above,  $s_{\hat{b}_j}$ , is the standard error for coefficient  $j$ . Without getting into the math, suffice it to say that the coefficient standard error is calculated using the standard error of estimate (SEE), which is the standard deviation of the error term. Any violation of an assumption that affects the error term will ultimately affect the coefficient standard error. Consequently, this will affect the  $t$ -statistic and  $F$ -statistic and any conclusions drawn from hypothesis tests involving these statistics.

---

### LOS 12.g: Discuss the types of heteroskedasticity and the effects of heteroskedasticity and serial correlation on statistical inference.

---

#### WHAT IS HETEROSKEDASTICITY?

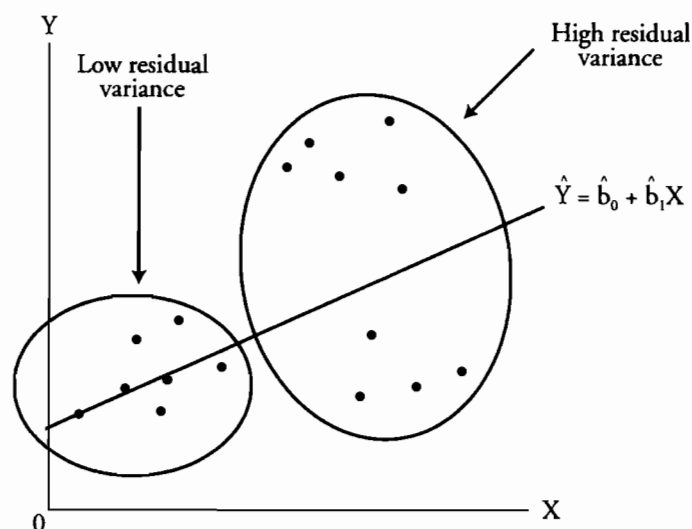
Recall from LOS 12.d that one of the assumptions of multiple regression is that the variance of the residuals is constant across observations. **Heteroskedasticity** occurs when the variance of the residuals is not the same across all observations in the sample. This happens when there are subsamples that are more spread out than the rest of the sample.

**Unconditional heteroskedasticity** occurs when the heteroskedasticity is not related to the level of the independent variables, which means that it doesn't systematically increase or decrease with changes in the value of the independent variable(s). While this is a

violation of the equal variance assumption, *it usually causes no major problems with the regression.*

**Conditional heteroskedasticity** is heteroskedasticity that is related to the level of (i.e., conditional on) the independent variables. For example, conditional heteroskedasticity exists if the variance of the residual term increases as the value of the independent variable increases, as shown in Figure 4. Notice in this figure that the residual variance associated with the larger values of the independent variable,  $X$ , is larger than the residual variance associated with the smaller values of  $X$ . Conditional heteroskedasticity *does create significant problems for statistical inference.*

**Figure 4: Conditional Heteroskedasticity**



### Effect of Heteroskedasticity on Regression Analysis

There are four effects of heteroskedasticity you need to be aware of:

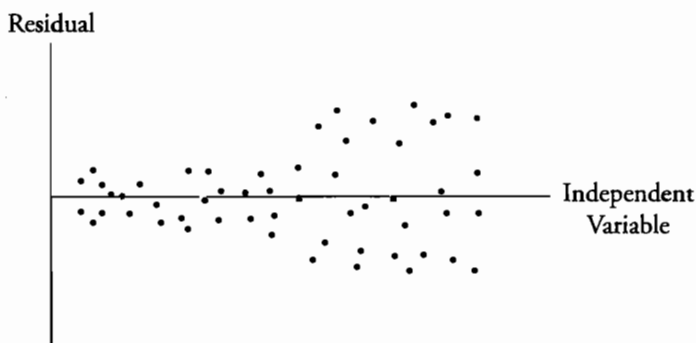
- The standard errors are usually unreliable estimates.
- The coefficient estimates (the  $\hat{b}_j$ ) aren't affected.
- If the standard errors are too small, but the coefficient estimates themselves are not affected, the  $t$ -statistics will be too large and the null hypothesis of no statistical significance is rejected too often. The opposite will be true if the standard errors are too large.
- The  $F$ -test is also unreliable.

### Detecting Heteroskedasticity

There are two methods to detect heteroskedasticity: examining scatter plots of the residuals and using the Breusch-Pagan chi-square test. A scatter plot of the residuals versus one or more of the independent variables can reveal patterns among observations.

**Example: Detecting heteroskedasticity with a residual plot**

You have been studying the monthly returns of a mutual fund over the past five years, hoping to draw conclusions about the fund's average performance. You calculate the mean return, the standard deviation, and the portfolio's beta by regressing the fund's returns on S&P 500 index returns (the independent variable). The standard deviation of returns and the fund's beta don't seem to fit the firm's stated risk profile. For your analysis, you have prepared a scatter plot of the error terms (actual return – predicted return) for the regression using five years of returns, as shown in the following figure. Determine whether the residual plot indicates that there may be a problem with the data.

**Residual Plot****Answer:**

The residual plot in the previous figure indicates the presence of conditional heteroskedasticity. Notice how the variation in the regression residuals increases as the independent variable increases. This indicates that the variance of the fund's returns about the mean is related to the level of the independent variable.

The more common way to detect conditional heteroskedasticity is the *Breusch-Pagan test*, which calls for the regression of the squared residuals on the independent variables. If conditional heteroskedasticity is present, the independent variables will significantly contribute to the explanation of the squared residuals. The test statistic for the Breusch-Pagan test, which has a chi-square distribution, is calculated as:

$$\text{BP chi-square test} = n \times R_{\text{resid}}^2 \text{ with } k \text{ degrees of freedom}$$

where:

$n$  = the number of observations

$R_{\text{resid}}^2 = R^2$  from a second regression of the squared residuals  
from the first regression on the independent variables

$k$  = the number of independent variables



*Professor's Note: The  $R^2$  used in the BP test is the  $R^2$  from a second regression, NOT the original regression.*

This is a one-tailed test because heteroskedasticity is only a problem if the  $R^2$  and the BP test statistic are too large.

#### Example: The Breusch-Pagan test

The residual plot of mutual fund returns over time shows evidence of heteroskedasticity. To confirm your suspicions, you regress the squared residuals from the original regression on the independent variable, S&P 500 index returns. The  $R^2$  from that regression is 8%. Use the Breusch-Pagan test to determine whether heteroskedasticity is present at the 5% significance level.

**Answer:**

With five years of monthly observations,  $n$  is equal to 60. The test statistic is:

$$n \times R^2 = 60 \times 0.08 = 4.8$$

The one-tailed critical value for a chi-square distribution with one degree of freedom and  $\alpha$  equal to 5% is 3.841. Therefore you should reject the null hypothesis and conclude that you have a problem with conditional heteroskedasticity.

### Correcting Heteroskedasticity

Heteroskedasticity is not easy to correct, and the details of the available techniques are beyond the scope of the CFA curriculum (which means you don't need to know the details for the exam!).

- The most common remedy and the one recommended in the CFA curriculum is to calculate *robust standard errors* (also called White-corrected standard errors or heteroskedasticity-consistent standard errors). These robust standard errors are then used to recalculate the  $t$ -statistics using the original regression coefficients. On the exam, use robust standard errors to calculate  $t$ -statistics if there is evidence of heteroskedasticity.

#### Example: Using White-corrected standard errors

An analyst runs a regression of annualized Treasury bill rates (the dependent variable) on annual inflation rates (the independent variable) using monthly data for ten years. The results of the regression are shown in the following table.

| Regression of T-Bill Rates on Inflation Rates |             |                |             |          |
|-----------------------------------------------|-------------|----------------|-------------|----------|
| Variable                                      | Coefficient | Standard Error | t-Statistic | p-Value  |
| Intercept                                     | 4.82        | 0.85           | 5.67        | < 0.0001 |
| Inflation                                     | 0.60        | 0.28           | 2.14        | 0.0340   |

He determines using the Breusch-Pagan test that heteroskedasticity is present, so he also estimates the White-corrected standard error for the coefficient on inflation to be 0.31. The critical two-tail 5% *t*-value for 118 degrees of freedom is 1.98. Is inflation statistically significant at the 5% level?

**Answer:**

The *t*-statistic should be recalculated using the White-corrected standard error as:

$$t = \frac{0.60}{0.31} = 1.94$$

This is less than the critical *t*-value of 1.98, which means after correcting for heteroskedasticity, the null hypothesis that the inflation coefficient is zero cannot be rejected. Therefore, inflation is not statistically significant. Notice that because the coefficient estimate of 0.60 was not affected by heteroskedasticity, but the original standard error of 0.28 was too low, the original *t*-statistic of 2.14 was too high. After using the higher White-corrected standard error of 0.31, the *t*-statistic fell to 1.94.

**WHAT IS SERIAL CORRELATION?**

Serial correlation, also known as autocorrelation, refers to the situation in which the residual terms are correlated with one another. Serial correlation is a relatively common problem with time series data.

- *Positive serial correlation* exists when a positive regression error in one time period increases the probability of observing a positive regression error for the next time period.
- *Negative serial correlation* occurs when a positive error in one period increases the probability of observing a negative error in the next period.

**Effect of Serial Correlation on Regression Analysis**

Because of the tendency of the data to cluster together from observation to observation, positive serial correlation typically results in coefficient standard errors that are too small, even though the estimated coefficients are accurate. These small standard error terms will cause the computed *t*-statistics to be larger than they should be, which will cause too many Type I errors: the rejection of the null hypothesis when it is actually true. The *F*-test will also be unreliable.



Because of the tendency of the data to diverge from observation to observation, negative serial correlation typically causes the standard errors to be too large, which leads to  $t$ -statistics that are too small. This will cause us to fail to reject the null hypothesis when it is actually false, resulting in too many Type II errors.



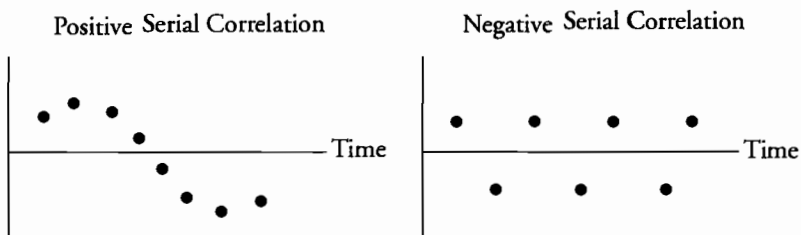
*Professor's Note: Positive serial correlation is much more common in economic and financial data, so focus your attention on its effects.*

## Detecting Serial Correlation

There are two methods that are commonly used to detect the presence of serial correlation: residual plots and the Durbin-Watson statistic.

A scatter plot of residuals versus time, like those shown in Figure 5, can reveal the presence of serial correlation. Figure 5 illustrates examples of positive and negative serial correlation.

**Figure 5: Residual Plots for Serial Correlation**



The more common method is to use the **Durbin-Watson statistic (DW)** to detect the presence of serial correlation. It is calculated as:

$$DW = \frac{\sum_{t=2}^T (\hat{\epsilon}_t - \hat{\epsilon}_{t-1})^2}{\sum_{t=1}^T \hat{\epsilon}_t^2}$$

where:

$\hat{\epsilon}_t$  = residual for period  $t$

If the sample size is very large:

$$DW \approx 2(1 - r)$$

where:

$r$  = correlation coefficient between residuals from one period and those from the previous period

You can see from the approximation that the Durbin-Watson test statistic is approximately equal to 2 if the error terms are homoskedastic and not serially correlated ( $r = 0$ ).  $DW < 2$  if the error terms are positively serially correlated ( $r > 0$ ), and  $DW > 2$  if the error terms are negatively serially correlated ( $r < 0$ ). But how much above or below the magic number 2 is statistically significant enough to reject the null hypothesis of no serial correlation?

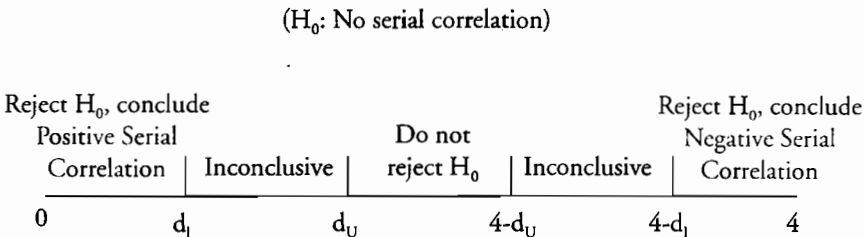
There are tables of DW statistics that provide upper and lower critical DW-values ( $d_u$  and  $d_l$ , respectively) for various sample sizes, levels of significance, and numbers of degrees of freedom against which the computed DW test statistic can be compared. The DW-test procedure for serial correlation is as follows:

$H_0$ : the regression has *no* serial correlation

The decision rules are rather complicated because they allow for rejecting the null in favor of either positive or negative correlation. The test can also be inconclusive, which means we don't accept or reject (See Figure 6).

- If  $DW < d_l$ , the error terms are *positively* serially correlated (i.e., reject the null hypothesis of no serial correlation).
- If  $d_l < DW < d_u$ , the test is inconclusive.
- If  $d_u < DW < 4 - d_u$ , there is no serial correlation (i.e., do not reject the null).
- If  $4 - d_u < DW < 4 - d_l$ , the test is inconclusive.
- If  $4 - d_l < DW < 4$ , the error terms are *negatively* serially correlated (i.e., reject the null hypothesis of no serial correlation).

Figure 6: Durbin-Watson Decision Rule



Example: The Durbin-Watson test for serial correlation

Suppose you have a regression output which includes three independent variables that provide you with a DW statistic of 1.23. Also suppose that the sample size is 40. At a 5% significance level, determine if the error terms are serially correlated.

Answer:

From a 5% DW table with  $n = 40$  and  $k = 3$ , the upper and lower critical DW values are found to be  $d_l = 1.34$  and  $d_u = 1.66$ , respectively. Since  $DW < d_l$  (i.e.,  $1.23 < 1.34$ ), you should reject the null hypothesis and conclude that the regression has positive serial correlation among the error terms.

## Correcting Serial Correlation

Possible remedies for serial correlation include:

- *Adjust the coefficient standard errors*, which is the method recommended in the CFA curriculum, using the Hansen method. The Hansen method also corrects for conditional heteroskedasticity. These adjusted standard errors, which are sometimes called serial correlation consistent standard errors or Hansen-White standard errors, are then used in hypothesis testing of the regression coefficients. Only use the Hansen method if serial correlation is a problem. The White-corrected standard errors are preferred if only heteroskedasticity is a problem. If both conditions are present, use the Hansen method.
- *Improve the specification of the model*. The best way to do this is to explicitly incorporate the time-series nature of the data (e.g., include a seasonal term). This can be tricky.

---

**LOS 12.h: Describe multicollinearity and discuss its causes and effects in regression analysis.**

---

**Multicollinearity** refers to the condition when two or more of the independent variables, or linear combinations of the independent variables, in a multiple regression are highly correlated with each other. This condition distorts the standard error of estimate and the coefficient standard errors, leading to problems when conducting *t*-tests for statistical significance of parameters.

### Effect of Multicollinearity on Regression Analysis

As a result of multicollinearity, there is a *greater probability that we will incorrectly conclude that a variable is not statistically significant* (e.g., a Type II error).

Multicollinearity is likely to be present to some extent in most economic models. The issue is whether the multicollinearity has a significant effect on the regression results.

### Detecting Multicollinearity

The most common way to detect multicollinearity is the situation where *t*-tests indicate that none of the individual coefficients is significantly different than zero, while the *F*-test is statistically significant and the  $R^2$  is high. This suggests that the variables together explain much of the variation in the dependent variable, but the individual independent variables don't. The only way this can happen is when the independent variables are highly correlated with each other, so while their common source of variation is explaining the dependent variable, the high degree of correlation also "washes out" the individual effects.

High correlation among independent variables is sometimes suggested as a sign of multicollinearity. In fact, answers to some old CFA questions suggest the following general rule of thumb: If the absolute value of the sample correlation between any two independent variables in the regression is greater than 0.7, multicollinearity is a potential problem.

However, this only works if there are exactly two independent variables. If there are more than two independent variables, while individual variables may not be highly correlated, linear combinations might be, leading to multicollinearity. High correlation among the independent variables suggests the possibility of multicollinearity, but low correlation among the independent variables *does not necessarily* indicate multicollinearity is *not* present.

#### Example: Detecting multicollinearity

Bob Watson, CFA, runs a regression of mutual fund returns on average P/B, average P/E, and average market capitalization, with the following results:

| Variable       | Coefficient | p-Value |
|----------------|-------------|---------|
| Average P/B    | 3.52        | 0.15    |
| Average P/E    | 2.78        | 0.21    |
| Market Cap     | 4.03        | 0.11    |
| F-test         | 34.6        | < 0.001 |
| R <sup>2</sup> | 89.6%       |         |

Determine whether or not multicollinearity is a problem in this regression.

**Answer:**

The R<sup>2</sup> is high and the F-test is statistically significant, which suggest that the three variables as a group do an excellent job of explaining the variation in mutual fund returns. However, none of the independent variables individually is statistically significant to any reasonable degree, since the p-values are larger than 10%. This is a classic indication of multicollinearity.

### Correcting Multicollinearity

The most common method to correct for multicollinearity is to omit one or more of the correlated independent variables. Unfortunately, it is not always an easy task to identify the variable(s) that are the source of the multicollinearity. There are statistical procedures that may help in this effort, like stepwise regression, which systematically remove variables from the regression until multicollinearity is minimized.

### WARM-UP: MODEL SPECIFICATION

*Regression model specification* is the selection of the explanatory (independent) variables to be included in the regression and the transformations, if any, of those explanatory variables.

For example, suppose we're trying to predict a P/E ratio using a cross-sectional regression with fundamental variables that are related to P/E. Valuation theory tells us that the stock's dividend payout ratio (DPO), growth rate (G), and beta (B) are associated with P/E. One specification of the model would be:

$$\text{Specification 1: } P/E = b_0 + b_1 DPO + b_2 G + b_3 B + \varepsilon$$

If we also decide that market capitalization (M) is related to P/E ratio, we would create a second specification of the model by including M as an independent variable:

$$\text{Specification 2: } P/E = a_0 + a_1 DPO + a_2 G + a_3 B + a_4 M + \varepsilon$$

Finally, suppose we conclude that market cap is not linearly related to P/E, but the natural log of market cap is linearly related to P/E. Then we would transform M by taking its natural log and creating a new variable  $\ln M$ . Thus our third specification would be:

$$\text{Specification 3: } P/E = c_0 + c_1 DPO + c_2 G + c_3 B + c_4 \ln M + \varepsilon$$



*Professor's Note: Notice that we used "a" instead of "b" in Specification 2 and "c" in Specification 3. We must do that to recognize that when we change the specifications of the model, the regression parameters change. For example, we wouldn't expect the intercept in Specification 1 ( $b_0$ ) to be the same as in Specification 2 ( $a_0$ ) or the same as Specification 3 ( $c_0$ ).*

---

**LOS 12.i: Discuss the effects of model misspecification on the results of a regression analysis and explain how to avoid the common forms of misspecification.**

---

There are three broad categories of *model misspecification*, or ways in which the regression model can be specified incorrectly, each with several subcategories:

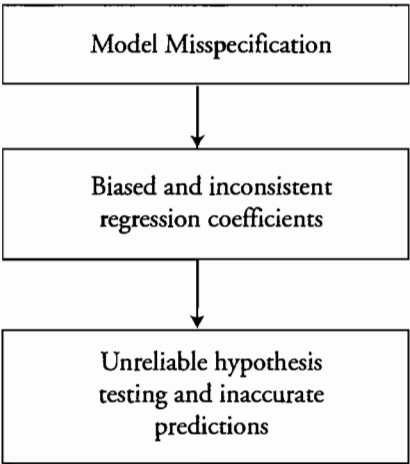
1. The functional form can be misspecified.
  - Important variables are omitted.
  - Variables should be transformed.
  - Data is improperly pooled.
2. Explanatory variables are correlated with the error term in time series models.
  - A lagged dependent variable is used as an independent variable.
  - A function of the dependent variable is used as an independent variable ("forecasting the past").
  - Independent variables are measured with error.
3. Other time-series misspecifications that result in nonstationarity.



*Professor's Note: We'll focus on the first two categories because nonstationarity in time series regressions is covered in the next topic review.*

The *effects of the model misspecification on the regression results*, as shown in Figure 7, are basically the same for all of the misspecifications we will discuss: regression coefficients are often biased and/or inconsistent, which means we can't have any confidence in our hypothesis tests of the coefficients or in the predictions of the model.

Figure 7: Effects of Model Misspecification



*Professor's Note: Recall the definitions of unbiased and consistent estimators from the Level 1 curriculum:*



- *An unbiased estimator is one for which the expected value of the estimator is equal to the parameter you are trying to estimate. For example, because the expected value of the sample mean is equal to the population mean, the sample mean is an unbiased estimator of the population mean.*
- *A consistent estimator is one for which the accuracy of the parameter estimate increases as the sample size increases. As the sample size increases, the standard error of the sample mean falls, and the sampling distribution bunches more closely around the population mean. In fact, as the sample size approaches infinity, the standard error approaches zero.*

**EXAMPLES OF MISSPECIFICATION OF FUNCTIONAL FORM**

Let's start with a regression in which we're trying to predict monthly returns on portfolios of Chinese stocks ( $R$ ) using four independent variables: portfolio beta ( $B$ ), the natural log of market capitalization ( $\ln M$ ), the natural log of the price-to-book ratio  $\ln(PB)$ , and free float ( $FF$ ). Free float is equal to the ratio of shares available to be traded by the investing public to total company shares. The regression is estimated with 72 monthly observations from July 1996 to June 2002. The correct specification of the model is as follows:

$$R = b_0 + b_1 B + b_2 \ln M + b_3 \ln PB + b_4 FF + \epsilon$$

Suppose we determine in this specification that both  $\ln M$  and  $FF$  are statistically significant at the 1% level.



*Professor's Note: The correct regression model specification is based on a study by Wang and Xu (2004).<sup>3</sup> The incorrect specifications that follow are designed to illustrate examples of common misspecifications, but they are not included in the Wang and Xu study.*

### Misspecification #1: Omitting a Variable

Suppose we do not include  $\ln M$  in the regression model:

$$R = a_0 + a_1 B + a_2 \ln PB + a_3 FF + \varepsilon$$

If  $\ln M$  is correlated with any of the remaining independent variables ( $B$ ,  $\ln PB$ , or  $FF$ ), then the error term is also correlated with the same independent variables and the resulting regression coefficients (the estimates of  $a_0$ ,  $a_1$ , and  $a_2$ ) are biased and inconsistent. That means our hypothesis tests and predictions using the model are unreliable.

### Misspecification #2: Variable Should Be Transformed

Regression assumes that the dependent variable is linearly related to each of the independent variables. Typically, however, market capitalization is not linearly related to portfolio returns, but the natural log of market cap is linearly related. If we include market cap in the regression without transforming it by taking the natural log—if we use  $M$  and not  $\ln(M)$ —we've misspecified the model.

$$R = c_0 + c_1 B + c_2 M + c_3 \ln PB + c_4 FF + \varepsilon$$

Other examples of transformations include squaring the variable or taking the square root of the variable. If financial statement data are included in the regression model, a common transformation is to standardize the variables by dividing by sales (for income statement or cash flow items) or total assets (for balance sheet items). You should recognize these as items from *common-size financial statements*.

### Misspecification #3: Incorrectly Pooling Data

Suppose the relationship between returns and the independent variables during the first three years is actually different than relationship in the second three-year period (i.e., the regression coefficients are different from one period to the next). By pooling the data and estimating one regression over the entire period, rather than estimating two separate regressions over each of the subperiods, we have misspecified the model and our hypothesis tests and predictions of portfolio returns will be misleading.

3. Fenghua Wang and Yexiao Xu. "What Determines Chinese Stock Returns." *Financial Analysts Journal* 6 (November/December 2004): 65–77.

**Misspecification #4: Using Lagged Dependent Variable as Independent Variable**

A lagged variable in a time series regression is the value of a variable from a prior period. In our example, the dependent variable is portfolio return in month  $t$ , so a lagged dependent variable would be the portfolio return in the previous period, month  $t - 1$  (which is denoted as  $R_{t-1}$ ).

$$R = d_0 + d_1B + d_2\ln M + d_3\ln PB + d_4FF + d_5R_{t-1} + \varepsilon$$

If the error terms in the regression model are also serially correlated (which is common in time series regressions), then this model misspecification will result in biased and inconsistent regression estimates and unreliable hypothesis tests and return predictions.

**Misspecification #5: Forecasting the Past**

The proper specification of the model is to measure the dependent variable as returns during a particular month (say July 1996), and the independent variable  $\ln(M)$  as the natural log of market capitalization *at the beginning* of July. Remember that market cap is equal to shares outstanding times price per share. If we measure market cap *at the end* of July and use it in our regression, we're naturally going to conclude that stocks with higher market cap at the end of July had higher returns during July. In other words, our model is misspecified because it is forecasting the past: we're using variables measured at the end of July to predict a variable measured during July.

**Misspecification #6: Measuring Independent Variables with Error**

The free float (FF) independent variable is actually trying to capture the relationship between corporate governance quality and portfolio returns. However, because we can't actually measure "corporate governance quality," we have to use a proxy variable. Wang and Xu used free float to proxy for corporate governance quality. The presumption is that the higher the level of free float, the more influence the capital markets have on management's decision making process and the more effective the corporate governance structure. However, because we're using free float as a proxy, we're actually measuring the variable we want to include in our regression—corporate governance quality—with error. Once again our regression estimates will be biased and inconsistent and our hypothesis testing and predictions unreliable.



*Professor's Note: For more information on corporate governance and the valuation implications of effective corporate governance practices, see the topic review of corporate governance in Study Session 9.*

Another common example when an independent variable is measured with error is when we want to use expected inflation in our regression but use actual inflation as a proxy.



---

**LOS 12.j: Discuss models with qualitative dependent variables.**


---

Financial analysis often calls for the use of a model that has a **qualitative dependent variable**, a dummy variable that takes on a value of either zero or one. An example of an application requiring the use of a qualitative dependent variable is a model that attempts to predict when a bond issuer will default. In this case, the dependent variable may take on a value of one in the event of default and zero in the event of no default. An ordinary regression model is not appropriate for situations that require a qualitative dependent variable. However, there are several different types of models that use a qualitative dependent variable.

- **Probit and logit models.** A probit model is based on the normal distribution, while a logit model is based on the logistic distribution. Application of these models results in estimates of the probability that the event occurs (e.g., probability of default). The maximum likelihood methodology is used to estimate coefficients for probit and logit models. These coefficients relate the independent variables to the likelihood of an event occurring, such as a merger, bankruptcy, or default.
- **Discriminant models.** Discriminant models are similar to probit and logit models but make different assumptions regarding the independent variables. Discriminant analysis results in a linear function similar to an ordinary regression which generates an overall score, or ranking, for an observation. The scores can then be used to rank or classify observations. A popular application of a discriminant model makes use of financial ratios as the independent variables to predict the qualitative dependent variable bankruptcy. A linear relationship among the independent variables produces a value for the dependent variable that places a company in a bankrupt or not bankrupt class.

The analysis of regression models with qualitative dependent variables is the same as we have been discussing all through this topic review. Examine the individual coefficients using *t*-tests, determine the validity of the model with the *F*-test and the  $R^2$ , and look out for heteroskedasticity, serial correlation, and multicollinearity.

---

**LOS 12.k: Interpret the economic meaning of the results of multiple regression analysis and critique a regression model and its results.**


---

The economic meaning of the results of a regression estimation focuses primarily on the slope coefficients. For example, suppose that we run a regression using a cross section of stock returns (in percent) as the dependent variable, and the stock betas (CAPM) and market capitalizations (in \$ billions) as our independent variables. The slope coefficients indicate the expected change in the stock returns for a one unit change in beta or market capitalization. The estimated regression equation is:

$$\text{Return} = 5.0 + 4.2 \text{ Beta} - 0.05 \text{ Mkt.Cap.} + \epsilon$$

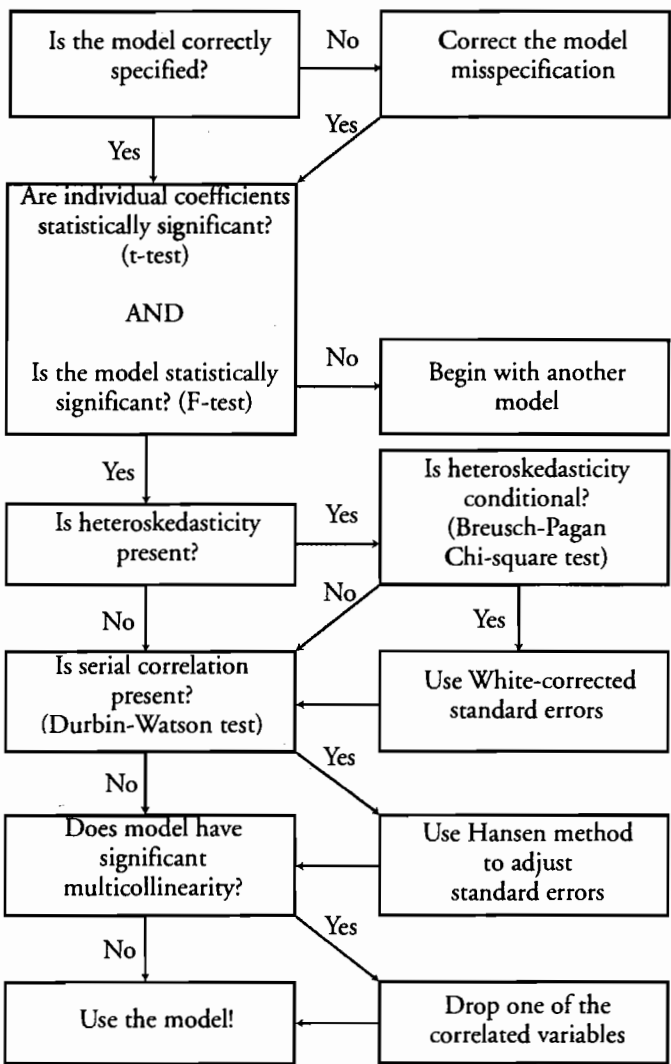
Furthermore, assume that these coefficient estimates are significantly different from zero in a statistical sense. The economic meaning of these results is that, on average, a one unit increase in beta risk is associated with a 4.2% *increase* in return, while a \$1 billion increase in market capitalization implies a 0.05% *decrease* in return.

As is always the case with statistical inferences, it is possible to identify a relationship that has statistical significance without having any economic significance. For instance, a study of dividend announcements may identify a statistically significant abnormal return following the announcement, but these returns may not be sufficient to cover transactions costs.

### ASSESSING A MULTIPLE REGRESSION MODEL—PUTTING IT ALL TOGETHER

The flow chart in Figure 8 will help you evaluate a multiple regression model and grasp the “big picture” in preparation for the exam.

Figure 8: Assessment of a Multiple Regression Model



## KEY CONCEPTS

### LOS 12.a

The multiple regression equation specifies a dependent variable as a linear function of two or more independent variables:

$$Y_i = b_0 + b_1X_{1i} + b_2X_{2i} + \dots + b_kX_{ki} + \epsilon_i$$

The intercept term is the value of the dependent variable when the independent variables are equal to zero. Each slope coefficient is the estimated change in the dependent variable for a one-unit change in that independent variable, holding the other independent variables constant.

### LOS 12.b

A  $t$ -test is used for hypothesis testing of regression parameter estimates:

$$t_{bj} = \frac{\hat{b}_j - b_j}{s_{\hat{b}_j}}, \text{ with } n - k - 1 \text{ degrees of freedom}$$

Testing for statistical significance means testing  $H_0: b_j = 0$  vs.  $H_a: b_j \neq 0$ .

### LOS 12.c

The confidence interval for regression coefficient is:

$$\text{estimated regression coefficient} \pm (\text{critical } t\text{-value})(\text{coefficient standard error})$$

The value of dependent variable  $Y$  is predicted as:

$$\hat{Y} = \hat{b}_0 + \hat{b}_1X_1 + \hat{b}_2X_2 + \dots + \hat{b}_kX_k$$

### LOS 12.d

Assumptions of multiple regression mostly pertain to the error term,  $\epsilon_i$ .

- A linear relationship exists between the dependent and independent variables.
- The independent variables are not random, and there is no exact linear relation between any two or more independent variables.
- The expected value of the error term is zero.
- The variance of the error terms is constant.
- The error for one observation is not correlated with that of another observation.
- The error term is normally distributed.

**LOS 12.e**

The  $F$ -distributed test statistic can be used to test the significance of all (or any subset of) the independent variables (i.e., the overall fit of the model) using a one-tailed test:

$$F = \frac{MSR}{MSE} = \frac{RSS/k}{SSE/[n-k-1]} \text{ with } k \text{ and } n-k-1 \text{ degrees of freedom}$$

The coefficient of determination,  $R^2$ , is the percentage of the variation in  $Y$  that is explained by the set of independent variables.

- $R^2$  increases as the number of independent variables increases—this can be a problem.
- The adjusted  $R^2$  adjusts the  $R^2$  for the number of independent variables.

An ANOVA table is used to assess the usefulness of a regression model's independent variable(s) in explaining the dependent variable:

| <i>Source</i> | <i>df<br/>(Degrees of Freedom)</i> | <i>SS<br/>(Sum of Squares)</i> | <i>MS<br/>Mean Square = (SS/df)</i> |
|---------------|------------------------------------|--------------------------------|-------------------------------------|
| Regression    | $k$                                | RSS                            | MSR                                 |
| Error         | $n - k - 1$                        | SSE                            | MSE                                 |
| Total         | $n - 1$                            | SST                            |                                     |

$$MSE = \frac{SSE}{n-k-1}; MSR = \frac{RSS}{k}; R^2 = \frac{RSS}{SST}; F = \frac{MSR}{MSE}; SEE = \sqrt{MSE}$$

**LOS 12.f**

Qualitative independent variables (dummy variables) capture the effect of a binary independent variable:

- Slope coefficient is interpreted as the change in the dependent variable for the case when the dummy variable is one.
- Use one less dummy variable than the number of categories.

**LOS 12.g,h**

Summary of what you need to know regarding violations of the assumptions of multiple regression:

| <i>Violation</i>   | <i>Conditional Heteroskedasticity</i>                       | <i>Serial Correlation</i>                       | <i>Multicollinearity</i>                                                                |
|--------------------|-------------------------------------------------------------|-------------------------------------------------|-----------------------------------------------------------------------------------------|
| <i>What is it?</i> | Residual variance related to level of independent variables | Residuals are correlated                        | Two or more independent variables are correlated                                        |
| <i>Effect?</i>     | Too many Type I errors                                      | Too many Type I errors (positive correlation)   | Too many Type II errors                                                                 |
| <i>Detection?</i>  | Breusch-Pagan chi-square test<br>$= n \times R^2$           | Durbin-Watson test<br>$\approx 2(1 - r)$        | Conflicting $t$ and $F$ statistics; correlations among independent variables if $k = 2$ |
| <i>Correction?</i> | Use White-corrected standard errors                         | Use the Hansen method to adjust standard errors | Drop one of the correlated variables                                                    |

**LOS 12.i**

There are six common misspecifications of the regression model that you should be aware of and able to recognize:

- Omitting a variable.
- Variable should be transformed.
- Incorrectly pooling data.
- Using lagged dependent variable as independent variable.
- Forecasting the past.
- Measuring independent variables with error.

The effects of the model misspecification on the regression results are basically the same for all of the misspecifications: regression coefficients are biased and inconsistent, which means we can't have any confidence in our hypothesis tests of the coefficients or in the predictions of the model.

**LOS 12.j**

Qualitative dependent variables (e.g., bankrupt versus non-bankrupt) require methods other than ordinary least squares (e.g., probit, logit, or discriminant analysis).

**LOS 12.k**

The values of the slope coefficients suggest the economic meaning of the relationship between the independent and dependent variables, but it is important for the analyst to keep in mind that a regression may have statistical significance even when there is no practical economic significance in the relationship.

## CONCEPT CHECKERS

Use the following ANOVA table for Questions 1 through 4.

| <i>Source</i> | <i>Sum of Squares (SS)</i> | <i>Degrees of Freedom</i> |
|---------------|----------------------------|---------------------------|
| Regression    | 1,025                      | 5                         |
| Error         | 925                        | 25                        |

1. The number of sample observations in the regression estimation is *closest* to:
  - A. 29.
  - B. 30.
  - C. 31.
2. The mean squared error (MSE) is *closest* to:
  - A. 37.
  - B. 82.
  - C. 205.
3. The  $R^2$  statistic is *closest* to:
  - A. 53%.
  - B. 50%.
  - C. 47%.
4. The  $F$ -statistic is *closest* to:
  - A. 1.1.
  - B. 3.3.
  - C. 5.5.

Use the following information to answer Questions 5 through 9.

Multiple regression was used to explain stock returns using the following variables:

Dependent variable:

RET = annual stock returns (%)

Independent variables:

MKT = Market capitalization = Market capitalization / \$1.0 million

IND = Industry quartile ranking (IND = 4 is the highest ranking)

FORT = Fortune 500 firm, where {FORT = 1 if the stock is that of a Fortune 500 firm, FORT = 0 if not a Fortune 500 stock}

The regression results are presented in the tables below.

|                       | <i>Coefficient</i> |           | <i>Standard Error</i> | <i>t-Statistic</i> | <i>p-Value</i>        |
|-----------------------|--------------------|-----------|-----------------------|--------------------|-----------------------|
| Intercept             | 0.5220             |           | 1.2100                | 0.430              | 0.681                 |
| Market Capitalization | 0.0460             |           | 0.0150                | 3.090              | 0.021                 |
| Industry Ranking      | 0.7102             |           | 0.2725                | 2.610              | 0.040                 |
| Fortune 500           | 0.9000             |           | 0.5281                | 1.700              | 0.139                 |
| <i>ANOVA</i>          | <i>df</i>          | <i>SS</i> | <i>MSS</i>            | <i>F</i>           | <i>Significance F</i> |
| Regression            | 3                  | 20.5969   | 6.8656                | 12.100             | 0.006                 |
| Error                 | 6                  | 3.4031    | 0.5672                |                    |                       |
| Total                 | 9                  | 24.0000   |                       |                    |                       |

| <i>Test</i>   | <i>Test-Statistic</i> |
|---------------|-----------------------|
| Breusch-Pagan | 17.7                  |
| Durbin-Watson | 1.8                   |

5. Based on the results in the table, which of the following *most accurately* represents the regression equation?
  - A.  $0.43 + 3.09(\text{MKT}) + 2.61(\text{IND}) + 1.70(\text{FORT})$ .
  - B.  $0.681 + 0.021(\text{MKT}) + 0.04(\text{IND}) + 0.139(\text{FORT})$ .
  - C.  $0.522 + 0.0460(\text{MKT}) + 0.7102(\text{IND}) + 0.9(\text{FORT})$ .
6. The expected amount of the stock return attributable to it being a Fortune 500 stock is *closest* to:
  - A. 0.522.
  - B. 0.139.
  - C. 0.900.
7. The expected return on the stock of a firm that is not in the Fortune 500, has a market capitalization of \$5 million, and is in an industry with a rank of 3 is *closest* to:
  - A. 2.88%.
  - B. 3.98%.
  - C. 1.42%.
8. Does being a Fortune 500 stock contribute significantly to stock returns?
  - A. Yes, at a 10% level of significance.
  - B. Yes, at a 5% level of significance.
  - C. No, not at a reasonable level of significance.

9. The  $p$ -value of the Breusch-Pagan test is 0.0005. The lower and upper limits for the Durbin-Watson test are 0.40 and 1.90, respectively. Based on this data and the information in the tables, there is evidence of:
- A. only serial correlation.
  - B. serial correlation and heteroskedasticity.
  - C. only heteroskedasticity.

Use the following information to answer Questions 10 and 11.

An analyst evaluates the sum of squared error and total sum of squares from a multiple regression with four independent variables to be 4,320 and 9,105 respectively. There are 65 observations in the sample.

10. The  $F$ -statistic is *closest* to:
- A. 13.54.
  - B. 13.77.
  - C. 16.61.
11. The critical  $F$ -value for testing  $H_0 = b_1 = b_2 = b_3 = b_4 = 0$  vs.  $H_a$ : at least one  $b_j \neq 0$  at the 5% significance level is *closest* to:
- A. 2.37.
  - B. 2.53.
  - C. 2.76.
12. Which of the following situations is *least likely* to result in the misspecification of a regression model with monthly returns as the dependent variable?
- A. Failing to include an independent variable that is related to monthly returns.
  - B. Using leading P/E from the previous period as an independent variable.
  - C. Using actual inflation as an independent variable to proxy for expected inflation.
13. The *least likely* result of regression model misspecification is:
- A. unreliable hypothesis tests of the regression coefficients.
  - B. inconsistent regression coefficients.
  - C. unbiased regression coefficients.



## CHALLENGE PROBLEMS

14. Phil Ohlmer is developing a regression model to predict returns on a hedge fund composite index using several different independent variables. Which of the following list of independent variables, if included in the model, is *most likely* to lead to biased and inconsistent regression coefficients and why?
- Small-cap index returns, high-yield bond index returns, and emerging market index returns; because small-cap returns and hedge fund index returns are likely to be correlated.
  - Small-cap index returns, high-yield bond index returns, and emerging market index returns; because small-cap returns and emerging market index returns are likely to be correlated.
  - Small-cap index returns, previous period hedge fund composite index returns, high-yield bond index returns, and emerging market index returns; because the regression model is likely to be misspecified.
15. What condition is the Durbin-Watson statistic designed to detect in multiple regression, and what is the *most appropriate* remedy to correct for that condition?
- | <u>Condition</u>      | <u>Remedy</u>                 |
|-----------------------|-------------------------------|
| A. Serial correlation | Use the Hansen method         |
| B. Autocorrelation    | Use generalized least squares |
| C. Heteroskedasticity | Use generalized least squares |
16. Which of the following situations is *least likely* the result of a multiple regression analysis with more than 50 observations?
- |    | <u>R<sup>2</sup></u> | <u>Adjusted R<sup>2</sup></u> |
|----|----------------------|-------------------------------|
| A. | 71%                  | 69%                           |
| B. | 83%                  | 86%                           |
| C. | 10%                  | -2%                           |

Use the following information for Questions 17 and 18.

Phil Ohlmer estimates a cross sectional regression in order to predict price to earnings ratios (P/E) with fundamental variables that are related to P/E, including dividend payout ratio (DPO), growth rate (G), and beta (B). In addition, all 50 stocks in the sample come from two industries, electric utilities or biotechnology. He defines the following dummy variable:

IND = 0 if the stock is in the electric utilities industry, or  
= 1 if the stock is in the biotechnology industry

The results of his regression are shown in the following table.

| Variable  | Coefficient | t-Statistic |
|-----------|-------------|-------------|
| Intercept | 6.75        | 3.89*       |
| IND       | 8.00        | 4.50*       |
| DPO       | 4.00        | 1.86        |
| G         | 12.35       | 2.43*       |
| B         | -0.50       | 1.46        |

\*significant at the 5% level

17. Based on these results, it would be *most appropriate* to conclude that:
  - A. biotechnology industry returns are statistically significantly larger than electric utilities industry returns.
  - B. electric utilities returns are statistically significantly larger than biotechnology industry returns, holding DPO, G, and B constant.
  - C. biotechnology industry returns are statistically significantly larger than electric utilities industry returns, holding DPO, G, and B constant.
18. Ohlmer is valuing a biotechnology stock with a dividend payout ratio of 0.00, a beta of 1.50, and an expected earnings growth rate of 0.14. The predicted P/E on the basis of the values of the explanatory variables for the company is *closest* to:
  - A. 7.7.
  - B. 15.7.
  - C. 17.2.
19. Assumptions underlying a multiple regression are *most likely* to include:
  - A. The expected value of the error term is  $0.00 < i < 1.00$ .
  - B. Linear and non-linear relationships exist between the dependent and independent variables.
  - C. The error for one observation is not correlated with that of another observation.
20. Qualitative dependent variables should be verified using:
  - A. a dummy variable based on the logistic distribution.
  - B. a discriminant model using a linear function for ranked observations.
  - C. tests for heteroskedasticity, serial correlation, and multicollinearity.

## ANSWERS – CONCEPT CHECKERS

1. C  $k = 5$  and  $n - 5 - 1 = 25$ , so  $n = 31$
2. A 
$$MSE = \frac{SSE}{df_{\text{error}}} = \frac{925}{25} = 37$$
3. A 
$$R^2 = \frac{SSR}{SST} = \frac{1,025}{1,950} = 53\%$$
4. C 
$$F = \frac{MSR}{MSE} = \frac{\frac{SSR}{df_{\text{regression}}}}{\frac{SSE}{df_{\text{error}}}} = \frac{\frac{1,025}{5}}{\frac{925}{25}} = \frac{205}{37} = 5.5$$
5. C The coefficients column contains the regression parameters.
6. C The regression equation is  $0.522 + 0.0460(\text{MKT}) + 0.7102(\text{IND}) + 0.9(\text{FORT})$ . The coefficient on FORT is the amount of the return attributable to the stock of a Fortune 500 firm.
7. A The regression equation is  $0.522 + 0.0460(\text{MKT}) + 0.7102(\text{IND}) + 0.9(\text{FORT})$ , so  $\text{RET} = 0.522 + 0.0460(5) + 0.7102(3) + 0.900(0) = 2.88\%$ .
8. C The  $p$ -value = 0.139, or 13.9%, which is not a reasonable level of significance.
9. C The Breusch-Pagan test is statistically significant at any reasonable level of significance, which indicates heteroskedasticity. The Durbin-Watson statistic is greater than the lower limit, but less than the upper limit, which places it in the “inconclusive” area. Thus, we are unable to reject the null hypothesis that there is no serial correlation present.
10. C  $SSR = 9,105 - 4,320 = 4,785$   

$$F = \frac{\frac{4,785}{4}}{\frac{4,320}{65 - 4 - 1}} = \frac{1,196.25}{72} = 16.61$$
11. B This is a one-tailed test, so the critical  $F$ -value at the 5% significance level with 4 and 60 degrees of freedom is approximately 2.53.
12. B Using leading P/E from a prior period as an independent variable in the regression is unlikely to result in misspecification because it is not related to any of the six types of misspecifications previously discussed. We’re not forecasting the past because leading P/E is calculated using beginning-of-period stock price and a forecast of earnings for the next period. Omitting a relevant independent variable from the regression and using actual instead of expected inflation (measuring the independent variable in error) are likely to result in model misspecification.
13. C The effects of the model misspecification on the regression results are basically the same for all of the misspecifications: regression coefficients are biased and inconsistent, which means we can’t have any confidence in our hypothesis tests of the coefficients or in the predictions of the model. Notice that choice C states that model misspecification will result in “unbiased” regression coefficients, while in fact model misspecification is most likely to result in “biased” regression coefficients.

## ANSWERS – CHALLENGE PROBLEMS

14. C Including a lagged dependent variable (previous period hedge fund composite index returns) in the list of independent variables is likely to lead to model misspecification and biased and inconsistent regression coefficients.

The fact that an independent variable (small-cap returns) and the dependent variable (hedge fund index returns) are correlated is not a problem for the regression model; we would expect that if the model has predictive power the dependent variable would be correlated with the independent variables. The fact that two independent variables (small-cap returns and emerging market index returns) are correlated is not a problem of model misspecification, but potentially one of multicollinearity, but without additional information we can't draw any conclusions concerning whether multicollinearity is a problem (remember "most likely").

15. A The Durbin-Watson statistic tests for serial correlation of the residuals. The appropriate remedy if serial correlation is detected is to use the Hansen method.
16. B Adjusted  $R^2$  must be less than or equal to  $R^2$ . However, if  $R^2$  is low enough and the number of independent variables is large, adjusted  $R^2$  may be negative.
17. C The  $t$ -statistic tests the null that industry returns are equal. The dummy variable is significant and positive, and the dummy variable is defined as being equal to one for biotechnology stocks, which means that biotechnology stock returns are statistically significantly larger than electric utility stock returns. Remember, however, this is only accurate if we hold the other independent variables in the model constant.
18. B Note that  $IND = 1$  because the stock is in the biotech industry. Predicted  $P/E = 6.75 + (8.00 \times 1) + (4.00 \times 0.00) + (12.35 \times 0.14) - (0.50 \times 1.5) = 15.7$ .
19. C Assumptions underlying a multiple regression include: the error for one observation is not correlated with that of another observation; the expected value of the error term is zero; a linear relationship exists between the dependent and independent variables; the variance of the error terms is constant.
20. C All qualitative dependent variable models must be tested for heteroskedasticity, serial correlation, and multicollinearity. Each of the alternatives are potential examples of a qualitative dependent variable model, but none are universal elements of all qualitative dependent variable models.

