March 2018 **SchweserNotes™** Level I

CAIA®
Exam Prep

Professional Standards and Ethics, Introduction to Alternative Investments, and Real Assets

eBook 1

KAPLAN UNIVERSITY SCHOOL OF PROFESSIONAL AND CONTINUING EDUCATION | SCHWESER

Getting Started

Level I CAIA® Exam

Welcome

As the Vice President of Product Management at Kaplan Schweser, I am pleased to have the opportunity to help you prepare for the March 2018 CAIA® exam. Getting an early start on your study program is important for you to sufficiently **Prepare ▶ Practice ▶ Perform®** on exam day. Proper planning will allow you to set aside enough time to master the Learning Objectives in the Level I curriculum.

Now that you've received your SchweserNotes™, here's how to get started:

Step 1: Access Your Online Tools

Visit www.schweser.com/caia and log in to your online account using the button located in the top navigation bar. After logging in, select the appropriate level and proceed to the dashboard where you can access your online products.

Step 2: Create a Study Plan

Create a study plan with the Schweser Study Calendar (located on the Schweser dashboard). Then view the Candidate Resource Library on-demand videos for an introduction to core concepts.

Step 3: Prepare and Practice

Read your SchweserNotes™

Our clear, concise study notes will help you **prepare** for the exam. At the end of each reading, you can answer the Concept Checker questions for better understanding of the curriculum.

Attend a Weekly Class

Attend our Live Online Weekly Class or review the on-demand archives as often as you like. Our expert faculty will guide you through the CAIA curriculum with a structured approach to help you **prepare** for the exam. (See our instruction packages to the right. Visit **www.schweser.com/caia** to order.)

Practice with SchweserPro™ QBank

Maximize your retention of important concepts and **practice** answering exam-style questions in the SchweserPro™ QBank and taking several Practice Exams. Use Schweser's QuickSheet for continuous review on the go. (Visit **www.schweser.com/caia** to order.)

Step 4: Final Review

A few weeks before the exam, make use of our Online Review Workshop Package. Review key CAIA curriculum concepts in every topic, **perform** by working through demonstration problems, and **practice** your exam techniques with our live Online Review Workshop on February 17 and 18.* Use Schweser's Secret Sauce® for convenient study on the go.

Step 5: Perform

As part of our Online Review Workshop Package, take the Online Schweser Mock Exam to ensure you are ready to **perform** on the actual CAIA exam. Put your skills and knowledge to the test and gain confidence before the exam.

Again, thank you for trusting Kaplan Schweser with your CAIA exam preparation!

Sincerely,

Derek Burkett

Derek Burkett, CFA, FRM, CAIA
VP, Product Management, Kaplan Schweser

The Kaplan Way for Learning

Prepare — Acquire new knowledge through demonstration and examples.

Practice — Apply new knowledge through simulation and practice.

Perform — Evaluate mastery of new knowledge and identify achieved outcomes.

CAIA® Instruction Packages:

- PremiumPlus™ Package
- Premium Instruction Package

Live Instruction:

Remember to join Schweser's Live Online Weekly Class starting December 16.*
Register online at **www.schweser.com/caia.**

Additional Study Packages:

- EssentialPlus Package
- Essential Self-Study Package
- SchweserNotes™ Package
- Online Review Workshop Package

*Dates, times, and instructors subject to change.

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Contact us for questions about your study package, upgrading your package, purchasing additional study materials, or for additional information:

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Book 1: Professional Standards and Ethics, Introduction to Alternative Investments, and Real Assets

Topic 1: Professional Standards and Ethics

Topic 2: Introduction to Alternative Investments

Topic 3: Real Assets

CAIA® 2018 MARCH LEVEL I SCHWESERNOTES™ BOOK 1: PROFESSIONAL STANDARDS AND ETHICS, INTRODUCTION TO ALTERNATIVE INVESTMENTS, AND REAL ASSETS

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Welcome to the 2018 SchweserNotes™

Thank you for purchasing the SchweserNotes. It is our hope that you find our product effective and easy to use. The following comments are designed to get you started on your studies and help you get the most out of the SchweserNotes. Further information regarding Kaplan Schweser products and the CAIA® program can be found on our website: *www.schweser.com*.

Highlights of the CAIA SchweserNotes

- The SchweserNotes encompass all of the material in the CAIA curriculum.
- Each topic review is organized with a focus on the CAIA Association's Learning Objectives (LOs), which form the basis for CAIA exam questions. The focus will enable you to zero in on the material you need to know for the exam without searching through unnecessary material.
- The SchweserNotes are organized numerically by topic and include tabs to help you quickly find topics of interest.

Overview of the CAIA Program

The CAIA program and the CAIA curriculum are very carefully structured to help you learn exactly what you need to know to pass the CAIA exam. The CAIA Study Guide, available on the web at *www.caia.org*, has a complete description of the CAIA program. The CAIA curriculum is based on a series of core readings from textbooks, professional publications, and other sources. We strongly encourage you to purchase and read the core readings as well as the SchweserNotes.