---

The following is a review of the Quantitative Methods principles designed to address the learning outcome statements set forth by CFA Institute®. This topic is also covered in:

# TIME-SERIES ANALYSIS

Study Session 3

---

## EXAM FOCUS

This topic review builds on the previous review on multiple regression, only here the focus is on time series analysis. A time series is a set of observations of a random variable spaced evenly through time (e.g., quarterly sales revenue for a company over the past 60 quarters). For the exam, identifying and correcting regression violations, such as heteroskedasticity, nonstationarity, serial correlation, etc., will be important, as well as being able to calculate a value when a time-series model is provided. Know why a log-linear model is sometimes used; understand the implications of seasonality and how to detect and correct it, as well as the root mean squared error (RMSE) criterion. Be sure you can look at a plot of data to detect nonstationarity or use the output from a regression analysis to analyze a time-series model.

---

**LOS 13.a: Calculate and evaluate the predicted trend value for a time series, modeled as either a linear trend or a log-linear trend, given the estimated trend coefficients.**

---

A **time series** is a set of observations for a variable over successive periods of time (e.g., monthly stock market returns for the past ten years). The series has a **trend** if a consistent pattern can be seen by plotting the data (i.e., the individual observations) on a graph. For example, a seasonal trend in sales data is easily detected by plotting the data and noting the significant jump in sales during the same month(s) each year.

## Linear Trend Model

A **linear trend** is a time series pattern that can be graphed using a straight line. A downward sloping line indicates a negative trend, while an upward-sloping line indicates a positive trend.

The simplest form of a linear trend is represented by the following linear trend model:

$$y_t = b_0 + b_1(t) + \epsilon_t$$

where:

$y_t$  = the value of the time series (the dependent variable) at time  $t$

$b_0$  = intercept at the vertical axis (y-axis)

$b_1$  = slope coefficient (or trend coefficient)

$\epsilon_t$  = error term (or residual term or disturbance term)

$t$  = time (the independent variable);  $t = 1, 2, 3 \dots T$

Ordinary least squares (OLS) regression (simple linear regression) is used to estimate the coefficient in the trend line, which provides the following prediction equation:

$$\hat{y}_t = \hat{b}_0 + \hat{b}_1(t)$$

where:

$\hat{y}_t$  = the predicted value of  $y$  (the dependent variable) at time  $t$

$\hat{b}_0$  = the estimated value of the intercept term

$\hat{b}_1$  = the estimated value of the slope coefficient

*Professor's Note: Don't let this model confuse you. It's very similar to the simple linear regression model we covered previously; only here,  $(t)$  takes on the value of the time period. For example, in period 2, the equation becomes:*

$$\hat{y}_2 = \hat{b}_0 + \hat{b}_1(2)$$



And, likewise, in period 3:

$$\hat{y}_3 = \hat{b}_0 + \hat{b}_1(3)$$

*This means  $\hat{y}$  increases by the value of  $\hat{b}_1$  each period.*

#### Example: Using a linear trend model

Assume you are given a linear trend model with  $\hat{b}_0 = 1.70$  and  $\hat{b}_1 = 3.0$ .

Calculate  $\hat{y}_t$  for  $t = 1$  and  $t = 2$ .

**Answer:**

When  $t = 1$ ,  $\hat{y}_1 = 1.70 + 3.0(1) = 4.70$

When  $t = 2$ ,  $\hat{y}_2 = 1.70 + 3.0(2) = 7.70$

Note that the difference between  $\hat{y}_1$  and  $\hat{y}_2$  is 3.0, or the value of the trend coefficient  $b_1$ .

**Example: Trend analysis**

Consider hypothetical time series data for manufacturing capacity utilization.

**Manufacturing Capacity Utilization**

| <i>Quarter</i> | <i>Time<br/>(t)</i> | <i>Manufacturing<br/>Capacity Utilization<br/>(in %)</i> | <i>Quarter</i> | <i>Time<br/>(t)</i> | <i>Manufacturing<br/>Capacity Utilization<br/>(in %)</i> |
|----------------|---------------------|----------------------------------------------------------|----------------|---------------------|----------------------------------------------------------|
| 2004.1         | 1                   | 82.4                                                     | 2005.4         | 8                   | 80.9                                                     |
| 2004.2         | 2                   | 81.5                                                     | 2006.1         | 9                   | 81.3                                                     |
| 2004.3         | 3                   | 80.8                                                     | 2006.2         | 10                  | 81.9                                                     |
| 2004.4         | 4                   | 80.5                                                     | 2006.3         | 11                  | 81.7                                                     |
| 2005.1         | 5                   | 80.2                                                     | 2006.4         | 12                  | 80.3                                                     |
| 2005.2         | 6                   | 80.2                                                     | 2007.1         | 13                  | 77.9                                                     |
| 2005.3         | 7                   | 80.5                                                     | 2007.2         | 14                  | 76.4                                                     |

Applying the OLS methodology to fit the linear trend model to the data produces the results shown below.

**Time Series Regression Results for Manufacturing Capacity Utilization**

Regression model:  $y_t = b_0 + b_1t + \epsilon_t$

|                   |       |
|-------------------|-------|
| R square          | 0.346 |
| Adjusted R square | 0.292 |
| Standard error    | 1.334 |
| Observations      | 14    |

|                           | <i>Coefficients</i> | <i>Standard Error</i> | <i>t-Statistic</i> |
|---------------------------|---------------------|-----------------------|--------------------|
| Intercept                 | 82.137              | 0.753                 | 109.066            |
| Manufacturing utilization | -0.223              | 0.088                 | -2.534             |

Based on this information, predict the projected capacity utilization for the time period involved in the study (i.e., in-sample estimates).

**Answer:**

As shown in the regression output, the estimated intercept and slope parameters for our manufacturing capacity utilization model are  $\hat{b}_0 = 82.137$  and  $\hat{b}_1 = -0.223$ , respectively. This means that the prediction equation for capacity utilization can be expressed as:

$$\hat{y}_t = 82.137 - 0.223t$$

With this equation, we can generate estimated values for capacity utilization,  $\hat{y}_t$ , for each of the 14 quarters in the time series. For example, using the model capacity utilization for the first quarter of 2004 is estimated at 81.914:

$$\hat{y}_t = 82.137 - 0.223(1) = 82.137 - 0.223 = 81.914$$

Note that the estimated value of capacity utilization in that quarter (using the model) is not exactly the same as the actual, measured capacity utilization for that quarter (82.4). The difference between the two is the error or residual term associated with that observation:

$$\text{Residual (error)} = \text{actual value} - \text{predicted value} \approx 82.4 - 81.9 = 0.5$$

Note that since the actual, measured value is greater than the predicted value of  $y$  for 2004.1, the error term is positive. Had the actual, measured value been less than the predicted value, the error term would have been negative.

The projections (i.e., values generated by the model) for all quarters are compared to the actual values below.

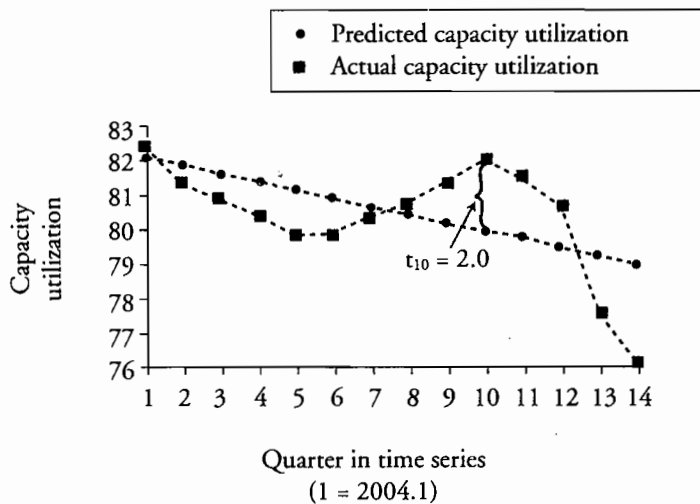
#### Projected Versus Actual Capacity Utilization

| Quarter | Time | $\hat{y}_t$ | $y_t$ | Quarter | Time | $\hat{y}_t$ | $y_t$ |
|---------|------|-------------|-------|---------|------|-------------|-------|
| 2004.1  | 1    | 81.914      | 82.4  | 2005.4  | 8    | 80.353      | 80.9  |
| 2004.2  | 2    | 81.691      | 81.5  | 2006.1  | 9    | 80.130      | 81.3  |
| 2004.3  | 3    | 81.468      | 80.8  | 2006.2  | 10   | 79.907      | 81.9  |
| 2004.4  | 4    | 81.245      | 80.5  | 2006.3  | 11   | 79.684      | 81.7  |
| 2005.1  | 5    | 81.022      | 80.2  | 2006.4  | 12   | 79.460      | 80.3  |
| 2005.2  | 6    | 80.799      | 80.2  | 2007.1  | 13   | 79.237      | 77.9  |
| 2005.3  | 7    | 80.576      | 80.5  | 2007.2  | 14   | 79.014      | 76.4  |

The following graph shows visually how the predicted values compare to the actual values, which were used to generate the regression equation. The **residuals**, or **error terms**, are represented by the distance between the predicted (straight) regression line and the actual data plotted in blue. For example, the residual for  $t = 10$  is  $81.9 - 79.907 = 2.0$



### Predicted vs. Actual Capacity Utilization



Since we utilized a linear regression model, the predicted values will by definition fall on a straight line. Since the raw data does not display a linear relationship, the model will not do a good job of predicting future values.

Notice that the error terms appear to be positively correlated: six of the first seven are negative, the next five are positive, and the last two are negative. This is also an indication that the model is not appropriate for the data, as we will discuss in LOS 13.c.

### Log-Linear Trend Models

Time series data, particularly financial time series, often display *exponential growth*. Positive exponential growth means that the data (i.e., the time series) tends to increase at some continuously compounded rate of growth. If we plot the data, the observations will form a convex (i.e., non-linear) curve. Negative exponential growth means that the data tends to decrease at some continuously compounded rate of growth, and the plotted time series will show a concave curve.

When a series exhibits exponential growth, each successive value of the series can be defined as:

$$y_t = e^{b_0 + b_1(t)}$$

where:

$y_t$  = the value of the dependent variable at time  $t$

$b_0$  = the intercept term

$b_1$  = the constant rate of growth

$e$  = the base of the natural logarithm

$t$  = time = 1, 2, 3...T

This model defines  $y$ , the dependent variable, as an *exponential* function of time, the independent variable. Rather than try to fit the curved nature of the data with a linear (straight line) regression, we take the natural log of both sides of the equation and arrive at the *log-linear* model. This is frequently used when time series data exhibit exponential growth.

$$\ln(y_t) = \ln\left(e^{b_0 + b_1(t)}\right) \Rightarrow \ln(y_t) = b_0 + b_1(t)$$

Notice that in the original equation, the exponent of  $e$ , the base of the natural logs, is itself a linear function. When you take the natural log of both sides of the equation, you arrive at a model which describes the *natural log* of  $y$  (i.e., the original dependent variable that showed exponential growth) as a *linear* function of time.

Now that the equation has been transformed from an exponential to a linear function, we can use a linear regression technique to model the series. The use of the transformed data produces a *linear* trend line with a better fit for the data and increases the predictive ability of the model. Because the log-linear model more accurately captures the behavior of the time series, the impact of *serial correlation* (discussed below) in the error terms is minimized.

#### Example: Log-linear trend model

An analyst estimates a log-linear trend model using quarterly revenue data (in millions of \$) from the first quarter of 1996 to the fourth quarter of 2007 for JP Northfield, Inc.:

$$\ln \text{revenue}_t = b_0 + b_1(t) + \varepsilon_t \quad t = 1, 2, \dots, 48$$

The results are shown in the following table.

|           | <i>Coefficient</i> | <i>Standard Error</i> | <i>t-statistic</i> |
|-----------|--------------------|-----------------------|--------------------|
| Intercept | 4.00               | 0.05                  | 80.0               |
| Trend     | 0.09               | 0.01                  | 9.0                |

Calculate JP Northfield's predicted revenues in the first quarter of 2008.

**Answer:**

In the first quarter of 2008,  $t$  is equal to 49 because the sample has 48 observations.

$$\ln \text{revenue}_{49} = 4.00 + 0.09(49) = 8.41$$

$$\text{revenue}_{49} = e^{\ln \text{revenue}_{49}} = e^{8.41} = \$4,492 \text{ million}$$

The first answer you get in this calculation is the natural log of the revenue forecast. In order to turn the natural log into a revenue figure, you use the 2nd function of the LN key ( $e^x$ ) on your BA II Plus: enter 8.41 and press [2nd]  $e^x$  = 4,492 million.

**LOS 13.b:** Discuss the factors that determine whether a linear or log-linear trend should be used with a particular time series and evaluate the limitations of trend models.

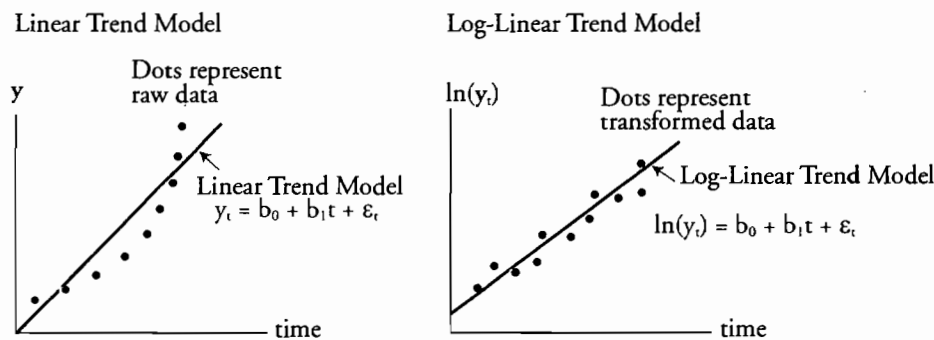
### FACTORS THAT DETERMINE WHICH MODEL IS BEST

To determine if a linear or log-linear trend model should be used, the analyst should plot the data. A *linear trend model* may be appropriate if the data points appear to be equally distributed above and below the regression line. Inflation rate data can often be modeled with a linear trend model.

If, on the other hand, the data plots with a non-linear (curved) shape, then the residuals from a linear trend model will be persistently positive or negative for a period of time. In this case, the *log-linear model* may be more appropriate. By taking the log of the  $y$  variable, a regression line can better fit the data. Financial data (e.g., stock indices and stock prices) and company sales data are often best modeled with a log-linear model.

Figure 1 shows a time series that is best modeled with a log-linear trend model rather than a linear trend model.

**Figure 1: Linear vs. Log-Linear Trend Models**



The left panel is a plot of data that exhibits exponential growth (e.g., compound growth) along with a linear trend line. The panel on the right is a plot of the natural logs of the original data and a representative log-linear trend line. The log-linear model fits the transformed data better than the linear trend model fits the original data and would, therefore, yield more accurate forecasts.

The bottom line is that growth at a constant *rate* calls for a log-linear model, so the raw data needs to be transformed. When the data grows by a constant *amount*, a linear trend model is more appropriate.

### LIMITATIONS OF TREND MODELS

Recall from the previous two topic reviews that one of the assumptions underlying linear regression is that the residual term is independently distributed and the residuals are uncorrelated with each other. A violation of this assumption is referred

to as autocorrelation (which is covered in LOS 13.d). In this case, the residuals are persistently positive or negative for a period of time and it is said that the data exhibit serial correlation. This is a significant limitation, as it means that the model is not appropriate for the time series and that we should not use it to predict future performance.

In the preceding discussion, we suggested that a log-linear trend model would be better than a linear trend model when there is serial correlation in the data. However, it may be the case that even a log-linear model is not appropriate in the presence of serial correlation. In this case, we will want to turn to the autoregressive models discussed below.



*Professor's Note: Recall from the previous topic review that the Durbin Watson statistic (DW) is used to detect autocorrelation. For a time series model without serial correlation DW should be approximately equal to 2.0. A DW significantly less than 2.0 suggests that the residual terms are positively correlated. Please see LOS 12.g from the previous topic review for more detail on implementing the DW test.*

---

**LOS 13.d: Discuss the structure of an autoregressive (AR) model of order  $p$ , calculate one- and two-period-ahead forecasts given the estimated coefficients, and explain how autocorrelations of the residuals can be used to test whether the autoregressive model fits the time series.**

---



*Professor's Note: In the material that follows, we discuss the LOS in the order that we believe is best suited for effective learning.*

Using a lagged dependent variable as an independent variable does not automatically mean that the regression is misspecified. In this section, we turn our attention to **autoregressive models (AR)**, in which the dependent variable is regressed against one or more lagged values of itself. For example, the sales for a firm in March could be regressed against the sales for the firm in the two previous months of January and February.

The following model illustrates how variable  $x$  would be regressed on itself with a lag of one and two periods:

$$x_t = b_0 + b_1x_{t-1} + b_2x_{t-2} + \varepsilon_t$$

A model with two lags is referred to as a *second-order* autoregressive model, or an AR(2) model (i.e., autoregressive model using two lagged values of the dependent variable). In general, an AR model of order  $p$ , AR( $p$ ), is expressed as:

$$x_t = b_0 + b_1x_{t-1} + b_2x_{t-2} + \dots + b_px_{t-p} + \varepsilon_t$$

where  $p$  indicates the number of lagged values that the autoregressive model will include.

## Forecasting With an Autoregressive Model

Autoregressive time series multi-period forecasts are calculated in the same manner as those for other regression models, but since the independent variable is a lagged value of the dependent variable, it is necessary to calculate a one-step-ahead forecast before a two-step-ahead forecast can be calculated. The calculation of successive forecasts in this manner is referred to as the **chain rule of forecasting**.

A one-period-ahead forecast for an AR(1) model is determined in the following manner:

$$\hat{x}_{t+1} = \hat{b}_0 + \hat{b}_1 x_t$$

Likewise, a two-step-ahead forecast for an AR(1) model is calculated as:

$$\hat{x}_{t+2} = \hat{b}_0 + \hat{b}_1 \hat{x}_{t+1}$$

Note that the ^ symbol above the variables in the equations indicates that the inputs used in multi-period forecasts are actually forecasts (estimates) themselves. This implies that multi-period forecasts are more uncertain than single period forecasts. For example, for a two-step-ahead model, there is the usual uncertainty associated with forecasting  $x_{t+1}$  using  $x_t$ , plus the additional uncertainty of forecasting  $x_{t+2}$  using the forecast value for  $x_{t+1}$ .

### Example: Forecasting

Suppose that an AR(1) model has been estimated and has produced the following prediction equation:  $x_t = 1.2 + 0.45x_{t-1}$ . Calculate a two-step-ahead forecast if the current value of  $x$  is 5.0.

#### Answer:

One-step-ahead forecast: If  $x_t = 5$ , then  $x_{t+1} = 1.2 + 0.45(5) = 3.45$ .

Two-step-ahead forecast: If  $x_{t+1} = 3.45$ , then  $x_{t+2} = 1.2 + 0.45(3.45) = 2.75$ .

## Autocorrelation & Model Fit

When an AR model is correctly specified, the residual terms will not exhibit *serial correlation*. Serial correlation (or autocorrelation) means the error terms are correlated. When the error terms are correlated, standard errors are unreliable and *t*-tests of individual coefficients can incorrectly show statistical significance or insignificance.

If the residuals possess some degree of serial correlation, the AR model that produced the residuals is not the best model for the time series being analyzed. The procedure to test whether an AR time series model is correctly specified involves three steps:

**Step 1:** Estimate the AR model being evaluated using linear regression:

Start with a first-order AR model [i.e., AR(1)] using  $x_t = b_0 + b_1 x_{t-1} + \epsilon_t$ .

**Step 2:** Calculate the autocorrelations of the model's residuals (i.e., the level of correlation between the forecast errors from one period to the next).

**Step 3:** Test whether the autocorrelations are significant:

If the model is correctly specified, none of the correlations will be statistically significant. To test for significance, a  $t$ -test is used to test the hypothesis that the correlations of the residuals are zero. The  $t$ -statistic is the estimated autocorrelation divided by the standard error. The standard error is

$\frac{1}{\sqrt{T}}$ , where  $T$  is the number of observations, so the test statistic for each autocorrelation is  $t = \frac{\rho_{\epsilon_t, \epsilon_{t-k}}}{1/\sqrt{T}}$  with  $(T - 2)$  degrees of freedom, where  $k$  is the

number of lagged terms and  $\rho_{\epsilon_t, \epsilon_{t-k}}$  is the correlation of error term  $t$  with the  $k$ th lagged error term.



*Professor's Note: The Durbin-Watson test that we used with trend models is not appropriate for testing for serial correlation of the error terms in an autoregressive model. Use this  $t$ -test instead.*

**Example: Testing an AR model for proper specification**

The correlations of the error terms from the estimation of an AR(1) model using a sample with 102 observations are presented in the following figure. Determine whether the model is correctly specified.

**Autocorrelation Analysis**

Model:  $y_t = b_0 + b_1 y_{t-1} + \epsilon_t$

| Lag | Autocorrelation | $t$ -Statistic | Lag | Autocorrelation | $t$ -Statistic |
|-----|-----------------|----------------|-----|-----------------|----------------|
| 1   | 0.0616114       | 0.622245       | 7   | -0.010146       | -0.102470      |
| 2   | 0.0843368       | 0.851760       | 8   | 0.0211711       | 0.213818       |
| 3   | 0.0258823       | 0.261398       | 9   | -0.0959502      | -0.969050      |
| 4   | 0.0188928       | 0.190808       | 10  | 0.0389730       | 0.393608       |
| 5   | 0.1001404       | 1.011368       | 11  | -0.0677132      | -0.683870      |
| 6   | -0.0638219      | -0.644570      | 12  | -0.0122798      | -0.124020      |

**Answer:**

The critical two-tail  $t$ -value at the 5% significance level and 100 degrees of freedom is 1.98. The  $t$ -statistics indicate that none of the autocorrelations of the residuals in the previous figure is statistically different from zero because their absolute values are less than 1.98. Thus, there is sufficient reason to believe that the error terms from the AR(1) model are not serially correlated.

If the  $t$ -tests indicate that any of the correlations computed in Step 2 are statistically significant (i.e.,  $t \geq 1.98$ ), the AR model is not specified correctly. Lags corresponding to the significant correlations are included in the model and the correlations of the residuals (error terms) are checked again. This procedure will be followed until all autocorrelations are insignificant.

**LOS 13.k:** Discuss how to test and correct for seasonality in a time-series model and calculate and interpret a forecasted value using an AR model with a seasonal lag.

Seasonality in a time-series is a pattern that tends to repeat from year to year. One example is monthly sales data for a retailer. Given that sales data normally vary according to the time of year, we might expect this month's sales to be related to sales for the same month last year.

When seasonality is present, modeling the associated time series data would be incomplete unless the regression model incorporates the effects of the seasonality.

#### Example: Detecting seasonality

You are interested in predicting occupancy levels for a resort hotel chain and have acquired the chain's quarterly occupancy levels for the most recent 40 quarters (ten years). You decide to model the quarterly occupancy time-series using the AR(1) model:

$$\ln y_t = b_0 + b_1 \ln y_{t-1} + \varepsilon_t$$

Determine whether seasonality exists using the results presented in the following example.

#### Autoregression Output for Log-Quarterly Hotel Occupancy

| <i>Resort Occupancy Levels</i>                               |                 |                |             |
|--------------------------------------------------------------|-----------------|----------------|-------------|
| AR(1)Model $\ln y_t = b_0 + b_1 \ln y_{t-1} + \varepsilon_t$ |                 |                |             |
| R <sup>2</sup>                                               | 0.7929          |                |             |
| Standard error                                               | 0.1952          |                |             |
| Observations                                                 | 39              |                |             |
|                                                              | Coefficients    | Standard Error | t-Statistic |
| Intercept                                                    | 0.0375          | 0.0274         | 1.369       |
| Lag 1                                                        | 0.5318          | 0.1635         | 3.2526      |
| <i>Autocorrelation of Residuals</i>                          |                 |                |             |
| Residual Lag                                                 | Autocorrelation | Standard Error | t-Statistic |
| 1                                                            | -0.0615         | 0.1601         | -0.3841     |
| 2                                                            | -0.0121         | 0.1601         | -0.0756     |
| 3                                                            | -0.0212         | 0.1601         | -0.1324     |
| 4                                                            | 0.8719          | 0.1601         | 5.4460      |

**Answer:**

The bottom part of the table contains the residual autocorrelations for the first four lags of the time series. What stands out is the relatively large correlation and  $t$ -statistic for the fourth lag. With 39 observations and two parameters, ( $b_0$  and  $b_1$ ), there are 37 degrees of freedom. At a significance level of 5%, the critical  $t$ -value is 2.026.

The  $t$ -statistics indicate that none of the first three lagged autocorrelations is significantly different from zero. However, the  $t$ -statistic at Lag 4 is 5.4460, which means that we must reject the null hypothesis that the Lag 4 correlation is zero and conclude that seasonality is present in the time-series. Thus, we conclude that this model is misspecified and will be unreliable for forecasting purposes. We need to include a seasonality term to make the model useable.



*Professor's Note: With an AR(1) model, we lose one observation (i.e., we go from 40 to 39 observations). With an AR(2) model, we lose two observations, and so on.*

**Correcting seasonality.** The interpretation of seasonality in the above example is that occupancy in any quarter is related to occupancy in the previous quarter and the same quarter in the previous year. For example, fourth quarter 2008 occupancy is related to third quarter 2008 occupancy as well as fourth quarter 2007 occupancy.

To adjust for seasonality in an AR model, an additional lag of the *dependent* variable (corresponding to the same season in the previous year) is added to the original model as another *independent* variable. For example, if quarterly data are used, the seasonal lag is 4; if monthly data are used the seasonal lag is 12; and so on.

**Example: Correcting for seasonality in a time-series model**

We continue with our resort occupancy level example, where the significant residual correlation at Lag 4 indicates seasonality in the quarterly time series. By testing the correlations of the error terms, it appears that occupancy levels in each quarter are related not only to the previous quarter, but also to the corresponding quarter in the previous year. To adjust for this problem, we add a lagged value of the dependent variable to the original model that corresponds to the seasonal pattern.

To model the autocorrelation of the same quarters from year to year, we use an AR(1) model with a seasonal lag:  $\ln y_t = b_0 + b_1(\ln y_{t-1}) + b_2(\ln y_{t-4}) + \epsilon_t$ . Note that this specification, the inclusion of a seasonal lag, does not result in an AR(2) model. It results in an AR(1) model incorporating a seasonal lag term.

The results obtained when this model is fit to the natural logarithm of the time series are presented in the following. Determine whether the model is specified correctly and if we can use it to predict resort occupancy levels.



| <i>Log-Resort Hotel Occupancy</i>                                                                      |                 |                |             |
|--------------------------------------------------------------------------------------------------------|-----------------|----------------|-------------|
| AR(1) Model with a Seasonal Lag: $\ln y_t = b_0 + b_1(\ln y_{t-1}) + b_2(\ln y_{t-4}) + \varepsilon_t$ |                 |                |             |
| R <sup>2</sup>                                                                                         | 0.948983874     |                |             |
| Standard error                                                                                         | 0.3754          |                |             |
| Observations                                                                                           | 38              |                |             |
|                                                                                                        | Coefficients    | Standard Error | t-Statistic |
| Intercept                                                                                              | 0.0085          | 0.0049         | 1.7347      |
| Lag 1                                                                                                  | 0.2598          | 0.0527         | 4.9298      |
| Lag 4                                                                                                  | 0.7921          | 0.2166         | 3.6570      |
| <i>Autocorrelation of Residuals</i>                                                                    |                 |                |             |
| Residual Lag                                                                                           | Autocorrelation | Standard Error | t-Statistic |
| 1                                                                                                      | -0.0526         | 0.1622         | -0.3243     |
| 2                                                                                                      | 0.0715          | 0.1622         | 0.4408      |
| 3                                                                                                      | -0.0241         | 0.1622         | -0.1486     |
| 4                                                                                                      | -0.0435         | 0.1622         | -0.2682     |

**Answer:**

Notice in the bottom of the table that the fourth-lag residual autocorrelation has dropped substantially and is, in fact, no longer statistically significant. Also notable in these results is the improvement in the R-square for the adjusted model (94.9%) compared to the R-square from the original model (79.3%). The results shown in the figure indicate that, by incorporating a seasonal lag term, the model is now specified correctly.

## FORECASTING WITH AN AR MODEL WITH A SEASONAL LAG

### Example: Forecasting with an autoregressive model

Based on the regression results from the previous example and the occupancy levels over the past year (presented below), forecast the level of hotel occupancy for the first quarter of 2003.

#### Quarterly Hotel Occupancy Levels

| Quarter         | 2002.1  | 2002.2  | 2002.3  | 2002.4  |
|-----------------|---------|---------|---------|---------|
| Occupancy Level | 250,000 | 750,000 | 450,000 | 600,000 |

**Answer:**

We express the seasonally adjusted forecasting equation as:

$$\ln y_t = 0.0085 + 0.2598(\ln y_{t-1}) + 0.7921(\ln y_{t-4})$$

where  $y_t$  is the occupancy level for the  $t$ th quarter ( $t$  = first, second, third, or fourth quarter).

To forecast the occupancy level for the hotel chain for the first quarter of 2003 (i.e., 2003.1), the following computation is made:

$$\ln y_{2003.1} = 0.0085 + 0.2598(\ln y_{2002.4}) + 0.7921(\ln y_{2002.1})$$

$$\ln y_{2003.1} = 0.0085 + 0.2598(\ln 600,000) + 0.7921(\ln 250,000)$$

$$\ln y_{2003.1} = 0.0085 + 0.2598(13.3047) + 0.7921(12.4292)$$

$$\ln y_{2003.1} = 13.3103$$

$$\text{Since } y = e^{\ln(y)}, y_{2003.1} = e^{13.3103} = 603,378.52$$

The forecasted level of hotel occupancy for the first quarter of 2003 is 603,379, a significant increase over the same quarter the previous year. With such a significant increase in forecasted occupancy, the analyst should re-examine the model and its inputs. Forecasting is always fraught with uncertainty, even when the model being used seems to fit the data well.



*Professor's Note: Once again, the first answer you get in this calculation is the natural log of the occupancy forecast. In order to turn the natural log into an occupancy figure, you use the 2nd function of the LN key ( $e^x$ ) on your BA II Plus: enter 13.3103 and press [2nd]  $e^x$  = 603,378.52.*

---

**LOS 13.f:** Contrast in-sample and out-of-sample forecasts and compare the forecasting accuracy of different time-series models based on the root mean squared error criterion.

---

**In-sample forecasts** are *within* the range of data (i.e., time period) used to estimate the model, which for a time series is known as the sample or test period. In-sample forecast errors are  $(y_t - \hat{y}_t)$ , where  $t$  is an observation within the sample period. In other words, we are comparing how accurate our model is in forecasting the actual data we used to develop the model. If the predicted value is greater than the actual value the error or residual term is negative. If the predicted value is less than the actual value the error or residual term is positive. The Predicted vs. Actual Capacity Utilization figure in our Trend Analysis example shows an example of values predicted by the model compared to the values used to generate the model.

**Out-of-sample forecasts** are made *outside* of the sample period. In other words, we compare how accurate a model is in forecasting the  $y$  variable value for a time period outside the period used to develop the model. Out-of-sample forecasts are important because they provide a test of whether the model adequately describes the time series and whether it has relevance (i.e., predictive power) in the real world. Nonetheless, an analyst should be aware that most published research employs in-sample forecasts only.

The **root mean squared error** criterion (RMSE) is used to compare the accuracy of autoregressive models in forecasting out-of-sample values. For example, a researcher may have two autoregressive (AR) models: an AR(1) model and an AR(2) model. To determine which model will more accurately forecast future values, we calculate the RMSE (the square root of the average of the squared errors) for the out-of-sample data. Note that the model with the lowest RMSE for in-sample data may not be the model with the lowest RMSE for out-of-sample data.

For example, assume we have 60 months of historical unemployment data. We estimate both models over the first 36 of 60 months. To determine which model will produce better (i.e., more accurate) forecasts, we then forecast the values for the last 24 of 60 months of historical data. Using the actual values for the last 24 months as well as the values predicted by the models, we can calculate the RMSE for each model.

The model with the lower RMSE for the out-of-sample data will have lower forecast error and will be expected to have better predictive power in the future.

In addition to examining the RMSE criteria for a model, we will also want to examine the stability of regression coefficients, which we discuss below.

---

**LOS 13.g: Discuss the instability of coefficients of time-series models.**

---

Financial and economic time series inherently exhibit some form of *instability* or *nonstationarity*. This is because financial and economic conditions are dynamic, and the estimated regression coefficients in one period may be quite different from those estimated during another period.

Models estimated with shorter time series are usually more stable than those with longer time series because a longer sample period increases the chance that the underlying economic process has changed. Thus, there is a tradeoff between the increased statistical reliability when using longer time periods and the increased stability of the estimates when using shorter periods.

The primary concern when selecting a time series sample period is the underlying economic processes. Have there been regulatory changes? Has there been a dramatic change in the underlying economic environment?

If the answer is yes, then the historical data may not provide a reliable model. Merely examining the significance of the autocorrelation of the residuals will not indicate whether the model is valid. We must also examine whether the data is covariance stationary.

---

**LOS 13.c: Explain the requirement for a time series to be covariance stationary and discuss the significance of a series not being stationary.**

---

Statistical inferences based on OLS estimates for an AR time series model may be invalid unless the time series being modeled is covariance stationary.

A time series is covariance stationary if it satisfies the following three conditions:

1. *Constant and finite expected value.* The expected value of the time series is constant over time. (In the next section, we will refer to this value as the mean-reverting level.)
2. *Constant and finite variance.* The time series' volatility around its mean (i.e., the distribution of the individual observations around the mean) does not change over time.
3. *Constant and finite covariance with leading or lagged values.* The covariance of the time series with leading or lagged values of itself is constant.

To determine if the first two requirements are satisfied, one can examine a plot of the data over time. If it appears that the mean or variance changes over time, then the data is not covariance stationary. It is often the case that financial or economic data are not covariance stationary. For example, if the data exhibit seasonality or trends over time (e.g., sales or consumption data), the mean will not be constant. Note also that data that were stationary in the past may not be stationary in the future if economic processes change.

To understand the concept behind the third requirement, consider the data in Figure 2. The first two columns contain original data from our manufacturing capacity utilization example. Columns three and four contain the corresponding lagged variables, with a lag of one quarter. Note that column one begins with the second quarter's observation while column three begins with the first quarter's observation. The third condition states that regardless of the lag or lead used (e.g., one quarter, two quarters), the covariance between the two series must be the same. In other words, the covariance between values from different time periods must always be the same, regardless of the length of the lead or lag that is employed.

Figure 2: Lagged Data for Manufacturing Capacity Utilization

| Quarter | Manufacturing<br>Capacity Utilization<br>$t$ | Lagged<br>Quarter | Manufacturing<br>Capacity Utilization<br>$t - 1$ |
|---------|----------------------------------------------|-------------------|--------------------------------------------------|
| 2004.2  | 81.5                                         | 2004.1            | 82.4                                             |
| 2004.3  | 80.8                                         | 2004.2            | 81.5                                             |
| 2004.4  | 80.5                                         | 2004.3            | 80.8                                             |
| 2005.1  | 80.2                                         | 2004.4            | 80.5                                             |
| 2005.2  | 80.2                                         | 2005.1            | 80.2                                             |
| 2005.3  | 80.5                                         | 2005.2            | 80.2                                             |
| 2005.4  | 80.9                                         | 2005.3            | 80.5                                             |
| 2006.1  | 81.3                                         | 2005.4            | 80.9                                             |
| 2006.2  | 81.9                                         | 2006.1            | 81.3                                             |
| 2006.3  | 81.7                                         | 2006.2            | 81.9                                             |
| 2006.4  | 80.3                                         | 2006.3            | 81.7                                             |
| 2007.1  | 77.9                                         | 2006.4            | 80.3                                             |
| 2007.2  | 76.4                                         | 2007.1            | 77.9                                             |

### LOS 13.e: Explain mean reversion and calculate a mean-reverting level.

A time series exhibits **mean reversion** if it has a tendency to move toward its mean. In other words, the time series has a tendency to decline when the current value is above the mean and rise when the current value is below the mean. If a time series is at its mean-reverting level, the model predicts that the next value of the time series will be the same as its current value (i.e.,  $\hat{x}_t = x_{t-1}$  when a time series is at its mean-reverting level).

For an AR(1) model,  $x_t = b_0 + b_1x_{t-1}$ , the above equality implies that  $x_t = b_0 + b_1x_t$ .

Solving for  $x_t$ , the mean-reverting level is expressed as  $x_t = \frac{b_0}{(1 - b_1)}$ .

So, if  $x_t > \frac{b_0}{(1 - b_1)}$ , the AR(1) model predicts that  $x_{t+1}$  will be lower than  $x_t$ , and if

$x_t < \frac{b_0}{1 - b_1}$ , the model predicts that  $x_{t+1}$  will be higher than  $x_t$ .

**Example: Mean-reverting time series**

Calculate the mean-reverting level for the manufacturing capacity utilization time series using the following regression results:

**Time Series Regression Results for Manufacturing Capacity Utilization**

| Regression model: $x_t = b_0 + b_1x_{t-1}$ |                     |                       |                    |
|--------------------------------------------|---------------------|-----------------------|--------------------|
| R square                                   | 0.346508            |                       |                    |
| Adjusted R square                          | 0.29205             |                       |                    |
| Standard error                             | 1.333885            |                       |                    |
| Observations                               | 14                  |                       |                    |
|                                            | <i>Coefficients</i> | <i>Standard Error</i> | <i>t-Statistic</i> |
| Intercept                                  | 82.137              | 0.753                 | 109.080            |
| Manufacturing utilization                  | -0.223              | 0.0884                | -2.522             |

**Answer:**

$b_0 = 82.137$  and  $b_1 = -0.223$ , so the mean-reverting level,  $b_0 / (1 - b_1)$ , is computed as: mean-reverting level =  $\frac{82.137}{1 - (-0.223)} = 67.16$

This means that if the current level of manufacturing capacity utilization is above 67.16, it is expected to fall in the next period, and if manufacturing capacity utilization is below 67.16 in the current period, it is expected to rise in the next period.

There are some data that do not have a tendency to move toward the mean. These data are not covariance stationary and follow a random walk.

**LOS 13.h: Describe the characteristics of random walk processes and contrast them to covariance stationary processes.**

**Random walk.** If a time series follows a random walk process, the predicted value of the series (i.e., the value of the dependent variable) in one period is equal to the value of the series in the previous period plus a random error term. Since the only change in the time series from one period to the next is a totally random value, it cannot be modeled unless the data are transformed in some way.

A time series that follows a simple random walk process is described in equation form as  $x_t = x_{t-1} + \varepsilon_t$ , where the best forecast of  $x_t$  is  $x_{t-1}$  and:

1.  $E(\varepsilon_t) = 0$ : The expected value of each error term is zero.

2.  $E(\varepsilon_t^2) = \sigma^2$ : The variance of the error terms is homoskedastic (i.e., constant).
3.  $E(\varepsilon_i, \varepsilon_j) = 0$ ; if  $i \neq j$ : There is no serial correlation in the error terms.

**Random Walk with a Drift.** If a time series follows a random walk *with a drift*, the intercept term is not equal to zero. That is, in addition to a random error term, the time series is expected to increase or decrease by a constant amount from period to period. A random walk with a drift can be described as:

$$x_t = b_0 + b_1 x_{t-1} + \varepsilon_t$$

where:

$b_0$  = the constant drift

$b_1 = 1$

**Covariance Stationarity.** Neither a random walk nor a random walk with a drift exhibits covariance stationarity. To show this, let's start by expressing a random walk as:

$$x_t = b_0 + b_1 x_{t-1} + \varepsilon_t$$

where:

$b_0 = 0$  (for a random walk without a drift)

$b_0 \neq 0$  (for a random walk with a drift)

$b_1 = 1$  (for a random walk with or without a drift)

In either case (with or without a drift), the mean-reverting level is  $\frac{b_0}{1-b_1} = \frac{b_0}{0}$  (the

division of any number by zero is undefined), and as we stated earlier, a time series must have a **finite mean-reverting level** to be covariance stationary. Thus, a random walk, with or without a drift, is not covariance stationary, and exhibits what is known as a unit root. The presence of a unit root means that the least squares regression procedure that we have been using to estimate an AR(1) model will not work without transforming the data. We discuss unit roots and how they are handled in the next section.

**LOS 13.i:** Discuss the implications of unit roots for time-series analysis, explain when unit roots are likely to occur and how to test for them, and demonstrate how a time series with a unit root can be transformed so it can be analyzed with an AR model.

**LOS 13.j:** Discuss the steps of the unit root test for nonstationarity and explain the relation of the test to autoregressive time-series models.



*Professor's Note: For purposes of clarity, we discuss LOS 13.j and the first two parts of LOS 13.i together. We then return to the final part of LOS 13.i, when we discuss the transformation of time series data under the title of "First Differencing."*

As we discussed in the previous LOS, if the coefficient on the lag variable is 1.0, the series is not covariance stationary. If the value of the lag coefficient is equal to one, the time series is said to have a **unit root** and will follow a random walk process. Since a time series that follows a random walk is not covariance stationary, modeling such a time series in an AR model can lead to incorrect statistical conclusions, and decisions made on the basis of these conclusions may be wrong. Unit roots are most likely to occur in time series that trend over time or have a seasonal element.

### Unit Root Test for Nonstationarity

**Nonstationarity** means that the time series is not covariance stationary. To determine whether a time series is covariance stationary, we can (1) plot the data, (2) run an AR model and examine autocorrelations, and/or (3) perform the Dickey Fuller test.

First, as discussed above, we can **plot the raw data** to see if the mean and variance appear constant. If the pattern of the plotted points (i.e., the individual dots on the graph) seems to expand or contract, the variance of the data is probably expanding or contracting (i.e., it is not constant). Also, if the plotted points seem to trend upward or downward, the mean is not constant.

An example of how plotted data can reveal nonstationarity can be found in retail sales. Plotting retail sales will usually indicate significantly different sales at the end of the year compared to the rest of the year. Likewise, a store that specializes in summer wear will typically realize the majority of its sales in the early part of the year.

This seasonality is an example of nonstationarity and can be detected using an **autoregressive** (AR) model. Thus, in the second method, an AR model is run and the significance of the autocorrelations is examined. A stationary process will usually have autocorrelations insignificantly different from zero at all lags or autocorrelations that decay to zero as the lag increases.

The third method utilizes the Dickey Fuller test. For statistical reasons, you cannot directly test whether the coefficient on the independent variable in an AR time series is equal to 1.0. To compensate, **Dickey and Fuller** created a rather ingenious test for a unit root. Remember, if an AR(1) model has a coefficient of 1.0, it has a unit root and no finite mean reverting level (i.e., it is not covariance stationary). Dickey and Fuller (DF) transform the AR(1) model to run a simple regression. To transform the model, they (1) start with the basic form of the AR(1) model and (2) subtract  $x_{t-1}$  from both sides:

$$(1) \quad x_t = b_0 + b_1 x_{t-1} + \varepsilon$$

$$(2) \quad x_t - x_{t-1} = b_0 + b_1 x_{t-1} - x_{t-1} + \varepsilon \rightarrow$$

$$x_t - x_{t-1} = b_0 + (b_1 - 1)x_{t-1} + \varepsilon$$

Then, rather than directly testing whether the original coefficient is different from 1.0, they test whether the new, transformed coefficient ( $b_1 - 1$ ) is different from zero using a modified  $t$ -test. If ( $b_1 - 1$ ) is not significantly different from zero, they say that  $b_1$  must be equal to 1.0 and, therefore, the series must have a unit root.





*Professor's Note: In their actual test, DF use the variable  $g$ , which equals  $(b_1 - 1)$ . The null hypothesis is  $g = 0$  (i.e., the time series has a unit root). Note that the DF test is used because a standard  $t$ -test cannot be used to test directly whether the coefficient of the AR(1) model is equal to 1.0. Also note that the LOS does not ask you to actually perform the DF test, so for the exam, understand how the test is conducted and be able to interpret its results. For example, if on the exam you are told the null cannot be rejected, your answer is that the time series has a unit root. If the null is rejected, the time series does not have a unit root.*

## FIRST DIFFERENCING

If we believe a time series is a random walk (i.e., has a unit root), we can transform the data to a covariance stationary time series using a procedure called **first differencing**. The first differencing process involves subtracting the value of the time series (i.e., the dependent variable) in the immediately preceding period from the current value of the time series to define a new dependent variable,  $y$ . Note that by taking first differences, you model the **change** in the value of the dependent variable rather than the value of the dependent variable.

So, if the original time series of  $x$  has a unit root, the change in  $x$ ,  $x_t - x_{t-1} = \varepsilon_t$ , is just the error term. This means we can define  $y_t$  as:

$$y_t = x_t - x_{t-1} \Rightarrow y_t = \varepsilon_t$$

Then, stating  $y$  in the form of an AR(1) model:

$$y_t = b_0 + b_1 y_{t-1} + \varepsilon_t$$

where :

$$b_0 = b_1 = 0$$

This transformed time series has a finite mean-reverting level of  $\frac{0}{1-0} = 0$  and is, therefore, covariance stationary.

### Example: Unit root

Suppose we decide to model the lagged capacity utilization data in Figure 2. Using an AR(1) model the results indicate that the capacity utilization time series probably contains a unit root and is, therefore, not covariance stationary. Discuss how this model can be transformed into a viable prediction model that is covariance stationary.

**Answer:**

Covariance stationarity can often be achieved by transforming the data using first differencing and modeling the first-differenced time series as an autoregressive time series.

**Example: First differencing**

The next figure contains the first-differences of our manufacturing capacity utilization time series for the period 2004.1 through 2007.3. The first two columns contain the original time series. The first differences of the original series are contained in the third column of the table, and the one-period lagged values on the first-differences are presented in the fourth column of the table. Note that the first differences in this example represent the *change* in manufacturing capacity from the preceding period and are designated as  $y_t$  and  $y_{t-1}$ .

**First-Differenced Manufacturing Capacity Utilization Data**

| <i>Quarter</i> | <i>Capacity</i> | <i>Change in Capacity</i><br>$y_t = x_t - x_{t-1}$ | <i>Lagged Change in Capacity</i><br>$y_{t-1} = x_{t-1} - x_{t-2}$ |
|----------------|-----------------|----------------------------------------------------|-------------------------------------------------------------------|
| 2004.1         | 82.4            |                                                    |                                                                   |
| 2004.2         | 81.5            | -0.9                                               |                                                                   |
| 2004.3         | 80.8            | -0.7                                               | -0.9                                                              |
| 2004.4         | 80.5            | -0.3                                               | -0.7                                                              |
| 2005.1         | 80.2            | -0.3                                               | -0.3                                                              |
| 2005.2         | 80.2            | 0.0                                                | -0.3                                                              |
| 2005.3         | 80.5            | 0.3                                                | 0.0                                                               |
| 2005.4         | 80.9            | 0.4                                                | 0.3                                                               |
| 2006.1         | 81.3            | 0.4                                                | 0.4                                                               |
| 2006.2         | 81.9            | 0.6                                                | 0.4                                                               |
| 2006.3         | 81.7            | -0.2                                               | 0.6                                                               |
| 2006.4         | 80.3            | -1.4                                               | -0.2                                                              |
| 2007.1         | 77.9            | -2.4                                               | -1.4                                                              |
| 2007.2         | 76.4            | -1.5                                               | -2.4                                                              |
| 2007.3         | 76.4            | 0.0                                                | -1.5                                                              |

After this transformation, it is appropriate to regress the AR(1) model,  $y_t = b_0 + b_1 y_{t-1}$ . The regression results for the first-differenced time series are presented in the next figure, where it can be seen that the estimated coefficient on the lag variable is less than one (0.655).

### Regression Output for First-Differenced Manufacturing Capacity

| Change in Capacity Utilization                        |              |                |             |         |
|-------------------------------------------------------|--------------|----------------|-------------|---------|
| AR(1) Model $y_t = b_0 + b_1 y_{t-1} + \varepsilon_t$ |              |                |             |         |
| R <sup>2</sup>                                        | 0.430869388  |                |             |         |
| Adjusted R <sup>2</sup>                               | 0.379130241  |                |             |         |
| Standard error                                        | 0.699210366  |                |             |         |
| Observations                                          | 13           |                |             |         |
|                                                       | Coefficients | Standard Error | t-Statistic | p-Value |
| Intercept                                             | -0.090014589 | 0.220409703    | -0.4084     | 0.69082 |
| Lag 1                                                 | 0.65496839   | 0.226964091    | 2.885780    | 0.0148  |

**LOS 13.m:** Explain how time-series variables should be analyzed for nonstationarity and/or cointegration before use in a linear regression.

Occasionally an analyst will run a regression using two time series (i.e., time series utilizing two different variables). For example, using the market model to estimate the equity beta for a stock, an analyst regresses a time series of the stock's returns on a time series of returns for the market. Notice that now we are faced with two different time series, either or both of which could be subject to nonstationarity.

To test whether the two time series have unit roots, the analyst first runs separate DF tests with five possible results:

1. Both time series are covariance stationary (i.e., neither has a unit root).
2. Only the dependent variable time series is covariance stationary (i.e., the independent variable time series has a unit root).
3. Only the independent variable time series is covariance stationary (i.e., the dependent variable time series has a unit root).
4. Neither time series is covariance stationary (i.e., they both have unit roots) and the two series *are not* cointegrated.
5. Neither time series is covariance stationary (i.e., they both have unit roots) and the two series *are* cointegrated.

In scenario 1 the analyst can use linear regression, and the coefficients should be statistically reliable, but regressions in scenarios 2 and 3 will not be reliable. Whether linear regression can be used in scenarios 4 and 5 depends upon whether the two time series are *cointegrated*.

Cointegration

Cointegration means that two time series are economically linked (related to the same macro variables) or follow the same trend and that relationship is not expected to change. If two time series are cointegrated, the error term from regressing one on the other is covariance stationary and the *t*-tests are reliable. This means that scenario 5 will produce reliable regression estimates, whereas scenario 4 will not.

To test whether two time series are cointegrated, we regress one variable on the other using the following model:

$$y_t = b_0 + b_1x_t + \varepsilon$$

where:  
 $y_t$  = value of time series *y* at time *t*  
 $x_t$  = value of time series *x* at time *t*

The residuals are tested for a unit root using the Dickey Fuller test with critical *t*-values calculated by Engle and Granger (i.e., the DF–EG test). If the test rejects the null hypothesis of a unit root, we say the error terms generated by the two time series are covariance stationary and the two series are cointegrated. If the two series are cointegrated, we can use the regression to model their relationship.



*Professor's Note: For the exam remember that the DF test does not use the standard critical *t*-values we typically use in testing the statistical significance of individual regression coefficients. The DF–EG test further adjusts them to test for cointegration. As with the DF test, you do not have to know critical *t*-values for the DF–EG test. Just remember that like the regular DF test, if the null is rejected, we say the series is covariance stationary.*

Figure 3: Using Regressions with More than One Time Series

| Time Series Corresponds to: |                    |               |                        |                        |
|-----------------------------|--------------------|---------------|------------------------|------------------------|
| Independent Variable        | Dependent Variable |               |                        |                        |
| Unit Root?                  | Unit Root?         | Cointegrated? | Covariance Stationary? | Use Linear Regression? |
| no                          | no                 | n/a           | yes                    | yes                    |
| yes                         | no                 | n/a           | no                     | no                     |
| no                          | yes                | n/a           | no                     | no                     |
| yes                         | yes                | no            | no                     | no                     |
| yes                         | yes                | yes           | yes                    | yes                    |

---

**LOS 13.l: Explain autoregressive conditional heteroskedasticity (ARCH) and discuss how ARCH models can be applied to predict the variance of a time series.**

---

When examining a single time series, such as an AR model, **autoregressive conditional heteroskedasticity (ARCH)** exists if the variance of the residuals in one period is *dependent* on the variance of the residuals in a previous period. When this condition exists, the standard errors of the regression coefficients in AR models and the hypothesis tests of these coefficients are invalid.

### Using ARCH Models

An ARCH model is used to test for autoregressive conditional heteroskedasticity. Within the ARCH framework, an ARCH(1) time series is one for which the variance of the residuals in one period is dependent on (i.e., a function of) the variance of the residuals in the preceding period. To test whether a time series is ARCH(1), the squared residuals from an estimated time-series model,  $\hat{\epsilon}_t^2$ , are regressed on the first lag of the squared residuals  $\hat{\epsilon}_{t-1}^2$ .

The ARCH(1) regression model is expressed as:

$$\hat{\epsilon}_t^2 = a_0 + a_1 \hat{\epsilon}_{t-1}^2 + \mu_t$$

where  $a_0$  is the constant and  $\mu_t$  is an error term.

If the coefficient,  $a_1$ , is statistically different from zero, the time series is ARCH(1).

If a time-series model has been determined to contain ARCH errors, regression procedures that correct for heteroskedasticity, such as *generalized least squares*, must be used in order to develop a predictive model. Otherwise, the standard errors of the model's coefficients will be incorrect, leading to invalid conclusions.

### Predicting the Variance of a Time Series

However, if a time series has ARCH errors, an ARCH model can be used to predict the variance of the residuals in future periods. For example, if the data exhibit an ARCH(1) pattern, the ARCH(1) model can be used in period  $t$  to predict the variance of the residuals in period  $t + 1$ :

$$\hat{\sigma}_{t+1}^2 = \hat{a}_0 + \hat{a}_1 \hat{\epsilon}_t^2$$

**Example: ARCH(1) time series**

The next figure contains the results from the regression of an ARCH(1) model. The squared errors for periods  $t$  through  $T$  are regressed on the squared errors for periods  $t - 1$  through  $T - 1$ . ( $\mu_t$  is the error term for the model.) Determine whether the results indicate autoregressive conditional heteroskedasticity (ARCH), and if so, calculate the predicted variance of the error terms in the next period if the current period squared error is 0.5625

**ARCH (1) Regression Results**

| Model: $\hat{\epsilon}_t^2 = a_0 + a_1\hat{\epsilon}_{t-1}^2 + \mu_t$ | Coefficients | Standard Error | t-Statistic | p-Value |
|-----------------------------------------------------------------------|--------------|----------------|-------------|---------|
| Constant                                                              | 5.9068       | 1.08631        | 5.4375      | < 0.001 |
| Lag 1                                                                 | 0.4515       | 0.09558        | 4.7238      | < 0.001 |

**Answer:**

Since the  $p$ -value for the coefficient on the lagged variable indicates statistical significance, we can conclude that the time series is ARCH(1). As such, the variance of the error term in the next period can be computed as:

$$\hat{\sigma}_{t+1}^2 = \hat{a}_0 + \hat{a}_1\hat{\epsilon}_t^2 = 5.9068 + 0.4515(0.5625) = 6.1608$$



*Professor's Note: If the coefficient  $a_1$  is zero, the variance is constant from period to period. If  $a_1$  is greater than (less than) zero, the variance increases (decreases) over time (i.e., the error terms exhibit heteroskedasticity).*

**LOS 13.n:** Select and justify the choice of a particular time-series model from a group of models.

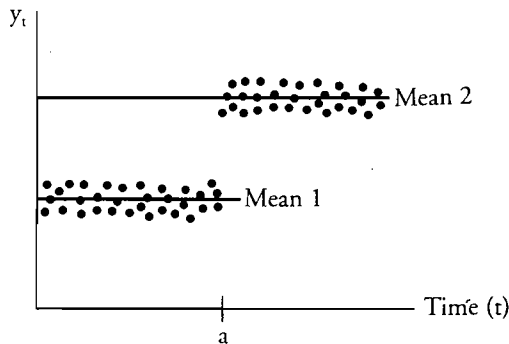
To determine what type of model is best suited to meet your needs, follow these guidelines:

1. Determine your goal.
  - Are you attempting to model the relationship of a variable to other variables (e.g., cointegrated time series, cross-sectional multiple regression)?
  - Are you trying to model the variable over time (e.g., trend model)?
2. If you have decided on using a time series analysis for an individual variable, plot the values of the variable over time and look for characteristics that would indicate nonstationarity, such as non-constant variance (heteroskedasticity), non-constant mean, seasonality, or structural change.

A **structural change** is indicated by a significant *shift* in the plotted data at a point in time that seems to divide the data into two distinct patterns. (Figure 4 shows a

data plot that indicates a structural shift in the time series at Point a.) When this is the case you have to run two different models, one incorporating the data before and one after that date, and test whether the time series has actually shifted. If the time series has shifted significantly, a single time series encompassing the entire period (i.e., both patterns) will likely produce unreliable results, so the most recent model may be more appropriate.

**Figure 4: A Structural Shift in a Time Series**



3. If there is no seasonality or structural shift, use a trend model.
  - If the data plot on a straight line with an upward or downward slope, use a linear trend model.
  - If the data plot in a curve, use a log-linear trend model.
4. Run the trend analysis, compute the residuals, and test for serial correlation using the Durbin Watson test.
  - If you detect no serial correlation, *you can use the model.*
  - If you detect serial correlation, you must use another model (e.g., AR).
5. If the data has serial correlation, reexamine the data for stationarity before running an AR model. If it is not stationary, treat the data for use in an AR model as follows:
  - If the data has a linear trend, first-difference the data.
  - If the data has an exponential trend, first-difference the natural log of the data.
  - If there is a structural shift in the data, run two separate models as discussed above.
  - If the data has a seasonal component, incorporate the seasonality in the AR model as discussed below.
6. After the series is covariance stationary, run an AR(1) model and test for serial correlation and seasonality.
  - If there is no remaining serial correlation, *you can use the model.*
  - If you still detect serial correlation, incorporate lagged values of the variable (possibly including one for seasonality—e.g., for monthly data, add the 12th lag of the time series) into the AR model until you have removed (i.e., modeled) any serial correlation.

7. Test for ARCH. Regress the square of the residuals on squares of lagged values of the residuals and test whether the resulting coefficient is significantly different from zero.
  - If the coefficient is not significantly different from zero, *you can use the model*.
  - If the coefficient is significantly different from zero, ARCH is present. Correct using generalized least squares.
8. If you have developed two statistically reliable models and want to determine which is better at forecasting, calculate their out-of-sample RMSE.



## KEY CONCEPTS

### LOS 13.a

A time series is a set of observations for a variable over successive periods of time. A time series model captures the time series pattern and allows us to make predictions about the variable in the future.

### LOS 13.b

A simple linear trend model is:  $y_t = b_0 + b_1t + \varepsilon_t$ , estimated for  $t = 1, 2, \dots, T$ .

A log-linear trend model,  $\ln(y_t) = b_0 + b_1t + \varepsilon_t$ , is appropriate for exponential data.

A plot of the data should be used to determine whether a linear or log-linear trend model should be used.

The primary limitation of trend models is that they are not useful if the residuals exhibit serial correlation.

### LOS 13.c

A time series is covariance stationary if its mean, variance, and covariances with lagged and leading values do not change over time. Covariance stationarity is a requirement for AR models.

### LOS 13.d

An autoregressive model is one in which the independent variable is a lagged value of the dependent variable. An AR model with  $p$  lags is referred to as an  $AR(p)$  model:

$$x_t = b_0 + b_1x_{t-1} + b_2x_{t-2} + \dots + b_px_{t-p} + \varepsilon_t$$

An  $AR(p)$  model is specified correctly if the autocorrelation of residuals is not significant.

Multiperiod forecasting with AR models is done one period at a time, where uncertainty increases with each successive forecast because it is based on previously forecasted values.

### LOS 13.e

A time series is mean reverting if it tends towards its mean over time. The mean

reverting level for an  $AR(1)$  model is  $\frac{b_0}{(1 - b_1)}$ .

### LOS 13.f

**In-sample forecasts** are made *within* the range of data used in the estimation. **Out-of-sample forecasts** are made *outside* of the time period for the data used in the estimation.

The **root mean squared error** criterion (RMSE) is used to compare the accuracy of autoregressive models in forecasting out-of-sample values. A researcher may have two autoregressive (AR) models, both of which seem to fit the data: an  $AR(1)$  model and an  $AR(2)$  model. To determine which model will more accurately forecast future values, we calculate the square root of the mean squared error (RMSE). The model with the lower RMSE for the out-of-sample data will have lower forecast error and will be expected to have better predictive power in the future.

**LOS 13.g**

Most economic and financial time series data are not stationary. The degree of the nonstationarity depends on the length of the series and the underlying economic environment.

**LOS 13.h**

A random walk time series is one for which the value in one period is equal to the value in another period, plus a random error. A random walk process does not have a mean reverting level and is not stationary.

**LOS 13.i**

A time series has a unit root if the coefficient on the lagged dependent variable is equal to one. A series with a unit root is not covariance stationary. Economic and finance time series frequently have unit roots. Data with a unit root must be first differenced before being used in a time series model.

**LOS 13.j**

To determine whether a time series is covariance stationary, we can (1) plot the data, (2) run an AR model, and/or (3) perform the Dickey Fuller test.

**LOS 13.k**

Seasonality in a time series is tested by calculating the autocorrelations of error terms. A statistically significant lagged error term corresponding to the periodicity of the data indicates seasonality. Seasonality can be corrected by incorporating the appropriate seasonal lag term in an AR model.

If a seasonal lag coefficient is appropriate and corrects the seasonality, the AR model with the seasonal terms will have no statistically significant autocorrelations of error terms.

**LOS 13.l**

ARCH is present if the variance of the residuals from an AR model are correlated across time. ARCH is detected by estimating  $\hat{\epsilon}_t^2 = a_0 + a_1 \hat{\epsilon}_{t-1}^2 + \mu_t$ . If  $a_1$  is significant, ARCH exists and the variance of errors can be predicted using:  $\hat{\sigma}_{t+1}^2 = \hat{a}_0 + \hat{a}_1 \hat{\epsilon}_t^2$ .

**LOS 13.m**

When working with two time series in a regression: (1) if neither time series has a unit root then the regression can be used; (2) if only one series has a unit root, the regression results will be invalid; (3) if both time series have a unit root and are cointegrated, then the regression can be used; (4) if both time series have a unit root but are not cointegrated, the regression results will be invalid.

The Dickey Fuller test with critical  $t$ -values calculated by Engle and Granger is used to determine whether two times series are cointegrated.

**LOS 13.n**

The RMSE criterion is used to determine which forecasting model will produce the most accurate forecasts. The RMSE equals the square root of the average squared error.

## CONCEPT CHECKERS

Use the following data to answer Questions 1 and 2.

The results of the estimation of monthly revolving credit outstanding (RCO) on the one-period lagged values for RCO from January 2006 through December 2008 are presented in the following table.

### Regression Results for Outstanding Revolving Credit Study

| Model: $RCO_t = b_0 + b_1 RCO_{t-1} + \varepsilon_t$ |                     |                       |                    |                |
|------------------------------------------------------|---------------------|-----------------------|--------------------|----------------|
| $R^2$                                                | 0.952643            |                       |                    |                |
| Adjusted $R^2$                                       | 0.951208            |                       |                    |                |
| Standard error                                       | 9.261452            |                       |                    |                |
| Observations                                         | 35                  |                       |                    |                |
|                                                      | <i>Coefficients</i> | <i>Standard Error</i> | <i>t-Statistic</i> | <i>p-Value</i> |
| Intercept                                            | -34.0019            | 24.19417              | -1.40537           | 0.169255       |
| Lag 1                                                | 1.065697            | 0.041362              | 25.76512           | < 0.0001       |

- What type of time-series model was used to produce the regression results in the table?
  - An AR model.
  - A heteroskedasticity (H) model.
  - A trend model with a drift.
- An approach that may work in the case of modeling a time series that has a unit root is to:
  - use an ARCH model.
  - use a trend model.
  - model the first differences of the time series.

Use the following data to answer Questions 3 through 7.

Consider the results of the regression of monthly real estate loans (RE) in billions of dollars by commercial banks over the period January 2005 through September 2008 in the following table:

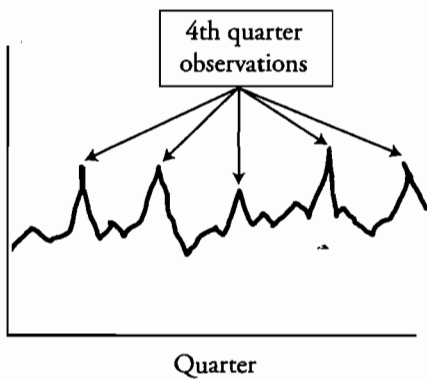
**Time Series Regression Results for Real Estate Loans**

| Model: $RE_t = b_0 + b_1t + \varepsilon_t$ $t = 1, 2, \dots, 45$ |                     |                       |
|------------------------------------------------------------------|---------------------|-----------------------|
| $R^2$                                                            | 0.967908            |                       |
| Adjusted $R^2$                                                   | 0.9671617           |                       |
| Standard error                                                   | 29.587649           |                       |
| Observations                                                     | 45                  |                       |
| Durbin-Watson                                                    | 0.601               |                       |
|                                                                  | <i>Coefficients</i> | <i>Standard Error</i> |
| Intercept                                                        | 1195.6241           | 8.9704362             |
| $b_1$                                                            | 12.230448           | 0.3396171             |

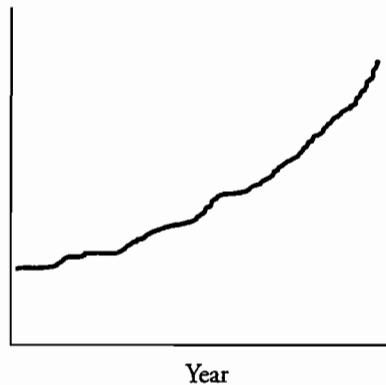
3. The regression of real estate loans against time is a(an):
  - A. trend line model.
  - B. AR model.
  - C. ARCH model.
4. The results of the estimation indicate a(an):
  - A. upward trend.
  - B. AR(2) model.
  - C. ARCH system.
5. Are the intercept and slope coefficient significantly different from zero at the 5% level?
  - A. Both are statistically significant.
  - B. One is, but the other is not.
  - C. Neither of them is statistically significant.
6. The forecasted value of real estate loans for October 2008 is *closest* to:
  - A. \$1,733.764 billion.
  - B. \$1,745.990 billion.
  - C. \$1,758.225 billion.

7. Based on the time series regression results, is there evidence of serial correlation of the residuals?
- Yes positive, but not negative serial correlation.
  - Yes negative, but not positive serial correlation.
  - Neither positive nor negative serial correlation.
8. An analyst has determined that monthly sport utility vehicle (SUV) sales in the United States have been increasing over the last ten years, but the growth rate over that period has been relatively constant. Which model is *most appropriate* to predict future SUV sales?
- $\text{SUVsales}_t = b_0 + b_1(t) + e_t$ .
  - $\ln\text{SUVsales}_t = b_0 + b_1(t) + e_t$ .
  - $\ln\text{SUVsales}_t = b_0 + b_1(\text{SUVsales}_{t-1}) + e_t$ .
9. Are the two time series shown in the following figures likely to be covariance stationary?

(a) Time Series Y:  
Quarterly Data



(b) Time Series Z:  
Annual Data



- Y is, but Z is not covariance stationary.
  - Z is, but Y is not covariance stationary.
  - Neither is covariance stationary.
10. Given the prediction equation:  $\hat{x}_t = 5 + 1.75x_{t-1}$ , what is the forecast value of  $x_{t+2}$  if  $x_{t-1}$  is 16.5?
- 64.28.
  - 117.49.
  - 210.61.

11. Which of the following AR models is *most appropriate* for a time series with annual seasonality using quarterly observations?
- A.  $b_1x_{t-1} + b_2x_{t-12} + \varepsilon_t$ .
  - B.  $b_0 + b_1x_{t-1} + b_2x_{t-4} + \varepsilon_t$ .
  - C.  $b_0 + b_1x_{t-4} + b_2x_{t-12} + \varepsilon_t$ .

Use the following data to answer Questions 12 through 14.

Regression Results for Monthly Cash Flow Study

|           | Coefficients | Standard Error | t-Statistic | p-Value  |
|-----------|--------------|----------------|-------------|----------|
| Intercept | 26.8625      | 12.15146       | 2.210639    | 0.035719 |
| Lag 1     | 0.7196       | 0.042584       | 16.89837    | < 0.0001 |

*Autocorrelation of the Residual*

| Lag | Autocorrelation | Standard Error | t-Statistic | p-Value |
|-----|-----------------|----------------|-------------|---------|
| 12  | -0.0254         | 0.0632         | -0.4019     | 0.5612  |

12. The number of observations in the time series used to estimate the model represented in the table above is *closest* to:
- A. 16.
  - B. 50.
  - C. 250.
13. Based on the information given, what type of model was used?
- A. AR(1).
  - B. AR(2).
  - C. AR(12).
14. Does the information indicate the presence of seasonality?
- A. No, because the lag-12 autocorrelation of the residual is not significant.
  - B. Yes, because the lag-12 autocorrelation of the residual is significantly different than one.
  - C. There is not enough information provided; the autocorrelation for the first lag is also needed to detect seasonality.

Use the following data to answer Questions 15 through 18.

A monthly time series of changes in payroll expenses (in millions of \$) at a major retail chain was regressed with an AR(1) model from January 2001 to June 2009 (102 months). The results of the regression, and the first 12 lagged residual autocorrelations are shown in the next two tables.

#### Regression Results for Payroll Changes

| Model: $y_t = b_0 + b_1 y_{t-1} + \varepsilon_t$ |              |                |             |
|--------------------------------------------------|--------------|----------------|-------------|
|                                                  | Coefficients | Standard Error | t-Statistic |
| Intercept                                        | 1.2304       | 0.00923135     | 133.28495   |
| Lag 1                                            | 0.1717       | 0.00476779     | 36.01249    |

#### Lagged Residual Autocorrelation Analysis

| Lag | Autocorrelation | t-Statistic | Lag | Autocorrelation | t-Statistic |
|-----|-----------------|-------------|-----|-----------------|-------------|
| 1   | -0.105          | ?           | 7   | 0.017           | 0.17170     |
| 2   | -0.140          | -1.4139     | 8   | -0.036          | -0.36360    |
| 3   | -0.044          | -0.4444     | 9   | 0.163           | 1.64620     |
| 4   | -0.032          | -0.3232     | 10  | -0.066          | -0.66660    |
| 5   | -0.170          | -1.7169     | 11  | 0.115           | 1.16140     |
| 6   | 0.109           | 1.1008      | 12  | 0.021           | 0.21209     |

15. The mean reverting level for this time series is *closest* to:  
A. 1.050.  
B. 1.342.  
C. 1.485.
16. The *t*-statistic for testing the hypothesis that the first order autocorrelation is zero is *closest* to:  
A. -1.0604.  
B. -10.710.  
C. -36.012.
17. If the change in payroll expense in June 2009 was \$1 million, the forecast for the change in payroll expense in August 2009 is *closest* to:  
A. \$1.402 million.  
B. \$1.471 million.  
C. \$1.511 million.
18. Assuming a 5% level of significance, does the model appear to be properly specified?  
A. Yes, because the lag coefficient is significant.  
B. No, because most of the autocorrelations are negative.  
C. Yes, because none of the autocorrelations are significant.

## ANSWERS – CONCEPT CHECKERS

1. A The independent variable is the dependent variable lagged one period, so the model is an AR(1) model.
2. C The first-differenced series usually does not have a unit root and is, therefore, covariance stationary.
3. A With a trend model, the independent variable is time,  $t$ .
4. A The slope is positive and significantly different from zero indicating an upward trend.
5. A The  $t$ -statistic to test the statistical significance of the intercept and slope coefficient is the parameter estimate divided by its standard error. We reject the null hypothesis and conclude the coefficients are statistically significant if the absolute value of the  $t$ -statistic is greater than the two-tail 5% critical  $t$ -value with 43 degrees of freedom, which is 2.02.

$$t_{b_0} = \frac{1,195.6241}{8.9704362} = 133.3$$

$$t_{b_1} = \frac{12.230448}{0.3396171} = 36.0$$

Both the intercept term and the slope coefficient are significantly different from zero at the 5% level because both  $t$ -statistics are greater than the critical  $t$ -value of 2.02.

6. C  $\hat{Y}_{46} = \$1,195.6241 + \$12.230448(46) = \$1,758.225$  billion.
7. A The Durbin-Watson statistic is used to detect serial correlation in the residuals. The lower critical value for a DW test with one independent variable and 45 observations is 1.48 and the upper critical value is 1.57. The actual DW-statistic is 0.601, which is less than the lower critical value. This indicates the residuals are positively serially correlated. The DW-statistic would have to be greater than  $4 - 1.48 = 2.52$  in order to conclude that negative serial correlation is present. See the previous topic review for details on implementing the Durbin-Watson test.
8. B A log-linear model (choice B) is most appropriate for a time series that grows at a relatively constant growth rate. Neither a linear trend model (choice A), nor an AR(1) model (choice C) are appropriate in this case.
9. C Time series Y has a seasonal pattern because the fourth quarter observations are significantly higher than the other quarters. This suggests that the expected value of time series Y is not constant, and therefore it is not covariance stationary.

Time series Z has a definite upward trend, which once again suggests the expected value of the time series Z is not constant, and therefore it is not covariance stationary.

10. B Given  $x_{t-1} = 16.5$ ,  $\hat{x}_t = 5 + 1.75(16.5) = 33.875$ . So,  $\hat{x}_{t+1} = 5 + 1.75\hat{x}_t = 5 + 1.75(33.875) = 64.28$ . So,  $\hat{x}_{t+2} = 5 + 1.75\hat{x}_{t+1} = 5 + 1.75(64.28) = 117.49$ .
11. B The seasonal (annual) lag occurs on a quarterly basis, so the appropriate model is  $b_0 + b_1 x_{t-1} + b_2 x_{t-4} + \varepsilon_t$ . The intercept  $b_0$  should be included in the model.



12. C The standard error of the estimated autocorrelations is  $1/\sqrt{T}$ , where  $T$  is the number of observations (periods). So, if the standard error is given as 0.0632, the number of observations,  $T$ , in the time series must be  $(1/0.0632)^2 \approx 250$ .
13. A The results in the table indicate that the prediction equation is  $x_t = 26.8625 + 0.7196x_{t-1}$ , which is estimated from an AR(1) model.
14. A The autocorrelation in the twelfth month is not statistically different from zero. Thus, there appears to be no seasonality.
15. C The mean-reverting level is  $b_0 / (1 - b_1) = 1.2304 / (1 - 0.1717) = 1.48545$ .
16. A 
$$t = \frac{-0.105}{1/\sqrt{102}} = -1.0604$$
17. B 
$$y_{\text{July 2009}} = 1.2304 + 0.1717(\$1) = \$1.402 \text{ million}$$
  
$$y_{\text{August 2009}} = 1.2304 + 0.1717(\$1.402) = \$1.471 \text{ million}$$
18. C The critical  $t$ -value at a 5% level of significance with 100 degrees of freedom is approximately 1.98. At this level, none of the residual autocorrelations is significant, indicating that the model is properly specified. The presence of an ARCH process, however, should also be tested.

## SELF-TEST: QUANTITATIVE METHODS



*Professor's Note: Remember that the Level 2 exam consists of all item set format questions; that is, a vignette presenting the relevant information followed by six multiple choice questions on that topic. For an accurate gauge of your preparedness, allow 18 minutes for this self-test.*

Use the following information to answer Questions 1 through 6.

Theresa Miller is attempting to forecast sales for Alton Industries based on a multiple regression model. The model Miller estimates is:

$$\text{sales} = b_0 + (b_1 \times \text{DOL}) + (b_2 \times \text{IP}) + (b_3 \times \text{GDP}) + \varepsilon_t$$

where:

sales = change in sales adjusted for inflation

DOL = change in the real value of the \$ (rates measured in €/£)

IP = change in industrial production adjusted for inflation (millions of \$)

GDP = change in inflation-adjusted GDP (millions of \$)

All changes in variables are in percentage terms.

Miller runs the regression using monthly data for the prior 180 months. The model estimates (with coefficient standard errors in parentheses) are:

$$\begin{array}{ccccccc} \text{sales} = 10.2 + (5.6 \times \text{DOL}) + (6.3 \times \text{IP}) + (9.2 \times \text{GDP}) \\ (5.4) \quad (3.5) \quad \quad (4.2) \quad \quad (5.3) \end{array}$$

The sum of squared errors is 145.6 and the total sum of squares is 357.2.

Miller is concerned that one or more of the assumptions underlying multiple regression has been violated in her analysis. In a conversation with Watson Crick, CFA, a colleague who is considered by many in the firm to be a quant specialist, Miller says, "Two of the key assumptions of multiple regression are:"

Assumption 1: The independent variables are not random, and there is no correlation between any two of the independent variables.

Assumption 2: The variance of the residuals is constant and not related to the level of the independent variables.

Miller tests and fails to reject each of the following two null hypotheses at the 99% confidence interval:

Hypothesis 1: A 2% increase in DOL will result in an increase in sales of more than 12%.

Hypothesis 2: A 1% increase in industrial production will result in a 1% decrease in sales.

Figure 1: Partial table of the Student's t-distribution (one-tailed probabilities)

| Df  | p = 0.10 | p = 0.05 | p = 0.025 | p = 0.01 | p = 0.005 |
|-----|----------|----------|-----------|----------|-----------|
| 170 | 1.287    | 1.654    | 1.974     | 2.348    | 2.605     |
| 176 | 1.286    | 1.654    | 1.974     | 2.348    | 2.604     |
| 180 | 1.286    | 1.653    | 1.973     | 2.347    | 2.603     |

Figure 2: Partial F-Table critical values for right-hand tail area equal to 0.05

|            | df 1 = 1 | df 1 = 3 | df 1 = 5 |
|------------|----------|----------|----------|
| df 2 = 170 | 3.90     | 2.66     | 2.27     |
| df 2 = 176 | 3.89     | 2.66     | 2.27     |
| df 2 = 180 | 3.89     | 2.65     | 2.26     |

Figure 3: Partial F-Table critical values for right-hand tail area equal to 0.025

|            | df 1 = 1 | df 1 = 3 | df 1 = 5 |
|------------|----------|----------|----------|
| df 2 = 170 | 5.11     | 3.19     | 2.64     |
| df 2 = 176 | 5.11     | 3.19     | 2.64     |
| df 2 = 180 | 5.11     | 3.19     | 2.64     |

- Are the two multiple regression assumptions proposed by Crick stated correctly?  

|        | <u>Assumption 1</u> | <u>Assumption 2</u> |
|--------|---------------------|---------------------|
| A. Yes |                     | No                  |
| B. No  |                     | Yes                 |
| C. No  |                     | No                  |
- Did Miller *correctly* interpret the results of the tests in making her reject or fail-to-reject decisions for Hypothesis 1 and Hypothesis 2?  

|        | <u>Hypothesis 1</u> | <u>Hypothesis 2</u> |
|--------|---------------------|---------------------|
| A. Yes |                     | Yes                 |
| B. Yes |                     | No                  |
| C. No  |                     | Yes                 |

3. The appropriate decision with regard to the  $F$ -statistic for testing the null hypothesis that all of the independent variables are simultaneously equal to zero at the 5% significance level is to:
  - A. reject the null hypothesis because the  $F$ -statistic is larger than the critical  $F$ -value of 3.19.
  - B. fail to reject the null hypothesis because the  $F$ -statistic is smaller than the critical  $F$ -value of 3.19.
  - C. reject the null hypothesis because the  $F$ -statistic is larger than the critical  $F$ -value of 2.66.
  
4. The unadjusted  $R^2$  and the standard error of the estimate (SEE) are *closest* to:
 

|    | <u>Unadjusted <math>R^2</math></u> | <u>SEE</u> |
|----|------------------------------------|------------|
| A. | 59.2%                              | 1.425      |
| B. | 59.2%                              | 0.910      |
| C. | 40.8%                              | 0.910      |
  
5. The multiple regression, as specified, *most likely* suffers from:
  - A. heteroskedasticity.
  - B. multicollinearity.
  - C. positive serial correlation of the error terms.
  
6. What is the width of the 99% confidence interval for GDP, and is zero in that 99% confidence interval?
 

|    | <u>Width of 99% CI</u> | <u>Zero in interval</u> |
|----|------------------------|-------------------------|
| A. | 13.8                   | Yes                     |
| B. | 13.8                   | No                      |
| C. | 27.6                   | Yes                     |

## SELF-TEST ANSWERS: QUANTITATIVE METHODS

1. B Assumption 1 is stated incorrectly. Some correlation between independent variables is unavoidable; high correlation results in multicollinearity. An exact linear relationship between linear combinations of two or more independent variables should not exist.

Assumption 2 is stated correctly. The assumption is that neither conditional nor unconditional heteroskedasticity is present in the residuals; in other words, the variance of the residuals is constant. Conditional heteroskedasticity occurs when the residual variance is related to the level of one or more of the independent variables.

2. A The critical values at the 1% level of significance (99% confidence) are 2.348 for a one-tailed test and 2.604 for a two-tailed test ( $df = 176$ ).

Hypothesis 1: This hypothesis is asking whether a 2% increase in DOL will increase sales by more than 12%. This will only happen if the value of the coefficient is greater than 6, since  $2 \times 6 = 12$ . Since the regression estimate for this coefficient is 5.6, the  $t$ -statistic for this test is  $(5.6 - 6) / 3.5 = -0.114$ . This is a one-tailed test, so the critical value is 2.348. Miller is correct in failing to reject the null.

Hypothesis 2: This hypothesis is asking whether the value of the coefficient is equal to  $-1.0$ , since that is the value that would correspond with a 1% increase in industrial production resulting in a 1% decrease in sales. Since the regression estimate for this coefficient is 6.3, the  $t$ -statistic for this test is  $[6.3 - (-1)] / 4.2 = 1.74$ . This is a two-tailed test, so the critical value is 2.604. Miller is correct in failing to reject the null.

3. C  $SSR = 357.2 - 145.6 = 211.6$ ,  $F$ -statistic  $= (211.6 / 3) / (145.6 / 176) = 85.3$ . The critical value for a one-tailed 5%  $F$ -test with 3 and 176 degrees of freedom is 2.66. Because the  $F$ -statistic is greater than the critical  $F$ -value, the null hypothesis that all of the independent variables are simultaneously equal to zero should be rejected.

4. B  $SEE = \sqrt{\frac{145.6}{180 - 3 - 1}} = 0.910$

$$\text{unadjusted } R^2 = \frac{357.2 - 145.6}{357.2} = 0.592$$

5. B The regression is highly significant (based on the  $F$ -stat in Question 3), but the individual coefficients are not. This is a result of a regression with significant multicollinearity problems. The  $t$ -stats for the significance of the regression coefficients are, respectively, 1.89, 1.6, 1.5, 1.74. None of these are high enough to reject the hypothesis that the coefficient is zero at the 5% level of significance (two-tailed critical value of 1.974 from  $t$ -table). There is no evidence in the vignette of heteroskedasticity or serial correlation (also known as autocorrelation).
6. C The confidence interval is  $9.2 \pm (5.3 \times 2.604)$ , where 2.604 is the two-tailed 1%  $t$ -statistic with 176 degrees of freedom (which is the same as a one-tailed 0.5%  $t$ -statistic with 176 degrees of freedom). The interval is  $-4.6$  to  $23.0$ , which has a width of 27.6 and zero is in that interval.

---

The following is a review of the Economics for Valuation principles designed to address the learning outcome statements set forth by CFA Institute®. This topic is also covered in:

# ECONOMIC GROWTH

Study Session 4

---

## EXAM FOCUS

This topic review covers the variables that affect the economic growth process along with three theories that provide insight into the key drivers of economic growth. There are important links here to the equity valuation material. You should be able to integrate this material with the equity valuation concepts in Study Session 11 and, in the country analysis component of global industry analysis, identify countries that are expected to experience higher economic growth.

---

## WARM-UP: PERCENTAGE GROWTH AND THE RULE OF 70

**Economic growth** is measured in terms of the annual percentage change in real gross domestic product (GDP).

The *rule of 70* is a rule of thumb (i.e., a heuristic) that gives us a quick approximation of the number of years it will take GDP (or any value for that matter) to double, given an expected percentage annual growth rate.

$$\text{approximate years to double} = \frac{70}{\text{growth rate}}$$

### Example:

Suppose that the real GDP of a rapidly growing economy is growing at 7%, while that for a more mature economy is growing at 2%. Using the rule of 70, approximately how long will it take for the real GDPs of these countries to double?

### Answer:

$$\text{rapidly growing economy to double} = \frac{70}{7} = 10 \text{ years}$$

$$\text{mature economy to double} = \frac{70}{2} = 35 \text{ years}$$

---

**LOS 14.a: Define the sources of economic growth and discuss the preconditions for economic growth.**

---

Sources of economic growth boil down to the amount of inputs used and the amount that can be produced with each unit of input. The inputs are more generally known as **factors of production**. These can be broadly classified as:

- *Land*: all natural resources available for production.
- *Capital goods*: manufactured goods that are used in production.
- *Labor*: physical and mental talents of workers that are used in production.
- *Entrepreneurial ability*: the act of combining the other three factors, making the decisions, and bearing the risk, in the hope of generating an economic profit.

The economy itself grows when the gross amount of any of the above factors grows, or the use of any of the above factors becomes more efficient. For example, looking at labor, there are two paths to growth—increases in aggregate hours and increases in labor productivity. How can these occur?

Aggregate hours can grow if the population of the country grows, a greater percentage of the working-age populace enters the workforce, or existing workers decide to work more hours.

Labor productivity can grow if there is an improvement in the caliber of the human capital (e.g., training/education, experience), there is an increase in capital goods available to workers with which to produce goods, or there are technological advances.

A suitable **incentive system** is the most important precondition for a society to realize economic growth. The three social institutions that are critical to the development of incentives are markets, property rights, and monetary exchange. Collectively, these three social institutions create incentives for people to specialize in the production of goods in which they have a comparative advantage, trade for those products in which they do not, save the profits from trading, and invest those savings to discover new technologies.

**Markets** facilitate the exchange of information between buyers and sellers and enable them to conduct business with each other. Market prices send information to buyers and sellers that give them the incentive to adjust the quantities they supply or demand. In order for markets to be effective, property rights and monetary exchange are required.

**Property rights** are laws and regulations that govern the ownership, use, and sale of goods, services, and factors of production (e.g., land, labor, and equipment). Property rights pertain to physical assets, intellectual property (such as patents and copyrights), and financial claims. If property rights are properly established and enforced, people will be assured that no government will seize their savings and investments.

**Monetary exchange** provides for the efficient exchange of goods and services, including the transfer of private property from one individual to another.



*Professor's Note: A specific form of political organization (e.g., democracy) is not one of the necessary preconditions for economic growth. Countries with communist and authoritarian governments have also experienced economic growth.*

---

**LOS 14.b: Discuss how the one-third rule can be used to explain the contributions of labor and technological change to growth in labor productivity.**

---

**Labor productivity** is quantified as real GDP per labor hour. The growth rate of labor productivity (i.e., economic growth) changes over time. In order to evaluate what drives these changes, the growth rate of labor productivity may be decomposed into two factors: growth in physical capital per labor hour and technological change. The influence of each can be evaluated separately.

Technological change includes everything that contributes to labor productivity growth except those things that are included in the growth of physical capital. Technological change is largely dependent on growth in human capital because technology only advances as long as knowledge advances.

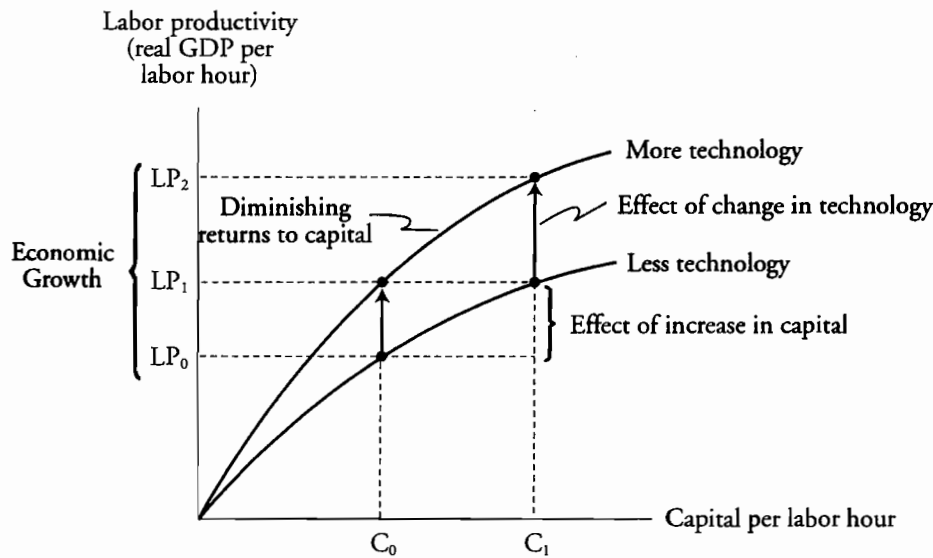
The **productivity curve** is the curve that results when labor productivity (real GDP per labor hour) is plotted against capital per labor hour at a given state of technology. The productivity curve shows how real GDP per labor hour changes as capital per labor hour changes, holding technology constant. Figure 1 illustrates two productivity curves under two different but constant states of technology. Two important properties of productivity curves can be seen in Figure 1:

1. *Growth in capital per labor hour causes movement along a productivity curve.* Real GDP per labor hour increases as capital per labor hour increases (at a given state of technology). Referring to the lower productivity curve in Figure 1 labeled “Less technology,” an increase in capital from  $C_0$  to  $C_1$  along the curve results in an increase in labor productivity from  $LP_0$  to  $LP_1$ . This increase in labor productivity represents real economic growth.
2. *Technological growth causes the productivity curve to shift upwards.* Real GDP per labor hour increases as the state of technology increases at any given level of capital per labor hour. In Figure 1, this is illustrated by the vertical distance  $LP_0$  to  $LP_1$  at  $C_0$ , or  $LP_1$  to  $LP_2$  at  $C_1$ .

The **law of diminishing returns** applies to productivity curves. This means that at a given level of technology, as more and more capital per labor hour is added, the increase in real GDP per labor hour gets smaller and smaller. For example, the increase in real GDP per labor hour resulting from a given \$10 increase in capital per labor hour will be greater than the increase in real GDP per labor hour from an additional \$10 increase in capital per labor hour.



Figure 1: Productivity Curve



## THE ONE-THIRD RULE



*Professor's Note: The material discussed in this section is part of the area of economics called growth accounting.*

In a healthy economy, productivity growth is always positive. However, the productivity growth rate is not constant. From one time period to the next, productivity growth may speed up or slow down.

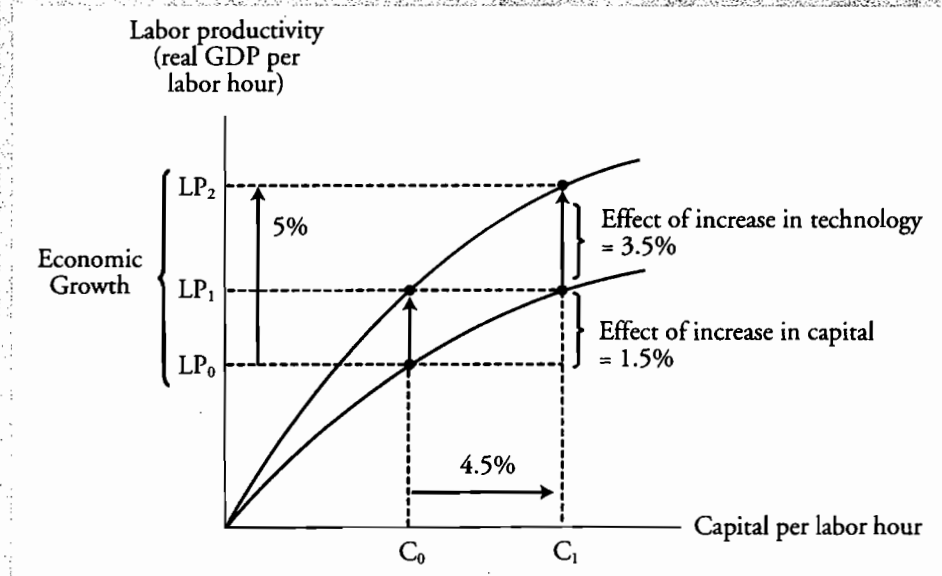
The “One-Third Rule” states that at a given level of technology, on average, a 1% increase in capital per labor hour results in a one third of 1% increase in real GDP per labor hour. The “One-Third Rule” can be used to divide a change in productivity growth into two components: (1) that which is attributable to a change in capital per labor hour (i.e., movement along a productivity curve); and (2) that which is attributable to technological change (i.e., shifts in a productivity curve).

### Example: One-third rule applied to productivity speedup

Assume that real GDP per labor hour grew by 5% over the past five years while capital per labor hour grew by 4.5%. Use the “One-Third Rule” to estimate the amount of real GDP per labor hour growth attributable to the increase in capital and the amount attributable to technological change.

**Answer:**

According to the one-third rule, capital has contributed one third of 4.5% toward the increase in real GDP per labor hour, or 1.5%. ( $1/3 \times 4.5\%$ ). This component results from the movement along the productivity curve. The remaining 3.5% ( $5\% - 1.5\%$ ) growth in real GDP per labor hour is attributable to technological change. This component results from the shift in the productivity curve. These two effects are illustrated in the following figure.

**Productivity Curve**

**Productivity slowdowns** result when technology is applied to deal with issues other than increasing productivity. For example, energy price shocks cause R&D to be diverted from productivity improvement to finding technologies that increase fuel efficiency, which contributes little to real economic growth. Also, technology applied to improving environmental quality creates benefits that are not measured as part of GDP and therefore don't contribute to economic growth.

The key methods for increasing economic growth (i.e., **productivity speedup**) include the following:

- *Encourage savings*, which leads to capital accumulation. Tax incentives are commonly used to encourage private savings.
- *Encourage basic R&D* to develop technological advances that are public goods. The problem is that a capital market will devote too few resources to basic research because the benefits must be shared and the returns are too low. Therefore, government policy must create incentives for basic research.
- *Stimulate international trade* to realize the gains from specialization.
- *Improve the quality of education* by investing in human capital. Once again, government tax policy can provide incentives in this area.

---

**LOS 14.c: Discuss how faster economic growth can be achieved by increasing the growth of physical capital, technological advances, and investment in human capital.**

---

With the proper incentives in place, economic growth occurs as people specialize in activities for which they have a comparative advantage and then trade with one another. As specialization and trading evolve, people acquire increasingly more goods and services in exchange for their labor, gross domestic product (GDP) per person increases, and the standard of living rises. However, in order for economic growth to continue, societies must also have incentives that encourage three activities: (1) savings and investment in new capital, (2) investment in human capital, and (3) discovery of new technologies.

**Saving and investment in new capital** increase labor productivity (which is economic growth) by increasing the level of capital per worker (i.e., “machines per worker”).

**Investment in human capital** is the investment in people’s skills and knowledge, and it is a key driver of economic growth. Both productivity improvements and technological advances derive from investment in human capital. Some fundamental examples of human capital include written language and scientific knowledge. A more subtle form of human capital is the knowledge that workers gain by repeating the same tasks and acquiring experience.

The **discovery of new technologies** contributes to sustained economic growth by making human capital and physical capital more productive. Research and development is the primary driver of the discovery of new technologies. While the most widespread and powerful technologies represent developments in human capital (written and spoken language, science, and mathematics), most technological progress involves improvements in the productivity of physical capital.

---

**LOS 14.d: Compare and contrast classical growth theory, neoclassical growth theory, and new growth theory.**

---

Growth theories have been developed to evaluate the relationship between the factors that affect economic growth. We will compare and contrast three popular growth theories: (1) classical growth theory, (2) neoclassical growth theory, and (3) new growth theory.

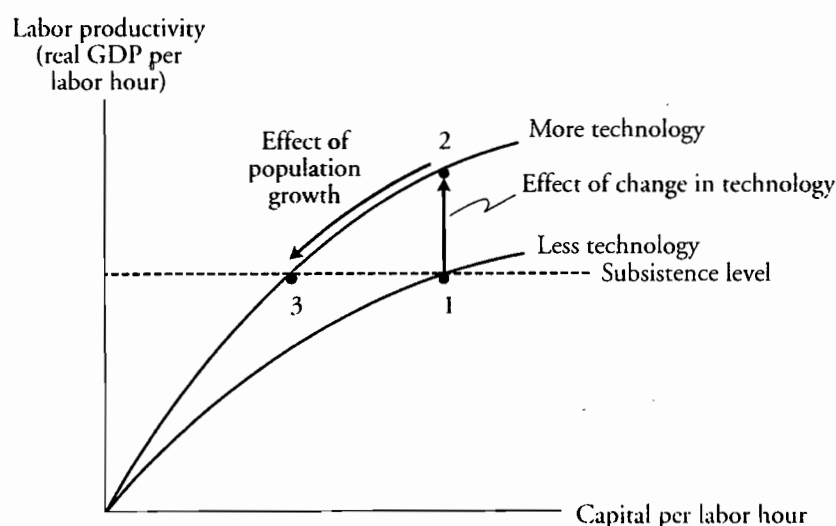
### **Classical Growth Theory**

**Classical growth theory** contends that growth in real GDP is not permanent. When real GDP per person rises above what is referred to as the **subsistence level**, a population explosion occurs, and GDP per person is driven back to the subsistence level.

What classical economists believe is that technological advances lead to increased investment in new capital, which increases labor productivity (in Figure 2, the economy moves from Point 1 to Point 2). With increased labor productivity, new businesses start and the demand for labor increases. This puts upward pressure on real wages and employment increases, which is good news.

However, classical economists also argue that increased real wages lead to a population explosion, which drives real GDP back to its original level (in Figure 2, the economy moves from Point 2 to Point 3). This argument is based on the concept of a **subsistence real wage**, which is defined as the minimum real wage necessary to support life. Whenever real wages are below the subsistence real wage, some people will not survive and the population will decline. When real wages are greater than the subsistence real wage, the population will increase. The increase in the number of workers from the population boom leads to diminishing returns to labor and, eventually, decreased labor productivity. The implication of the classical view is that no matter how much technology advances, real wages will eventually be driven back to the subsistence level and no permanent productivity growth or improvement in the standard of living will occur.

Figure 2: Classical Growth Theory



*Professor's Note: The key to classical growth theory is the population explosion that occurs whenever real GDP per labor hour increases above the subsistence level will eventually eliminate any gains from increased labor productivity.*

## Neoclassical Growth Theory

Neoclassical growth theory holds that without technological change, no long-term growth in real GDP will occur. Neoclassical economists believe that changes in technology lead to increased saving and investment, which causes capital per labor hour to grow.

The big difference between the neoclassical theory and the classical theory is the neoclassical treatment of population growth. Unlike the classical economists, neoclassical economists believe that population growth is not simply a matter of adjustments centered on the subsistence real wage rate.

Neoclassical economists argue that the most important economic influence on population growth is the *opportunity cost* to women for entering the workplace. As real wages for women rise and their job opportunities expand, the opportunity cost of staying home and raising children increases. As the opportunity cost of having children increases, birth rates decline, and population growth slows.

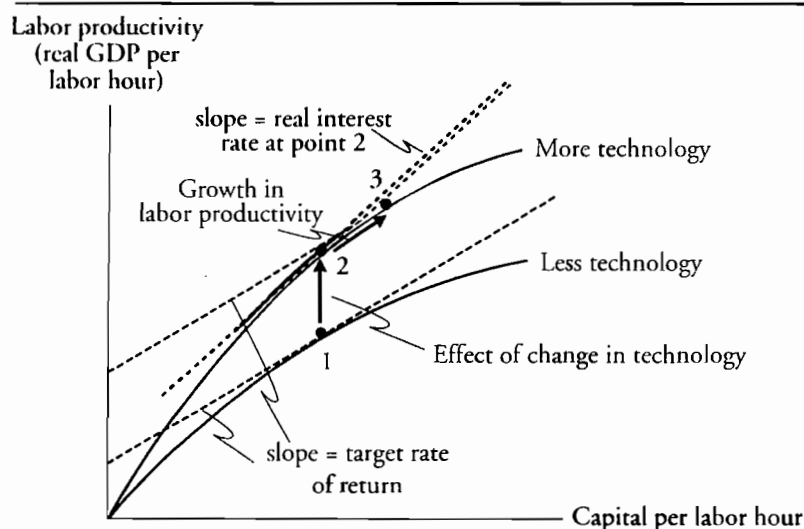
Don't forget that population growth is not only dependent on the birth rate; it is also a function of the death rate. Neoclassical economists argue that as technology advances and productivity increases, incomes rise and more is spent on healthcare. The increased spending on healthcare ultimately increases life expectancy, which causes population growth to increase.

As technology advances in a neoclassical world, both the birth rate and death rate decrease. As it turns out, these opposing economic forces on population growth essentially offset each other. *The bottom line is that population growth is independent of economic growth in the neoclassical model.*

Neoclassical economists argue that technology drives economic growth, but technological growth is not influenced by economic growth. Technological advances in a neoclassical framework occur through a process of trial and error. When the results of R&D are successful, technology grows rapidly. When R&D is not successful, the rate of technological growth slows.

A key assumption of neoclassical growth theory is that there is a **target rate of return** that people use as a benchmark when making their savings decisions. The target rate of return is represented in Figure 3 as the slope of the dashed straight lines labeled “target rate of return.” The actual real interest rate at any point is the slope of the line tangent to the productivity curve at that point.

Figure 3: Neoclassical Growth Theory





*Professor's Note: Although this may seem a little confusing, remember that a return is basically income divided by invested capital. The slope of that line in Figure 3 is "real GDP per labor hour" divided by "capital per labor hour." You should recognize the result, real GDP divided by capital, as a form of a return measure.*

Improvements in technology lead to an increase in labor productivity (the economy moves from Point 1 to Point 2 in Figure 3). Remember that the slope of the productivity curve at the point where the economy is operating is equal to the real rate of return. At Point 2, the real interest rate exceeds the target rate of return (i.e., the slope of the dashed blue line tangent to the curve at Point 2 is greater than the slope of the dashed black line). At that point, savings will be sufficient to support an increase in the growth of capital per labor hour. When this occurs, technology will advance, and new profit opportunities will be created. Existing business will expand, new business will be formed, and investment and savings will increase further. The economy will experience prosperity and growth in labor productivity (the economy moves from Point 2 to Point 3 in Figure 3).

Neoclassical economists believe that economic growth will decline if and only if technology stops advancing. *Unlike classical growth theory*, there is no population growth to slow economic growth.

The primary reason why technology may stop growing is because ultimately, real interest rates adjust. Initially, the high returns from technological change will increase savings and the accumulation of capital. Up to a point, capital accumulation supports further technological advances. However, capital accumulation eventually leads to diminishing returns, which lowers real interest rates. The lower real rates result in decreased savings and a decline in the rate of capital accumulation. Ultimately, technological growth declines and economic growth stops. In Figure 3, growth stops at Point 3, when the real interest rate is equal to the target rate of return.

## New Growth Theory

**New growth theory** is based on two properties of market economies: (1) discoveries are the result of choices, and (2) discoveries lead to profit and competition eliminates profit.

New growth theory, like neoclassical growth theory, contends that the discovery of new products and techniques that lead to technological advancement is the result of luck. However, unlike the neoclassical theory, the rate at which discoveries are made depends on the number of people looking for new technologies and how large the incentive (i.e., the return on the investment) is to find them.

Competition threatens profits, and profits are what drive technological change, so there is an ongoing search to discover technologies that will increase profit by lowering costs, or produce better products that can be sold at higher prices.

There are two other assumptions that are important to new growth theory:

1. Discoveries are public capital goods.
2. The law of diminishing returns does not apply to knowledge capital.

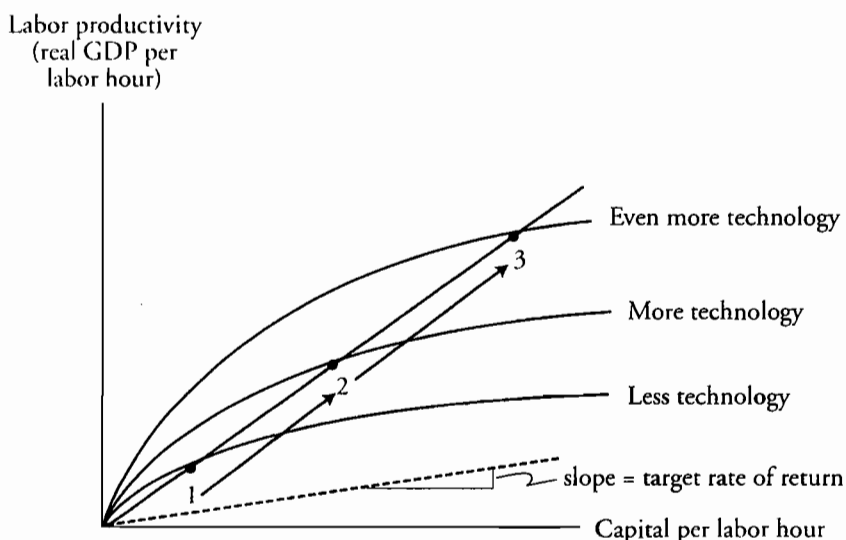
A **public good** is a good that is available to everyone, and its use by one person does not restrict its use by others. The interstate highway system in the United States is an example of a public good.

Knowledge capital is also a public good. As the benefits of a new discovery become interwoven in a society, free resources become available to everyone. Knowledge is a free resource because it has no opportunity cost. That is, nothing must be sacrificed when it is used.

Knowledge capital is a special type of public good because it is not subject to the law of diminishing returns. In a production model, increasing the contribution of labor with a fixed amount of equipment will result in diminishing returns. Likewise, diminishing returns are realized when the amount of equipment is increased while holding labor constant. But, increasing knowledge capital makes both labor and equipment more productive.

The proposition that knowledge is not subject to the law of diminishing returns is a key element of new growth theory. The implication is that, unlike the classical or neoclassical growth theories, there is no mechanism to stop economic growth in a new growth theory framework. Under neoclassical theory, capital accumulation leads to decreased real interest rates, which stifles economic growth. To the contrary, under the new growth theory, a decrease in real interest rates will intensify peoples' incentive to discover new products and methods in order to earn higher profits. However, there is also an offsetting effect on real interest rates. As discovery occurs, real interest rates rise (and stay consistently above the target rate of return), and real GDP per labor hour grows indefinitely (from Point 1 to Point 2 to Point 3 in Figure 4).

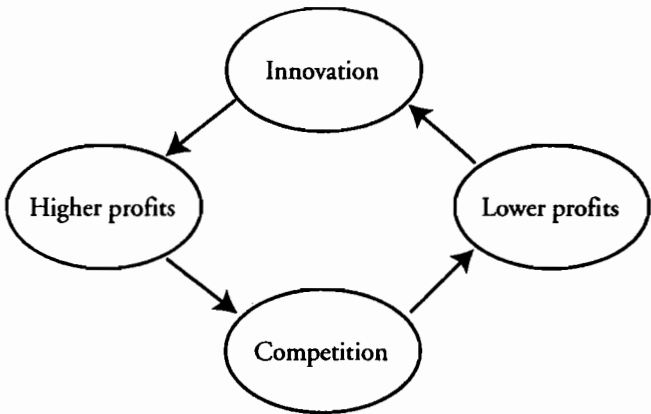
**Figure 4: New Growth Theory**



Notice in Figure 4 that, although the productivity curves exhibit diminishing returns to capital (where capital refers to physical capital, human capital, and technology), the new growth theory predicts that economic growth (growth in labor productivity) will equal growth in capital per labor hour.

The new growth theory describes the economy as a “perpetual motion economy,” as shown in Figure 5. Innovation leads to new technologies and economic growth, which generate higher profits. The higher profits attract competition, which reduces profits. Lower profits provide the incentive to innovate in search of even newer technologies and more economic growth, and the cycle starts again.

Figure 5: New Growth Theory: The Perpetual Motion Economy



The key difference between the new growth theory and neoclassical theory is that neoclassical theory does not include the link between lower profits and the resulting incentive to innovate. Under the neoclassical model, lower profits do not provide an incentive for companies to innovate and develop new technologies.



## KEY CONCEPTS

### LOS 14.a

Sources of economic growth (the inputs are factors of production) can be broadly classified as:

- Land: all natural resources available for production.
- Capital goods: manufactured goods that are used in production.
- Labor: physical and mental talents of workers that are used in production.
- Entrepreneurial ability: the act of combining the other three factors, making the decisions, and bearing the risk, in the hope of generating an economic profit.

There are three social institutions that are preconditions to economic growth because they are critical to the development of incentives:

- Market prices send information to buyers and sellers that give them the incentive to adjust the quantities they supply or demand.
- Property rights are laws and regulations that govern ownership, use, and sale of goods, services, and factors of production.
- Monetary exchange provides for the efficient exchange of goods and services.

### LOS 14.b

The two factors that contribute to labor productivity growth (real GDP per labor hour) are growth in physical capital per labor hour and technological change.

Productivity curves are a plot of labor productivity (y-axis) against capital per labor hour (x-axis) at a given state of technology. Properties of productivity curves include:

- Productivity increases as capital per labor hour increases, at a given state of technology. Growth in capital per labor hour causes movements along a productivity curve.
- Productivity increases as the state of technology increases at any given level of capital per labor hour. Technological growth causes the productivity curve to shift upward.
- Productivity curves exhibit the law of diminishing returns.

The “One-Third Rule” states that at a given level of technology, a 1% increase in capital per labor hour results in a one third of 1% increase in real GDP per labor hour. It can be used to decompose a change in productivity growth into two components attributable to:

- Change in capital per labor hour.
- Technological change.

### LOS 14.c

Three activities are necessary to result in persistent economic growth:

- Savings and investment in new capital increase labor productivity, which is defined as real GDP per labor hour. Saving and investment in new capital increases the level of capital per worker.
- Investment in human capital is the investment in people’s skills and knowledge, leading to productivity improvements and technological advances.
- Discovery of new technologies contributes to sustained economic growth by making human capital and physical capital more productive.

**LOS 14.d**

Classical growth theory contends that growth in real GDP is temporary—real GDP per person rises above the subsistence level, a population explosion occurs, and GDP per person is driven back to the subsistence level.

Neoclassical growth theory holds that without technological change, no growth in real GDP will occur because changes in technology lead to increased saving and investment, which causes capital per labor hour to grow and the real rate of return to fall. When the real return falls to the target rate of return, economic growth stops. The main difference between the neoclassical theory and the classical theory is that neoclassical economists believe that population growth is independent of economic growth.

New growth theory argues that economic growth continues indefinitely as technology advances. This occurs because decreases in the real rate intensify the incentive to discover new products and methods, the discovery of which increases the real interest rate and keeps it above the target rate of return. According to the new growth theory, the economy is a perpetual motion machine: innovation leads to new technologies that produce higher profits; higher profits lead to competition, which reduces profits; the lower profits provide the incentive to innovate and develop even newer technologies.

## CONCEPT CHECKERS

1. If real GDP in India is growing at 3.5% a year, and inflation is 5%, approximately how many years will it take for real GDP to double? (Use the rule of 70 and assume population growth is 0.)
  - A. 8.2 years.
  - B. 14.0 years.
  - C. 20.0 years.
2. If nominal GDP in the United States is growing at 4% a year, and inflation is 2%, approximately how many years will it take for real GDP to double? (Use the rule of 70 and assume population growth is 0.)
  - A. 11.6 years.
  - B. 17.5 years.
  - C. 35.0 years.
3. Which of the following is *not* a source of economic growth?
  - A. Property rights.
  - B. Technological advance.
  - C. Increases in labor productivity.

Use the following information to answer Questions 4 and 5.

4. The Board of NHY Risk, Inc., revises the company's economic forecast and credit risk policy every six weeks. Bond analyst Ann Grey is giving a report on sources of economic growth for the board meeting. She is *least likely* to include a discussion of:
  - A. monetary exchange.
  - B. human capital growth.
  - C. aggregate hours.
5. Ann Grey is also studying time series data from the nation-state of Bundy. She has created the following summary chart on the average annual change in real GDP per capita:

|           |               |
|-----------|---------------|
| 1886–1905 | estimated <1% |
| 1906–1925 | +1.3%         |
| 1926–1945 | –0.9%         |
| 1946–1965 | +4.8%         |
| 1966–1985 | +7.2%         |
| 1986–2005 | +2.3%         |

Which of the following is *most likely* the source of the growth spurt between 1946 and 1985?

- A. Growth in aggregate hours.
- B. Trade policy shift from import restrictions to tariffs.
- C. Reduction in both the federal budget deficit and the current account deficit.

6. Which of the following is *least likely* to be associated with the incentive system that an economy must have as a precondition to experience economic growth?
  - A. Human capital that promotes the discovery of new technologies.
  - B. Monetary exchange that facilitates the efficient exchange of goods and services.
  - C. Property rights that govern the ownership, use, and exchange of physical and intellectual property.
7. Which of the following is *least likely* to be associated with the law of diminishing returns?
  - A. Investment in labor.
  - B. Investment in knowledge capital.
  - C. Investment in physical capital.
8. Which of the following is *most* closely associated with the classical theory of economic growth?
  - A. A target rate of return.
  - B. A subsistence real wage.
  - C. The opportunity cost of raising children.
9. Between 1965 and 1979, labor productivity increased from \$12.00 per labor hour to \$12.84 per labor hour. Over the same period, investment in new capital increased from \$30.00 per labor hour to \$31.05 per labor hour. The contribution of the increased investment in new capital and technological advancement toward economic growth over this period are *closest* to:
 

| <u>Investment in new capital</u> | <u>Technological advancement</u> |
|----------------------------------|----------------------------------|
| A. 1.17%                         | 5.83%                            |
| B. 5.83%                         | 1.17%                            |
| C. 5.83%                         | 5.83%                            |
10. Which of the following *most accurately* represents a general property of a labor productivity curve?
  - A. Movement along a productivity curve is caused by a change in capital per labor hour, holding all else constant.
  - B. A shift in a labor productivity curve is caused by a change in capital per labor hour, holding all else constant.
  - C. Movement along a labor productivity curve is caused by technological advancement, holding all else constant.
11. Are the new growth and neoclassical growth theories supported by the premise that knowledge capital is NOT subject to the law of diminishing returns?
 

| <u>New growth theory</u> | <u>Neoclassical growth theory</u> |
|--------------------------|-----------------------------------|
| A. Yes                   | Yes                               |
| B. Yes                   | No                                |
| C. No                    | Yes                               |
12. The two economic factors that are *most* important to the new theory of economic growth are:
  - A. population growth and real interest rates.
  - B. investment in new capital and real interest rates.
  - C. the creation of knowledge capital and real interest rates.

**CHALLENGE PROBLEMS**

13. Refer to Figure 3, Neoclassical Growth Theory, from the topic review to answer this question. Assume that the target rate of return is 10%. What are the *most likely* values for the real interest rate at:
- |    | <u>Point 2?</u> | <u>Point 3?</u> |
|----|-----------------|-----------------|
| A. | 10%             | 15%             |
| B. | 10%             | 10%             |
| C. | 15%             | 10%             |
14. Refer to Figure 3, Neoclassical Growth Theory, from the topic review to answer this question. What are the *most likely* values for growth in real GDP per labor hour at:
- |    | <u>Point 2?</u> | <u>Point 3?</u> |
|----|-----------------|-----------------|
| A. | 3%              | 3%              |
| B. | 3%              | 0%              |
| C. | 0%              | 3%              |
15. Refer to Figure 4, New Growth Theory, from the topic review to answer this question. What are the *most likely* values for growth in real GDP per labor hour at:
- |    | <u>Point 2?</u> | <u>Point 3?</u> |
|----|-----------------|-----------------|
| A. | 3%              | 3%              |
| B. | 3%              | 0%              |
| C. | 0%              | 3%              |
16. The two great nations of Bundy and Bandi share a border and a common language, but little else. In 2009 they sign a trade agreement to improve both economies; initially the real GDP in Bundy is four times that of Bandi. If real GDP in Bandi is growing at 10% a year, and real GDP in Bundy is now growing at 3.5% a year, approximately how many years will it take for real GDP in the two nations to match? (Use the rule of 70 and assume population growth is 0.)
- A. 14 years.  
B. 21 years.  
C. 35 years.

## ANSWERS – CONCEPT CHECKERS

1. C The rule of 70 states real GDP will double every  $70/r$  years. Inflation is not relevant to this problem since we are working with real rates.
2. C Real GDP = Nominal GDP – inflation. The rule of 70 states real GDP will double every  $70/r$  years.
3. A The sources of economic growth are growth in aggregate hours, increases in labor productivity, physical capital growth, human capital growth, and technological advance. Property rights are a precondition.
4. A The sources of economic growth are aggregate hours, labor productivity, physical capital growth, human capital growth, and technological advance. Monetary exchange is a precondition, but not a source.
5. A The sources of economic growth are aggregate hours, labor productivity, physical capital growth, human capital growth, and technological advance. A trade policy shift to tariffs or a reduction in the federal budget deficit and the current account deficit may or may not increase real GDP growth.
6. A The three institutions that are critical to the development incentives that promote economic growth are markets, property rights, and monetary exchange. With these institutions in place, investment in human capital can lead to economic growth.
7. B Knowledge capital is a special type of public good that is not subject to the law of diminishing returns. Investment in labor and physical capital do exhibit diminishing returns, which are reflected in the shape of the productivity curve.
8. B Classical growth theory contends that growth in real GDP is temporary. Whenever real wages rise above the subsistence real wage, a population explosion occurs, and GDP per person is driven back to the subsistence level.
9. A According to the “One-Third Rule,” at a given level of technology, a 1% increase in capital per labor hour results in a  $1/3\%$  increase in real GDP per labor hour. The percent change in capital per labor hour is  $3.5\% = (31.05 / 30) - 1$ . The increase in productivity due to the increase in capital per labor hour is  $1/3 \times 3.5\% = 1.17\%$ . Economic growth (growth in GDP per labor hour) is  $7\% = (12.84 / 12.00) - 1$ . The remainder of the increase in GDP per labor hour,  $7\% - 1.17\% = 5.83\%$ , is due to technology change.
10. A Productivity (GDP per labor hour) increases as capital per labor hour increases, at a given state of technology, resulting in movement along a productivity curve. Productivity increases as the state of technology increases at any given level of capital per labor hour, resulting in a shift in the productivity curve. Population growth is only relevant to economic growth under the classical theory, and will not result in a shift in a productivity curve.
11. B The idea that knowledge is not subject to the law of diminishing returns is the underpinning of new growth theory. The implication of this is that, unlike the neoclassical growth theory, there is no mechanism to stop economic growth.

12. C The new growth theory argues that productivity growth is a function of society's ability to discover new products and methods (i.e., the creation of knowledge capital) and real interest rates. A key part of new growth theory is that knowledge is not subject to the law of diminishing returns.

## ANSWERS – CHALLENGE PROBLEMS

13. C According to the neoclassical growth theory, the real interest rate is equal to the slope of the line tangent to the productivity curve. At Point 2, the real interest rate is greater than the target rate of return (which is assumed to be 10%), while at Point 3, the real interest rate and the target rate of return are equal. Therefore, only Choice C is consistent with the 10% target rate of return.
14. B At Point 2, the real interest rate is greater than the target rate of return, so savings are sufficient to support an increase in the growth of capital per labor hour. When this occurs, technology will advance, new profit opportunities will be created, and investment and savings will increase further. As a result, labor productivity (real GDP per labor hour) will experience growth, so the growth rate must be greater than 0% at Point 2.

At Point 3, real interest rates adjust to the level of the target rate of return, capital accumulation stops, and the growth rate falls to 0%.

Only Choice B is consistent with a positive growth rate at Point 2 and a zero growth rate at Point 3.

15. A Under the new growth theory as depicted in Figure 4, real GDP per labor hour will grow indefinitely at a positive rate because the real interest rate is consistently above the target rate of return. Only Choice A is consistent with a positive growth rate at both Point 2 and Point 3.
16. B The rule of 70 states real GDP will double every  $70 / r$  years. Bandi is doubling every 7 years. Bundy is doubling every 20 years. If we arbitrarily assume Bandi's GDP is 1 unit and Bundy's is 4, Bundy's will increase from 4 to 8 over the next 20 years. During roughly the same period, Bandi's will increase from 1 to 2 to 4 to 8 over 21 years. Thus, based on the rule of 70, it will take approximately 20 to 21 years before they are equal.

# REGULATION AND ANTITRUST POLICY IN A GLOBALIZED ECONOMY

Study Session 4

---

## EXAM FOCUS

This topic review addresses the issue of how governments can influence a country's future economic growth through regulation. There is an important link between this reading and the global industry analysis material in Study Session 11. Analysis of heavily regulated industries requires an understanding of the economic analysis of government regulation. Focus your attention on the terminology introduced here and on the positive and negative effects of regulation on companies, industries, and society as a whole.

---

## WARM-UP: NATURAL MONOPOLIES

Natural monopolies occur when a single firm has the capacity to produce all of an industry's output at the lowest per-unit cost. This arises in industries where economies of large-scale production prevail, such as the electric utilities industry. Smaller, less efficient producers have higher long-run average costs, resulting in the most efficient producer emerging and dominating the industry. A profit maximizing monopolist will produce the quantity for which marginal revenue equals marginal cost.

---

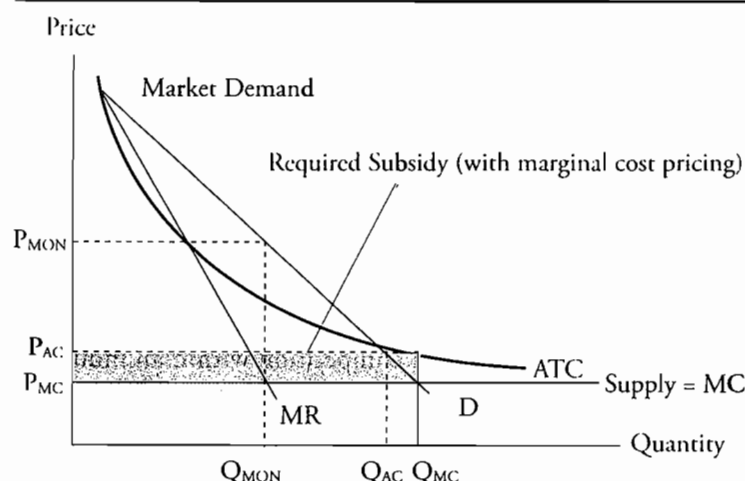
**LOS 15.a: Explain the rationale for government regulation in the form of 1) economic regulation of natural monopolies and 2) social regulation of nonmonopolistic industries.**

---

**Economic regulation** refers to government regulation of specific industries, such as electric utilities, banking, or insurance. The rationale for economic regulation of industries considered natural monopolies is that social welfare (economic benefit) is increased by regulation. The standard (single price) monopoly analysis and regulatory alternatives are represented in Figure 1.



Figure 1: Natural Monopoly—Average Cost and Marginal Cost Pricing



A single-price monopolist will maximize profit by producing quantity  $Q_{MON}$  and selling it at a price of  $P_{MON}$ . Economic analysis tells us that the maximum social benefit is achieved if the monopolist produces  $Q_{MC}$ , the quantity where marginal social cost (shown by the supply curve) equals marginal social benefit (shown by the demand curve). In order to reduce the deadweight loss of monopoly pricing, government regulation must increase the quantity produced and decrease the price.

One type of regulation of a natural monopoly is **cost-of-service** regulation which can take the form of marginal-cost or average-cost pricing. Regulators may impose a price equal to marginal cost,  $P_{MC}$ , in order to achieve the optimal production quantity,  $Q_{MC}$ . With *marginal-cost pricing*, however, the price is less than average cost and the monopolist could only continue to produce if a subsidy (as shown in Figure 1) were paid to the monopolist. Therefore, the alternative of *average-cost pricing* is often used. If the regulators can force the price to  $P_{AC}$ , quantity  $Q_{AC}$  will be purchased (produced) and no subsidy will be required. This reduces the deadweight loss of monopolistic pricing compared to the unregulated outcome, but does not eliminate it as marginal-cost pricing with a subsidy would.



*Professor's Note: Marginal-cost and average-cost pricing are discussed in the Economics section of Level 1.*

Another type of regulation of natural monopolies is **rate-of-return** regulation, where the regulators set the price so that a competitive rate of return is earned by the monopolist company.

**Social regulation** is concerned with product quality and market failures other than those from monopolies. *Asymmetric information* refers to a situation where the seller and buyer have different (access to) information about product quality. In the United States, the Food and Drug Administration regulates pharmaceutical products, the SEC regulates publicly traded securities, the FAA regulates aircraft, the Federal Reserve Board regulates financial institutions, and the Federal Trade Commission regulates business practices. The rationale is to protect consumers, since they have limited access to the information necessary to judge product quality.

Other social regulation is designed to improve the functioning of markets. The Environmental Protection Agency in the United States regulates pollution, an example of a market externality that leads to overproduction (and over-pollution) in the absence of regulation.

---

**LOS 15.b: Discuss the potential benefits and possible negative side effects of social regulation.**

---

In almost all instances, increased regulation results in higher production costs, and those incremental costs are ultimately absorbed by the consumer. In addition, higher levels of regulation may have an unintended, negative impact on competition within an industry, because compliance with regulations may impose a disproportionately larger expense on smaller firms than on larger firms, thus negatively affecting their profitability.

However, the benefits of social regulation, although difficult to quantify, can be far-reaching and can positively affect society for years to come. Safer products, safer workplaces, and a cleaner environment are some of the positive outcomes of social regulation. The debate over the merits of social regulation typically focuses on the appropriate extent of the regulation and the accompanying complexity of the cost-benefit analysis, and not whether a governing body should utilize regulation at all.

Firms subject to regulation (that will raise their costs of production and lower their profitability) may attempt to avoid the regulation or minimize the costs. A firm can conform to the letter, but not the intent, of the regulation through what is referred to as a **creative response**. For example, consider a law that requires employers in an industry to equally consider all qualified applicants for open positions within the firm, regardless of the applicants' gender, age, or race. A firm may conform to the law by granting interviews to all applicants, but only extending job offers to men. In this instance, the firm may conform to the law by granting interviews to women, but not the intent of the law by only making job offers to men.

A **feedback effect** is a typical example of a creative response to regulation. It occurs when consumers' behavior is changed as a result of the new regulation. An example of a feedback effect would be if regulators required that automobiles utilize fuel more efficiently, consumers in turn may become less diligent in their effort to conserve fuel and drive more because their cost to drive per mile has decreased. The effect is to undermine the original intent of the regulation, which was to reduce fuel consumption.

---

**LOS 15.c: Differentiate between the capture hypothesis and the share-the-gains, share-the-pains theory of regulator behavior.**

---

Regulators are selected and compensated by the applicable governing entity (i.e., federal or state government). In theory, regulators' actions are not influenced by the market or any of its participants. In reality, this is not always the case. There are two predominant theories of regulators' behavior that can help explain how regulation has at times both helped and harmed the consumer.

The **capture hypothesis** is based upon the assumption that, regardless of the original purpose behind its establishment, a regulatory body will, at some point in time, be influenced or even possibly controlled by the industry that is being regulated. The rationale behind the theory is that regulators will be selected from among the available pool of industry “experts” (people who have experience in the industry). Although no longer directly employed in the industry, these “experts,” in their new roles as regulators, still have contacts and relationships with those in the industry, thus affecting the regulators’ ability to render impartial decisions.

An additional bias in favor of industry participants is the fact that at a regulatory hearing, interested consumers and taxpayers will almost certainly be at a disadvantage to the opposing party, members of the industry. With a greater financial position at stake, industry participants are motivated to spend more resources to be better prepared at a regulatory hearing than the group of affected consumers, and are thus able to present a more persuasive argument to the regulators who are responsible for establishing the industry standards. Under the capture theory, only the interests of the industry participants are of concern to the regulatory agency.

The **share-the-gains, share-the-pains theory** is based upon the assumption that regulators will strive to satisfy all three interested parties: the legislators, the customers, and the regulated firms themselves. In contrast to the capture hypothesis, under this theory the regulators are not completely captured by the regulated firm; instead, regulators consider the consequences of their decisions from the standpoint of each of the three affected parties. For example, suppose an industry experiences a sudden and unexpected increase in fuel costs, which increases the cost of production. The share-the-gains, share-the-pains theory would predict that regulators would allow the regulated industry to pass along only part of the cost increase, and then only gradually over time. In the same scenario, the capture theory would anticipate that regulators would permit producers in the industry to pass through the bulk of the higher costs to consumers (or as much as consumers can tolerate) in a shorter period of time.

## KEY CONCEPTS

### LOS 15.a

The main objective of economic regulation is to control the prices that the regulated firms are permitted to charge, especially natural monopolies. Cost-of-service regulation requires the producers in the regulated industry to charge prices based upon the actual cost (marginal or average) of producing the product or providing the service to consumers. Rate-of-return regulation is designed to permit producers in the regulated industry to charge prices that provide a competitive rate of return on their investment, with no opportunities to earn a positive economic profit.

Social regulation is applicable to all industries, and its benefits include industry-wide improvements in such areas as product quality, product safety, and the safety of employees in the workplace.

### LOS 15.b

There can be unintended negative effects of regulation, such as members of a regulated industry attempting to circumvent full compliance with the regulation, or the unforeseen consequences of consumers modifying their behavior in response to a regulation (i.e., a creative response known as a feedback effect).

### LOS 15.c

The capture hypothesis is based upon the assumption that regardless of the reason why a regulatory agency was established, it will eventually be influenced or “captured” by the industry that is being regulated. The share-the-gains, share-the-pains theory is based upon the assumption that regulators will strive to satisfy all three interested parties: the legislators, the customers, and the regulated firms themselves.

## CONCEPT CHECKERS

1. A regulatory commission that requires firms in the industry to charge prices that are close to the average costs of production is utilizing which of the following methods of regulation?
  - A. Rate-of-return regulation.
  - B. Cost-of-service regulation.
  - C. Average cost regulation.
2. The main purpose of economic regulation by a government is to:
  - A. promote higher product quality, increased product safety, and safer workplace conditions.
  - B. preserve the profitability of existing industry participants.
  - C. control the prices that regulated companies are allowed to charge.
3. The behavior of a regulatory agency whose actions are attempts to satisfy the legislators, the regulated industry, and the consumers can *best* be described as:
  - A. the share-the-gains, share-the-pains theory.
  - B. the capture hypothesis.
  - C. social regulation.

## CHALLENGE PROBLEMS

Use the following data to answer Questions 4 and 5.

The Environmental Protection Agency (EPA), a U.S. regulatory agency that develops and enforces environmental standards, has recently imposed a new restriction on the tire industry, requiring that new tires produced in the United States utilize 20% more renewable resources than previously required.

4. The new government regulation is *most appropriately* classified as an example of:
  - A. social regulation, because its primary goal is for a better quality of life through a less polluted environment.
  - B. economic regulation, because higher-cost producers will be forced to exit the industry.
  - C. rate of return regulation, because industry participants will still achieve a normal, competitive rate of return.
5. Tire Empire, a leading U.S. manufacturer of tires, decides to move its manufacturing operations abroad, which will decrease its production costs by significantly more than it will increase distribution costs. Tire Empire's strategy is *best* described as:
  - A. creative response.
  - B. feedback effect.
  - C. deregulation.

## ANSWERS – CONCEPT CHECKERS

1. **B** Cost-of-service regulation establishes pricing policies for the industry based upon the actual average costs of the products or services.
2. **C** Economic regulation seeks to prevent both monopoly profits and predatory competition by controlling prices charged to consumers.
3. **A** A regulator that attempts to distribute the burden of regulation upon the three main interested parties is acting in accordance with the share-the-gains, share-the-pains theory.

## ANSWERS – CHALLENGE PROBLEMS

4. **A** The most obvious goal of the regulation would be to conserve natural resources, which would align most closely with social regulation's focus on a better quality of life.
5. **A** Tire Empire is technically complying with the law by simply moving its manufacturing operations out of the United States. However, the move undermines the spirit of the law by not utilizing a greater amount of renewable resources, which would benefit the environment in the United States as well as globally.

---

The following is a review of the Economics for Valuation principles designed to address the learning outcome statements set forth by CFA Institute®. This topic is also covered in:

# TRADING WITH THE WORLD

Study Session 4

---

## EXAM FOCUS

The main points of this topic review are three-fold. First, you should understand the principle of comparative advantage as that is the basis of the case for free trade. Second, make sure you understand the difference between the effects of tariffs and the effects of quotas, and how restrictions on trade in general decrease the wealth of a country. Third, know who gains and who loses from trade restrictions and that trade restrictions are considered to be primarily driven by the political activity of those who stand to gain from specific trade restrictions.

---

**LOS 16.a: Explain comparative advantage and how countries can gain from international trade.**

---

*Comparative advantage* refers to the lowest *opportunity cost* to produce a product.

The **law of comparative advantage** holds that *trading partners can be made better off if they specialize* in the production of goods for which they are the low-opportunity-cost producer (have a comparative advantage) and trade for those goods for which they are the high-opportunity-cost producer. A country gains (i.e., it realizes expanded consumption possibilities) from international trade when it *exports* those goods for which it has a comparative advantage and *imports* those goods for which it does *not*.

An example will illustrate the gains from trade in terms of expanded consumption opportunities for two countries. Figures 1 and 2 show the production possibility frontiers (PPF) for two countries, Alton and Borton, for two generic goods, food and machinery.

**Figure 1: Production Possibility Frontier for Alton**

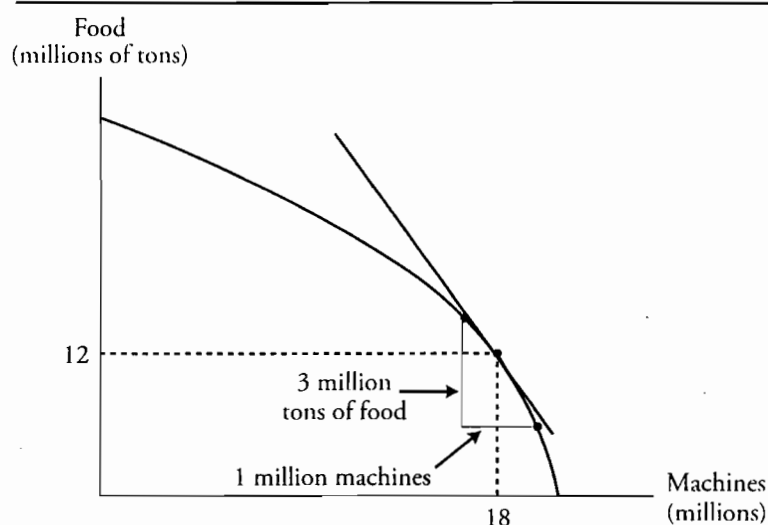
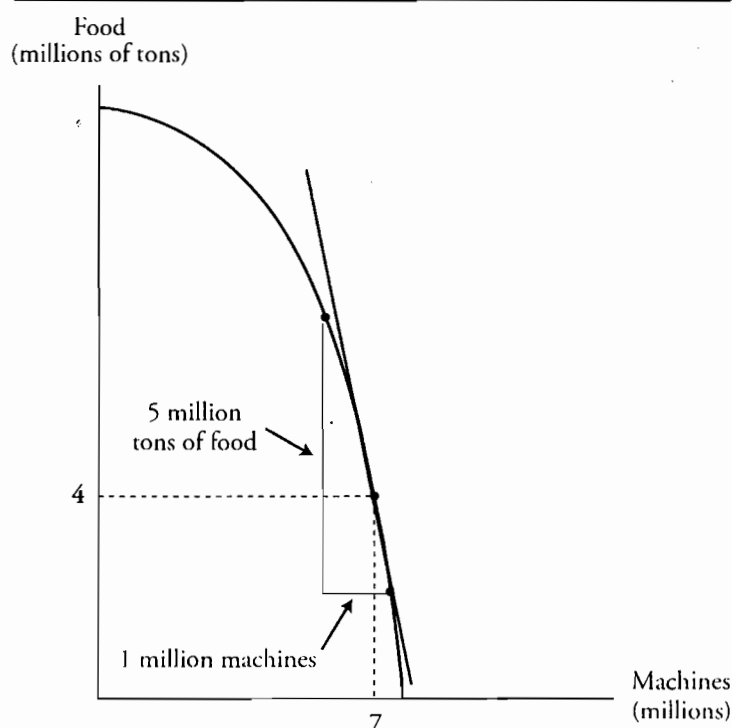


**Figure 2: Production Possibility Frontier for Borton**



Without trade, Alton chooses to produce 12 million tons of food and 18 million units of machinery, while Borton chooses to produce 4 million tons of food and 7 million machines. The slope of the each country's PPF at its chosen production point represents the opportunity cost of food in terms of machinery. Given their possible production levels of the two goods, the opportunity cost of producing a unit of one good can be expressed in terms of how many units of the other good they must give up to produce it.



For Alton, the opportunity cost of producing another million units of machinery is 3 million tons of food, while for Borton, the opportunity cost of producing another million units of machinery is 5 million tons of food. The opportunity costs of food are simply the reciprocals of these amounts. For Alton, the opportunity cost of producing another million tons of food is  $1/3$  million units of machinery, and for Borton, the opportunity cost of producing another million tons of food is  $1/5$  million units of machinery. If one country has a lower opportunity cost of producing one good, the other country must have a comparative advantage in the production of the other good. Alton has a comparative advantage in the production of (the lowest opportunity cost of producing) machinery and that Borton has a comparative advantage in the production of food. Next we will show that, as long as their opportunity costs of production differ, trade will allow both countries to consume more than they can without trade.

Since Alton has a comparative advantage in the production of machinery, it will be advantageous for Alton to produce more machinery and to trade with Borton for food. For example, Alton could produce 2 million more units of machinery and 6 million tons less food. Borton could produce 6 million more tons of food and, given that their opportunity cost of a million tons of food is  $1/5$  of a million units of machinery, produce 1.2 million fewer units of machinery.

The table in Figure 3 illustrates the total output of both countries with and without specialization and trade.

**Figure 3: Gain From Trade**

|        | <i>Without Trade</i> |                       | <i>With Trade</i>  |                        |
|--------|----------------------|-----------------------|--------------------|------------------------|
|        | <i>Machinery</i>     | <i>Food</i>           | <i>Machinery</i>   | <i>Food</i>            |
| Alton  | 18 million           | 12 million tons       | 20.0 million       | 6 million tons         |
| Borton | <u>7 million</u>     | <u>4 million tons</u> | <u>5.8 million</u> | <u>10 million tons</u> |
| Total  | 25 million           | 16 million tons       | 25.8 million       | 16 million tons        |

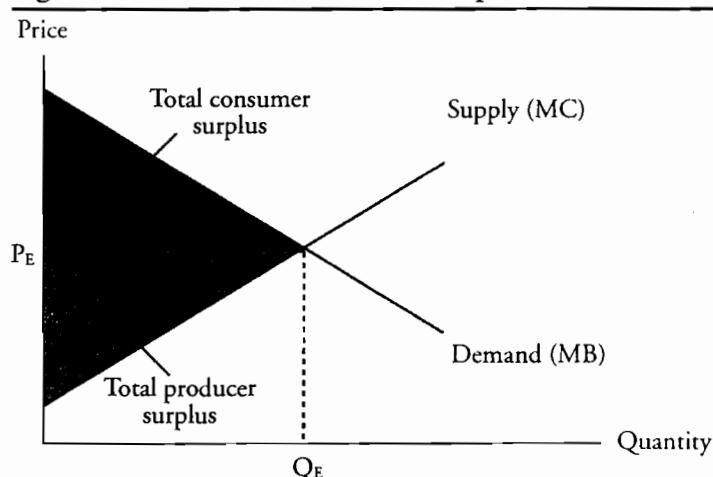
When each country specializes in the good for which they have a comparative advantage and trades with the other, there are clear gains in our example. Total food production can remain at 16 million tons while the total output of machinery is increased by 0.8 million units. Alton will export machinery, since they are the low (opportunity) cost producer of machinery, and import food from Borton. Borton has a comparative advantage in the production of food and will export food to Alton and import Alton-produced machinery.

How the gains from specialization and trade will be shared between the two countries is not determined here, but clearly there is a possible exchange that will allow both countries to enjoy a combination of food and machinery that they could not reach on their own without trade. In terms of our PPF graphs, each country can consume at a point *outside* its PPF through specialization and trade. That's the important point here, as long as opportunity costs differ, two countries can both benefit from trade.

### WARM-UP: CONSUMER AND PRODUCER SURPLUS

Recall from Level 1 that the consumer surplus is the difference between the total value to consumers of the quantity of a good or service consumed and the total amount consumers pay for that production. The producer surplus is the difference between the total cost of producing the output of a good or service and the total amount received for that output. The equilibrium quantity produced and consumed in well-functioning unregulated competitive markets is the quantity for which the sum of consumer surplus and producer surplus is maximized. This point is illustrated in Figure 4.

**Figure 4: Consumer and Producer Surplus**



### LOS 16.b: Compare and contrast tariffs, nontariff barriers, quotas, and voluntary export restraints.

Although the gains from trade are very apparent, countries erect barriers to trade, including tariffs and quotas, and sometimes impose voluntary export restraints (VERs).

#### Tariffs

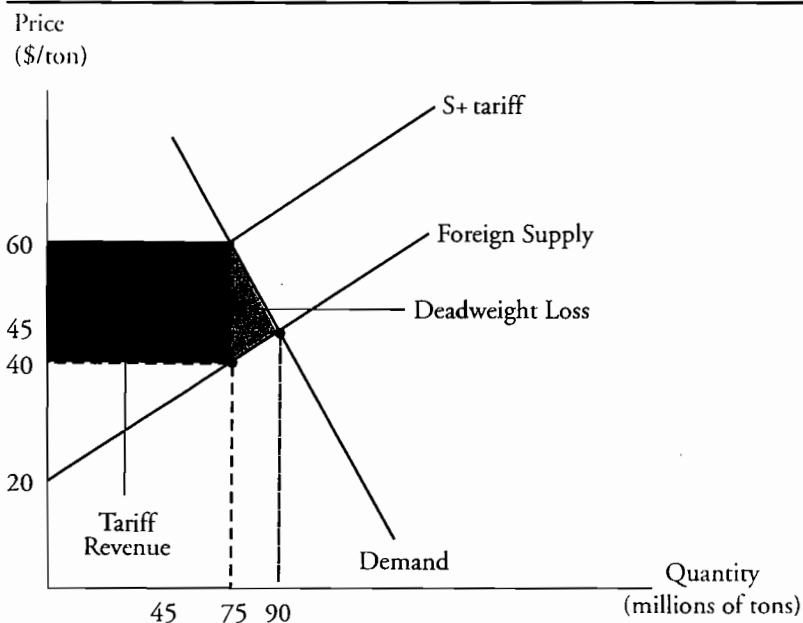
A *tariff* is a tax imposed on imported goods while a *quota* is a limitation on the quantity of goods imported.

Tariffs benefit domestic producers because the level of imports will be reduced due to an effective increase in the price of the good. For example, if the world price of semiconductors is \$40, and domestic producers can only profitably meet domestic semiconductor demand at a price of \$45, foreign producers have a comparative advantage. Hence, domestic producers will not be able to compete in their own domestic semiconductor market. However, if the government places a tariff of at least \$5 on imported semiconductors, domestic producers will become competitive with foreign producers in the domestic market, and domestic semiconductor production will rise compared to the level of production without tariffs. Tariffs will also benefit the

government, because it will collect the tax (tariff) on all foreign semiconductors sold in the domestic market.

In Figure 5, without trade restrictions the equilibrium price is \$45/ton and the equilibrium quantity is 90 million tons. With the imposition of a tariff of \$20/ton, the supply curve shifts up by the amount of the tariff to “S + tariff.” The equilibrium price paid by domestic consumers increases to \$60/ton and the quantity imported decreases to 75 million tons. The amount of the tariff revenue is the tariff (\$20/ton) multiplied by the quantity imported (75 million tons). Note that the gains from trade (equal to the sum of producer and consumer surplus) are reduced by more than the amount of the tariff revenue. While the tariff revenue is collected by the domestic government, the triangle of the lost gains from trade in excess of the tariff revenues represents a loss in the overall value produced by the exchange of goods and is a deadweight loss.

**Figure 5: Effects of a Tariff**



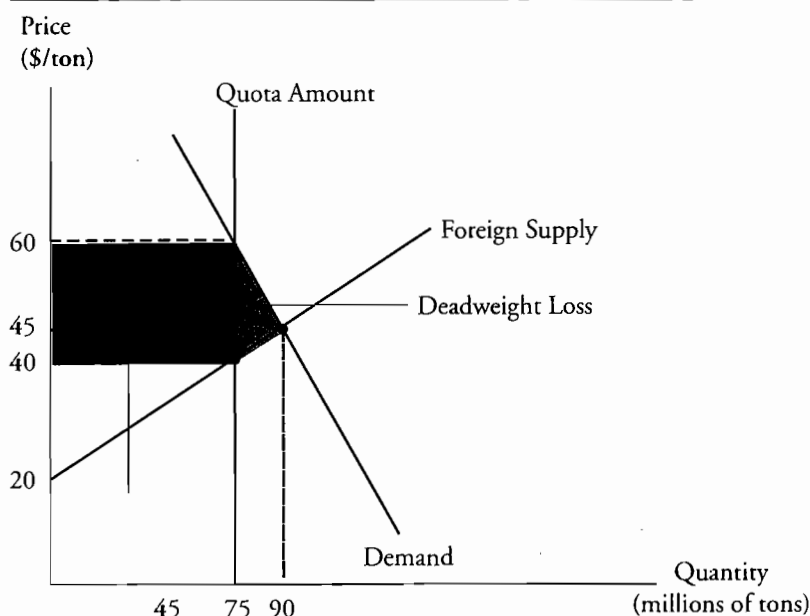
## Quotas

A quota has an effect very similar to that of a tariff. Under a quota system, importers are given licenses to import specific amounts of a foreign-produced good. The supply of imported goods is reduced, and a lower supply means a higher price and reduction in the equilibrium domestic quantity. Clearly, domestic producers benefit from the quota because competition from foreign producers is reduced.

In Figure 6 we illustrate the effects of a quota. In order to illustrate the difference between the effects of a quota and an equivalent tariff, we have set the quota amount equal to 75 million tons, the equilibrium quantity exchanged when there is a \$20 tariff (Figure 5). With the supply fixed at the quota amount of 75 million tons, the equilibrium price is \$60/ton, as with the \$20 tariff. Wealth is transferred from domestic

consumers (lost consumer surplus) to those (either domestic importers or foreign producers) holding the allocations of some of the quota amount. The deadweight loss is the same with the quota and with the tariff, the price paid by domestic consumers is the same with the quota and with the tariff, but the revenue under the tariff collected by the domestic government is now excess revenue transferred to the quota holders. Those that gain the right to import some of the quota amount have received a valuable right. The way in which import quotas are allocated among them will determine who gets these gains in producer surplus.

**Figure 6: Effects of a Quota**



**Voluntary export restraints (VERs)** are agreements by exporting countries to voluntarily limit the quantity of goods they will export to an importing country. The primary difference between VERs and quotas is that the gains that accrue to those with import licenses under a quota system are received by the firms in the exporting countries that hold export permits under a VER system. It is probably common that the foreign government officials who determine which exporters get permits find ways to receive some of the value of these licenses.

#### **LOS 16.c: Critique the arguments for trade restrictions.**

It is reasonable at this point to ask why trade restrictions are as common as they are, given that free trade appears to offer societal gains to all countries. While trade restrictions have fallen over recent decades, they are still prevalent and significant in such products as sugar, textiles, footwear, meat, and metals, among others.

The primary forces underlying trade restrictions are twofold. Governments like tariff revenue, and domestic producers affected by lower-cost imports use political means to gain protection from foreign competition. In developing countries, the ability to collect

income tax revenue is restricted by both the lack of financial records and problems of compliance. This makes tariff revenue an attractive alternative.

In theory, the benefits of free trade could be used to compensate domestic producers that lose as a result of free trade. This, however, is problematic and seldom done. The affected parties, such as domestic steel producers and steel workers or domestic textile manufacturers and textile workers, have a strong incentive to use their votes and political contributions to gain protection in the form of tariffs, quotas, or voluntary export restraints.

A variety of arguments are made for trade restrictions to hide the reality that they are imposed to benefit one group at the expense of the entire economy and its citizens. Whether they are defended on the basis of saving jobs, protecting workers from competition with low-wage countries, temporarily protecting a developing “infant” industry, lower environmental protection standards in exporting countries, or preventing the “exploitation” of less-developed countries, most economists agree that trade restrictions benefit specific groups at the expense of the whole economy.

Some arguments commonly made to support trade restrictions that have some support among economists are:

- *Developing industries (infant industries) should be protected while they get up to world standards of productivity and quality.* There are two problems with this argument. First, the benefits of a developing industry mainly accrue to the firms and workers in those industries and not to the economy as a whole. Second, it is argued that a government subsidy (rather than a market distorting tariff or quota) given to the industry as it develops would be a much more economically efficient way to gain any benefits that are expected to accrue to the whole economy when the industry becomes globally competitive.
- *Exporters should be prohibited from selling goods abroad at less than production cost (anti-dumping argument).* It is difficult to estimate production costs, and just the fact that a foreign firm sells at a lower price in the export market than in its own domestic market is not evidence of dumping as it is usually defined. Even if a foreign firm managed to drive domestic firms out of business, there could still be foreign competition from other countries, and domestic firms could re-enter the business if the foreign firm subsequently raised prices.
- *Industries associated with national defense should be protected by trade restrictions so they will exist domestically in case of war.* One problem with this argument is that it is hard to find an industry that does not contribute, or cannot potentially contribute, to national defense. From an economic efficiency perspective, it is better for the government to subsidize strategic industries judged essential to national defense directly, rather than impose costs on all domestic consumers by imposing trade restrictions.

Other arguments for trade restrictions that have very little support among economists are:

- *Trade barriers protect jobs.* Part of the popularity of trade restrictions stems from their ability to protect easily identifiable jobs and the high wage levels in these jobs. Tariffs or quotas on imported steel will protect domestic steelworkers' jobs and benefit domestic steel producers. However, in the long run, trade restrictions cannot protect the *net* number of jobs in the country. The number of jobs protected by import restrictions will be offset by jobs lost in other industries in general (that would sell less because more is spent on higher-priced goods that are affected by the tariffs or quotas) and in the import/export industry. Import/export firms will be unable to sell the overpriced domestic product abroad or import and sell as much of the lower-priced, restricted foreign-made product.
- *Trade restrictions create jobs.* In the short run maybe, but in the long run, no. First of all, trade restrictions prevent your trading partners from developing the purchasing power needed to buy import goods from you, thus depressing your own export industry. Secondly, the higher price of the protected domestic goods dampens domestic aggregate purchasing power, taking sales away from other domestic products. Finally, some jobs that would have been created in the import industry are never created.
- *Trade with low-wage countries depresses wage rates in high-wage countries.* The belief that trading with low-wage countries depresses wages is based on a misunderstanding of the law of comparative advantage. A high hourly wage does not necessarily mean high per-unit labor costs. Labor productivity must be considered. The worker's skill level, the amount of invested capital, and production methods may produce labor costs per unit of output below those found in low-wage countries. Consider the law of comparative advantage. When each country produces goods for which it has a comparative advantage, both countries will benefit. High-wage countries will have an advantage in high-tech manufacturing, and low-wage countries will have an advantage in labor-intensive goods. When both produce the goods in which they have a comparative advantage, total output and the availability of goods will increase.

In summary, tariffs benefit domestic producers, workers in protected industries, and governments, at the expense of domestic consumers and workers outside the protected industry. Quotas benefit domestic producers, workers in protected industries, and those who receive the import licenses, at the expense of domestic consumers and workers outside the protected industry. VERs benefit domestic producers, workers in protected industries, and those with export licenses or the power to grant them, at the expense of domestic consumers and workers outside the protected industry.

## KEY CONCEPTS

### LOS 16.a

If two countries have different opportunity costs of producing goods, each will have a comparative advantage in some goods, and trade will increase the total production and consumption possibilities in both countries, improving economic welfare.

International trade will tend to increase domestic supply as imports are available and increase domestic demand because exports will be possible.

### LOS 16.b

Tariffs are taxes on imports. Quotas restrict physical amounts of imports by granting import licenses. Voluntary export restraints are agreements by exporting countries to limit exports to an importing country. An exporting country gives export licenses for specific quantities to its exporting firms.

Trade barriers reduce the consumption possibilities of a country's citizens.

Tariffs benefit domestic producers, workers in protected industries, and government, at the expense of domestic consumers.

Quotas benefit domestic producers, workers in protected industries, and import license holders, at the expense of domestic consumers.

Voluntary export restraints by foreign countries benefit domestic producers, domestic workers in protected industries, and export license holders in the foreign country, at the expense of domestic consumers.

### LOS 16.c

In general, trade restrictions arise from a desire by government for tariff revenue and from economically motivated political activity by the domestic groups who will gain from protection from foreign competition.

Of the reasons commonly used to support trade restrictions, national defense arguments, infant industry arguments, and anti-dumping arguments may have some validity, but the goals of maintaining these industries are likely reached in a more economically efficient manner by direct government subsidy than by imposing costs on all domestic consumers and the entire economy.

Other arguments for trade restrictions are not supported by economic theory.

CONCEPT CHECKERS

1. Which of the following statements about international trade is *least accurate*? If two countries have different opportunity costs of production for two goods, by engaging in trade:
- A. each country gains by importing the good for which it has a comparative advantage.
  - B. each country can achieve a level of consumption outside its domestic production possibility frontier.
  - C. the low opportunity cost producer of each good will export to the high opportunity cost producer of that good.
2. The *least likely* result of import quotas and voluntary export restraints is:
- A. increased revenue for the government.
  - B. a decrease in the quantity of imports of the product.
  - C. a shift in production toward higher-cost suppliers.
3. Consider the following statements about the imposition of trade restrictions.
- Statement 1: Trade restrictions are needed to ensure the existence of industries needed for national defense and to protect developing industries until they grow to a competitive size.
- Statement 2: Developing industries should be protected until they become competitive and trade restrictions will prevent trade with low-wage countries from depressing the wages of high-wage trading partners.
- Do economists generally support:
- | <u>Statement 1?</u> | <u>Statement 2?</u> |
|---------------------|---------------------|
| A. Yes              | No                  |
| B. No               | Yes                 |
| C. No               | No                  |
4. Which of the following groups would be *most* harmed by the imposition of a tariff on steel imports?
- A. Domestic steel producers.
  - B. Workers in the domestic auto industry.
  - C. Workers in the domestic steel industry.



## ANSWERS – CONCEPT CHECKERS

1. **A** Each country gains by *exporting* the good for which it has a comparative advantage.
2. **A** Import quotas and voluntary export restraints, unlike tariffs, do not generate tax revenue. The other choices describe effects that result from all trade restrictions, including tariffs, quotas, and VERs.
3. **A** Economists generally support Statement 1. Trade restrictions (1) to ensure the existence of industries producing goods important to national defense, (2) to offer temporary protection of developing industries, and (3) to prevent countries from exporting products at less than their production costs, all have more support among economists than other arguments put forward as reasons for restricting trade. It can be argued, however, that direct subsidies to such industries would be a more efficient way to achieve these ends than restricting trade.

Economists generally do not support Statement 2 because it contains the argument that trade with low-wage countries depresses wages in the home country.

4. **B** Imposing a tariff on steel imports benefits domestic steel producers and workers by increasing the domestic price of steel, and benefits the national government by increasing tax (tariff) revenue. However, the increase in the domestic price of steel would increase costs in industries that use significant amounts of steel, such as the automobile industry. The resulting increase in the price of automobiles reduces the quantity of automobiles demanded and ultimately reduces employment in that industry.

# THE EXCHANGE RATE AND THE BALANCE OF PAYMENTS

Study Session 4

---

## EXAM FOCUS

This review covers some of the fundamentals of the foreign exchange markets. For the exam, the most important thing to gain here is an understanding of the factors that influence supply and demand in the foreign exchange markets and how these forces affect exchange rates. Two of the exchange rate parity relationships (interest rate parity and purchasing power parity) are introduced. Don't dwell on them here, since these relationships are examined in much greater detail in subsequent readings. The last two subjects (the international accounting relationship known as the balance of payments and exchange rate policies) are lightly treated elsewhere in the curriculum. Be sure that you can describe both of them before moving on.

---

---

### LOS 17.a: Define an exchange rate and differentiate between the nominal exchange rate and the real exchange rate.

---

The foreign exchange rate (FX) is the price of one currency in terms of another. For example, the price of one euro may be 1.5 U.S. dollars and also may be 165 yen. These are nominal exchange rates—prices that we observe in the marketplace for units of one currency in terms of another.

When we talk of the real exchange rate, the focus shifts from the quotations in the foreign exchange market to what the currencies actually purchase in terms of real goods and services. For example, suppose that we define a standard consumption basket (food, transportation, rent, health care, etc.) for a representative consumer, one in Europe buying in euros and the other in the United States buying in dollars. Further suppose that we determine that these same consumption baskets cost USD150 and EUR100 when the exchange rate is \$1.50 per euro. Then we can determine the real exchange rate between the dollar and the euro with the following equation:

$$\text{real exchange rate} = \text{FX}_{\text{nominal}} \times \text{price in Europe} / \text{price in U.S.} = 1.5 \times 100 / 150 = 1.0$$

where the nominal exchange rate,  $\text{FX}_{\text{nominal}}$ , is expressed in USD per euro.

Now suppose that the price of this basket of goods increases by 10% in Europe. If the nominal exchange rate stays at \$1.50 per euro, the new real exchange rate is:

$$1.5 \times 110 / 150 = 1.1$$

In effect, it will now take 10% more dollars than it did previously to purchase the same level of real consumption in Europe. Increased prices in Europe, relative to those in the United States, have increased the real exchange rate expressed as USD per euro. We can say that it now requires \$1.10 to purchase European goods (in euros) that could be purchased in the United States for \$1.00.

---

**LOS 17.b: Explain the factors that influence supply and demand in the foreign exchange market.**

---

### Currency Demand

Changes in the current spot exchange rate will influence the quantity demanded by causing movement along the demand curve. Decreases in the currency value should increase quantity demanded, and increases in currency value should decrease quantity demanded. This will occur for at least two reasons:

- The export effect suggests that, all else being equal, if a currency falls in value, the demand for exports denominated in that currency should increase. At an exchange rate of \$1.50 per euro, a machine priced at €100 would cost a U.S. customer USD 150. If the exchange value of a euro falls to \$1.30, that same machine now costs the U.S. customer \$130. This will increase demand for the quantity of euros demanded by U.S.-based customers.
- The expected profit effect is based on the idea that for a given future exchange rate, a decrease in the current exchange value of one country's currency will increase the expected profit on investment in the other country, and therefore the quantity demanded of the other country's currency.

The basic determinants of the demand for any currency are:

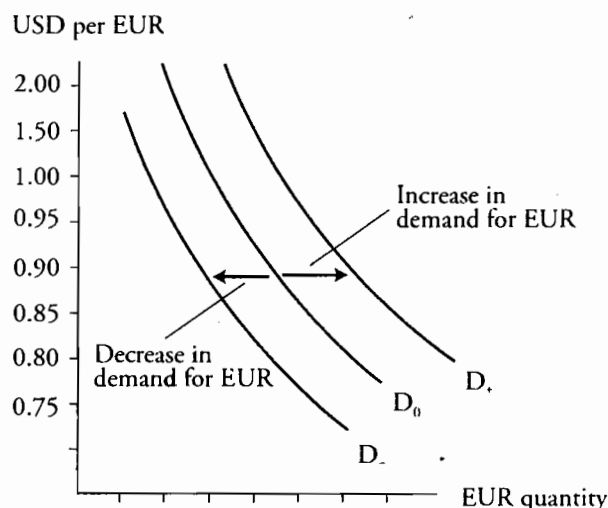
1. The demand for exports from the country (or area). An increase in the demand for exports from China will increase demand for the yuan (Chinese currency).
2. Interest rates for assets denominated in the currency. An increase in the nominal interest rates will increase the demand for financial assets denominated in the country's currency.
3. The expected future exchange rate. If expectations are for a currency to appreciate in value, this will create demand from investors who want to hold the currency in anticipation of making gains on the change in the exchange rate.

Let's conclude this discussion of the factors underlying demand with some simple examples. In specific, consider *increases* in:

- World demand for exports from Europe.
- Euro interest rates relative to other currencies.
- The expected value of the euro in the future.

Increases in export demand, euro interest rates, and the expected future value of the euro will all have the impact of increasing the demand for euros. This will cause the demand curve for the euro to shift from  $D_0$  to  $D_+$  (or shift from  $D_0$  to  $D_1$  in the event of a decrease in demand), as shown in Figure 1.

Figure 1: Demand for Euros



### Currency Supply

Changes in the current spot exchange rate will influence the quantity supplied by causing movement along the supply curve. Increases in the currency value should increase quantity supplied, and decreases in currency value should decrease quantity supplied. This will occur for at least two reasons:

- The imports effect suggests that increases in the currency value will lead to an increase in the import demand in that currency area. For example, if the euro appreciates relative to the yen, the expectation would be that demand for Japanese imports would increase within the euro currency area.
- The expected profit effect concerns how changes in the spot rate affect expected returns from investments in financial assets and currency speculation.

The basic determinants of the supply for any currency are:

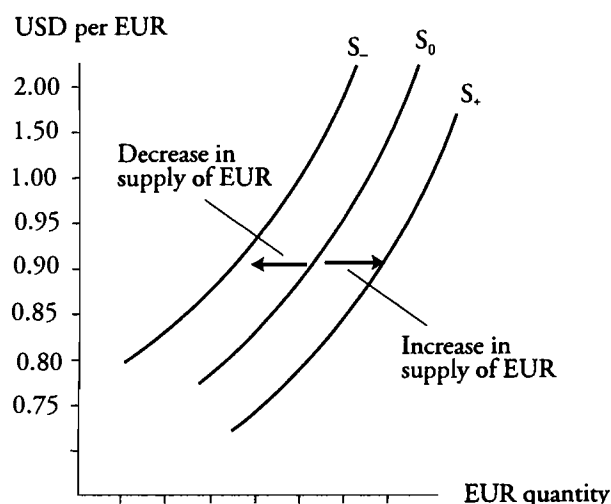
1. The demand for imports within the currency area. If Canadian consumers have an increase in overall desire to purchase imports, this will increase the supply of Canadian dollars in FX markets.
2. Interest rates for assets denominated in other currencies. If domestic interest rates are low, more funds will be supplied to purchase investment assets yielding higher returns in other countries.
3. The expected future exchange rate. If a currency is expected to depreciate, holders will increase the supply of the currency available on FX markets.

As we did for demand, let's conclude this discussion of the factors underlying supply with some simple examples. In specific, consider:

- Increases in European demand for imports from the rest of the world.
- Euro interest rates decrease relative to other currencies.
- The expectation is for the value of the euro to decrease in the future.

All of these examples will have the impact of increasing the supply of euros. This will cause the supply curve for the euro to shift from  $S_0$  to  $S_+$  (or shift from  $S_0$  to  $S_-$  in the event of a decrease in supply), as shown in Figure 2:

**Figure 2: Supply of Euros**

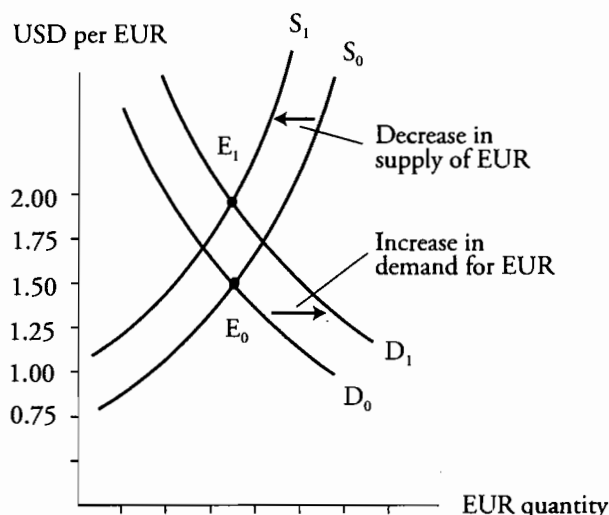


*Professor's Note: The factors for supply and demand are simply opposites. Remember what drives demand, and you will also remember what drives supply.*

### LOS 17.c: Discuss how the supply and demand for a currency changes the exchange rate.

In our typical analysis of supply and demand equilibrium, supply and demand are considered independently, as we have done previously. However, since supply and demand curves for foreign exchange are both affected by the same factors, the adjustment is different. Figure 3 shows the demand and supply for dollars as functions of the euro-dollar exchange rate. Initially, the equilibrium price of a euro is \$1.40, at the intersection of  $S_0$  and  $D_0$ .

If the exchange rate is less than \$1.40, there is excess demand for euros, and the exchange rate will rise toward equilibrium. If the exchange rate (USD per EUR) is greater than \$1.40, there is an excess supply of euros, and the exchange rate will fall toward the equilibrium rate. Now consider the scenario under which euro area interest rates increase. This will lead to a decrease in the supply of euros for investment in other currencies. It will also lead to an increase in the demand for euros from investors outside of the euro area.

**Figure 3: Demand and Supply Shifts in the Foreign Exchange Market**

The curve  $S_1$  represents the decreased supply of euros that would result from an increase in euro interest rate since fewer euro-based investors would now seek foreign currency-denominated investments.  $D_1$  represents the increased demand for euros.

Note that while the new equilibrium exchange rate is higher as a result of both the increase in demand and the decrease in supply, the equilibrium quantity of euros traded appears to be very close to the quantity prior to the shifts in supply and demand. For this reason, exchange rates may be quite volatile (more so than if supply and demand were independent), even when the quantity of currencies actually exchanged is not.

#### LOS 17.d: Differentiate between interest rate parity and purchasing power parity.

**Interest rate parity** is the idea that exchange rates must change so that the return on investments with identical risk will be the same in any currency. Another way to say this is that differences in interest rates are equal to differences in expected changes in exchange rates. If the U.S. interest rate is 6% and the U.K. interest rate (on British pounds) is 4%, we might think that all U.K. investors would want to convert their pounds to dollars so that they could earn 2% more. The key here is expected future exchange rates. If the dollar is expected to depreciate 2% relative to the pound over the next year, there is no expected gain from investing in dollars rather than pounds. At the end of one year, a U.K.-based investor could have 6% more dollars but would have to exchange them for pounds at an exchange rate 2% below the current rate. So, rather than having 6% more pounds at the end of one year, a U.K. investor would have 4% more pounds, just as they would have investing in pounds rather than in dollars. This is the meaning of interest rate parity—changes in exchange rates over time should just offset interest rate differences between countries.

The concept of **purchasing power parity** is based on the idea that the same goods should cost the same amount in different countries once we have factored in the current exchange rate. If a barrel of oil costs \$100 in the United States and  $\text{USD:JPY} = 125$ , a barrel of oil should cost ¥12,500 ( $= 125 \times 100$ ) in Japan.

In practice, differences in transportation costs and other factors mean that the relationship does not hold exactly.

More importantly than exact parity in the prices of goods, purchasing power parity implies that *changes* in the price levels in the two countries should be reflected in changes in the exchange rate. Consider an example where the inflation rate in the United States is greater than the inflation rate in Japan. Since U.S. goods have increased in price relative to Japanese goods, they are less attractive at the existing exchange rate. Purchasing power parity requires that the exchange rate adjust (dollar depreciate relative to the yen) so that exchange-rate adjusted prices return to the same relation that existed before the changes in the Japanese and U.S. price levels. Since financial markets are forward-looking, this also implies that inflation expectations are reflected in expected changes in exchange rates.



*Professor's Note: Parity relationships are discussed in detail in a subsequent reading.*

---

LOS 17.e: Describe the balance of payments accounts.

---

### Balance of Payments Equation

Balance-of-payments (BOP) accounting is a method used to keep track of transactions between a country and its international trading partners. It includes government transactions, consumer transactions, and business transactions. The BOP accounts reflect all payments and liabilities to foreigners and all payments and liabilities from foreigners. The BOP equation is:

$$\text{current account} + \text{capital account} + \text{official settlements account} = 0$$

The **current account** measures the exchange of merchandise goods, services, investment income, and unilateral transfers (gifts to and from other nations). The *current account balance* is the net exchange of goods and services, investment income, and unilateral transfers.

The **capital (or financial) account** measures the flow of funds for the principal value of investment into a country from abroad and out of a country due to investment by its citizens in foreign assets. This includes investment in real assets as well as purchases of financial securities. When a country runs a current account deficit (imports more than it exports), one way to make up the difference is to borrow from foreign countries, which leads to a capital account surplus.

The **official settlements account** is where changes in official reserves are recorded. **Official reserves** include foreign currencies, gold, International Monetary Fund special drawing rights (SDRs), and other foreign assets held by the monetary authorities of the country. In 1997, the United States ran a current account deficit and a smaller surplus in its capital account. As a result, the United States ran a surplus in the reserve account to balance the BOP accounts. A surplus in the official reserve account means that the United States traded dollars for foreign currency. These official reserve

balances are used by the Fed to *intervene* in the foreign exchange markets in an attempt to loosely control exchange rates.

### Impact of Borrowing

The impact of borrowing to finance a deficit in the current account over time depends on whether the country is borrowing to finance investment or borrowing to finance consumption. If the deficit is the result of borrowing primarily to finance consumption, consumption in the future must be reduced to repay the borrowings. If, on the other hand, the borrowing is primarily to finance investment, then future growth in the economy will provide the means to repay the borrowings without an equal decrease in consumption.

---

#### LOS 17.f: Describe the following exchange rate policies: flexible exchange rates, fixed exchange rates, and crawling pegs.

---

An exchange rate policy is the issuing government's plan for the maintenance of currency value. There are three common strategies.

A **flexible exchange rate policy** allows nominal exchange rates to be determined by supply and demand without direct intervention in the foreign exchange market by the central bank, even though central bank actions may influence the exchange rate indirectly. For instance, an increase in interest rates may cause a country's currency to appreciate. The earlier discussion regarding supply and demand factors describes the fundamentals that underlie a flexible exchange rate policy.

A **fixed exchange rate policy** pegs the value of a currency at a predetermined level set by the government, which intervenes directly in the foreign exchange market to offset the forces of supply and demand and keep the currency at the fixed value. Maintaining a fixed exchange rate requires active government intervention in the foreign exchange markets. However, the level of government reserves of foreign currency sets a limit on the degree of intervention it can achieve and thus its ability to maintain a fixed exchange rate. When this limit is reached, the fixed rate will not hold. The rationale for maintaining a fixed rate is to reduce exchange rate risk for importers, exporters, and other entities that buy and sell FX.

A **crawling peg exchange rate policy** sets a target range (i.e., a limited range within which it can fluctuate on a daily basis) for the exchange rate for a limited period of time (e.g., one year). After this time, the target range is reset to reflect current market conditions. The governmental monetary authorities keep the currency within the band the same way as would be done to maintain a fixed rate—through government intervention in the foreign exchange markets. The motivation for the crawling peg is largely the same as for a fixed rate. That is to reduce risk for FX market participants. However, by periodically resetting the rate to reflect current market conditions, the government reduces the risk that it will run out of (or accumulate too much) reserves of foreign currency.



## KEY CONCEPTS

### LOS 17.a

The nominal exchange rate is the price of one currency in terms of another in the foreign exchange markets. The real exchange rate between countries A and B is the nominal exchange rate (currency A per unit of currency B) multiplied by the ratio of the two price levels:

$$\text{real exchange rate} = \text{FX}_{\text{nominal}} \times (P_B / P_A)$$

The real exchange rate tells us the exchange rate in terms of the relative cost of equivalent baskets of goods in two different countries.

### LOS 17.b

The demand for a country's currency is a downward-sloping function of its exchange rate per foreign currency unit and is increased by increases in the country's interest rates, its export demand, and the expected future exchange value of its currency.

The supply of a country's currency is an upward-sloping function of its exchange rate per foreign currency unit and is decreased by increases in the country's interest rates, by decreases in import demand, and by increases in the expected future value of the currency.

### LOS 17.c

Since factors that increase (decrease) currency demand also decrease (increase) currency supply, exchange rates can be quite volatile even with relatively stable trading volume.

### LOS 17.d

Purchasing power parity holds when the difference between two countries' inflation rates is approximately equal to the appreciation (depreciation) of each country's exchange rate relative to the other's.

Interest rate parity holds when the difference between two countries' nominal interest rates is approximately equal to the appreciation (depreciation) of each country's exchange rate relative to the other's.

### LOS 17.e

The balance of payments relation states that

$$\text{current account} + \text{capital account} + \text{official reserve account} = 0$$

The current account includes international payments for goods and services (net exports), the net income from asset ownership, and net gifts.

The capital account includes international payments for the purchase and sales of debt and equity securities and real assets.

Official reserve accounts consist of the foreign currencies held by governments.

**LOS 17.f**

Central bank intervention in currency markets (buying or selling their country's currency) can reduce short-term exchange rate volatility but cannot prevent real long-term changes in equilibrium exchange rates.

A flexible exchange rate is determined by supply and demand without direct intervention in the foreign exchange market. A fixed exchange rate policy pegs the value of a currency at a level set by the government. Maintaining a fixed exchange rate requires active government intervention in the foreign exchange markets. A crawling peg exchange rate policy sets a target path for the exchange rate and supports this path through government intervention in the foreign exchange markets.

## CONCEPT CHECKERS

1. Which of the following is *least likely* a component of the current account?
  - A. Unilateral transfers.
  - B. Flow of funds for investment.
  - C. Payments for goods and services.
2. Which of the following equations is *most accurate*?
  - A. Balance of payments + current account = capital account.
  - B. Current account + goods and service balance = official reserves.
  - C. Current account + capital account + official settlements account = 0.
3. The Fredonian currency (the fredo) is currently valued at 2.50 per U.S. dollar. Fredo deposit rates are 1% above U.S. dollar deposit rates. Economists forecast (1) the Fredonia interest rate—U.S. interest rate differential will decrease to 0.5%, and (2) the expected exchange rate in one year is 2.6 fredos per dollar. All other things equal, how would either forecast affect demand for the fredo on the foreign exchange markets?
  - A. Both would increase demand for the fredo.
  - B. Both would decrease demand for the fredo.
  - C. One would increase and the other decrease demand for the fredo.
4. Which of these statements is *most accurate*? Exchange rates can be especially volatile because:
  - A. the supply of a currency is a function of expected future exchange rates.
  - B. interest rate differentials determine the demand for currencies.
  - C. supply and demand for currencies are affected by the same factors.
5. The theory of interest rate parity suggests that:
  - A. exchange rates will change so that the return on investments with identical risk will be the same in any currency.
  - B. changes in the price levels in two countries should be reflected in changes in the exchange rate.
  - C. the same combinations of goods should cost the same in different countries once we have factored in the current exchange rates.
6. Which type of exchange rate policy entails the *highest* risk of depleting foreign exchange reserves?
  - A. Floating exchange rate policy.
  - B. Fixed exchange rate policy.
  - C. Crawling peg exchange rate.

## ANSWERS – CONCEPT CHECKERS

1. B The flow of funds for investment in debt and equity is recorded in the capital account. Exchange of investment income, such as interest payments, is a component of the current account, along with goods and services trade and unilateral transfers.
2. C The three balance of payments accounts must sum to zero.
3. B A decrease in foreign interest rates relative to U.S. rates and a decrease in the expected future value of the foreign dollar (it is expected that it will take more of them to purchase 1 dollar in one year) would both decrease demand for the foreign dollar.
4. C Because shifts in supply and demand are affected by the same factors, exchange rates may be quite volatile even though the quantity of currencies actually exchanged is not.
5. A The other choices describe the concept of purchasing power parity.
6. B A fixed exchange rate policy requires the greatest intervention in the marketplace and thus entails the greatest risk of depleting reserves of foreign currency.

---

The following is a review of the Economics for Valuation principles designed to address the learning outcome statements set forth by CFA Institute®. This topic is also covered in:

# CURRENCY EXCHANGE RATES

Study Session 4

---

## EXAM FOCUS

No fluff here; you need it all. Take it slow and get a good understanding of direct and indirect quotes, spot rates and spreads, forward rates, forward discounts and premiums, currency cross rates, triangular arbitrage, interest rate parity, and covered interest arbitrage. Arbitrage is always a challenging topic for Level 2 candidates. Master the basics now so if you see an arbitrage question on exam day, it won't slow you down. The probability of this material being tested is *very high*.

---

**LOS 18.a:** Define direct and indirect methods of foreign exchange quotations and convert direct (indirect) foreign exchange quotations into indirect (direct) foreign exchange quotations.

---

As you know from the previous topic review, the foreign exchange rate (FX) is the price of one currency in terms of another. For example, if the Australian dollar (AUD) is trading at 0.60 U.S. dollars (\$0.60), each AUD will buy 60 U.S. cents. Market convention would be to quote this relationship as:

$$\text{AUD:USD} = 0.60$$

*Professor's Note: The CFA Curriculum Texts previously used the convention 0.60 USD/AUD to express "60 US cents per Australian dollar." You may have seen this type of foreign currency notation in your studies. The current-year curriculum presents this exchange rate as 0.60 AUD:USD, which has exactly the same meaning. One way to remember this is to think of the "/" symbol as meaning "per" and the ":" symbol as meaning "in" so that USD/AUD is US dollars per (one) Australian dollar and AUD:USD is (one) Australian dollar in US dollars. Just to confuse things a bit more, FOREX exchange rate quotes use EUR/USD to mean USD price per euro (see, for example, foreign exchange quotes at [finance.yahoo.com](http://finance.yahoo.com)).*



*For purposes of the CFA Exam, specific exchange rate conventions and symbols or abbreviations for foreign currencies should not be a concern. Question writers typically make it very clear what they mean. In this topic review, we will use the convention of AUD:USD (U.S. dollars per Australian dollar) or USD:AUD (Australian dollars per U.S. dollar).*

*The naming conventions for various currencies vary. For example, currency traders use USD, AUD, and JPY for US dollars, Australian dollars, and Japanese yen. Yen and ¥ are both used to indicate Japanese yen, and euros are indicated alternatively as EUR or €.*

FX quotations are sometimes described as direct or indirect. However, this distinction depends on the home currency of the user.

- **Direct quotes** are for units of foreign currency. The quotation 0.60 AUD:USD is a direct quote to a USD investor. It tells the investor the cost of one AUD in his domestic currency (USD).
- **Indirect quotes** are expressed as units of the “foreign” currency per each unit of the “domestic” currency. The above quote is an indirect quote to a AUD investor.

To convert an indirect quote into a direct quote, a user can simply reverse the units of the quotation. The quoted rate would simply be the *reciprocal* of the above rate:

$$\text{USD:AUD} = 1 / 0.60 = 1.67$$

Now we have a direct quote for USD from the perspective of an AUD investor. The key issue to remember is that when given an indirect quotation, you can easily change it to a direct quote by taking the inverse.

## FX Appreciation and Depreciation

In the previous topic review, we explained how appreciation and depreciation of a currency's value affects the supply and demand for the currency. Therefore, it is important to be able to tell from a change in the quoted rate how the value has changed. For example, suppose that the dollar-Swiss franc exchange rate increases from USD:CHF = 1.7799 to 1.8100. Has the franc appreciated or depreciated? The Swiss franc has depreciated relative to the dollar—it now takes more Swiss francs (1.81) to buy a dollar. An increase in the numerical value of this exchange rate means that the USD has appreciated and that the CHF has depreciated.

### Example: Exchange rate appreciation and depreciation

If the AUD:USD moves from 0.60 to 0.70, has the AUD depreciated or appreciated?

**Answer:**

The quote represents the USD price of one AUD, so the AUD has *appreciated*—previously each AUD would only cost 60 cents, whereas now each AUD costs 70 cents. What has the U.S. dollar done in this example? To find out, invert each quote to see that the USD:AUD rate has changed from  $1 / 0.6 = 1.67$  to  $1 / 0.7 = 1.43$ . The U.S. dollar has *depreciated* in value. It used to buy 1.67 AUD but only buys 1.43 AUD today. Note that when one of the quoted currencies appreciates, the other has depreciated.

## FX Markets

Currencies are traded in foreign exchange (FX) markets, which have the primary function of facilitating international trade and investment. Knowledge of the operation

and mechanics of these markets is important for a fundamental understanding of international financial management.

The foreign exchange market permits the transfer of purchasing power denominated in one currency into another currency. This market is not a physical place but rather an electronically linked network of banks, foreign exchange brokers, and dealers whose function it is to bring together buyers and sellers of foreign exchange. Transactions occur over the phone, telex, or the SWIFT system (Society for Worldwide Interbank Financial Telecommunications).

Most foreign exchange market transactions (in terms of value) occur on what is known as the *interbank market*. As the name suggests, the primary participants are large commercial banks. Other participants include foreign exchange brokers, major multinational corporate customers, and central banks. This is the wholesale market for foreign exchange. The interbank market is segmented into three segments: (1) the spot market, (2) the forward market, and (3) the currency swap market.

A significant proportion of interbank market trades are organized by foreign exchange brokers who match buyers and sellers for a small commission (e.g., 1/32 of 1%). Foreign-exchange brokers provide *information*, participant *anonymity*, and *reduced time and effort* (meaning a bank need only deal with one broker rather than contacting several other banks) in trading. The typical small client gets foreign exchange from a local bank. The local bank in turn gets the exchange from its major correspondent bank.

---

**LOS 18.b: Calculate and interpret the spread on a foreign currency quotation and explain how spreads on foreign currency quotations can differ as a result of market conditions, bank/dealer positions, and trading volume.**

---

Banks and other dealers generally do not charge commissions on foreign currency transactions. Instead, they make their profit from the *bid-ask spread*.

- The *bid price* is always listed first. It is the price the *dealer will pay* to buy the currency.
- The *ask price* is always listed second. It is the price at which the *dealer will sell* the currency.

Let's return to our previous quotation, only now with a bid rate and an ask rate as follows:

$$\text{AUD:USD} = 0.6000 - 0.6015$$

The dealer, who is the market-maker providing the quotes, will buy AUD for USD 0.6000 and will sell AUD for USD 0.6015. Unless you are a market-maker, you should think from the perspective of a market-taker (the party asking for a foreign exchange quotation from the market-maker). If you want to buy AUD (and sell USD), you do so at the ask, and you sell AUD (and buy USD) at the bid.

In this example, the spread is 0.0015 USD. The size of the spread is often expressed as a percentage of either the bid, midpoint, or the ask rate. For the above quote, we get a percentage spread as a percentage of the ask as:

$$\text{spread} = \frac{0.6015 - 0.6000}{0.6015} = 0.0025 \text{ or } 0.25\%$$

The spread depends on market conditions, the dealer's position, and trading volume in the currency pair.

- *Market conditions.* Exchange rate volatility (uncertainty) typically increases the spread. Larger spreads compensate dealers for the higher risk of dealing in more volatile currencies.
- *Bank and currency dealer positions.* If the dealer has excess inventory in a given currency, they will adjust the midpoint of the spread. That is, they will shift the entire spread up (increasing the likelihood of buying the base currency) or down (increasing the likelihood of selling base) to reflect their trading objectives. For example, a dealer who changes her bid-ask in EUR:USD from 1.30–1.33 to 1.29–1.32 would expect to buy less euros (lower bid) and to sell more euros (lower ask), which would decrease her inventory position in euros.
- *Trading volume.* Greater volume leads to narrower spreads (and vice versa). Thus, the most active currency pairs, like EUR:USD, USD:JPY, and EUR:JPY, typically have narrower spreads than other less-active currency pairs.

---

**LOS 18.c: Calculate and interpret currency cross rates, given two spot exchange quotations involving three currencies.**

---

The **cross rate** is the exchange rate between two currencies implied by their exchange rates with a common third currency. Cross rates are necessary when there is no active FX market in the currency pair. The rate must be computed from the exchange rates between each of these two currencies and a third currency, usually the USD or EUR.

Let's return to our previous quotation for the Australian dollar and the U.S. dollar (AUD:USD = 0.60). Let's assume that we also have the following quotation for Mexican pesos:USD:MXN = 10.70. What is the cross rate between Australian dollars and pesos (AUD:MXN)?

$$\frac{\text{MXN}}{\text{AUD}} = \frac{\text{USD}}{\text{AUD}} \times \frac{\text{MXN}}{\text{USD}} = 0.60 \times 10.70 = 6.42$$

So our AUD:MXN cross rate is 6.42 pesos per Australian dollar. The key to calculating cross rates is to note that the basis of the quotations must be such that we get the desired result algebraically. If we had started with a USD:AUD quotation of 1.67, we would have taken the inverse to get the quotation into AUD:USD terms. Another approach is to divide through, as is illustrated in the following example.



### Example: Cross rate calculation

The spot exchange rate between the Swiss franc (CHF) and the USD is USD:CHF = 1.7799, and the spot exchange rate between the New Zealand dollar (NZD) and the U.S. dollar is USD:NZD = 2.2529. Calculate the NZD:CHF spot rate.

**Answer:**

The NZD:CHF cross rate is:

$$\frac{1.7799 \frac{\text{CHF}}{\text{USD}}}{2.2529 \frac{\text{NZD}}{\text{USD}}} = 0.79005 \frac{\text{CHF}}{\text{NZD}}$$

### CROSS RATES WITH BID-ASK SPREADS

Bid-ask spreads complicate the calculation of cross rates considerably. The most intuitive way to think about the calculations is to think of the process as a triangle (see following Figure 1). Think of the AUD being at the bottom of the triangle on the left side, MXN on the right, and the USD at the top. You want to exchange AUD for MXN but cannot do so directly. The bottom side of the triangle is missing: the only way to make the trade is up one side to the USD and down the other to the desired currency. Here are the steps, depending upon your trading objective:

- *Sell AUD and buy MXN:* Sell AUD and buy USD, then sell USD and buy MXN. Thus you will have effectively sold AUD and bought MXN. This results in the **cross rate bid** because you are selling the base currency in the AUD:MXN pair.
- *Sell MXN and buy AUD:* Sell MXN and buy USD, then sell USD and buy AUD. Thus you will have effectively sold MXN and bought AUD. This results in the **cross rate ask** because you are buying the base currency in the AUD:MXN pair.

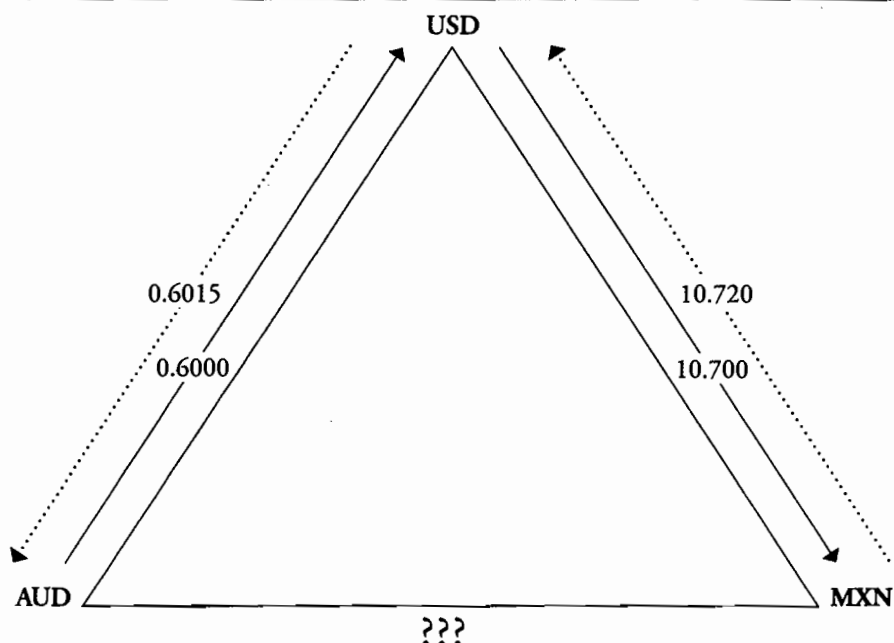
Let's return to our previous quotation for the Australian dollar, the Mexican peso, and the U.S. dollar, only now with both bid and ask prices. Our FX rate quotations are now:

AUD:USD 0.6000 – 0.6015

and

USD:MXN 10.700 – 10.720

Figure 1: Cross-Rate Calculation with Bid-Ask Spreads



*Obtaining the cross rate bid:* Sell AUD at the bid of 0.60 (receive USD) and sell USD at the bid of 10.70 (receive MXN). Resulting bid rate:

$$\text{AUD:MXN} = 0.6000 \times 10.700 = 6.4200$$

*Obtaining the cross rate ask:* Sell MXN at the ask of 10.720 (receive USD) and purchase AUD at the ask of 0.6015. Resulting ask rate:

$$\text{AUD:MXN} = 0.6015 \times 10.720 = 6.4481$$

Thus, our cross rates are:

bid = 6.4200 MXN per AUD

and

ask = 6.4481 MXN per AUD

**LOS 18.d:** Calculate the profit on a triangular arbitrage opportunity, given the bid-ask quotations for the currencies of three countries involved in the arbitrage.

Continuing on from our example above, suppose that you were on vacation in Mexico, and a local bank offered a rate of AUD:MXN 6.3000 – 6.3025. Further assume that the exchange rate quotations between these two currencies and the USD are those in the previous example. Would a triangular arbitrage be profitable under these circumstances?

From our previous calculations, we know that the correct cross rates, based on the relationships of the currencies to the USD, are:

$$\text{AUD:MXN} = 6.4200 - 6.4481$$

In fact, these rates are enforced by arbitrage. Since the rate quoted to you by the Mexican bank is outside of these cross rates, arbitrage is possible. Observe that the quotes made to you by the Mexican bank are too low with respect to the AUD. You can buy AUD for MXN more cheaply (6.3 pesos per dollar, versus 6.4), so the AUD is undervalued. You want to buy AUD for MXN from the Mexican bank, and then resell through the USD until you wind up back with MXN. Since you will wind up with more pesos than you started with, you will have made a profit via triangular arbitrage. The following steps will illustrate the process, assuming that you start with an arbitrary amount of MXN—we will assume 1 million pesos.

*Step 1:* Buy AUD with MXN at the ask from the Mexican bank.

$$1\text{m} / 6.3025 = \text{AUD } 158,667.$$

*Step 2:* Sell AUD for USD at the bid.  $158,667 \times 0.6000 = \text{USD } 95,200.$

*Step 3:* Sell USD for MXN at the bid.  $95,200 \times 10.700 = \text{MXN } 1,018,643.$

*Result:* You have made an arbitrage profit of MXN 18,643.

If the bank had given you AUD:MXN rates for which both the bid and the ask were greater than 6.4481, the AUD would have been overvalued, and the arbitrage steps would be just the opposite. Attempts by speculators to capture arbitrage profits will drive at least one side (either the bid or ask) of the Mexican bank's quotation back within the cross rate band of 6.4200 / 6.4481, and the arbitrage opportunity will be eliminated. Because this type of arbitrage is relatively easy for participants in the interbank market to exploit, it is relatively rare for such opportunities to persist for any sustained period of time.

---

#### LOS 18.e: Distinguish between the spot and forward markets for foreign exchange.

---

**Spot FX markets** refer to transactions that call for immediate delivery of the currency. In practice, the settlement period is two business days after the trade date.

**Forward FX markets** are for an exchange of currencies that will occur in the future. Both parties to the transaction agree to exchange one currency for another at a specific future date at a price that is fixed today. Forward contracts are typically for transactions 30, 60, 90, or 180 days into the future, although the contracts can be written for any period. There is no option involved in the contract; both parties to a forward currency contract are obligated to execute the specified transaction in the future.

A firm that has a foreign-currency-denominated obligation in 60 days can remove any uncertainty about the cost of the obligation in its home currency by entering into a forward contract to buy the required amount of foreign currency 60 days from now at the 60-day forward rate. The forward exchange rate in the contract will reflect the interest rate differential between the two currencies, and the forward rate may be greater than or less than the current spot rate.

**Example: Forward FX transactions**

A U.S. firm is obligated to make a future payment of CHF100,000 in 60 days. To manage its exchange rate risk, the firm contracts to buy the Swiss francs 60 days in the future at USD:CHF = 1.7530. The current exchange rate is 1.7799.

**Part 1:** How much would the U.S. firm gain or lose on its commitment if, at the time of payment, the exchange rate fell to 1.6556 Swiss francs to the dollar?

**Answer:**

Without the forward contract, the cost to the firm would have been CHF 100,000 / 1.6556 = USD 60,401. With the contract, the cost to the firm is CHF 100,000 / 1.7530 = USD 57,045. The firm has saved itself \$3,356.

**Part 2:** How much would the U.S. firm gain or lose on its commitment if, at the time of payment, the exchange rate rose to 1.8250 Swiss francs to the dollar?

**Answer:**

Without the forward contract, the cost to the firm would have been CHF 100,000 / 1.8250 = USD 54,795. With the contract, the cost to the firm is CHF 100,000 / 1.7530 = USD 57,045. The contract has cost the firm \$2,250.

Note that in both cases, the cost with the forward contract in place was the same. Foreign exchange risk is eliminated.

---

**LOS 18.f:** Calculate and interpret the spread on a forward foreign currency quotation and explain how spreads on forward foreign currency quotations can differ as a result of market conditions, bank/dealer positions, trading volume, and maturity/length of contract.

---

Consider a 6-month (180-day) forward exchange rate quote from a U.S. currency dealer of GBP:USD = 1.6384 / 1.6407. This means that the dealer will commit today to buy pounds for 1.6384 dollars in six months, or sell pounds in six months for 1.6407 dollars.

In this example, the spread is 0.0023 or 23 pips. We can also express this as a percentage of the ask rate. For the above quote, we get a percentage spread as:

$$\text{spread} = \frac{1.6407 - 1.6384}{1.6407} = 0.0014 \text{ or } 0.14\%$$

As was the case in the spot market, the spread depends on market conditions, the dealer's position, and trading volume in the currency pair. In the case of forwards, the spread also depends on the length of the forward contract. Since we have already explained the relationship between spreads and the first three factors—and the same relationships apply here—we will focus on the relationship between the spread and length of the

contract. In general, the longer the term of the contract, the greater the level of uncertainty, the greater the impact of interest rate changes on contract value, and the smaller the trading volume. All of these factors work to increase the size of the spread as the maturity grows longer.

---

**LOS 18.g:** Calculate and interpret a forward discount or premium and express it as an annualized rate.

---

A currency is quoted at a **forward discount** relative to a second currency if the forward price (per unit of the second currency) is greater than the spot price.

A currency is quoted at a **forward premium** relative to a second currency if the forward price (per unit of the second currency) is less than the spot price.

If investors must pay less (more) in their domestic currency per unit of a foreign currency in the future, the domestic currency is at a forward premium (discount).

The **forward premium or discount** is frequently stated as an annualized percentage. Given spot and forward exchange rates, the annualized forward premium (discount) can be calculated using the following formula:

$$\text{annualized forward premium/discount} = \left( \frac{\text{forward rate}_n - \text{spot rate}}{\text{spot rate}} \right) \left( \frac{360}{n} \right)$$

where forward rate<sub>n</sub> is the exchange rate for transactions *n* days from now.

**Example: Annualized forward rate premium and discount**

Assume the 90-day forward rate for the NZD:USD = 0.4439, and the spot rate is NZD:USD = 0.4315. Determine if the NZD is trading at a forward premium or discount to the USD. Calculate the annualized premium or discount and determine whether the NZD is strong or weak.

**Answer:**

Since it takes more U.S. dollars to buy the NZD in the forward market relative to the spot, the NZD is trading at a *forward premium* versus the dollar.

$$\text{annualized forward premium} = \left( \frac{0.4439 - 0.4315}{0.4315} \right) \left( \frac{360}{90} \right) = 0.1149 \text{ or } 11.49\%$$

The NZD is selling at a forward premium to the USD, so the NZD is considered strong and is expected to appreciate.

**Example: Calculating the forward premium/discount**

Given the following quotes in yen per U.S. dollar, calculate the forward premium/discount on the U.S. dollar relative to the Japanese yen and indicate whether the U.S. dollar is strong or weak:

|                      |        |
|----------------------|--------|
| Spot rate:           | 125.00 |
| 90-day forward rate: | 126.25 |

**Answer:**

$$\text{forward premium on \$} = \left( \frac{126.25 - 125.00}{125.00} \right) \left( \frac{360}{90} \right) = 0.04 \text{ or } 4.0\%$$

The USD is selling at a forward premium, so it is considered strong.

*Professor's Note:*



1. If you are given bid-ask spot and forward quotes, use the bid-ask midpoints to calculate the forward premium/discount unless you're specifically instructed to do something else.
2. If one currency is trading at a forward premium, the other currency must be trading at a forward discount and vice versa.

---

**LOS 18.h: Explain interest rate parity and illustrate covered interest arbitrage.**


---

**Interest rate parity** holds when any forward premium or discount just offsets differences in interest rates so that an investor will earn the same return investing in either currency. If euro interest rates are higher than dollar interest rates, a depreciation of the euro relative to the dollar will just offset the higher euro interest when interest rate parity holds.

Formally, interest rate parity requires that:

$$\frac{F}{S_0} = \frac{(1 + R_A)}{(1 + R_B)}$$

where forward ( $F$ ) and spot ( $S$ ) are quoted in terms of B:A (direct quote to Country A investor) and  $R$  is the nominal risk-free rate in each country.

Alternatively we can state interest rate parity as:

$$\frac{F - S_0}{S_0} = \frac{R_A - R_B}{1 + R_B}$$

which states that the (discounted) interest rate difference between the countries is equal to the forward discount or premium. Again, the currency with the higher (lower) nominal interest rate will be selling at a forward discount (premium) relative to the other when interest rate parity holds.

The following example illustrates how the interest rate parity relation can be used to find a forward rate and the expected appreciation or depreciation of one currency relative to another. Since forward contracts typically are for periods of three months or less, we have used a 3-month forward in the example and assumed that annual interest rates are simple annualized rates based on a 12-month year.

**Example: Forward premiums or discounts from interest rate parity**

Assume the annualized U.S. dollar interest rate is 9%, and the annualized euro interest rate is 12% when the spot exchange rate is \$1.30 per euro. Calculate the expected exchange rate for a 3-month forward contract and the expected appreciation or depreciation of the USD three months.

First we must get the 3-month interest rates from the annual rates by multiplying by 3/12. Our 3-month rates are  $9\%(3/12) = 3\%$  in USD and  $12\%(3/12) = 4\%$  in EUR.

Since the U.S. dollar rate is less, the dollar will appreciate and the euro will depreciate according to interest rate parity.

The euro should depreciate to  $(1.03 / 1.04)1.30 = \$1.2875$  per euro.

The expected depreciation in the euro is  $(0.03 - 0.04)/1.04 = -0.009615$  or 0.9615%.

To check for consistency, we have  $(F - S) / S = (1.2875 - 1.30) / 1.30 = -0.009615$ , a 0.9615% depreciation of the euro.

Forward contracts are not always available for every currency pair, and when they are not, interest rate parity is simply a theoretical relationship. It may or may not hold. When currencies are freely traded and forward contracts are available in the marketplace, interest rate parity must hold. If it does not hold, arbitrage trading will take place until interest rate parity holds with respect to the forward exchange rate. Such arbitrage is referred to as **covered interest arbitrage**. For simplicity, we will illustrate the process of exploiting deviations from interest rate parity using annual interest rates and a 1-year forward exchange rate.

**Example: Covered interest arbitrage**

The U.S. dollar interest rate is 8% and the euro interest rate is 6%. The spot exchange rate is \$1.30 per euro and the forward rate is \$1.35 per euro. Determine whether a profitable arbitrage exists, and illustrate such an arbitrage if it does.

First we note that the forward value of the euro is “too high.” Interest rate parity would require a forward rate of:

$$\$1.30(1.08/1.06) = \$1.3245.$$

The forward rate of \$1.35 is therefore higher than that implied by interest rate parity and we should hold euros rather than hold dollars, for a profitable arbitrage. The dollar is depreciating more than would be implied by interest rate parity. The steps in the covered interest arbitrage are:

Initially:

*Step 1:* Borrow \$1,000 at 8% and purchase  $1,000/1.30 = 769.23$  euros.

*Step 2:* Invest the euros at 6%.

*Step 3:* Sell the expected proceeds at the end of one year,  $769.23 (1.06) = 815.38$  euros, forward 1 year at \$1.35 each.

After one year:

*Step 1:* Sell the 815.38 euros under the terms of the forward contract at \$1.35 to get \$1,100.76.

*Step 2:* Repay the \$1,000 8% loan, which is \$1,080.

*Step 3:* Keep the difference of \$20.76 as an arbitrage profit.

---

**LOS 18.i: Distinguish between spot and forward transactions, calculate the annualized forward premium/discount for a given currency, and infer whether the currency is “strong” or “weak.”**

---

The spot rate is the exchange rate for immediate transactions while the forward exchange rate is for transactions at a specific future date.

A currency selling at a forward premium is considered “strong” relative to the second currency and is expected to appreciate. A currency selling at a forward discount is considered “weak” and is expected to depreciate.



## KEY CONCEPTS

### LOS 18.a

Direct foreign exchange quotations are in domestic currency per unit (or 100 units) of foreign currency, and indirect quotations are in the foreign currency per unit of the domestic currency.

### LOS 18.b

The difference between the bid and ask prices for foreign currency is the spread, often expressed as a percentage of the ask price.

Foreign currency spreads increase with exchange rate volatility and decrease with increased trading volume.

### LOS 18.c

The exchange rates of two currencies with a third can be used to obtain a cross rate (of exchange) between the two currencies.

### LOS 18.d

If quoted cross rates are above or below the cross rates calculated using the currencies' exchange rates with a common third currency, there are arbitrage opportunities.

### LOS 18.e

Forward foreign exchange rates are for currency to be exchanged at a future date while spot rates are for immediate delivery.

### LOS 18.f

Forward foreign exchange rates have a bid-ask spread calculated as for spot rates. These spreads tend to increase with the length of the contract.

### LOS 18.g

The forward contract price is said to be at a forward premium (discount) for a currency if the forward value of that currency is higher (lower) than the spot rate.

A forward premium or discount can be stated as an annualized percentage of the spot rate:

$$\text{annualized forward premium/discount} = \left( \frac{\text{forward rate}_n - \text{spot rate}}{\text{spot rate}} \right) \left( \frac{360}{n} \right)$$

**LOS 18.h**

Interest rate parity requires that:

$$\frac{F}{S_0} = \frac{(1 + R_A)}{(1 + R_B)}$$

where forward ( $F$ ) and spot ( $S$ ) are quoted in terms of B:A (direct quote to Country A investors) and  $R$  is the nominal risk-free rate over the forward period.

This relation implies that the discounted interest rate differential is equal to the forward discount or premium:

$$\frac{F - S_0}{S_0} = \frac{R_A - R_B}{1 + R_B}$$

When interest rate parity does not hold and forward contracts are traded there is a profitable (covered interest) arbitrage from borrowing one currency, exchanging it for the other, investing it, and entering into a forward contract to convert the proceeds at the end of the loan period back into the borrowed currency.

**LOS 18.i**

A currency selling at a forward premium is considered “strong” relative to the second currency, while a currency selling at a forward discount is considered “weak.”

## CONCEPT CHECKERS

1. Suppose that the quote for British pounds (GBP) in New York is 1.3110 GBP:USD. What is the quote for U.S. dollars (USD) in London (USD:GBP)?  
A. 1.3110.  
B. 0.3110.  
C. 0.7628.
2. The annual interest rates in the United States (USD) and Sweden (SEK) are 4% and 7% per year, respectively. If the current spot rate is USD:SEK = 9.5238, then the 1-year forward rate in USD:SEK is:  
A. USD:SEK = 9.2568.  
B. USD:SEK = 10.2884.  
C. USD:SEK = 9.7985.
3. The annual risk-free interest rate is 10% in the United States (USD) and 4% in Switzerland (CHF), respectively, and the 1-year forward rate is CHF:USD = 0.80. If interest rate parity holds, today's CHF:USD spot rate must be:  
A. 0.8462.  
B. 0.7564.  
C. 0.8888.
4. The spot rate on the New Zealand dollar (NZD) is USD:NZD = 1.4286, and the 180-day forward rate is USD:NZD = 1.3889. If interest rate parity holds, this difference means:  
A. interest rates must be lower in the United States than in New Zealand.  
B. interest rates must be higher in the United States than in New Zealand.  
C. the NZD is expected to depreciate and the dollar is expected to appreciate.
5. Today's spot rate for the Indonesian rupiah (IDR) is USD:IDR = 2,400, and the New Zealand dollar trades at USD:NZD = 1.60. The IDR:NZD cross rate is:  
A. IDR:NZD = 0.00067.  
B. IDR:NZD = 1,492.53.  
C. IDR:NZD = 3,840.
6. Today's spot NZD:USD ask exchange rate is 0.6010, and the bid is 0.6000. The percentage spread on the USD is:  
A. 0.6600%.  
B. 0.1664%.  
C. 6.0010%.
7. The NZD is trading at 0.3500 NZD:USD, and the SEK is trading at 0.3100 SEK:NZD. The SEK:USD cross rate is:  
A. 8.8573 SEK:USD.  
B. 9.2166 SEK:USD.  
C. 0.1085 SEK:USD.

8. Suppose that the quote for GBP in New York is 1.7574 – 1.7584 GBP:USD. The equivalent quote for U.S. dollars in London would be:
  - A. USD:GBP 0.5687 – 0.5690.
  - B. USD:GBP 0.5690 – 0.5687.
  - C. GBP:USD 1.7584 – 1.7574.
9. Assume the Philippine peso is at a 1-year forward discount of 1.25% to the Thai baht, and Thailand's 1-year interest rate is at 3.00%. If IRP holds exactly, the Philippine interest rate is *closest* to:
  - A. 4.25%.
  - B. 1.75%.
  - C. 1.25%.
10. The bid-ask quote for yen (JPY) in London (JPY:GBP) is 0.0050 – 0.00504. In New York, the bid-ask quote for British pounds (GBP:USD) is 1.671 – 1.678. What is the JPY:USD ask as a cross rate?
  - A. 0.008390.
  - B. 0.008457.
  - C. 0.008422.

Use the following information to answer Questions 11 and 12.

CHF:USD spot rate = 0.8000 – 0.8100

CHF:USD 180-day forward rate = 0.8400 – 0.8500

USD:GBP spot rate = 0.5500 – 0.5600

USD:GBP 180-day forward rate = 0.5300 – 0.5400

11. Relative to the Swiss franc (CHF) and based on a 360-day year, the dollar is *closest* to trading at an annualized forward:
  - A. premium of 10.38%.
  - B. premium of 9.47%.
  - C. discount of 9.47%.
12. What is the *most appropriate* characterization of the strength of the USD versus the Swiss franc and the pound?
  - A. The USD is strong versus both currencies.
  - B. The USD is weak versus both currencies.
  - C. The USD is strong versus only one of the two currencies.

## CHALLENGE PROBLEMS

13. Suppose the spot rate is 0.7102 CHF:USD. Swiss and U.S. interest rates are 7.6% and 5.2%, respectively. If the 1-year forward rate is 0.7200 CHF:USD, an investor could:
- A. not earn arbitrage profits.
  - B. earn arbitrage profits by investing in USD.
  - C. earn arbitrage profits by investing in CHF.
14. The bid-ask quotes for the USD, GBP, and EUR are:
- (USD:EUR): 0.7000 – 0.7010
  - (GBP:USD): 1.7000 – 1.7010
  - (GBP:EUR): 1.2000 – 1.2010

The potential arbitrage profits from triangular arbitrage based on an initial position of 1 million USD are *closest* to:

- A. 0 USD.
- B. 7,212 USD.
- C. 6,372 USD.

## ANSWERS – CONCEPT CHECKERS

1. C  $1 / 1.311 = 0.7628$  USD:GBP
2. C The forward rate in SEK/USD is  $9.7985 = 9.5238 \left( \frac{1.07}{1.04} \right)$ . Since the SEK interest rate is the higher of the two, the SEK must depreciate approximately 3%.
3. B We can solve interest rate parity for the spot rate as follows:  
 With F and S quoted as CHF:USD, the spot is  $0.7564 = 0.80 \left( \frac{1.04}{1.10} \right)$ . Since the interest rate is higher in the United States, it should take fewer USD to buy CHF in the spot market. In other words, the forward USD must be depreciating relative to the spot.
4. B Interest rates are higher in the United States than in New Zealand. It takes fewer NZD to buy one USD in the forward market than in the spot market, so the USD is expected to depreciate (is at a forward discount).
5. A Start with one NZD and exchange for  $1/1.6 = 0.625$  USD. Exchange the USD for  $0.625 \times 2,400 = 1,500$  IDR. We get a cross rate of 1,500 NZD:IDR or 0.00067 IDR:NZD.
6. B The USD percent spread  $= \frac{0.6010 - 0.6000}{0.6010} (100) = 0.1664\%$ .
7. C  $0.3500$  NZD:USD  $\times$   $0.3100$  SEK:NZD  $= 0.1085$  SEK:USD.  
 Notice that the NZD cancels in the multiplication.
8. A Invert the quotes:  $1 / 1.7574 = 0.5690$  and  $1 / 1.7584 = 0.5687$ .  
 Remember, when you invert a quote, the ask becomes the bid for the other currency and vice versa. So the quote is  $0.5687 - 0.5690$  USD:GBP.
9. A If there are no arbitrage opportunities, IRP holds, and the interest rate differential is equal to the forward differential. Since the PHP is trading at a forward discount, PHP interest rates must be greater than THB interest rates.  
 $3 + 1.25 = 4.25\%$
10. B Multiplying the asks yields  $0.00504 \times 1.678 = 0.008457$  JPY:USD.
11. C spot midpoint Sf per \$  $= \frac{1}{0.805} = 1.2422$   
 forward midpoint in Sf per \$  $= \frac{1}{0.845} = 1.1834$   
 forward discount on \$  $= \left( \frac{1.1834 - 1.2422}{1.2422} \right) \left( \frac{360}{180} \right) = -0.0947 = -9.47\%$

12. B The dollar is selling at a discount relative to the Swiss franc (as we determined in Question 12); therefore, it is weak relative to the Swiss franc. The pound/U.S. dollar rates are quoted in USD:GBP, and the spot rate midpoint (0.555) is greater than the forward rate midpoint (0.535), so the dollar is also selling at a forward discount relative to the pound; therefore, the dollar is also weak relative to the pound.

## ANSWERS – CHALLENGE PROBLEMS

13. C Note that while the USD has the lower interest rate, it is also trading at a forward discount relative to the CHF. Since the USD will earn less interest *and* depreciate in value, we definitely want to invest in CHF (not in USD), and no calculation is necessary.

As an illustration of covered interest arbitrage, we have:

$$(1 + R_A) < \frac{(1 + R_B)(\text{forward rate})}{\text{spot rate}}$$

$$1.052 < \frac{(1.076)(0.72)}{0.7102} = 1.0908$$

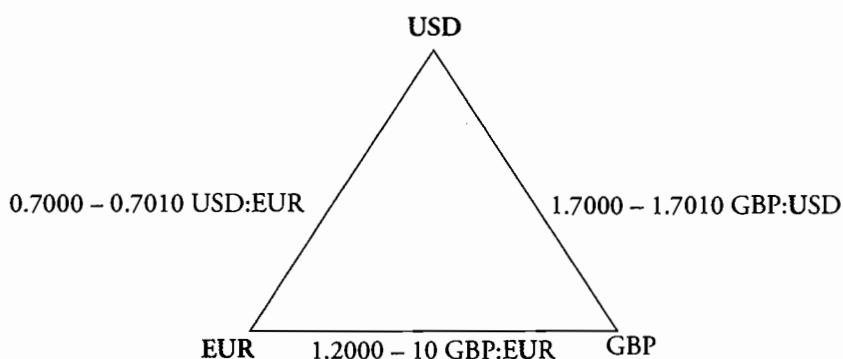
Today:

- 1) Borrow USD1 at 5.2% and purchase CHF at \$0.7102 to get \$1 / 0.7102 = 1.408 CHF at spot rate.
- 2) Lend the purchased CHF at 7.6% and sell forward 1.5150 CHF at the forward rate of 0.7200 CHF:USD.

In one year:

- 1) Use the proceeds of the savings account [(1.408)(1.076) = 1.5150 CHF] to purchase USD1.0908 at the forward rate (1.515 CHF × 0.72 CHF:USD).
- 2) Pay off the loan of USD1 × 1.052 = USD1.052 and earn a riskless profit = USD1.0908 – USD1.052 = USD0.0388.

14. C Here is what the triangle looks like with the bid-ask quotes filled in:



If we start with 1 million USD and move clockwise around the triangle (USD to GBP to EUR to USD), we first convert 1 million USD into GBP at the ask:

$$\frac{1 \text{ million USD}}{1.7010} = 587,889 \text{ GBP}$$

Then we sell the GBP for EUR at the bid:

$$587,889 \text{ GBP} \times \left( \frac{1.20 \text{ EUR}}{\text{GBP}} \right) = 705,467 \text{ EUR}$$

Finally, we purchase USD at the ask in euros:

$$\frac{705,467 \text{ EUR}}{0.7010} = 1,006,372 \text{ USD}$$

Arbitrage profits are  $1,006,372 \text{ USD} - 1,000,000 \text{ USD} = 6,372 \text{ USD}$ .



---

The following is a review of the Economics for Valuation principles designed to address the learning outcome statements set forth by CFA Institute®. This topic is also covered in:

# FOREIGN EXCHANGE PARITY RELATIONS

Study Session 4

---

## EXAM FOCUS

This topic review develops a framework for explaining the interrelationships between exchange rates, interest rates, and inflation rates. These are the well-known international parity relationships that are considered to be a key component of the core body of knowledge at Level 2. For those not regularly involved with the foreign exchange markets, the concepts can be challenging and require considerable time to digest. The discussion concerning exchange rate systems and determination, balance of payments accounts, and the effects of monetary and fiscal policy are the foundation. These provide the points of reference for your understanding of the discussion of the international parity relationships that follows.

---

### LOS 19.a: Explain how exchange rates are determined in a flexible (or floating) exchange rate system.

---

In a flexible (floating) exchange rate system, rates are determined by supply and demand in the foreign exchange markets. If there is an excess demand for U.S. dollars by Australians at the current exchange rate, for example, they will sell Australian dollars and buy U.S. dollars. This will cause the USD to appreciate relative to the AUD. How might this happen? If Australians increase their imports of U.S. goods and services or purchases of U.S. dollar-denominated assets, then this results in an increase in demand for USD and an increase in the supply of AUD.

---

### LOS 19.b: Explain the role of each component of the balance of payments accounts.

---

**Balance-of-payments (BOP)** accounting is a method used to keep track of transactions between a country and its international trading partners. It includes government transactions, consumer transactions, and business transactions. The balance-of-payments accounts reflect all payments and liabilities to foreigners, and all payments and obligations received from foreigners. The BOP equation is:

$$\text{current account} + \text{financial account} + \text{official reserve account} = 0$$

The **current account** measures the exchange of merchandise goods, the exchange of services, the exchange of investment income, and unilateral transfers (gifts to and from other nations). The *balance on current account* summarizes whether we are selling more goods and services to the rest of the world than we are buying from them (a current account surplus), or buying more from the rest of the world than we are selling to them (a current account deficit).

The **financial (capital) account** measures the flow of funds for debt and equity investment into and out of the country.

**Official reserve account** transactions are those in the reserves held by the official monetary authorities of the country. These reserves are typically in the form of gold, other foreign currencies, and special drawing rights at the International Monetary Fund (IMF). These reserve balances are what is used by the monetary authorities when they intervene in the foreign-exchange markets in an attempt to affect exchange rate values.



*Professor's Note: For the exam, unless told otherwise, assume that the official reserve account is equal to zero (or fixed). Then, if you are given (or you determine) a change in the current account (e.g., the country ran a \$100 billion current account deficit), you know that the financial account must change in the opposite direction by the same amount (i.e., a \$100 billion surplus) so that the BOP equation holds.*

---

**LOS 19.c: Explain how current account deficits or surpluses and financial account deficits or surpluses affect an economy.**

---

Is a nation's current account balance, by itself, a good measure of its economic health? No, there is no law, economic or political, which states that the current account balance must be positive. Unlike running a *budget deficit* in which a person or institution spends more than it makes, running a deficit in the current account balance simply means a country imports more than it exports, and a country can do this for a long time. Also, countries that run current account deficits tend to run financial account surpluses so that they offset each other. Is a net inflow of capital bad? No, if the capital is being invested in such a way as to enhance the productive capacity of the country. Conversely, is a current account surplus and financial account deficit an indication of economic strength? No, and particularly not if the exodus of financial capital occurs because there are few good investment opportunities in the country.

---

**LOS 19.d: Describe the factors that cause a nation's currency to appreciate or depreciate.**

---

There are a variety of factors that cause a country's currency to appreciate or depreciate relative to another's.

- **Differences in income growth** among nations will, in the short run at least, cause nations with the highest income growth to demand more imported goods. In part this can be due to the fact that demand for goods is growing faster than the domestically-produced supply. The heightened demand for imports will increase demand for foreign currencies, appreciating the foreign currencies relative to the domestic currency.
- **Differences in inflation rates** will usually cause the currency in the country with the higher inflation rate to depreciate as its purchasing power erodes compared with lower-inflation countries.

- **Differences in real interest rates** will cause a flow of capital into those countries with the highest available *real* rates of interest. Therefore, there will be an increased demand for those currencies, and they will appreciate relative to the currencies of countries whose available real rate of return is low.
- **Changes in the investment climate** are changes in the factors that affect investment risk, such as the fairness of the legal system, the stability and transparency of the monetary policy, the nature of the tax laws, and the effectiveness of the political system. A positive change in the investment climate (decrease in risk) implies an appreciation in the country's currency.

Figure 1 summarizes the factors that cause a nation's currency to appreciate or depreciate.

**Figure 1: Factors That Affect Currency Movements**

| <i>Factors*</i>             | <i>Lower</i> | <i>Higher</i> |
|-----------------------------|--------------|---------------|
| Income growth rate          | Appreciation | Depreciation  |
| Inflation rate              | Appreciation | Depreciation  |
| Domestic real interest rate | Depreciation | Appreciation  |
| Investment climate change** | Depreciation | Appreciation  |

\* Relative to trading partners.

\*\* Lower implies adverse change, higher implies positive change.

#### **LOS 19.e: Explain how monetary and fiscal policies affect the exchange rate and balance of payments components.**

Expansionary monetary policy and expansionary fiscal policy will likely have opposite effects on exchange rates. As you might suspect, increasing the growth rate of the money supply will lead to depreciation of a country's currency. Expansionary monetary policy will increase domestic economic growth (greater demand for imports) and will increase inflation (less demand for exports). This will lead to a decrease in net exports, a deterioration of the current account, and a decreased demand for the domestic currency.

Expansionary monetary policy will also reduce the real interest rate (rate of return) and consequently the demand for domestic physical and financial assets. This decrease in financial inflows (deterioration of the financial account) reduces the demand for the domestic currency for investment purposes. The decrease in demand for the country's currency will lead to a depreciation of the domestic currency. Restrictive monetary policy will have the opposite effects and lead to an increased demand for and appreciation in the value of the domestic currency.

Expansionary fiscal policy (an increased deficit from lower taxes or higher government spending) will increase government borrowing and consequently the real interest rate. An increase in the real interest rate will attract foreign investors, improve the financial account, and consequently *increase* the demand for the domestic currency. Expansionary

fiscal policy will also increase economic activity (growth) and inflation, leading to a deterioration of the current account and a *decrease* in demand for the domestic currency. With these two opposite effects on currency demand, the net effect on exchange rates is subject to some debate. The prevailing view, however, is that the financial flows effect will dominate the goods flow effect, and the currency will typically appreciate as a result of expansionary fiscal policy. A more restrictive fiscal policy will typically lead to depreciation of the domestic currency relative to others.



*Professor's Note: To remember these relations, just remember that increasing the money supply (expansionary monetary policy) leads to currency depreciation, and that expansionary fiscal policy typically has the opposite effect. The intuition that increasing the supply of money tends to decrease its (foreign exchange) value should be easy to remember.*

---

#### LOS 19.f: Describe a fixed exchange rate and a pegged exchange rate system.

---

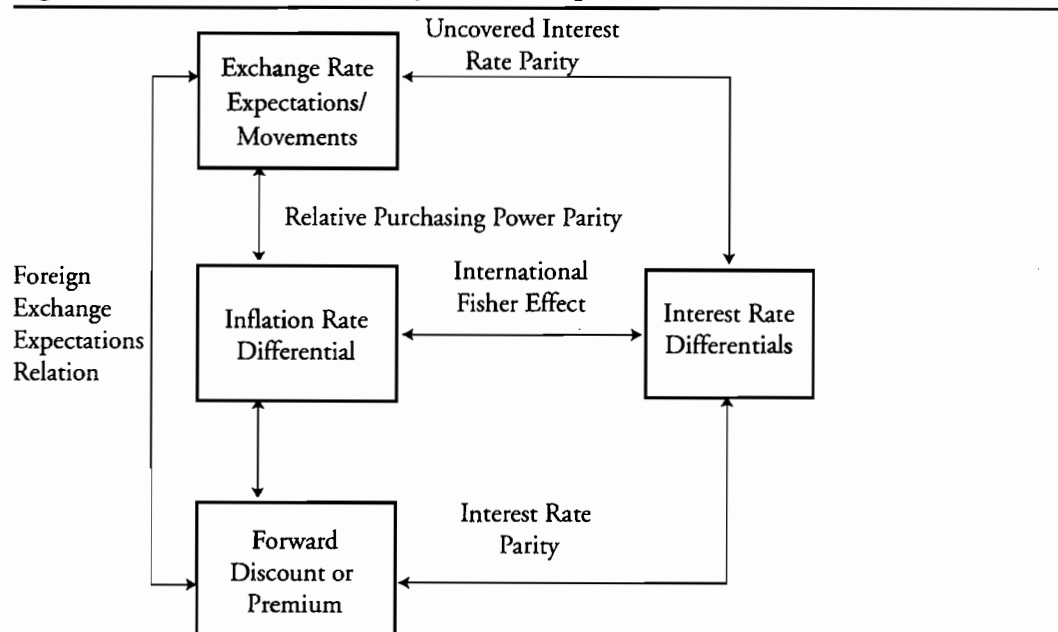
A **fixed exchange rate system** is one in which the rate of exchange is fixed against one of the major currencies. This entails that the country adopting the system be willing to sacrifice the independence of its monetary policy to obtain the relative stability of the fixed exchange rate. For example, Hong Kong has absolutely fixed the value of its currency relative to the U.S. dollar through the use of a *currency board*. This means that the local currency in circulation is backed by a fixed amount of USD assets, and the board stands ready to redeem local currency for USD (and USD for local currency), as necessary to enforce the fixed rate. Consequently, the value of the local currency will rise and fall in lock-step with the value of the USD against other currencies.

A **pegged exchange rate system** involves a commitment of a country to use fiscal and monetary policy to maintain the country's exchange rate within a narrow band relative to another (usually stronger) currency, or to a bundle of currencies. This type of system requires a country to use its monetary policy to maintain the desired exchange rate. Sometimes a **crawling peg** is used, meaning that the peg is set for a fixed period of time, after which the peg is reset to reflect the current economic conditions. This has the benefit of giving importers and exporters a degree of exchange rate stability for planning purposes, but also gives the government the ability to revalue the currency at the end of the period without the negative signaling effects that often accompany the announcement that a country is abandoning a fixed peg.

### INTERNATIONAL PARITY RELATIONS

Before we begin our examination of each one of the various parity relations, it will be useful to establish how these all fit together. In Figure 2, you can see that these relationships are concerned with the differences between spot exchange rates, expected future spot exchange rates, forward exchange rates, interest rates, and inflation rates. Though these relationships are not all exact, together they provide an extremely useful framework for thinking about the foreign exchange markets and values.

Figure 2: The International Parity Relationships Combined



LOS 19.g: Define and discuss absolute purchasing power parity and relative purchasing power parity.

LOS 19.h: Calculate the end-of-period exchange rate implied by purchasing power parity, given the beginning-of-period exchange rate and the inflation rates.

The law of one price states that identical goods should have the same price in all locations. For instance, a pair of designer jeans should cost the same in New York and London after adjusting for the exchange rate. The potential for arbitrage profits is the basis for the law of one price. If widgets cost less in New York than in Paris, an enterprising individual will buy widgets in New York and sell them in Paris until the price differential disappears. The law of one price does not hold in practice due to the effects of tariffs and transportation costs.

Instead of focusing on individual products, **absolute purchasing power parity** (absolute PPP) compares the average price of a representative basket of consumption goods between countries. Absolute PPP only requires that the law of one price is correct *on average*, that is, for a like basket of goods in each country. In practice, even if the law of one price held for every good in two economies, absolute PPP might not hold because the weights (consumption patterns) of the various goods in the two economies may not be the same (e.g., people eat more potatoes in Russia, more rice in Japan).

## Relative Purchasing Power Parity

Relative purchasing power parity (relative PPP) is based on the idea that even if absolute PPP does not hold, there may still be a relationship between exchange rate movements and differences in inflation rates between two countries. Simply put, if (over a 1-year period) Country A has a 6% inflation rate and Country B has a 4% inflation rate, then Country A's currency should *depreciate* by approximately 2% relative to Country B's currency over the period. Relative PPP states that changes in exchange rates should exactly offset the price effects of any inflation differential between the two countries.

The equation for relative PPP is as follows:

$$S_0 \left[ \frac{1 + \text{inflation}_{\text{domestic}}}{1 + \text{inflation}_{\text{foreign}}} \right]^t = E(S_t)$$

where:

- $S_0$  = spot exchange rate today (FC:DC)
- $E(S_t)$  = expected spot exchange rate after  $t$  periods (FC:DC)
- $\text{inflation}_{\text{domestic}}$  = expected inflation rate per period for the domestic currency
- $\text{inflation}_{\text{foreign}}$  = expected inflation rate per period for the foreign currency

The following example illustrates the use of the relative PPP relation.

### Example: Calculating the exchange rate predicted by relative PPP

The current spot rate is AUD:USD = 0.6525. You expect the annualized Australian inflation rate to be 6% over the next 6 months, and the annualized U.S. inflation rate to be 3% over the same period. According to relative form PPP, what is the expected spot rate in 6 months?

**Answer:**

$$0.6525 \left[ \frac{1.03}{1.06} \right]^{0.5} = 0.6432 \text{ AUD:USD}$$

Since the AUD has the higher inflation rate, the expectation is for the AUD to depreciate. To keep the cost of goods and services the same across borders, countries with higher rates of inflation should see their currencies depreciate. In fact, the estimated depreciation is approximately 3% (annualized).



*Professor's Note: The intuition here is that if Australia's annual inflation rate is 3% greater than the U.S. inflation rate, the AUD will depreciate (at an approximate 3% annual rate). For a spot exchange rate given as a direct exchange rate (foreign:domestic or domestic/foreign) the domestic inflation rate will be in the numerator. Viewing the previous example from the standpoint of a U.S. investor, the spot price of an AUD in USD must decline since the expected U.S. inflation rate is less than the Australian rate and the AUD will depreciate as a result. In order for it to decline we must put the smaller (U.S.) inflation rate in the numerator and the greater (AUD) rate in the denominator so the multiplier in the Relative Purchasing Power Parity formula is less than one.*

Because there is no true arbitrage available to force the PPP relation to hold, violations of the relative PPP relation in the short run are common. However, because the evidence suggests that the relative form of PPP holds approximately in the long run, it remains a useful method for estimating the relationship between exchange rates and inflation rates, on average.

---

**LOS 19.i: Define and discuss the international Fisher relation.**

**LOS 19.j: Calculate the real interest rate, given interest rates and inflation rates and the assumption that the international Fisher relation holds.**

**LOS 19.k: Calculate the international Fisher relation, and its linear approximation, between interest rates and expected inflation rates.**

---

Professor Irving Fisher originated the idea that the nominal rate of return is (approximately) the sum of the real rate and the expected rate of inflation.

We can write this approximate relation as:

$$R_{\text{nominal}} = R_{\text{real}} + E(\text{inflation})$$

or, the precise relation as:

$$(1 + R_{\text{nominal}}) = (1 + R_{\text{real}})[1 + E(\text{inflation})]$$

From this idea that the difference between the nominal rate of return and the real rate of return is due to differences in expected inflation, we need to add only an assumption that real rates of return are equalized across countries, to get the **international Fisher relation**.

Using the Fisher relation for two Countries, A and B, we have:

$$(1 + R_{\text{nominal A}}) = (1 + R_{\text{real A}})[1 + E(\text{inflation}_A)]$$

$$(1 + R_{\text{nominal B}}) = (1 + R_{\text{real B}})[1 + E(\text{inflation}_B)]$$

So we can write:

$$\frac{(1 + R_{\text{nominal A}})}{(1 + R_{\text{nominal B}})} = \frac{(1 + R_{\text{real A}})[1 + E(\text{inflation}_A)]}{(1 + R_{\text{real B}})[1 + E(\text{inflation}_B)]}$$

Under the assumption that  $R_{\text{real A}} = R_{\text{real B}}$ , we get the international Fisher relation:

$$\frac{(1 + R_{\text{nominal A}})}{(1 + R_{\text{nominal B}})} = \frac{[1 + E(\text{inflation}_A)]}{[1 + E(\text{inflation}_B)]}$$

or the linear approximation:

$$R_{\text{nominal A}} - R_{\text{nominal B}} = E(\text{inflation}_A) - E(\text{inflation}_B)$$

which tells us that the difference between two country's nominal rates is equal to the difference between their inflation rates.

For the international Fisher relation to hold,  $R_{\text{real}}$  must approximately equal  $R_{\text{nominal}} - E(\text{inflation})$  for all countries. Under the assumption that  $R_{\text{real}}$  is equal across countries, the differential,  $R_{\text{nominal}} - E(\text{inflation})$ , is the same in every country.

#### Example: Calculating the real interest rate

Suppose the nominal South African interest rate is 9.0% and the expected inflation rate is 3.5%. Calculate the real interest rate.

**Answer:**

Exact methodology:

$$(1.090) = (1 + \text{real } r_{\text{ZAR}})(1.035) \Rightarrow \text{real } r_{\text{ZAR}} = 0.053 = 5.3\%$$

Linear approximation:

$$0.090 \approx \text{real } r_{\text{ZAR}} + 0.035 \Rightarrow \text{real } r_{\text{ZAR}} \approx 0.090 - 0.035 = 0.055, \text{ or } 5.5\%$$

If we move to a 2-country scenario, we will now have two nominal interest rates and two expected inflation rates. If the real rates for both countries are assumed to be equal, they drop out of the equation, and we are left with the international Fisher relation in both its exact formulation and as a linear approximation, as shown in the following example.



**Example: Using the international Fisher relation**

Suppose that the Eurozone expected annual inflation rate is 9.0%, and that the expected South African inflation rate is 13.0%. The nominal interest rate is 10.09% in the Eurozone. Use the international Fisher relation, and its linear approximation, to estimate the nominal interest rate in South Africa.

Exact methodology:

$$\frac{1 + R_{EUR}}{1 + R_{ZAR}} = \frac{1 + E(I_{EUR})}{1 + E(I_{ZAR})}$$

$$\frac{1.1009}{1 + R_{ZAR}} = \frac{1.09}{1.13}$$

$$R_{ZAR} = \frac{1.1009(1.13)}{1.09} - 1 = 14.13\%$$

Linear approximation:

$$\text{real rate EUR} \approx 10.09\% - 9\% = 1.09\%$$

$$R_{ZAR} = 13\% + 1.09\% = 14.09\%$$

which are the nominal ZAR interest rates if the international Fisher relation holds.

The argument for the equality of real interest rates across countries is based on the idea that with free capital flows between countries, funds will move to a country with a higher real rate until real rates are again equalized. Many economists would argue that business cycle phases differ across countries so that countries with faster economic growth (better investment opportunities) may have persistently higher real rates of return.

---

**LOS 19.l: Define and discuss the theory of uncovered interest rate parity and explain the theory's relation to other exchange rate parity theories.**

**LOS 19.m: Calculate the expected change in the exchange rate, given interest rates and the assumption that uncovered interest rate parity holds.**

---

With covered interest rate parity, we saw that arbitrage would force the forward contract exchange rate to a level consistent with the difference between two country's nominal interest rates. If forward currency contracts are not available or capital flows are restricted so as to prevent arbitrage, the relationship need not hold. Uncovered interest rate parity refers to such a situation where currency risk cannot be 'covered' with a forward currency exchange rate contract. By combining relative purchasing power parity with the international Fisher relation, however, we can derive the equation for uncovered

interest rate parity. We get a relation that looks just like covered interest parity, but with the forward contract rate replaced by the expected future spot rate,  $E(S_t)$ .

The exact relation for uncovered interest rate parity to hold is:

$$\frac{E[S_1]}{S_0} = \frac{\text{expected spot rate at } t = 1}{\text{spot exchange rate}} = \frac{(1 + R_{\text{domestic}})}{(1 + R_{\text{foreign}})}$$

where  $S$  is expressed as a direct quote (foreign:domestic), and  $R$  is the nominal risk-free rate. The foreign currency is expected to appreciate (depreciate if  $< 0$ ) by approximately  $R_{\text{domestic}} - R_{\text{foreign}}$  when the difference is positive (negative).



*Professor's Note: Remember, if you have a direct quote for the spot exchange rate (domestic/foreign), then you simply put the domestic interest rate in the numerator and foreign interest rate in the denominator to set up the parity relationship.*

Here is an example of how we can use uncovered interest rate parity to *forecast* future spot exchange rates using market interest rates.

#### Example: Forecasting spot rates with uncovered interest rate parity

Suppose the spot exchange rate quote is EUR:ZAR = 8.385. The 1-year nominal rate in the Eurozone is 10.0% and the 1-year nominal rate in South Africa is 8.0%. Calculate the expected spot rate one year from today using uncovered interest rate parity.

**Answer:**

$$8.3850 \times \frac{[1 + 0.08]}{[1 + 0.10]} = 8.2325$$

The rand interest rate is lower than the euro rate, so uncovered interest rate parity predicts that the value of the rand will rise (it will take fewer rand to buy one euro) because of higher inflation expectations in the Eurozone. Note that if the interest rates given had been 180-day rates, you would have needed to adjust them by multiplying by (180/360).

There is no reason that uncovered interest rate parity must hold in the short run, and indeed it typically does not. There is evidence that it does hold in the long run to a significant extent, so that longer term expected future spot rates, based on uncovered interest rate parity, are often used as forecasts of future exchange rates.

---

**LOS 19.n: Discuss the foreign exchange expectation relation between the forward exchange rate and the expected exchange rate.**

---

The foreign exchange expectation relation says that the forward rate is an unbiased predictor of the expected future spot rate:

$$F_t = E(S_t)$$

We can also say that the forward discount or premium is an unbiased predictor of the expected change in the spot exchange rate:

$$\frac{F_t - S_0}{S_0} = E(\Delta S_0)$$

If it turns out that the forward rate *is* an unbiased predictor of the expected future spot rate, then there is no reward for bearing foreign currency exposure. In other words, there's no advantage to holding an unhedged position in a foreign currency and speculating on how exchange rates might change.

If this relationship doesn't hold, then there is a foreign currency risk premium present. For example, some investors may be willing to pay a premium to hedge the uncertainty of holding foreign currency-denominated assets. If such a premium is present, there will be a "cost" to hedging foreign currency-denominated assets with forward contracts.



*Professor's Note: The empirical evidence seems to suggest that the forward rate is not an unbiased predictor of the expected future spot rate and, therefore, there is a premium for bearing foreign exchange risk. In the topic review of international asset pricing in Study Session 18, we address the existence of this risk premium.*

## KEY CONCEPTS

### LOS 19.a

Supply and demand determine the exchange rates in flexible (or floating) exchange rate systems; there is supply of, and demand for, every currency in the foreign exchange market. Increased demand for a given currency (or reduced supply) will cause the currency to appreciate in value.

### LOS 19.b

The balance of payments is given by the equation:

$$\text{current account balance} + \text{financial account balance} + \text{official reserve account balance} = 0$$

- The current account includes the exchange of goods, services, investment income, and unilateral transfers (net foreign aid and other gifts).
- The financial account includes payments for securities, direct investment, and bank deposits.
- Official reserve account transactions are funds held at the *International Monetary Fund* (IMF) in the form of gold, foreign currencies, and special drawing rights at the IMF.

### LOS 19.c

A current account deficit means that a country imports more than it exports.

All other factors constant, a deficit balance on a country's current account implies that there is an excess supply of its currency in foreign exchange markets and its currency should depreciate.

All other factors constant, a surplus balance in a country's financial account implies that there is an excess demand for assets denominated in its currency and its currency should appreciate.

### LOS 19.d

Three major factors cause a country's currency to appreciate or depreciate:

| <i>Factors*</i>             | <i>Lower</i> | <i>Higher</i> |
|-----------------------------|--------------|---------------|
| Income growth rate          | Appreciation | Depreciation  |
| Inflation rate              | Appreciation | Depreciation  |
| Domestic real interest rate | Depreciation | Appreciation  |
| Investment climate change** | Depreciation | Appreciation  |

\* Relative to trading partners.

\*\* Lower implies adverse change, higher implies positive change.

#### LOS 19.e

The impacts of expansionary monetary and fiscal policy are typically as follows:

| <i>Policy</i>          | <i>Currency</i> | <i>Current Account</i> | <i>Financial Account</i> |
|------------------------|-----------------|------------------------|--------------------------|
| <i>Monetary policy</i> | Depreciation    | Deficit                | Deficit                  |
| <i>Fiscal policy</i>   | Appreciation    | Deficit                | Surplus                  |

#### LOS 19.f

A fixed exchange rate system has a set rate of exchange and is supported by giving up discretion in monetary policy. Some countries fix their exchange rates to other currencies, such as the U.S. dollar, and sacrifice independent monetary policy.

A pegged exchange rate system involves a commitment of a country to use fiscal and monetary policy to maintain the country's exchange rate within a narrow band relative to another (stronger) currency or to a bundle of currencies. This type of system requires a country to use its monetary policy to maintain the desired exchange rate.

#### LOS 19.g

Absolute PPP compares the price of a basket of similar goods between two countries. Under absolute PPP, price levels should be the same across borders after adjustment has been made for the exchange rate.

Relative PPP states that the exchange rate between two countries will adjust to offset differences in inflation rates. It is the rate of inflation that is critical here. Relative PPP requires only that the exchange rate be proportional to the ratio of the two price indexes. The value of higher-inflation currencies will be depressed relative to the value of lower-inflation currencies, all other things equal.

#### LOS 19.h

Countries with higher relative inflation rates should see their currencies depreciate through time, all else equal.

The formal equation for relative PPP is as follows:

$$S_0 \left[ \frac{1 + I_{\text{domestic}}}{1 + I_{\text{foreign}}} \right]^t = E(S_t)$$

where  $S$  is the exchange rate expressed as a direct quote (foreign:domestic or domestic/foreign).

#### LOS 19.i

The international Fisher relation specifies that the difference between two countries' nominal interest rates should be approximately equal to the difference between their expected inflation rates.

LOS 19.j

Real interest rate formula is as follows:

$$(1 + R_{\text{real}}) = \frac{(1 + R_{\text{nominal}})}{[1 + E(\text{inflation})]}$$

$$\text{Linear approximation: } (R_{\text{real}}) \approx [R_{\text{nominal}} - E(\text{inflation})]$$

LOS 19.k

The international Fisher relation formula:

$$\text{Exact methodology: } \frac{1 + R_B}{1 + R_A} = \frac{1 + E(\text{inflation}_B)}{1 + E(\text{inflation}_A)}$$

$$\text{Linear approximation: } R_B - R_A \approx E(\text{inflation}_B) - E(\text{inflation}_A)$$

LOS 19.l,m

Uncovered interest rate parity holds when expected currency depreciation (appreciation) just offsets interest rate differences between two countries:

$$S_0 \times \frac{\left[1 + R_{\text{domestic}} \left(\frac{n}{360}\right)\right]}{\left[1 + R_{\text{foreign}} \left(\frac{n}{360}\right)\right]} = E[S_n]$$

where  $S$ , the spot exchange rate, is expressed as a direct quote (foreign:domestic),  $R$  is the annualized nominal rate of interest, and  $n$  is the days to maturity for the quoted interest rates.

LOS 19.n

The foreign exchange expectation relation states that the forward exchange rate quoted today for delivery at some time in the future is equivalent to the expected value of the spot exchange rate at some time in the future:

$$F_t = E(S_t)$$

We can also say that the  $t$ -period forward discount or premium is an unbiased predictor of the expected percentage change in the spot exchange rate over  $t$  periods:

$$\frac{F_t - S_0}{S_0} = E(\Delta S_0)$$

If it turns out that the forward rate is an unbiased predictor of the expected future spot rate, then there is no reward for bearing foreign currency exposure. If this relationship doesn't hold, then there is a foreign currency risk premium.

**CONCEPT CHECKERS**

1. If the U.S. dollar was quoted at USD:AUD1.73 yesterday and today the U.S. dollar is trading at USD:AUD1.80, the U.S. dollar has:
  - A. remained unchanged, the AUD has appreciated.
  - B. depreciated, and will purchase less Australian goods.
  - C. appreciated, and will purchase more Australian goods.
2. A country's currency will *depreciate* if its:
  - A. income is growing slowly relative to the rest of the world.
  - B. inflation rate is lower than that of its trading partners.
  - C. real interest rate is lower than real rates in other countries.
3. If there were an unexpected decline in the growth rate of the dollar money supply:
  - A. real interest rates, output, and prices would fall, causing the dollar to depreciate.
  - B. real interest rates would rise, causing an appreciation of the dollar.
  - C. real interest rates, output, and prices would rise, causing the dollar to appreciate.
4. If the current account is in surplus, the *sum* of the financial account and official reserve transactions must be:
  - A. in deficit.
  - B. in surplus.
  - C. equal to zero.
5. In a flexible exchange rate system, the value of a currency is determined by the:
  - A. World Bank.
  - B. country's currency board.
  - C. supply and demand for the country's currency in the foreign exchange markets.
6. Which of the following would be the *most likely* consequence for a country that ran a current account deficit for ten consecutive years?
  - A. There would be no negative consequences.
  - B. Rapid economic growth.
  - C. High real interest rates.
7. Relative purchasing power parity:
  - A. does not hold in the short run or the long run.
  - B. tends to hold in the short run but not the long run.
  - C. tends to hold in the long run but not the short run.

8. Assume that the current spot rate of exchange between the U.S. dollar and the euro is €1.2500 per USD. If the U.S. inflation rate is expected to be 5% and the inflation rate in Europe is expected to be 4%, the expected spot rate of exchange three years from today is *closest* to:
- A. €1.2864.
  - B. €1.2146.
  - C. €1.2381.
9. Suppose the exchange rate quote is \$1.15 per euro, and expected inflation rates are 10% in the European Economic Community (EEC) and 8% in the United States. The end-of period exchange rate implied by PPP is *closest* to:
- A. \$1.1291.
  - B. \$1.1270.
  - C. \$1.1710.
10. Which statement is *most likely* to be true if the forward rate is an unbiased predictor of the expected future spot rate?
- A. The market will not reward bearing foreign currency exposure.
  - B. The foreign currency risk premium will be positive.
  - C. Currencies will tend to trade at a forward premium.
11. Suppose the spot exchange rate quote is 0.7132 Canadian dollars (C\$) per U.S. dollar. The 1-year nominal interest rate in Canada is 7.0% and the 1-year nominal interest rate in the United States is 5.0%. The expected exchange rate using the linear approximation of uncovered interest rate parity is *closest* to:
- A. C\$0.6896.
  - B. C\$0.6989.
  - C. C\$0.7275.
12. The spot exchange rate between the Danish kroner (DK) and the U.S. dollar (USD) is 6.812 DK per USD. The 6-month forward rate is 6.953 DK per USD. The expected change in the U.S. dollar exchange rate over the next six months is *closest* to:
- A. +2.1%.
  - B. -1.4%.
  - C. +1.4%.
13. The five international parity relationships indicate that the expected return on risk-free securities should be the same in all countries and exchange rate risk is really just inflation risk. Which of the following is *least likely* to be considered a practical implication from this framework?
- A. Investors will earn the same real rate of return on investments once their own currency impact is accounted for.
  - B. Interest rate differentials reflect currency expectations. As a result, covered interest arbitrage will provide a return in any foreign currency that is equal to the domestic return.
  - C. There are significant rewards for bearing foreign exchange risk.



## CHALLENGE PROBLEMS

Use the information below to answer Questions 14 through 18.

Sally Franklin, CFA, is a financial advisor to Jamie Curtess, a U.S. citizen interested in learning more about how her investments will be affected by exchange rates and differences in interest rates internationally. Franklin has gathered the following information based on Curtess's investment interests.

The current spot exchange rate: \$1 = €0.74.

|                               | <u>Europe</u> | <u>United States</u> |
|-------------------------------|---------------|----------------------|
| Nominal 1-year interest rate: | 0.04          | ?                    |
| Expected annual inflation:    | 0.02          | 0.01                 |

Franklin also gathers the following information.

|                               | <u>Switzerland</u> | <u>South Africa</u> |
|-------------------------------|--------------------|---------------------|
| Nominal 1-year interest rate: | 0.05               | 0.07                |
| Expected annual inflation:    | 0.03               | 0.05                |

14. According to the international Fisher relation, the 1-year nominal interest rate in the United States is *closest* to:
  - A. 2.98%.
  - B. 4.34%.
  - C. 6.24%.
  
15. If the relative form of the PPP holds, expected exchange rate in one year is *closest* to:
  - A. \$1.3381 per €.
  - B. \$0.7463 per €.
  - C. \$1.1650 per €.
  
16. Use the answer from Question 15 to answer this question. If interest rate parity holds, the 1-year forward rate is *closest* to:
  - A. \$0.6772 per €.
  - B. \$0.7463 per €.
  - C. \$1.3381 per €.

17. Curtess wonders how spot rates are expected to change in the future and asks the following question: “What are the implications for the South African rand relative to the Swiss franc under uncovered interest rate parity, and the implications for the euro relative to the U.S. dollar under the relative form of purchasing power parity?” Franklin responds by making two statements:

Statement 1: I expect the South African rand to depreciate relative to the Swiss franc.

Statement 2: I expect the euro to depreciate relative to the U.S. dollar.

Based upon the underlying parity relationships cited, are Franklin’s Statements 1 and 2 accurate?

- A. No, both statements are inaccurate.
  - B. Yes, both statements are accurate.
  - C. One statement is accurate and one is inaccurate.
18. For this question only, assume the nominal interest rate in the United States is 3%. Real interest rates, using the linear approximation of the international Fisher relation, are *most likely* to be:
- A. greater in the United States than in Europe.
  - B. lower in Europe than in South Africa.
  - C. equal across all four countries.

## ANSWERS – CONCEPT CHECKERS

1. C If it took 1.73 Australian dollars to buy 1 U.S. dollar yesterday and today it takes 1.80 Australian dollars to buy 1 U.S. dollar, the U.S. dollar has appreciated and will purchase more Australian goods.
2. C A country's currency will depreciate when the real interest rate is lower than real rates in other countries. With a lower real interest rate, foreign investors will not buy the country's currency to invest.
3. B If there were an unexpected decline in the growth rate of the money supply, real interest rates would rise, causing an appreciation of the dollar.
4. A The balance-of-payments equation is:

$$\text{current account} + \text{financial account} + \text{official reserve account} = 0$$

So, if the current account balance is in surplus, the sum of the other two accounts must reflect a deficit in order for the sum of all three to be zero.

5. C In a flexible exchange rate system, currency value is determined by the supply of and demand for the country's currency. Anything that affects the supply of or demand for the country's currency will affect the exchange rate.
6. A A current account deficit simply means that a country imports more than it exports.  
  
If it persists, it is an indication that the country's financial assets have been willingly purchased to maintain the balance of payments. Thus, of the three scenarios presented, the most likely is that there been no negative consequences.
7. C PPP is a poor predictor of short-run exchange rate movements. However, PPP tends to converge to parity and hold over the long run. Reasons why PPP does not hold in the short term:
  - The measurement of inflation varies across countries. A homogeneous basket of goods does not exist.
  - Transaction, labor, taxes, and tariffs prevent arbitrage.
  - Factors of production are not completely mobile in the short term.
  - Since physical goods arbitrage is constrained in the short run, other variables can have a major impact on the short-term exchange rates. Factors such as political risk and supply and demand imbalances also create disequilibria pressures.

8. B  $S_3 = €1.2500 \times \frac{1.04^3}{1.05^3} = €1.2146$

The higher expected rate of inflation in the United States should force the USD to depreciate over the 3-year period. The purpose of the expected depreciation is to ensure that the relative cost of goods and services between the United States and Europe remains constant after adjusting for inflation.

9. A  $S_1 = \$1.15 \times \frac{1.08}{1.10} = \$1.1291$

10. A If the forward rate is an unbiased predictor of the expected future spot rate, there is no reward for bearing foreign currency exposure and on average the spot rate will equal the forward rate. There is a foreign currency risk premium only if this relationship doesn't hold.

11. C The higher interest rates in Canada suggest that the C\$ will depreciate (the USD will appreciate) by 2% to C\$0.7275, according to uncovered interest rate parity:

$$\frac{E(S_1) - S_0}{S_0} = \% \Delta S \approx r_{CS} - r_{U.S.} = 0.07 - 0.05 = 0.02 = 2.0\%$$

$$E(S_1) = C\$0.7132 \times (1.02) = C\$0.7275$$

12. A According to the forward foreign exchange relation:

$$E(\% \Delta S) = \frac{F - S_0}{S_0} = \frac{6.9530 - 6.8120}{6.8120} = 0.021 = 2.1\%$$

13. C Combining all parity relationships indicates that the expected return on risk-free securities should be the same in all countries and exchange rate risk is really just inflation risk. There are five practical implications from this framework:
1. The real, risk-free return will be the same in all countries.
  2. Investing in countries with high nominal interest rates will not generate excess returns because the high nominal interest rates will be accompanied by local currency depreciation.
  3. All investors will earn the same expected return in their own currency on any investment denominated in a foreign currency.
  4. Exchange rate risk is simply inflation risk, so investors interested in real returns will not face exchange rate risk.
  5. Foreign currency risk can be hedged without cost because there is no foreign currency risk premium. There is no reward for bearing foreign currency risk.

## ANSWERS – CHALLENGE PROBLEMS

14. A According to the international Fisher relation:

$$(1 + r) = (1 + \text{real } r)[1 + E(I)]$$

From European data:

$$(1.04) = (1 + \text{real } r)(1.02)$$

$$\text{real } r = 1.96\%$$

For United States:

$$(1 + r) = (1.96)(1.01)$$

$$r = 2.98\%$$

15. A According to relative purchasing power parity, the expected spot rate in one year (in \$ per €) is calculated as follows:

$$€0.74 \text{ per } \$ = \$ \left( \frac{1}{0.74} \right) \text{ per } €$$

$$E(S_1) = S_0 \times \left( \frac{1+i_{\$}}{1+i_{€}} \right) = \left( \frac{1}{0.74} \right) \times \left( \frac{1.01}{1.02} \right) = \$1.3381 \text{ per } €$$

Notice that you would get the same answer by using the uncovered interest rate parity relation and the U.S. interest rate of 2.98% calculated from Question 15:

$$€0.74 \text{ per } \$ = \$ \left( \frac{1}{0.74} \right) \text{ per } €$$

$$E(S_1) = S_0 \times \left( \frac{1+r_{\$}}{1+r_{€}} \right) = \left( \frac{1}{0.74} \right) \times \left( \frac{1.0298}{1.04} \right) = \$1.3381 \text{ per } €$$

16. C According to interest rate parity, the forward rate in one year (in \$ per €) is calculated as follows:

$$€0.74 \text{ per } \$ = \$ \left( \frac{1}{0.74} \right) \text{ per } €$$

$$F = S_0 \times \left( \frac{1+r_{\$}}{1+r_{€}} \right) = \left( \frac{1}{0.74} \right) \times \left( \frac{1.0298}{1.04} \right) = \$1.3381 \text{ per } €$$

Note that this is the same as the expected spot exchange rate in one year from Question 16, which means the forward exchange expectation relation also holds.

17. B Relative form purchasing power parity predicts that countries with higher expected inflation will experience a depreciation of their currencies. South Africa's expected inflation rate (5%) is higher than the expected inflation rate in Switzerland (3%). The expected inflation rate in Europe (2%) is higher than the expected inflation rate in the United States (1%). According to purchasing power parity, the rand should depreciate relative to the franc, and the euro should depreciate relative to the U.S. dollar.

Uncovered interest parity makes the same predictions with regard to relative interest rates: countries with higher nominal interest rates can be expected to experience currency depreciation. The South African interest rate (7%) is higher than the Swiss rate (5%), so uncovered interest rate parity predicts that the rand will depreciate with respect to the franc. The interest rate in Europe (4%) is higher than the interest rate in the United States (2.98%), so the euro should depreciate relative to the U.S. dollar.

Franklin is correct with respect to both of his statements: the rand should depreciate relative to the franc and the euro should depreciate relative to the dollar.

18. C According to the linear approximation of the international Fisher relation, the real interest rate is equal to the nominal interest rate minus the expected inflation rate. The real interest rate in each of the four countries is 2%.

# MEASURING ECONOMIC ACTIVITY

Study Session 4

---

## EXAM FOCUS

Be prepared to compare and contrast Gross Domestic Product (GDP), Gross National Income (GNI), and Net National Income (NNI) and understand the output, expenditure, and income approaches to estimating GDP. Understand that differences between factor costs and market prices in output data result from indirect taxes and government subsidies. Finally, be able to explain how the implicit (GDP) price deflator measure of inflation can be used to convert nominal economic aggregates to their real output equivalents.

---

### LOS 20.a: Distinguish between the different measures of economic activity and their components.

---

The three most widely utilized measures of annual economic activity are **gross domestic product (GDP)**, **gross national income (GNI)**, and **net national income (NNI)**.

- *GDP* is the total market value of all final goods and services produced within a country's geographic boundaries over one year. To avoid double counting, the values of goods and services at their intermediate stages of production are not included in the calculation. Financial transactions and transfers of income are not included because they do not involve current production. Thus, the output of a U.S.-based company from its factories in Mexico would not count toward the GDP of the United States.
- *GNI* (formerly referred to as gross national product or GNP) is a measure of the total goods and services produced *by the residents of a country*. It differs from GDP in that it includes the incomes (rent, interest, profits, and dividends) earned by all of the residents of a country, regardless of where the assets are located. Therefore, the GNI of the United States includes income earned by a U.S.-owned company that manufactures products in Mexico. GNI does not include the income earned in the United States by non-U.S. citizens, for example.
- *NNI* is equal to GNI less depreciation. Depreciation (which is also called capital consumption) attempts to quantify the amount of resources utilized or worn out by the production process throughout the year. In practice, it is difficult to measure by actual usage. Estimates of depreciation are based upon expected asset lives and may vary greatly from their actual usage.

GDP, GNI, and NNI are related as follows:

$$\begin{array}{l} \text{Gross Domestic Product (GDP)} \\ + \text{net property income from abroad} \\ \hline \text{Gross National Income (GNI)} \\ - \text{depreciation} \\ \hline \text{Net National Income (NNI)} \end{array}$$

Although NNI is theoretically more accurate, the measure is not widely used because of the difficulty in quantifying the actual economic cost of depreciation. In most instances, there is very little difference between GDP and GNI. GDP is considered to be the preferred method of productivity measurement among industrialized nations; however, the GDP measure has two primary shortcomings. First, data for the GDP calculation is collected primarily through surveys, which is time-consuming and inaccurate. Second, GDP understates a country's actual economic output because of presence of shadow or underground economies.

A country's GDP can be measured in one of three different ways: output, expenditure, or income.

- *Output* is measured as the net value added (total value of production less total cost) of all businesses in a country. Output data are presented as an index relative to a designated base year's output of 100.
- *Expenditure* is broadly defined as all spending within a country over a given year. GDP based on expenditures is calculated by summing the values of three components: consumption (spending on domestically produced consumer items), investment (capital spending), and net export of goods and services [spending by foreigners on goods and services (exports) minus domestic spending on foreign-produced goods and services (imports)].
- *Income* includes all earnings of both employees and self-employed workers, trading profits of corporate and governmental endeavors, and rental income.

In a perfect world, output = expenditure = income. Because of date inaccuracies and timing issues, there may be discrepancies among the three. Typically, *output* is considered to be the most reliable measure, while *income* is regarded as the least reliable.

The specific calculations for each measure of GDP are shown in Figure 1. Note the terms for intermediate sums using the expenditure method.

**Figure 1: Methods of Measuring GDP**

| <i>Output</i>           | <i>Expenditure</i>                     | <i>Income</i>                                 |
|-------------------------|----------------------------------------|-----------------------------------------------|
| Value of production     | Consumption                            | Wages and salaries                            |
| – <u>Cost of inputs</u> | + <u>Investment</u>                    | + Self-employment income                      |
| GDP                     | <i>Total domestic expenditure</i>      | + Company trading profits                     |
|                         | + <u>Exports of goods and services</u> | + Government and enterprise trading surpluses |
|                         | <i>Total final expenditure</i>         |                                               |
|                         | – <u>Imports of goods and services</u> | + <u>Rental income</u>                        |
|                         | GDP                                    | GDP                                           |

---

**LOS 20.b: Differentiate between GDP at market prices and GDP at factor cost and explain the adjustments made.**


---

The expenditure component of GDP is based on market prices, which for certain transactions may include the effects of indirect taxes and/or subsidies. Examples of indirect taxes include sales taxes, value added taxes (VATs), and goods and services taxes (GSTs).

State-subsidized medical care expenditures would, for example, be less than expenditures without the subsidy. However, the output and income components of GDP are stated at their factor prices, which do not include the effects of indirect taxes. Therefore, an adjustment must be made to compare all GDP components in a consistent manner, either all at market prices or all at factor prices.

Beginning with GDP at market prices, subtract indirect taxes and add back subsidies to arrive at GDP at factor cost. That is, add indirect taxes and subtract subsidies. Opposite adjustments can be made to convert GDP at factor cost to GDP at market prices.

$$\begin{array}{r}
 \text{GDP at market prices} \\
 - \text{indirect taxes} \\
 + \text{subsidies} \\
 \hline
 \text{GDP at factor prices}
 \end{array}$$

Note that both GDP at market prices and at factor prices are accepted conventions, and it is important to clarify which method a country is using to measure its productivity. The U.S. economy is measured at market prices, while Great Britain reports its productivity both ways.

---

**LOS 20.c: Differentiate between current and constant prices and describe the GDP deflator.**


---

Economic aggregates may be reported at current prices or using base year (constant) prices. While expenditure data is often reported both in current price and base-year price terms, income data is typically reported in current year dollars (prices). Aggregates calculated using constant prices yield aggregates that clearly demonstrate increases in real output, as opposed to including increases in nominal output due to inflation.

Once expenditure data is calculated under both the current price and constant price methods, we can calculate the percentage difference between nominal GDP (current prices) and real GDP (constant or base-year prices) growth. This results in a measure of overall inflation called a price deflator, which we can use to convert income data to its constant-price equivalent value. Note that the Consumer Price Index (CPI) is based on a fixed basket of goods, whereas the implicit price (GDP) deflator allows for changes in the economy's output mix over time, including adjustments due to changing relative prices of goods.

Since different countries report economic aggregates differently in this regard, the price deflator can be used to convert these values for comparison and to estimate changes in real (inflation adjusted) output as necessary. Price deflators are subject to estimation error and errors estimating the rate of inflation can have very significant effects on estimates of real output growth, especially when inflation is relatively high.



## KEY CONCEPTS

### LOS 20.a

Gross domestic product (GDP) is the total market value of all final goods and services produced within a country's borders over a period of time, typically one year. Gross national income (GNI) is a measure of the total goods and services produced by the citizens of a country. Net national income (NNI) is GNI less depreciation. GDP is the most widely used measure of economic production.

### LOS 20.b

The expenditure measure of GDP is based on market prices, including the effect of indirect taxes and subsidies, while income-based measures typically use factor prices, which are not affected by taxes and subsidies.

$$\text{GDP (market prices)} - \text{indirect taxes} + \text{subsidies} = \text{GDP (factor prices)}$$

### LOS 20.c

The components of GDP may be reported in either current prices or base-year (constant) prices. The GDP deflator can be derived and used as a general measure of inflation trends.

## CONCEPT CHECKERS

1. GDP is *best* described as the measure of total goods and services produced:
  - A. by the citizens of a country.
  - B. in a country.
  - C. by the citizens of a country, net of depreciation.
2. Which of the following statements regarding GDP and GNI is *least accurate*?
  - A. GDP and GNI are equally preferred by the major industrialized countries as their primary measure of economic productivity.
  - B. There is typically very little difference between the GDP and GNI measures for most countries in any given year.
  - C. GDP and GNI tend to understate production, in part because of the existence of shadow economies.
3. The *most* significant difference between GDP at market prices and GDP at factor prices is an adjustment for:
  - A. tax avoidance or evasion.
  - B. black market activity.
  - C. indirect taxes and subsidies.

## ANSWERS – CONCEPT CHECKERS

1. B GDP is the total market value of all final goods and services produced in a country over a stated period of time, typically one year. GNI is a measure of the total goods and services produced by the citizens of a country. It differs from GDP in that it includes the incomes (rent, interest, profits, and dividends) earned by all of the residents of the country, regardless of where the assets are located. NNI is GNI net of depreciation.
2. A All major industrialized countries now use GDP as their primary measure of production.
3. C The factor cost adjustment begins with GDP at market prices, subtracts indirect taxes and adds back subsidies, resulting in GDP at factor cost.

## SELF-TEST: ECONOMICS



*Professor's Note: Remember that the Level 2 exam consists of all item set format questions; that is, a vignette presenting the relevant information followed by six multiple choice questions on that topic. For an accurate gauge of your preparedness, allow 18 minutes for this self-test.*

**Use the following information to answer Questions 1 through 6.**

Teresa Young, CFA, is the head of the research department manager for a large financial services corporation based in New York City. The company's clients include pension funds, endowments, and large foundations. Young manages the group that produces research for use within the company as well as for its clients. Members of the research department include economists that perform short- and long-range forecasting, as well as analysts that follow industry trends and the various individual companies within the industry.

Many of the firm's clients have globally diversified portfolios, and one of Young's group's responsibilities is to provide appropriate support to the firm's portfolio managers. One of the European equities managers has come to Young for some assistance in handling a longtime client who is based in Dallas. The client's existing portfolio is well-diversified, with approximately 60% domestic securities and the remaining 40% in global investments, primarily in Europe and Asia. The client is unhappy with the portfolio's recent performance and is convinced that there is too much exchange rate exposure because of the large foreign allocation. The manager would like to provide evidence to the contrary to the client, and believes the client is lacking a fundamental understanding of foreign exchange parity relations.

Young pulls together some basic information regarding the theoretical relationships between exchange rates, interest rates, and inflation rates. She also obtains information on some of the client's key non-U.S. holdings. She observes that the client currently has a large position in Banyo, a Japanese manufacturer and distributor of consumer electronics with a dominant position in markets worldwide. The client also has a substantial investment in Seine Industries, a French producer of paper products whose primary market is Western Europe.

**Current bid-ask spot rates:**

- 1.3200 USD (\$) per EUR (€).
- 95 JPY (¥) per USD (\$).

**Expected inflation rates:**

- United States: 4.00%.
- France: 6.50%.
- Japan: 8.00%.

1. The major difference between the law of one price (LOP) and absolute purchasing power parity (absolute PPP) is that the LOP:
  - A. reflects the relative rate of change in price for a good in two countries, while absolute PPP is adjusted for absolute changes in price.
  - B. focuses on the price of a single good, while absolute PPP is concerned with a weighted average price of a representative basket of goods.
  - C. assumes that competitive markets exist without transportation costs or tariffs, while absolute PPP takes into consideration all transaction costs.
2. Utilizing the spot exchange rate and the inflation rate information given above, calculate the dollar per yen exchange rate predicted for one year from today by relative purchasing power parity (relative PPP).
  - A. ¥90.28 per USD.
  - B. ¥91.49 per USD.
  - C. ¥98.65 per USD.
3. When Young discusses the International Fisher Relation with the client, she should explain that it is based on a belief that real interest rates are stable over time and equal across international boundaries because:
  - A. forward rates already reflect any difference in expected real interest rates between countries.
  - B. any expected inflation differential between countries will be brought back to equilibrium by consumers' demands for the least expensive goods and services.
  - C. any difference in real interest rates between countries would encourage capital flows to take advantage of the disparity, ultimately bringing rates back to equality.
4. Assume that the 1-year nominal euro interest rate is 7.25%, and the U.S. dollar rate is 6.50%. The expected exchange rate one year from now, using the linear approximation of uncovered interest rate parity, is *closest* to:
  - A. \$1.3101 per EUR.
  - B. \$1.3299 per EUR.
  - C. \$1.4058 per EUR.
5. Assume that the 6-month forward rate is \$1.35/€. Utilizing the foreign exchange expectation relation, the expected change in the spot exchange rate over the next six months is *closest* to:
  - A. 1.13%.
  - B. 2.27%.
  - C. 5.47%.
6. An unanticipated shift to a more expansive fiscal policy *least likely* results in a:
  - A. financial account deficit.
  - B. current account deficit.
  - C. currency appreciation.

## SELF-TEST ANSWERS: ECONOMICS

1. **B** The law of one price (LOP) states that any one good or service should have the identical real price in all countries. Absolute PPP is an average version of the law of one price and is based upon a weighted average price level of a representative basket of goods and services.

2. **C** The equation for relative PPP is:

$$E(S_t) = S_0 \times [(1 + E(I_{JPY})) / (1 + E(I_{USD}))]^t,$$

where  $I$  is the expected annual inflation rate and  $S_t$  is the spot rate at time  $t$  in JPY per USD, and  $t$  is measured in years.

Since the ¥ has the higher inflation rate, the ¥ should depreciate.

$$\text{Therefore, } E(S_1) = ¥95 \times [(1 + 0.08) / (1 + 0.04)] = ¥95 \times 1.0385 = ¥98.6538.$$

3. **C** The International Fisher Relation states that the difference between the nominal interest rates in two countries should be equal to the difference between their expected inflation rates. Countries with higher expected inflation will have higher nominal interest rates, but real interest rates are assumed to be equal across countries.

4. **A** The higher interest rates in euros implies that the euro will depreciate relative to the USD.

$$[E(S_1) - S_0] / S_0 = \% \Delta S \approx r_{\$} - r_{\text{€}} = 6.50\% - 7.25\% = -0.75\%$$

$$E(S_1) = \$1.3200 \times (0.9925) = \$1.3101/\text{€}.$$

5. **B** The foreign exchange expectation relation states that the forward rate is an unbiased predictor of the expected future spot rate. Additionally, the forward discount or premium is an unbiased predictor of the expected change in the spot exchange rate. Therefore:  $E(\% \Delta S) = (F - S_0) / S_0 = (1.35 - 1.32) / 1.32 = 0.0227 = 2.27\%$ .

6. **A** An unanticipated shift to a more expansive fiscal policy will result in an increase in aggregate demand. The increased aggregate demand encourages imports and discourages exports, which moves the current account toward deficit. Meanwhile, the higher interest rates attract foreign investment and discourage domestic investment from leaving the country, moving the financial account toward surplus.

The adverse impact on the current account will increase the supply of the country's currency in the foreign exchange markets, causing the currency to depreciate. The positive impact on the country's financial account will increase demand for the country's currency in the foreign exchange markets, causing the currency to appreciate. Thus, the overall effect is mixed, but the interest rate effect will likely dominate in the short term, leading the exchange rate appreciation.

# FORMULAS

---

## STUDY SESSION 3: QUANTITATIVE METHODS

---

### Covariance and Correlation

$$\text{sample covariance: } \text{cov}_{XY} = \frac{\sum_{i=1}^n (X_i - \bar{X})(Y_i - \bar{Y})}{n - 1}$$

$$\text{sample correlation coefficient: } r_{XY} = \frac{\text{cov}_{XY}}{(s_X)(s_Y)}$$

$$t\text{-test for correlation coefficient: } t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}} \text{ with } n - 2 \text{ df}$$

### Simple Linear Regression

$$\text{slope coefficient: } \hat{b}_1 = \frac{\text{cov}_{XY}}{\sigma_X^2}$$

$$\text{intercept term: } \hat{b}_0 = \bar{Y} - \hat{b}_1 \bar{X}$$

confidence interval for coefficient:

$$\hat{b}_1 \pm (t_c \times s_{\hat{b}_1}), \text{ or } \left[ \hat{b}_1 - (t_c \times s_{\hat{b}_1}) < b_1 < \hat{b}_1 + (t_c \times s_{\hat{b}_1}) \right]$$

$$\text{coefficient } t\text{-test: } t_{b_1} = \frac{\hat{b}_1 - b_1}{s_{\hat{b}_1}} \text{ with } n - 2 \text{ df}$$

$$\text{predicted value of the dependent variable: } \hat{Y} = \hat{b}_0 + \hat{b}_1 X_p$$

confidence interval for a predicted value (simple linear regression only):

$$\hat{Y} \pm (t_c \times s_f) \Rightarrow \left[ \hat{Y} - (t_c \times s_f) < Y < \hat{Y} + (t_c \times s_f) \right]$$

### ANOVA Table Information (Simple Linear Regression)

total sum of squares (SST): 
$$SST = \sum_{i=1}^n (Y_i - \bar{Y})^2$$

regression sum of squares (RSS): 
$$RSS = \sum_{i=1}^n (\hat{Y}_i - \bar{Y})^2$$

sum of squared errors (SSE): 
$$SSE = \sum_{i=1}^n (Y_i - \hat{Y}_i)^2$$

coefficient of determination: 
$$R^2 = \frac{\text{total variation} - \text{unexplained variation}}{\text{total variation}} = \frac{SST - SSE}{SST}$$

standard error of estimate (SEE): 
$$\sqrt{\frac{SSE}{n-2}} = \sqrt{MSE}$$

F-statistic: 
$$F = \frac{MSR}{MSE} = \frac{RSS/k}{SSE/(n-k-1)} \text{ with } n-2 \text{ df}$$

### Multiple Regression

predicted y-value: 
$$\hat{Y}_i = \hat{b}_0 + \hat{b}_1 X_{1i} + \hat{b}_2 X_{2i} + \dots + \hat{b}_k X_{ki}$$

t-test for regression coefficient: 
$$t = \frac{\hat{b}_j - b_j}{s_{\hat{b}_j}} \text{ with } n - k - 1 \text{ df}$$

confidence interval for regression coefficient:

$$\hat{b}_1 \pm (t_c \times s_{\hat{b}_1}), \text{ or } \left[ \hat{b}_1 - (t_c \times s_{\hat{b}_1}) < b_1 < \hat{b}_1 + (t_c \times s_{\hat{b}_1}) \right]$$

ANOVA: total variation (SST) = explained variation (RSS) + unexplained variation (SSE)



mean squared error:  $MSE = \frac{SSE}{n - k - 1}$

mean regression sum of squares:  $MSR = \frac{RSS}{k}$

F-test for multiple regression:  $F = \frac{MSR}{MSE} = \frac{RSS/k}{SSE/[n - k - 1]}$ , with k and n - k - 1 df

adjusted  $R^2$ :  $R_a^2 = 1 - \left[ \left( \frac{n - 1}{n - k - 1} \right) \times (1 - R^2) \right]$

Breusch-Pagan Chi-square test for heteroskedasticity:

$BP = n \times R_{\text{resid}}^2$  with k degrees of freedom

Durbin-Watson test for serial correlation:  $DW = \frac{\sum_{t=2}^T (\hat{\epsilon}_t - \hat{\epsilon}_{t-1})^2}{\sum_{t=1}^T \hat{\epsilon}_t^2} \approx 2(1 - r)$

## Time-Series Analysis

AR model of order p,  $AR(p)$ :  $x_t = b_0 + b_1x_{t-1} + b_2x_{t-2} + \dots + b_px_{t-p} + \epsilon_t$

Mean reverting level of  $AR(1)$ :  $x_t = \frac{b_0}{(1 - b_1)}$

ARCH(1) model:  $\hat{\epsilon}_t^2 = a_0 + a_1\hat{\epsilon}_{t-1}^2 + \mu_t$

## STUDY SESSION 4: ECONOMICS FOR VALUATION

---

**balance of payments equation:**

$$\text{current account} + \text{capital account} + \text{official settlements account} = 0$$

$$\text{annualized forward premium/discount: } \left( \frac{\text{forward rate} - \text{spot rate}}{\text{spot rate}} \right) \left( \frac{360}{\text{number of days forward}} \right)$$

$$\text{interest rate parity: } \frac{F}{S_0} = \frac{(1 + R_A)}{(1 + R_B)}$$

$$\text{relative PPP: } S_0 \left[ \frac{1 + \text{inflation}_{\text{domestic}}}{1 + \text{inflation}_{\text{foreign}}} \right]^t = E(S_t)$$

$$\text{international Fisher relation: } \frac{(1 + R_{\text{nominal A}})}{(1 + R_{\text{nominal B}})} = \frac{[1 + E(\text{inflation}_A)]}{[1 + E(\text{inflation}_B)]}$$

$$\text{linear approximation: } R_{\text{nominal A}} - R_{\text{nominal B}} = E(\text{inflation}_A) - E(\text{inflation}_B)$$

$$\text{uncovered interest rate parity: } \frac{E[S_1]}{S_0} = \frac{\text{expected spot rate at } t = 1}{\text{spot exchange rate}} = \frac{(1 + R_{\text{domestic}})}{(1 + R_{\text{foreign}})}$$

**foreign exchange expectation relation:**

$$F_t = E(S_t)$$

$$\frac{F_t - S_0}{S_0} = E(\Delta S_0)$$

# APPENDIX A:

## AREAS UNDER THE NORMAL CURVE

Most of the examples in this book have used the Student's  $t$ -distribution (which is found in Appendix B) to check for statistical significance. CFA Level 2 candidates should also know how to use the  $z$ -table to find the area under the normal curve. Here we present some examples of how to use the cumulative  $z$ -table.

### Probability Example

Assume that the annual earnings per share (EPS) for a large sample of firms is normally distributed with a mean of \$5.00 and a standard deviation of \$1.50. What is the approximate probability of an observed EPS value falling between \$3.00 and \$7.25?

If  $EPS = x = \$7.25$ , then  $z = (x - \mu) / \sigma = (\$7.25 - \$5.00) / \$1.50 = +1.50$

If  $EPS = x = \$3.00$ , then  $z = (x - \mu) / \sigma = (\$3.00 - \$5.00) / \$1.50 = -1.33$

### Solving Using The Cumulative Z-Table

*For  $z$ -value of 1.50:* Use the row headed 1.5 and the column headed 0 to find the value 0.9332. This represents the area under the curve to the left of the critical value 1.50.

*For  $z$ -value of -1.33:* Use the row headed 1.3 and the column headed 3 to find the value 0.9082. This represents the area under the curve to the left of the critical value +1.33. The area to the left of -1.33 is  $1 - 0.9082 = 0.0918$ .

The area between these critical values is  $0.9332 - 0.0918 = 0.8414$ , or 84.14%.

### Hypothesis Testing – One-Tailed Test Example

A sample of a stock's returns on 36 non-consecutive days results in a mean return of 2.0%. Assume the population standard deviation is 20.0%. Can we say with 95% confidence that the mean return is greater than 0%?

$H_0: \mu \leq 0.0\%$ ,  $H_A: \mu > 0.0\%$ . The test statistic =  $z$ -statistic =  $\frac{\bar{x} - \mu_0}{\sigma / \sqrt{n}} = (2.0 - 0.0) / (20.0 / 6) = 0.60$ .

The significance level =  $1.0 - 0.95 = 0.05$ , or 5%. Since we are interested in a return greater than 0.0%, this is a one-tailed test.

### Using The Cumulative Z-Table

Since this is a one-tailed test with an alpha of 0.05, we need to find the value 0.95 in the cumulative  $z$ -table. The closest value is 0.9505, with a corresponding critical  $z$ -value of 1.65. Since the test statistic is less than the critical value, we fail to reject  $H_0$ .

### Hypothesis Testing – Two-Tailed Test Example

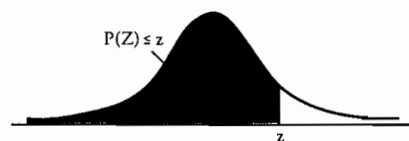
Using the same assumptions as before, suppose that the analyst now wants to determine if he can say with 99% confidence that the stock's return is not equal to 0.0%.

$H_0: \mu = 0.0\%$ ,  $H_A: \mu \neq 0.0\%$ . The test statistic ( $z$ -value) =  $(2.0 - 0.0) / (20.0 / 6) = 0.60$ . The significance level =  $1.0 - 0.99 = 0.01$ , or 1%. Since we are interested in whether or not the stock return is nonzero, this is a two-tailed test.

#### Using The Cumulative Z-Table

Since this is a two-tailed test with an alpha of 0.01, there is a 0.005 rejection region in both tails. Thus, we need to find the value 0.995 ( $1.0 - 0.005$ ) in the table. The closest value is 0.9951, which corresponds to a critical  $z$ -value of 2.58. Since the test statistic is less than the critical value, we fail to reject  $H_0$  and conclude that the stock's return equals 0.0%.

# CUMULATIVE Z-TABLE

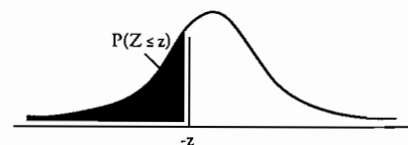


## STANDARD NORMAL DISTRIBUTION

$P(Z \leq z) = N(z)$  FOR  $z \geq 0$

| z   | 0.00   | 0.01   | 0.02   | 0.03   | 0.04   | 0.05   | 0.06   | 0.07   | 0.08   | 0.09   |
|-----|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0.0 | 0.5000 | 0.5040 | 0.5080 | 0.5120 | 0.5160 | 0.5199 | 0.5239 | 0.5279 | 0.5319 | 0.5359 |
| 0.1 | 0.5398 | 0.5438 | 0.5478 | 0.5517 | 0.5557 | 0.5596 | 0.5636 | 0.5675 | 0.5714 | 0.5753 |
| 0.2 | 0.5793 | 0.5832 | 0.5871 | 0.5910 | 0.5948 | 0.5987 | 0.6026 | 0.6064 | 0.6103 | 0.6141 |
| 0.3 | 0.6179 | 0.6217 | 0.6255 | 0.6293 | 0.6331 | 0.6368 | 0.6406 | 0.6443 | 0.6480 | 0.6517 |
| 0.4 | 0.6554 | 0.6591 | 0.6628 | 0.6664 | 0.6700 | 0.6736 | 0.6772 | 0.6808 | 0.6844 | 0.6879 |
|     |        |        |        |        |        |        |        |        |        |        |
| 0.5 | 0.6915 | 0.6950 | 0.6985 | 0.7019 | 0.7054 | 0.7088 | 0.7123 | 0.7157 | 0.7190 | 0.7224 |
| 0.6 | 0.7257 | 0.7291 | 0.7324 | 0.7357 | 0.7389 | 0.7422 | 0.7454 | 0.7486 | 0.7517 | 0.7549 |
| 0.7 | 0.7580 | 0.7611 | 0.7642 | 0.7673 | 0.7704 | 0.7734 | 0.7764 | 0.7794 | 0.7823 | 0.7852 |
| 0.8 | 0.7881 | 0.7910 | 0.7939 | 0.7967 | 0.7995 | 0.8023 | 0.8051 | 0.8078 | 0.8106 | 0.8133 |
| 0.9 | 0.8159 | 0.8186 | 0.8212 | 0.8238 | 0.8264 | 0.8289 | 0.8315 | 0.8340 | 0.8365 | 0.8389 |
|     |        |        |        |        |        |        |        |        |        |        |
| 1.0 | 0.8413 | 0.8438 | 0.8461 | 0.8485 | 0.8508 | 0.8531 | 0.8554 | 0.8577 | 0.8599 | 0.8621 |
| 1.1 | 0.8643 | 0.8665 | 0.8686 | 0.8708 | 0.8729 | 0.8749 | 0.8770 | 0.8790 | 0.8810 | 0.8830 |
| 1.2 | 0.8849 | 0.8869 | 0.8888 | 0.8907 | 0.8925 | 0.8944 | 0.8962 | 0.8980 | 0.8997 | 0.9015 |
| 1.3 | 0.9032 | 0.9049 | 0.9066 | 0.9082 | 0.9099 | 0.9115 | 0.9131 | 0.9147 | 0.9162 | 0.9177 |
| 1.4 | 0.9192 | 0.9207 | 0.9222 | 0.9236 | 0.9251 | 0.9265 | 0.9279 | 0.9292 | 0.9306 | 0.9319 |
|     |        |        |        |        |        |        |        |        |        |        |
| 1.5 | 0.9332 | 0.9345 | 0.9357 | 0.9370 | 0.9382 | 0.9394 | 0.9406 | 0.9418 | 0.9429 | 0.9441 |
| 1.6 | 0.9452 | 0.9463 | 0.9474 | 0.9484 | 0.9495 | 0.9505 | 0.9515 | 0.9525 | 0.9535 | 0.9545 |
| 1.7 | 0.9554 | 0.9564 | 0.9573 | 0.9582 | 0.9591 | 0.9599 | 0.9608 | 0.9616 | 0.9625 | 0.9633 |
| 1.8 | 0.9641 | 0.9649 | 0.9656 | 0.9664 | 0.9671 | 0.9678 | 0.9686 | 0.9693 | 0.9699 | 0.9706 |
| 1.9 | 0.9713 | 0.9719 | 0.9726 | 0.9732 | 0.9738 | 0.9744 | 0.9750 | 0.9756 | 0.9761 | 0.9767 |
|     |        |        |        |        |        |        |        |        |        |        |
| 2.0 | 0.9772 | 0.9778 | 0.9783 | 0.9788 | 0.9793 | 0.9798 | 0.9803 | 0.9808 | 0.9812 | 0.9817 |
| 2.1 | 0.9821 | 0.9826 | 0.9830 | 0.9834 | 0.9838 | 0.9842 | 0.9846 | 0.9850 | 0.9854 | 0.9857 |
| 2.2 | 0.9861 | 0.9864 | 0.9868 | 0.9871 | 0.9875 | 0.9878 | 0.9881 | 0.9884 | 0.9887 | 0.9890 |
| 2.3 | 0.9893 | 0.9896 | 0.9898 | 0.9901 | 0.9904 | 0.9906 | 0.9909 | 0.9911 | 0.9913 | 0.9916 |
| 2.4 | 0.9918 | 0.9920 | 0.9922 | 0.9925 | 0.9927 | 0.9929 | 0.9931 | 0.9932 | 0.9934 | 0.9936 |
|     |        |        |        |        |        |        |        |        |        |        |
| 2.5 | 0.9938 | 0.9940 | 0.9941 | 0.9943 | 0.9945 | 0.9946 | 0.9948 | 0.9949 | 0.9951 | 0.9952 |
| 2.6 | 0.9953 | 0.9955 | 0.9956 | 0.9957 | 0.9959 | 0.9960 | 0.9961 | 0.9962 | 0.9963 | 0.9964 |
| 2.7 | 0.9965 | 0.9966 | 0.9967 | 0.9968 | 0.9969 | 0.9970 | 0.9971 | 0.9972 | 0.9973 | 0.9974 |
| 2.8 | 0.9974 | 0.9975 | 0.9976 | 0.9977 | 0.9977 | 0.9978 | 0.9979 | 0.9979 | 0.9980 | 0.9981 |
| 2.9 | 0.9981 | 0.9982 | 0.9982 | 0.9983 | 0.9984 | 0.9984 | 0.9985 | 0.9985 | 0.9986 | 0.9986 |
| 3.0 | 0.9987 | 0.9987 | 0.9987 | 0.9988 | 0.9988 | 0.9989 | 0.9989 | 0.9989 | 0.9990 | 0.9990 |

# CUMULATIVE Z-TABLE (CONT.)



## STANDARD NORMAL DISTRIBUTION

$P(Z \leq z) = N(z)$  FOR  $z \leq 0$

| z    | 0.00   | 0.01   | 0.02   | 0.03   | 0.04   | 0.05   | 0.06   | 0.07   | 0.08   | 0.09   |
|------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0.0  | 0.5000 | 0.4960 | 0.4920 | 0.4880 | 0.4840 | 0.4801 | 0.4761 | 0.4721 | 0.4681 | 0.4641 |
| -0.1 | 0.4602 | 0.4562 | 0.4522 | 0.4483 | 0.4443 | 0.4404 | 0.4364 | 0.4325 | 0.4286 | 0.4247 |
| -0.2 | 0.4207 | 0.4168 | 0.4129 | 0.4090 | 0.4052 | 0.4013 | 0.3974 | 0.3936 | 0.3897 | 0.3859 |
| -0.3 | 0.3821 | 0.3783 | 0.3745 | 0.3707 | 0.3669 | 0.3632 | 0.3594 | 0.3557 | 0.3520 | 0.3483 |
| -0.4 | 0.3446 | 0.3409 | 0.3372 | 0.3336 | 0.3300 | 0.3264 | 0.3228 | 0.3192 | 0.3156 | 0.3121 |
|      |        |        |        |        |        |        |        |        |        |        |
| -0.5 | 0.3085 | 0.3050 | 0.3015 | 0.2981 | 0.2946 | 0.2912 | 0.2877 | 0.2843 | 0.2810 | 0.2776 |
| -0.6 | 0.2743 | 0.2709 | 0.2676 | 0.2643 | 0.2611 | 0.2578 | 0.2546 | 0.2514 | 0.2483 | 0.2451 |
| -0.7 | 0.2420 | 0.2389 | 0.2358 | 0.2327 | 0.2297 | 0.2266 | 0.2236 | 0.2207 | 0.2177 | 0.2148 |
| -0.8 | 0.2119 | 0.2090 | 0.2061 | 0.2033 | 0.2005 | 0.1977 | 0.1949 | 0.1922 | 0.1894 | 0.1867 |
| -0.9 | 0.1841 | 0.1814 | 0.1788 | 0.1762 | 0.1736 | 0.1711 | 0.1685 | 0.1660 | 0.1635 | 0.1611 |
|      |        |        |        |        |        |        |        |        |        |        |
| -1.0 | 0.1587 | 0.1562 | 0.1539 | 0.1515 | 0.1492 | 0.1469 | 0.1446 | 0.1423 | 0.1401 | 0.1379 |
| -1.1 | 0.1357 | 0.1335 | 0.1314 | 0.1292 | 0.1271 | 0.1251 | 0.1230 | 0.1210 | 0.1190 | 0.1170 |
| -1.2 | 0.1151 | 0.1131 | 0.1112 | 0.1093 | 0.1075 | 0.1057 | 0.1038 | 0.1020 | 0.1003 | 0.0985 |
| -1.3 | 0.0968 | 0.0951 | 0.0934 | 0.0918 | 0.0901 | 0.0885 | 0.0869 | 0.0853 | 0.0838 | 0.0823 |
| -1.4 | 0.0808 | 0.0793 | 0.0778 | 0.0764 | 0.0749 | 0.0735 | 0.0721 | 0.0708 | 0.0694 | 0.0681 |
|      |        |        |        |        |        |        |        |        |        |        |
| -1.5 | 0.0668 | 0.0655 | 0.0643 | 0.0630 | 0.0618 | 0.0606 | 0.0594 | 0.0582 | 0.0571 | 0.0559 |
| -1.6 | 0.0548 | 0.0537 | 0.0526 | 0.0516 | 0.0505 | 0.0495 | 0.0485 | 0.0475 | 0.0465 | 0.0455 |
| -1.7 | 0.0446 | 0.0436 | 0.0427 | 0.0418 | 0.0409 | 0.0401 | 0.0392 | 0.0384 | 0.0375 | 0.0367 |
| -1.8 | 0.0359 | 0.0351 | 0.0344 | 0.0336 | 0.0329 | 0.0322 | 0.0314 | 0.0307 | 0.0301 | 0.0294 |
| -1.9 | 0.0287 | 0.0281 | 0.0274 | 0.0268 | 0.0262 | 0.0256 | 0.0250 | 0.0244 | 0.0239 | 0.0233 |
|      |        |        |        |        |        |        |        |        |        |        |
| -2.0 | 0.0228 | 0.0222 | 0.0217 | 0.0212 | 0.0207 | 0.0202 | 0.0197 | 0.0192 | 0.0188 | 0.0183 |
| -2.1 | 0.0179 | 0.0174 | 0.0170 | 0.0166 | 0.0162 | 0.0158 | 0.0154 | 0.0150 | 0.0146 | 0.0143 |
| -2.2 | 0.0139 | 0.0136 | 0.0132 | 0.0129 | 0.0125 | 0.0122 | 0.0119 | 0.0116 | 0.0113 | 0.0110 |
| -2.3 | 0.0107 | 0.0104 | 0.0102 | 0.0099 | 0.0096 | 0.0094 | 0.0091 | 0.0089 | 0.0087 | 0.0084 |
| -2.4 | 0.0082 | 0.0080 | 0.0078 | 0.0076 | 0.0073 | 0.0071 | 0.0069 | 0.0068 | 0.0066 | 0.0064 |
|      |        |        |        |        |        |        |        |        |        |        |
| -2.5 | 0.0062 | 0.0060 | 0.0059 | 0.0057 | 0.0055 | 0.0054 | 0.0052 | 0.0051 | 0.0049 | 0.0048 |
| -2.6 | 0.0047 | 0.0045 | 0.0044 | 0.0043 | 0.0041 | 0.0040 | 0.0039 | 0.0038 | 0.0037 | 0.0036 |
| -2.7 | 0.0035 | 0.0034 | 0.0033 | 0.0032 | 0.0031 | 0.0030 | 0.0029 | 0.0028 | 0.0027 | 0.0026 |
| -2.8 | 0.0026 | 0.0025 | 0.0024 | 0.0023 | 0.0023 | 0.0022 | 0.0021 | 0.0021 | 0.0020 | 0.0019 |
| -2.9 | 0.0019 | 0.0018 | 0.0018 | 0.0017 | 0.0016 | 0.0016 | 0.0015 | 0.0015 | 0.0014 | 0.0014 |
| -3.0 | 0.0014 | 0.0013 | 0.0013 | 0.0012 | 0.0012 | 0.0011 | 0.0011 | 0.0011 | 0.0010 | 0.0010 |

# APPENDIX B:

## STUDENT'S T-DISTRIBUTION

### STUDENT'S T-DISTRIBUTION

| Level of Significance for One-Tailed Test |       |       |       |      |       |        |
|-------------------------------------------|-------|-------|-------|------|-------|--------|
| df                                        | 0.100 | 0.050 | 0.025 | 0.01 | 0.005 | 0.0005 |

| Level of Significance for Two-Tailed Test |       |       |        |        |        |         |
|-------------------------------------------|-------|-------|--------|--------|--------|---------|
| df                                        | 0.20  | 0.10  | 0.05   | 0.02   | 0.01   | 0.001   |
| 1                                         | 3.078 | 6.314 | 12.706 | 31.821 | 63.657 | 636.619 |
| 2                                         | 1.886 | 2.920 | 4.303  | 6.965  | 9.925  | 31.599  |
| 3                                         | 1.638 | 2.353 | 3.182  | 4.541  | 5.841  | 12.294  |
| 4                                         | 1.533 | 2.132 | 2.776  | 3.747  | 4.604  | 8.610   |
| 5                                         | 1.476 | 2.015 | 2.571  | 3.365  | 4.032  | 6.869   |
| 6                                         | 1.440 | 1.943 | 2.447  | 3.143  | 3.707  | 5.959   |
| 7                                         | 1.415 | 1.895 | 2.365  | 2.998  | 3.499  | 5.408   |
| 8                                         | 1.397 | 1.860 | 2.306  | 2.896  | 3.355  | 5.041   |
| 9                                         | 1.383 | 1.833 | 2.262  | 2.821  | 3.250  | 4.781   |
| 10                                        | 1.372 | 1.812 | 2.228  | 2.764  | 3.169  | 4.587   |
| 11                                        | 1.363 | 1.796 | 2.201  | 2.718  | 3.106  | 4.437   |
| 12                                        | 1.356 | 1.782 | 2.179  | 2.681  | 3.055  | 4.318   |
| 13                                        | 1.350 | 1.771 | 2.160  | 2.650  | 3.012  | 4.221   |
| 14                                        | 1.345 | 1.761 | 2.145  | 2.624  | 2.977  | 4.140   |
| 15                                        | 1.341 | 1.753 | 2.131  | 2.602  | 2.947  | 4.073   |
| 16                                        | 1.337 | 1.746 | 2.120  | 2.583  | 2.921  | 4.015   |
| 17                                        | 1.333 | 1.740 | 2.110  | 2.567  | 2.898  | 3.965   |
| 18                                        | 1.330 | 1.734 | 2.101  | 2.552  | 2.878  | 3.922   |
| 19                                        | 1.328 | 1.729 | 2.093  | 2.539  | 2.861  | 3.883   |
| 20                                        | 1.325 | 1.725 | 2.086  | 2.528  | 2.845  | 3.850   |
| 21                                        | 1.323 | 1.721 | 2.080  | 2.518  | 2.831  | 3.819   |
| 22                                        | 1.321 | 1.717 | 2.074  | 2.508  | 2.819  | 3.792   |
| 23                                        | 1.319 | 1.714 | 2.069  | 2.500  | 2.807  | 3.768   |
| 24                                        | 1.318 | 1.711 | 2.064  | 2.492  | 2.797  | 3.745   |
| 25                                        | 1.316 | 1.708 | 2.060  | 2.485  | 2.787  | 3.725   |
| 26                                        | 1.315 | 1.706 | 2.056  | 2.479  | 2.779  | 3.707   |
| 27                                        | 1.314 | 1.703 | 2.052  | 2.473  | 2.771  | 3.690   |
| 28                                        | 1.313 | 1.701 | 2.048  | 2.467  | 2.763  | 3.674   |
| 29                                        | 1.311 | 1.699 | 2.045  | 2.462  | 2.756  | 3.659   |
| 30                                        | 1.310 | 1.697 | 2.042  | 2.457  | 2.750  | 3.646   |
| 40                                        | 1.303 | 1.684 | 2.021  | 2.423  | 2.704  | 3.551   |
| 60                                        | 1.296 | 1.671 | 2.000  | 2.390  | 2.660  | 3.460   |
| 120                                       | 1.289 | 1.658 | 1.980  | 2.358  | 2.617  | 3.373   |
| ∞                                         | 1.282 | 1.645 | 1.960  | 2.326  | 2.576  | 3.291   |

# APPENDIX C:

## F-TABLE AT 5 PERCENT (UPPER TAIL)

F-TABLE, CRITICAL VALUES, 5 PERCENT IN UPPER TAIL

Degrees of freedom for the numerator along top row  
 Degrees of freedom for the denominator along side row

|     | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   | 12   | 15   | 20   | 24   | 30   | 40   |
|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 1   | 161  | 200  | 216  | 225  | 230  | 234  | 237  | 239  | 241  | 242  | 244  | 246  | 248  | 249  | 250  | 251  |
| 2   | 18.5 | 19.0 | 19.2 | 19.2 | 19.3 | 19.3 | 19.4 | 19.4 | 19.4 | 19.4 | 19.4 | 19.4 | 19.4 | 19.5 | 19.5 | 19.5 |
| 3   | 10.1 | 9.55 | 9.28 | 9.12 | 9.01 | 8.94 | 8.89 | 8.85 | 8.81 | 8.79 | 8.74 | 8.70 | 8.66 | 8.64 | 8.62 | 8.59 |
| 4   | 7.71 | 6.94 | 6.59 | 6.39 | 6.26 | 6.16 | 6.09 | 6.04 | 6.00 | 5.96 | 5.91 | 5.86 | 5.80 | 5.77 | 5.75 | 5.72 |
| 5   | 6.61 | 5.79 | 5.41 | 5.19 | 5.05 | 4.95 | 4.88 | 4.82 | 4.77 | 4.74 | 4.68 | 4.62 | 4.56 | 4.53 | 4.50 | 4.46 |
| 6   | 5.99 | 5.14 | 4.76 | 4.53 | 4.39 | 4.28 | 4.21 | 4.15 | 4.10 | 4.06 | 4.00 | 3.94 | 3.87 | 3.84 | 3.81 | 3.77 |
| 7   | 5.59 | 4.74 | 4.35 | 4.12 | 3.97 | 3.87 | 3.79 | 3.73 | 3.68 | 3.64 | 3.57 | 3.51 | 3.44 | 3.41 | 3.38 | 3.34 |
| 8   | 5.32 | 4.46 | 4.07 | 3.84 | 3.69 | 3.58 | 3.50 | 3.44 | 3.39 | 3.35 | 3.28 | 3.22 | 3.15 | 3.12 | 3.08 | 3.04 |
| 9   | 5.12 | 4.26 | 3.86 | 3.63 | 3.48 | 3.37 | 3.29 | 3.23 | 3.18 | 3.14 | 3.07 | 3.01 | 2.94 | 2.90 | 2.86 | 2.83 |
| 10  | 4.96 | 4.10 | 3.71 | 3.48 | 3.33 | 3.22 | 3.14 | 3.07 | 3.02 | 2.98 | 2.91 | 2.85 | 2.77 | 2.74 | 2.70 | 2.66 |
| 11  | 4.84 | 3.98 | 3.59 | 3.36 | 3.20 | 3.09 | 3.01 | 2.95 | 2.90 | 2.85 | 2.79 | 2.72 | 2.65 | 2.61 | 2.57 | 2.53 |
| 12  | 4.75 | 3.89 | 3.49 | 3.26 | 3.11 | 3.00 | 2.91 | 2.85 | 2.80 | 2.75 | 2.69 | 2.62 | 2.54 | 2.51 | 2.47 | 2.43 |
| 13  | 4.67 | 3.81 | 3.41 | 3.18 | 3.03 | 2.92 | 2.83 | 2.77 | 2.71 | 2.67 | 2.60 | 2.53 | 2.46 | 2.42 | 2.38 | 2.34 |
| 14  | 4.60 | 3.74 | 3.34 | 3.11 | 2.96 | 2.85 | 2.76 | 2.70 | 2.65 | 2.60 | 2.53 | 2.46 | 2.39 | 2.35 | 2.31 | 2.27 |
| 15  | 4.54 | 3.68 | 3.29 | 3.06 | 2.90 | 2.79 | 2.71 | 2.64 | 2.59 | 2.54 | 2.48 | 2.40 | 2.33 | 2.29 | 2.25 | 2.20 |
| 16  | 4.49 | 3.63 | 3.24 | 3.01 | 2.85 | 2.74 | 2.66 | 2.59 | 2.54 | 2.49 | 2.42 | 2.35 | 2.28 | 2.24 | 2.19 | 2.15 |
| 17  | 4.45 | 3.59 | 3.20 | 2.96 | 2.81 | 2.70 | 2.61 | 2.55 | 2.49 | 2.45 | 2.38 | 2.31 | 2.23 | 2.19 | 2.15 | 2.10 |
| 18  | 4.41 | 3.55 | 3.16 | 2.93 | 2.77 | 2.66 | 2.58 | 2.51 | 2.46 | 2.41 | 2.34 | 2.27 | 2.19 | 2.15 | 2.11 | 2.06 |
| 19  | 4.38 | 3.52 | 3.13 | 2.90 | 2.74 | 2.63 | 2.54 | 2.48 | 2.42 | 2.38 | 2.31 | 2.23 | 2.16 | 2.11 | 2.07 | 2.03 |
| 20  | 4.35 | 3.49 | 3.10 | 2.87 | 2.71 | 2.60 | 2.51 | 2.45 | 2.39 | 2.35 | 2.28 | 2.20 | 2.12 | 2.08 | 2.04 | 1.99 |
| 21  | 4.32 | 3.47 | 3.07 | 2.84 | 2.68 | 2.57 | 2.49 | 2.42 | 2.37 | 2.32 | 2.25 | 2.18 | 2.10 | 2.05 | 2.01 | 1.96 |
| 22  | 4.30 | 3.44 | 3.05 | 2.82 | 2.66 | 2.55 | 2.46 | 2.40 | 2.34 | 2.30 | 2.23 | 2.15 | 2.07 | 2.03 | 1.98 | 1.94 |
| 23  | 4.28 | 3.42 | 3.03 | 2.80 | 2.64 | 2.53 | 2.44 | 2.37 | 2.32 | 2.27 | 2.20 | 2.13 | 2.05 | 2.01 | 1.96 | 1.91 |
| 24  | 4.26 | 3.40 | 3.01 | 2.78 | 2.62 | 2.51 | 2.42 | 2.36 | 2.30 | 2.25 | 2.18 | 2.11 | 2.03 | 1.98 | 1.94 | 1.89 |
| 25  | 4.24 | 3.39 | 2.99 | 2.76 | 2.60 | 2.49 | 2.40 | 2.34 | 2.28 | 2.24 | 2.16 | 2.09 | 2.01 | 1.96 | 1.92 | 1.87 |
| 30  | 4.17 | 3.32 | 2.92 | 2.69 | 2.53 | 2.42 | 2.33 | 2.27 | 2.21 | 2.16 | 2.09 | 2.01 | 1.93 | 1.89 | 1.84 | 1.79 |
| 40  | 4.08 | 3.23 | 2.84 | 2.61 | 2.45 | 2.34 | 2.25 | 2.18 | 2.12 | 2.08 | 2.00 | 1.92 | 1.84 | 1.79 | 1.74 | 1.69 |
| 60  | 4.00 | 3.15 | 2.76 | 2.53 | 2.37 | 2.25 | 2.17 | 2.10 | 2.04 | 1.99 | 1.92 | 1.84 | 1.75 | 1.70 | 1.65 | 1.59 |
| 120 | 3.92 | 3.07 | 2.68 | 2.45 | 2.29 | 2.18 | 2.09 | 2.02 | 1.96 | 1.91 | 1.83 | 1.75 | 1.66 | 1.61 | 1.55 | 1.50 |
| ∞   | 3.84 | 3.00 | 2.60 | 2.37 | 2.21 | 2.10 | 2.01 | 1.94 | 1.88 | 1.83 | 1.75 | 1.67 | 1.57 | 1.52 | 1.46 | 1.39 |



# APPENDIX D: F-TABLE AT 2.5 PERCENT (UPPER TAIL)

F-TABLE, CRITICAL VALUES, 2.5 PERCENT IN UPPER TAILS

Degrees of freedom for the numerator along top row  
Degrees of freedom for the denominator along side row

|     | 1     | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    | 12    | 15    | 20    | 24    | 30    | 40    |
|-----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1   | 648   | 799   | 864   | 900   | 922   | 937   | 948   | 957   | 963   | 969   | 977   | 985   | 993   | 997   | 1001  | 1006  |
| 2   | 38.51 | 39.00 | 39.17 | 39.25 | 39.30 | 39.33 | 39.36 | 39.37 | 39.39 | 39.40 | 39.41 | 39.43 | 39.45 | 39.46 | 39.46 | 39.47 |
| 3   | 17.44 | 16.04 | 15.44 | 15.10 | 14.88 | 14.73 | 14.62 | 14.54 | 14.47 | 14.42 | 14.34 | 14.25 | 14.17 | 14.12 | 14.08 | 14.04 |
| 4   | 12.22 | 10.65 | 9.98  | 9.60  | 9.36  | 9.20  | 9.07  | 8.98  | 8.90  | 8.84  | 8.75  | 8.66  | 8.56  | 8.51  | 8.46  | 8.41  |
| 5   | 10.01 | 8.43  | 7.76  | 7.39  | 7.15  | 6.98  | 6.85  | 6.76  | 6.68  | 6.62  | 6.52  | 6.43  | 6.33  | 6.28  | 6.23  | 6.18  |
| 6   | 8.81  | 7.26  | 6.60  | 6.23  | 5.99  | 5.82  | 5.70  | 5.60  | 5.52  | 5.46  | 5.37  | 5.27  | 5.17  | 5.12  | 5.07  | 5.01  |
| 7   | 8.07  | 6.54  | 5.89  | 5.52  | 5.29  | 5.12  | 4.99  | 4.90  | 4.82  | 4.76  | 4.67  | 4.57  | 4.47  | 4.41  | 4.36  | 4.31  |
| 8   | 7.57  | 6.06  | 5.42  | 5.05  | 4.82  | 4.65  | 4.53  | 4.43  | 4.36  | 4.30  | 4.20  | 4.10  | 4.00  | 3.95  | 3.89  | 3.84  |
| 9   | 7.21  | 5.71  | 5.08  | 4.72  | 4.48  | 4.32  | 4.20  | 4.10  | 4.03  | 3.96  | 3.87  | 3.77  | 3.67  | 3.61  | 3.56  | 3.51  |
| 10  | 6.94  | 5.46  | 4.83  | 4.47  | 4.24  | 4.07  | 3.95  | 3.85  | 3.78  | 3.72  | 3.62  | 3.52  | 3.42  | 3.37  | 3.31  | 3.26  |
| 11  | 6.72  | 5.26  | 4.63  | 4.28  | 4.04  | 3.88  | 3.76  | 3.66  | 3.59  | 3.53  | 3.43  | 3.33  | 3.23  | 3.17  | 3.12  | 3.06  |
| 12  | 6.55  | 5.10  | 4.47  | 4.12  | 3.89  | 3.73  | 3.61  | 3.51  | 3.44  | 3.37  | 3.28  | 3.18  | 3.07  | 3.02  | 2.96  | 2.91  |
| 13  | 6.41  | 4.97  | 4.35  | 4.00  | 3.77  | 3.60  | 3.48  | 3.39  | 3.31  | 3.25  | 3.15  | 3.05  | 2.95  | 2.89  | 2.84  | 2.78  |
| 14  | 6.30  | 4.86  | 4.24  | 3.89  | 3.66  | 3.50  | 3.38  | 3.29  | 3.21  | 3.15  | 3.05  | 2.95  | 2.84  | 2.79  | 2.73  | 2.67  |
| 15  | 6.20  | 4.77  | 4.15  | 3.80  | 3.58  | 3.41  | 3.29  | 3.20  | 3.12  | 3.06  | 2.96  | 2.86  | 2.76  | 2.70  | 2.64  | 2.59  |
| 16  | 6.12  | 4.69  | 4.08  | 3.73  | 3.50  | 3.34  | 3.22  | 3.12  | 3.05  | 2.99  | 2.89  | 2.79  | 2.68  | 2.63  | 2.57  | 2.51  |
| 17  | 6.04  | 4.62  | 4.01  | 3.66  | 3.44  | 3.28  | 3.16  | 3.06  | 2.98  | 2.92  | 2.82  | 2.72  | 2.62  | 2.56  | 2.50  | 2.44  |
| 18  | 5.98  | 4.56  | 3.95  | 3.61  | 3.38  | 3.22  | 3.10  | 3.01  | 2.93  | 2.87  | 2.77  | 2.67  | 2.56  | 2.50  | 2.44  | 2.38  |
| 19  | 5.92  | 4.51  | 3.90  | 3.56  | 3.33  | 3.17  | 3.05  | 2.96  | 2.88  | 2.82  | 2.72  | 2.62  | 2.51  | 2.45  | 2.39  | 2.33  |
| 20  | 5.87  | 4.46  | 3.86  | 3.51  | 3.29  | 3.13  | 3.01  | 2.91  | 2.84  | 2.77  | 2.68  | 2.57  | 2.46  | 2.41  | 2.35  | 2.29  |
| 21  | 5.83  | 4.42  | 3.82  | 3.48  | 3.25  | 3.09  | 2.97  | 2.87  | 2.80  | 2.73  | 2.64  | 2.53  | 2.42  | 2.37  | 2.31  | 2.25  |
| 22  | 5.79  | 4.38  | 3.78  | 3.44  | 3.22  | 3.05  | 2.93  | 2.84  | 2.76  | 2.70  | 2.60  | 2.50  | 2.39  | 2.33  | 2.27  | 2.21  |
| 23  | 5.75  | 4.35  | 3.75  | 3.41  | 3.18  | 3.02  | 2.90  | 2.81  | 2.73  | 2.67  | 2.57  | 2.47  | 2.36  | 2.30  | 2.24  | 2.18  |
| 24  | 5.72  | 4.32  | 3.72  | 3.38  | 3.15  | 2.99  | 2.87  | 2.78  | 2.70  | 2.64  | 2.54  | 2.44  | 2.33  | 2.27  | 2.21  | 2.15  |
| 25  | 5.69  | 4.29  | 3.69  | 3.35  | 3.13  | 2.97  | 2.85  | 2.75  | 2.68  | 2.61  | 2.51  | 2.41  | 2.30  | 2.24  | 2.18  | 2.12  |
| 30  | 5.57  | 4.18  | 3.59  | 3.25  | 3.03  | 2.87  | 2.75  | 2.65  | 2.57  | 2.51  | 2.41  | 2.31  | 2.20  | 2.14  | 2.07  | 2.01  |
| 40  | 5.42  | 4.05  | 3.46  | 3.13  | 2.90  | 2.74  | 2.62  | 2.53  | 2.45  | 2.39  | 2.29  | 2.18  | 2.07  | 2.01  | 1.94  | 1.88  |
| 60  | 5.29  | 3.93  | 3.34  | 3.01  | 2.79  | 2.63  | 2.51  | 2.41  | 2.33  | 2.27  | 2.17  | 2.06  | 1.94  | 1.88  | 1.82  | 1.74  |
| 120 | 5.15  | 3.80  | 3.23  | 2.89  | 2.67  | 2.52  | 2.39  | 2.30  | 2.22  | 2.16  | 2.05  | 1.94  | 1.82  | 1.76  | 1.69  | 1.61  |
| ∞   | 5.02  | 3.69  | 3.12  | 2.79  | 2.57  | 2.41  | 2.29  | 2.19  | 2.11  | 2.05  | 1.94  | 1.83  | 1.71  | 1.64  | 1.57  | 1.48  |

# APPENDIX E: CHI-SQUARED TABLE

Values of  $\chi^2$  (Degrees of Freedom, Level of Significance)  
Probability in Right Tail

| Degrees of Freedom | 0.99     | 0.975    | 0.95     | 0.9    | 0.1     | 0.05    | 0.025   | 0.01    | 0.005   |
|--------------------|----------|----------|----------|--------|---------|---------|---------|---------|---------|
| 1                  | 0.000157 | 0.000982 | 0.003932 | 0.0158 | 2.706   | 3.841   | 5.024   | 6.635   | 7.879   |
| 2                  | 0.020100 | 0.050636 | 0.102586 | 0.2107 | 4.605   | 5.991   | 7.378   | 9.210   | 10.597  |
| 3                  | 0.1148   | 0.2158   | 0.3518   | 0.5844 | 6.251   | 7.815   | 9.348   | 11.345  | 12.838  |
| 4                  | 0.297    | 0.484    | 0.711    | 1.064  | 7.779   | 9.488   | 11.143  | 13.277  | 14.860  |
| 5                  | 0.554    | 0.831    | 1.145    | 1.610  | 9.236   | 11.070  | 12.832  | 15.086  | 16.750  |
| 6                  | 0.872    | 1.237    | 1.635    | 2.204  | 10.645  | 12.592  | 14.449  | 16.812  | 18.548  |
| 7                  | 1.239    | 1.690    | 2.167    | 2.833  | 12.017  | 14.067  | 16.013  | 18.475  | 20.278  |
| 8                  | 1.647    | 2.180    | 2.733    | 3.490  | 13.362  | 15.507  | 17.535  | 20.090  | 21.955  |
| 9                  | 2.088    | 2.700    | 3.325    | 4.168  | 14.684  | 16.919  | 19.023  | 21.666  | 23.589  |
| 10                 | 2.558    | 3.247    | 3.940    | 4.865  | 15.987  | 18.307  | 20.483  | 23.209  | 25.188  |
| 11                 | 3.053    | 3.816    | 4.575    | 5.578  | 17.275  | 19.675  | 21.920  | 24.725  | 26.757  |
| 12                 | 3.571    | 4.404    | 5.226    | 6.304  | 18.549  | 21.026  | 23.337  | 26.217  | 28.300  |
| 13                 | 4.107    | 5.009    | 5.892    | 7.041  | 19.812  | 22.362  | 24.736  | 27.688  | 29.819  |
| 14                 | 4.660    | 5.629    | 6.571    | 7.790  | 21.064  | 23.685  | 26.119  | 29.141  | 31.319  |
| 15                 | 5.229    | 6.262    | 7.261    | 8.547  | 22.307  | 24.996  | 27.488  | 30.578  | 32.801  |
| 16                 | 5.812    | 6.908    | 7.962    | 9.312  | 23.542  | 26.296  | 28.845  | 32.000  | 34.267  |
| 17                 | 6.408    | 7.564    | 8.672    | 10.085 | 24.769  | 27.587  | 30.191  | 33.409  | 35.718  |
| 18                 | 7.015    | 8.231    | 9.390    | 10.865 | 25.989  | 28.869  | 31.526  | 34.805  | 37.156  |
| 19                 | 7.633    | 8.907    | 10.117   | 11.651 | 27.204  | 30.144  | 32.852  | 36.191  | 38.582  |
| 20                 | 8.260    | 9.591    | 10.851   | 12.443 | 28.412  | 31.410  | 34.170  | 37.566  | 39.997  |
| 21                 | 8.897    | 10.283   | 11.591   | 13.240 | 29.615  | 32.671  | 35.479  | 38.932  | 41.401  |
| 22                 | 9.542    | 10.982   | 12.338   | 14.041 | 30.813  | 33.924  | 36.781  | 40.289  | 42.796  |
| 23                 | 10.196   | 11.689   | 13.091   | 14.848 | 32.007  | 35.172  | 38.076  | 41.638  | 44.181  |
| 24                 | 10.856   | 12.401   | 13.848   | 15.659 | 33.196  | 36.415  | 39.364  | 42.980  | 45.558  |
| 25                 | 11.524   | 13.120   | 14.611   | 16.473 | 34.382  | 37.652  | 40.646  | 44.314  | 46.928  |
| 26                 | 12.198   | 13.844   | 15.379   | 17.292 | 35.563  | 38.885  | 41.923  | 45.642  | 48.290  |
| 27                 | 12.878   | 14.573   | 16.151   | 18.114 | 36.741  | 40.113  | 43.195  | 46.963  | 49.645  |
| 28                 | 13.565   | 15.308   | 16.928   | 18.939 | 37.916  | 41.337  | 44.461  | 48.278  | 50.994  |
| 29                 | 14.256   | 16.047   | 17.708   | 19.768 | 39.087  | 42.557  | 45.722  | 49.588  | 52.335  |
| 30                 | 14.953   | 16.791   | 18.493   | 20.599 | 40.256  | 43.773  | 46.979  | 50.892  | 53.672  |
| 50                 | 29.707   | 32.357   | 34.764   | 37.689 | 63.167  | 67.505  | 71.420  | 76.154  | 79.490  |
| 60                 | 37.485   | 40.482   | 43.188   | 46.459 | 74.397  | 79.082  | 83.298  | 88.379  | 91.952  |
| 80                 | 53.540   | 57.153   | 60.391   | 64.278 | 96.578  | 101.879 | 106.629 | 112.329 | 116.321 |
| 100                | 70.065   | 74.222   | 77.929   | 82.358 | 118.498 | 124.342 | 129.561 | 135.807 | 140.170 |

# APPENDIX F: CRITICAL VALUES FOR THE DURBIN-WATSON STATISTIC

CRITICAL VALUES FOR THE DURBIN-WATSON STATISTIC ( $\alpha = 0.05$ )

|     | K = 1          |                | K = 2          |                | K = 3          |                | K = 4          |                | K = 5          |                |
|-----|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| n   | D <sub>l</sub> | D <sub>u</sub> | D <sub>l</sub> | D <sub>u</sub> | D <sub>l</sub> | D <sub>u</sub> | D <sub>l</sub> | D <sub>u</sub> | D <sub>l</sub> | D <sub>u</sub> |
| 15  | 1.08           | 1.36           | 0.95           | 1.54           | 0.82           | 1.75           | 0.69           | 1.97           | 0.56           | 2.21           |
| 16  | 1.10           | 1.37           | 0.98           | 1.54           | 0.86           | 1.73           | 0.74           | 1.93           | 0.62           | 2.15           |
| 17  | 1.13           | 1.38           | 1.02           | 1.54           | 0.90           | 1.71           | 0.78           | 1.90           | 0.67           | 2.10           |
| 18  | 1.16           | 1.39           | 1.05           | 1.53           | 0.93           | 1.69           | 0.82           | 1.87           | 0.71           | 2.06           |
| 19  | 1.18           | 1.40           | 1.08           | 1.53           | 0.97           | 1.68           | 0.86           | 1.85           | 0.75           | 2.02           |
| 20  | 1.20           | 1.41           | 1.10           | 1.54           | 1.00           | 1.68           | 0.90           | 1.83           | 0.79           | 1.99           |
| 21  | 1.22           | 1.42           | 1.13           | 1.54           | 1.03           | 1.67           | 0.93           | 1.81           | 0.83           | 1.96           |
| 22  | 1.24           | 1.43           | 1.15           | 1.54           | 1.05           | 1.66           | 0.96           | 1.80           | 0.86           | 1.94           |
| 23  | 1.26           | 1.44           | 1.17           | 1.54           | 1.08           | 1.66           | 0.99           | 1.79           | 0.90           | 1.92           |
| 24  | 1.27           | 1.45           | 1.19           | 1.55           | 1.10           | 1.66           | 1.01           | 1.78           | 0.93           | 1.90           |
| 25  | 1.29           | 1.45           | 1.21           | 1.55           | 1.12           | 1.66           | 1.04           | 1.77           | 0.95           | 1.89           |
| 26  | 1.30           | 1.46           | 1.22           | 1.55           | 1.14           | 1.65           | 1.06           | 1.76           | 0.98           | 1.88           |
| 27  | 1.32           | 1.47           | 1.24           | 1.56           | 1.16           | 1.65           | 1.08           | 1.76           | 1.01           | 1.86           |
| 28  | 1.33           | 1.48           | 1.26           | 1.56           | 1.18           | 1.65           | 1.10           | 1.75           | 1.03           | 1.85           |
| 29  | 1.34           | 1.48           | 1.27           | 1.56           | 1.20           | 1.65           | 1.12           | 1.74           | 1.05           | 1.84           |
| 30  | 1.35           | 1.49           | 1.28           | 1.57           | 1.21           | 1.65           | 1.14           | 1.74           | 1.07           | 1.83           |
| 31  | 1.36           | 1.50           | 1.30           | 1.57           | 1.23           | 1.65           | 1.16           | 1.74           | 1.09           | 1.83           |
| 32  | 1.37           | 1.50           | 1.31           | 1.57           | 1.24           | 1.65           | 1.18           | 1.73           | 1.11           | 1.82           |
| 33  | 1.38           | 1.51           | 1.32           | 1.58           | 1.26           | 1.65           | 1.19           | 1.73           | 1.13           | 1.81           |
| 34  | 1.39           | 1.51           | 1.33           | 1.58           | 1.27           | 1.65           | 1.21           | 1.73           | 1.15           | 1.81           |
| 35  | 1.40           | 1.52           | 1.34           | 1.58           | 1.28           | 1.65           | 1.22           | 1.73           | 1.16           | 1.80           |
| 36  | 1.41           | 1.52           | 1.35           | 1.59           | 1.29           | 1.65           | 1.24           | 1.73           | 1.18           | 1.80           |
| 37  | 1.42           | 1.53           | 1.36           | 1.59           | 1.31           | 1.66           | 1.25           | 1.72           | 1.19           | 1.80           |
| 38  | 1.43           | 1.54           | 1.37           | 1.59           | 1.32           | 1.66           | 1.26           | 1.72           | 1.21           | 1.79           |
| 39  | 1.43           | 1.54           | 1.38           | 1.60           | 1.33           | 1.66           | 1.27           | 1.72           | 1.22           | 1.79           |
| 40  | 1.44           | 1.54           | 1.39           | 1.60           | 1.34           | 1.66           | 1.29           | 1.72           | 1.23           | 1.79           |
| 45  | 1.48           | 1.57           | 1.43           | 1.62           | 1.38           | 1.67           | 1.34           | 1.72           | 1.29           | 1.78           |
| 50  | 1.50           | 1.59           | 1.46           | 1.63           | 1.42           | 1.67           | 1.38           | 1.72           | 1.34           | 1.77           |
| 55  | 1.53           | 1.60           | 1.49           | 1.64           | 1.45           | 1.68           | 1.41           | 1.72           | 1.38           | 1.77           |
| 60  | 1.55           | 1.62           | 1.51           | 1.65           | 1.48           | 1.69           | 1.44           | 1.73           | 1.41           | 1.77           |
| 65  | 1.57           | 1.63           | 1.54           | 1.66           | 1.50           | 1.70           | 1.47           | 1.73           | 1.44           | 1.77           |
| 70  | 1.58           | 1.64           | 1.55           | 1.67           | 1.52           | 1.70           | 1.49           | 1.74           | 1.46           | 1.77           |
| 75  | 1.60           | 1.65           | 1.57           | 1.68           | 1.54           | 1.71           | 1.51           | 1.74           | 1.49           | 1.77           |
| 80  | 1.61           | 1.66           | 1.59           | 1.69           | 1.56           | 1.72           | 1.53           | 1.74           | 1.51           | 1.77           |
| 85  | 1.62           | 1.67           | 1.60           | 1.70           | 1.57           | 1.72           | 1.55           | 1.75           | 1.52           | 1.77           |
| 90  | 1.63           | 1.68           | 1.61           | 1.70           | 1.59           | 1.73           | 1.57           | 1.75           | 1.54           | 1.78           |
| 95  | 1.64           | 1.69           | 1.62           | 1.71           | 1.60           | 1.73           | 1.58           | 1.75           | 1.56           | 1.78           |
| 100 | 1.65           | 1.69           | 1.63           | 1.72           | 1.61           | 1.74           | 1.59           | 1.76           | 1.57           | 1.78           |

# INDEX

---

## A

absolute purchasing power parity 333  
ad hoc trade allocation 121  
adjusted R<sup>2</sup> 187, 361  
agency trade 94, 96  
alternative hypothesis 154  
analysis of variance (ANOVA) 153, 157, 188, 360  
analyst conference call 30  
artificial price volatility 34  
ask price 311  
autocorrelation 162, 200  
autoregressive conditional heteroskedasticity (ARCH) 245, 248, 361  
autoregressive models (AR) 228, 247, 361

## B

balance of payments  
    accounting 329  
    accounts 303  
    equation 303  
balance on current account 329  
barriers to trade 290  
beneficial owner 65  
best execution 95  
bid-ask spread 311  
bid price 311  
Bloomberg 98  
Breusch-Pagan test 197, 198, 361  
brokerage 94  
budget deficit 330  
buy-side clients 22

## C

capital account 303  
capital consumption 350  
CAPM 209  
capture hypothesis 283  
CFA candidate, responsibilities 18  
CFA Institute 5, 14  
CFA Institute membership 72  
CFA Institute Professional Conduct Program (PCP) 45  
chain rule of forecasting 229  
changes in the investment climate 331  
changing investment objectives 123  
chi-square test 197, 361  
classical growth theory 267

client brokerage 94  
client-directed brokerage 94, 96  
client relationships 121  
Code and Standards 104  
Code of Ethics 14  
coefficient of determination 153, 165, 186, 360  
coefficient t-test 359  
cointegration 244  
communication with clients 17, 57  
comparative advantage 287  
compensation arrangements 17, 51, 121  
compliance and enforcement 108  
compliance procedures 52, 53  
conditional heteroskedasticity 197  
conduct 18, 69  
confidence interval 156  
    for a predicted value (simple linear regression only) 359  
    for coefficient 359  
    regression coefficient 153, 182, 360  
confidentiality 45  
conflicts of interest 18, 61  
correcting serial correlation 203  
correlation analysis 145  
correlation coefficient 142  
    population 146  
    sample 142  
    test of significance 147  
cost-of-service 281  
covariance 141, 150  
covariance, sample 141  
covariance stationary 236, 243  
covered employee 104, 105  
covered interest arbitrage 319  
crawling peg exchange rate policy 304  
creative response 282  
cross rate 312  
cross rates with bid-ask spreads 313  
cumulative Z-Table 364  
currency board 332  
currency demand 299  
currency supply 300  
currency swap market 311  
current account 303, 329  
current account deficits 330  
current account surpluses 330  
current prices 352

## D

degrees of freedom 146, 158, 165, 178, 182, 189, 198, 202, 230  
delegation of duty 126  
dependent variable 147  
    lagged 208  
    predicting 183  
    qualitative 209  
Depression 124  
determinants of the demand for any currency 299  
determinants of the supply for any currency 300  
df, denominator 185  
DF–EG test 244  
df, numerator 185  
Dickey Fuller (DF) 240, 244  
differences in income growth 330  
differences in inflation rates 330  
differences in real interest rates 331  
diligence and reasonable basis 17, 119  
direct quotes 310  
disclosure 62, 97, 109  
disclosure of conflicts 18, 61, 114, 119  
disclosure of investment objectives 123  
discovery of new technologies 267  
discriminant models 209  
disturbance term 149  
diversification 125  
dummy variables 193, 209  
Durbin-Watson 201, 202, 361  
duties to clients 16, 35, 116, 120  
duties to employers 17, 47, 114, 117, 119

## E

economic growth 262  
economic regulation 280  
employee trade 30  
endogenous variable 147  
Engle and Granger (EG) 244  
equilibrium exchange rate 302  
error term 149  
evaluation of research 96  
exchange rate 298, 301, 329  
exchange rate policies 304  
exogenous variable 147  
expansionary fiscal policy 331  
expansionary monetary policy 331  
expenditure component of GDP 352  
exponential growth 225

## F

factors of production 263  
factors that affect currency movements 331

fair dealing 16, 38  
feedback effect 282  
fiduciaries 94  
fiduciary standards 125  
financial account 330  
financial account deficits 330  
financial account surpluses 330  
firewall 22, 30  
first differencing 241  
fixed exchange rate system 332  
fixed rate policy 304  
flexible exchange rate policy 304  
forecasting 234  
forecasting the past 208  
foreign currency risk premium 339  
foreign exchange expectation relation 339  
foreign-exchange markets 310  
forward discount 317  
forward markets 311, 315  
forward premium 317  
free float (FF), independent variable 208  
front running 108  
F-statistic 160, 184, 360  
F-statistic, interpreting 161, 186  
F-test for multiple regression 361  
FX appreciation and depreciation 310  
FX markets 310

## G

GDP at factor cost 352  
GDP at market prices 352  
gifts 22  
gross domestic product (GDP) 350  
gross national income (GNI) 350  
gross national product (GNP) 350  
group research 55

## H

Hansen method 203  
heteroskedastic 162  
heteroskedasticity 196  
hypothesis testing 154  
hypothesis testing, regression coefficients 178

## I

illegal activities 45  
immediate family 105  
imports 329  
inadequate disclosure 123  
independence and objectivity 15, 21, 114  
independent practice 47  
independent variable 147  
indirect quotations 310

in-sample forecasts 234  
insider-trading 30  
instability 235  
integrity of capital markets 15, 30  
interbank market 311  
intercept term 149, 177, 359  
interest rate parity 302, 318  
international Fisher relation 335  
International Monetary Fund 340  
international parity relations 332  
interpretation of p-values 179  
investment action 17, 54  
investment analysis 17, 54  
investment banking 22, 106  
investment in human capital 267  
investment manager 105  
investment policy statement (IPS) 41  
investment recommendations 17, 54  
IPOs 22, 40, 55, 65, 107, 108, 109, 121  
issuer-paid research 22

## K

knowledge capital 271  
knowledge of the law 15, 19

## L

labor productivity 263, 264  
law of comparative advantage 287  
law of diminishing returns 264  
law of one price 333  
leaving an employer 47  
linear regression, assumptions 148  
linear trend 221  
logit model 209  
log-linear trend model 225, 247  
loyalty 16, 17, 35, 47

## M

market manipulation 15, 33  
material nonpublic information 15, 30  
mean regression sum of squares (MSR) 159, 185, 361  
mean reversion 237  
mean reverting level 361  
mean squared error (MSE) 159, 185, 361  
measures of economic activity 350  
members 19  
methods of measuring GDP 351  
misconduct 15, 28  
misrepresentation 15, 25  
misrepresenting performance 20  
mixed use 98  
mixed use research 94

model fit 229  
model misspecification 203, 204, 205  
model misspecification, see model specification 206  
monetary exchange 263  
multicollinearity 203  
multiple regression 175  
    analysis 175  
    assumptions 184  
    assumption violations 196  
    dummy variable 195  
    formulation 176  
    interpretation 177

## N

natural monopolies 280  
negative correlation 143  
negative serial correlation 200  
neoclassical growth theory 268  
net national income (NNI) 350  
new growth theory 270  
nominal exchange rate 298  
nonlinear relationships 146  
nonpublic 30  
nonstationarity 235, 240  
null hypothesis 154

## O

official reserve account 330, 340  
official reserves 303  
official settlements account 303  
one-tailed test 160, 181, 364  
One-Third Rule 265  
opportunity cost 269  
ordinary least squares (OLS) 150, 222  
outliers 145  
out-of-sample forecasts 235

## P

parameter instability 162  
partial designation 71  
partial slope coefficients 177  
pegged exchange rate system 332  
performance presentation 16, 43  
permissible research 98  
perpetual motion economy 272  
personal investments and trading 108  
personal transactions 65  
plagiarism 25  
pooling data 207  
population growth 268  
portfolio context 126  
positive correlation 143

positive serial correlation 200  
preconditions for economic growth 263  
predicted value 149  
    confidence interval 156  
    dependent variable 155, 359  
preservation of confidentiality 16  
principal trade 94  
priority of transactions 18, 65, 120  
probit model 209  
productivity curve 264  
productivity slowdowns 266  
productivity speedup 266  
Professional Conduct Statement (PCS) 70  
professionalism 15, 19  
properties of productivity curves 264  
property rights 263  
proper usage of the CFA marks 72  
proprietary research 94  
proprietary trading 31  
proxies 36  
proxy variable 208  
prudence 16, 35  
prudence in perspective 124  
Prudent Investor Rule 124  
Prudent Man Rule 124  
public appearance 105, 106  
public companies 22  
public good 271  
purchasing power parity 302  
p-value 179

## Q

qualitative dependent variable 209  
quiet periods 107  
quotas 291

## R

$R^2$  159  
 $R^2$ , adjusted 187  
 $R^2$ , coefficient of determination 186  
random walks 238  
random walk with a drift 239  
rate-of-return regulation 281  
rating system 109  
real exchange rate 298  
reasonable and adequate basis 54, 106  
reasonable care 16, 35  
reasonable judgment 17  
record keeping 97  
record retention 17, 60  
referencing candidacy in the CFA Program 72  
referral fee 18, 67  
regression analysis 196  
    heteroskedasticity 197

    limitations 162  
    model misspecification 204  
    multicollinearity 203  
    serial correlation 200  
regression coefficient 151  
    confidence interval 153, 182  
    hypothesis testing 178  
    tail tests 181  
    t-test 154  
regression model specification 204  
regression sum of squares (RSS) 157, 185, 360  
regulation  
    negative side effects of 282  
regulator behavior 282  
relationships with subject companies 107  
relative purchasing power parity (relative PPP)  
    334  
request for proposal (RFP) 49  
research 94  
research analyst 105  
research analyst compensation 107  
research objectivity policy 105  
Research Objectivity Standards 104  
residual 148  
residual plot 198  
responsibilities, CFA candidate 18, 69  
responsibilities of supervisors 17  
restricted list 30  
rho 146  
risk management 126  
road shows 22  
robust standard errors 199  
root mean squared error (RMSE) 235, 248  
rule of 70 262  
rumor list 30

## S

sample correlation coefficient 359  
sample covariance 359  
saving and investment in new capital 267  
scatter plot 144  
seasonality 231, 247  
secondary research 55  
selection of brokers 96  
serial correlation 200, 247  
share-the-gains, share-the-pains theory 283  
simple linear regression 147  
slope coefficient 149, 150, 359  
social regulation 281  
    negative side effects of 282  
soft commissions 36  
soft dollars 36, 94  
sources of economic growth 263

S&P 500 183  
 spot FX markets 315  
 spot market 311  
 spot rates 315  
 spreads in forward markets 316  
 spurious correlation 145  
 standard error of estimate (SEE) 152, 159, 360  
 standard error of the forecast 156  
 standard error of the regression 152  
 standard error of the residual 152  
 standard errors 203  
 standard errors, White-corrected 199  
 Standards of Practice Handbook 9th Edition 14  
 Standards of Professional Conduct 15  
 statistical inferences 236  
 statistical significance 178  
 statistical software packages 153  
 structural change 246  
 structural shift 247  
 subject company 105  
 subsistence level 267  
 subsistence real wage 268  
 suitability 16, 41  
 sum of squared errors (SSE) 149, 157, 185, 360  
 supervisors, responsibilities of 52

## T

target rate of return 269  
 tariff 290  
 technological change 264  
 theory of uncovered interest rate parity 337  
 third-party research 55, 94  
 timeliness 108  
 time series 221  
 total sum of squares (SST) 157, 360  
 total variation 158  
 trade allocation 121  
 trade restrictions 292  
     reasons for 293  
 triangular arbitrage 314  
 t-test 154  
 t-test for correlation coefficient 359  
 t-test for regression coefficient 360  
 two-tailed test 146  
 two-tailed test example 365  
 two-tail test 181  
 Type I errors 200  
 Type II errors 201, 203

## U

unbiased predictor 339  
 unconditional heteroskedasticity 196  
 uncovered interest rate parity 337  
 unit root 243  
 using the CFA Designation 72

## V

variable omission 207  
 variable transformation 207  
 violations 19  
 voluntary export restraints (VER) 292

## W

watch list 30  
 whistleblowing 48  
 White-corrected standard errors 203



## Notes

**Required Disclaimers:**

CFA Institute does not endorse, promote, or warrant the accuracy or quality of the products or services offered by Kaplan Schweser. CFA Institute, CFA®, and Chartered Financial Analyst® are trademarks owned by CFA Institute.

Certified Financial Planner Board of Standards Inc. owns the certification marks CFP®, CERTIFIED FINANCIAL PLANNER™, and federally registered CFP (with flame design) in the U.S., which it awards to individuals who successfully complete initial and ongoing certification requirements.

Kaplan University does not certify individuals to use the CFP®, CERTIFIED FINANCIAL PLANNER™, and CFP (with flame design) certification marks.

CFP® certification is granted only by Certified Financial Planner Board of Standards Inc. to those persons who, in addition to completing an educational requirement such as this CFP® Board-Registered Program, have met its ethics, experience, and examination requirements.

Kaplan Schweser and Kaplan University are review course providers for the CFP® Certification Examination administered by Certified Financial Planner Board of Standards Inc. CFP Board does not endorse any review course or receive financial remuneration from review course providers.

GARP® does not endorse, promote, review, or warrant the accuracy of the products or services offered by Kaplan Schweser of FRM® related information, nor does it endorse any pass rates claimed by the provider. Further, GARP® is not responsible for any fees or costs paid by the user to Kaplan Schweser, nor is GARP® responsible for any fees or costs of any person or entity providing any services to Kaplan Schweser. FRM®, GARP®, and Global Association of Risk Professionals™ are trademarks owned by the Global Association of Risk Professionals, Inc.

CAIAA does not endorse, promote, review or warrant the accuracy of the products or services offered by Kaplan Schweser nor does it endorse any pass rates claimed by the provider. CAIAA is not responsible for any fees or costs paid by the user to Kaplan Schweser nor is CAIAA responsible for any fees or costs of any person or entity providing any services to Kaplan Schweser. CAIA®, CAIA Association®, Chartered Alternative Investment Analyst™, and Chartered Alternative Investment Analyst Association®, are service marks and trademarks owned by CHARTERED ALTERNATIVE INVESTMENT ANALYST ASSOCIATION, INC., a Massachusetts non-profit corporation with its principal place of business at Amherst, Massachusetts, and are used by permission.

CPCU® is a registered mark owned by the American Institute for CPCU and the Insurance Institute of America.

ChFC®, Chartered Financial Consultant®, CLU®, Chartered Life Underwriter®, and CASL®, Chartered Advisor for Senior Living® are registered marks owned by The American College. Kaplan Schweser is not affiliated or associated in any way with The American College. The American College does not endorse, promote, review, or warrant the accuracy of any courses, exam preparation materials, or other products or services offered by Kaplan Schweser and does not verify or endorse any claims made by Kaplan Schweser regarding such products or services, including any claimed pass rates.