Here are a few key points to remember about Learning Objectives (LOs):

- The action words (e.g., calculate, define, describe) indicate what you are expected to be able to do after you have read and studied the material in each assigned reading.
- The LOs will direct you toward specific sections of the readings and away from other material that is not intended to be part of the curriculum. Use the LOs to guide your study program.
- The LOs should not be viewed as a proxy for exam questions, but mastery of the LOs is necessary to your success.

Designing an Effective Study Program

If you are reading this four months or more before the exam date, you should have time to study each topic review reading in full detail, review our commentary, and work all of the Concept Checker problems in the SchweserNotes. About two or three weeks before the exam date, your focus should shift away from the narrative material and toward the Practice Exams, using Books 1 and 2 to clear up any problem areas.

Stay on schedule. Regardless of the exact nature of your study program, approaching the material in a systematic and thorough manner is key to passing the exam. A sample study schedule is provided following this introductory letter. In addition, the online Schweser Study Calendar breaks the curriculum into a series of tasks and will help you monitor your study progress.

Read the SchweserNotes first. We encourage candidates to purchase the original CAIA Association-assigned core readings, but we recommend that you read the SchweserNotes before you read the source material. This will give you an overview of what is in the assigned core readings. After the overview, focus on core readings that cover material that is new or uncomfortable for you.

Develop your own notes. We recommend jotting down your personal study notes in the margins of the SchweserNotes. By doing this, all your notes will be together in one place allowing you to review the material quickly without the confusion of flipping between notebooks.

Use the Concept Checkers for practice. After reading a topic review in the SchweserNotes, work the Concept Checker questions at the end. If you can't work these problems, study the material in the topic review again.

Save the Practice Exams for last. A good strategy is to take one practice exam under simulated exam conditions in each of the three weeks leading up to the real exam. Remember, no matter how challenging we make our practice exams, the actual exam will look and feel different.

Use other Kaplan Schweser study products. The SchweserPro™ Question Bank and Flashcards will maximize your study time and effort. Everyone studies differently—use the study tools that maximize your ability to keep the material in front of you as much as possible. You may also want to consider joining the Schweser CAIA Weekly Online Class, our online review seminar covering the entire CAIA curriculum over a 9-week period. Our expert instruction can give you the edge you need for success on the exam. More information about all Kaplan Schweser products can be found at *www.schweser.com*.

If You Are Starting Late

If you are starting to study less than three months before the exam date, you may not be able to give full attention to each topic. Based on your existing skill set, decide which reviews to study and which reviews can be skipped or glossed over. If you're starting late—focus on the Practice Exams while you are studying Books 1 and 2.

On Exam Day

(Check the CAIA Association website for exam dates and sites: ***www.caia.org*****)**

Don't be surprised. Determine your travel route beforehand and get to the exam site early!

Know what to expect. All topics will be covered on the exam, but not all individual LOs can or will be covered. The guideline topic area weights, as developed by the CAIA Association, are as follows:

Topic Area	Approx. Number of Questions	Exam Weight
Professional Standards & Ethics	30–40	15–20%
Introduction to Alternative Investments	40–50	20–25%
Real Assets	20–40	10–20%
Hedge Funds	20–40	10–20%
Private Equity	10–20	5–10%
Structured Products	20–30	10–15%
Risk Management and Portfolio Management	10–20	5–10%

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The Level I CAIA examination will be 100% multiple choice. Keep in mind that the CAIA Association will do its best to develop tricky answer choices intended to pull your attention away from the correct answer. Read each question thoroughly, answer carefully, and move on.

Be ready to do some number crunching. The CAIA Association has stated that up to 30% of exam questions will require a calculation. Therefore, you need to be ready to calculate correct answers and provide interpretations for those answers. The CAIA Association will NOT provide a formula list on the exam. At a minimum, make sure you know the formulas associated with LOs that use the command word "calculate." Note, however, that equations presented in LOs without the "calculate" command word may also appear on the exam. Thus, we recommend being comfortable with *all* equations that appear in the SchweserNotes.

Guess if you must. Attempt to answer every question, even if it means guessing! An incorrect answer simply earns zero points. No additional (i.e., penalty) points are deducted for incorrect answers.

Take the test! Even if you don't feel fully prepared, take the test anyway. You paid for the right to take the exam, so you might as well give it a shot and gain insight from the exam experience.

Exam results will come to you. Each candidate will be sent an email stating their pass/fail status within about three weeks after the close of the testing window. You can also log in to the CAIA Association website after the grading period to receive exam results.

I would like to take this opportunity to thank the content contributors, editors, and graphic designers who worked many long hours in creating the CAIA SchweserNotes. I would especially like to thank Adam Stueber, CAIA; Eric Smith, CFA, FRM; Penelope Bonnar, Allison Bottcher, Katherine Bourgeois Dassow, Alyssa Britson, Alyssa Brunner, Lindsey Casto, Jessica Caulum, Tiffany Finstuen, Laura Goetzinger, Ryan Henry, Hannah Kelley, Alissa Knop, Genevieve Kretschmer, Gretchen Panzer, Jessica Pearse, and Ashley Sinclair. Without their efforts and dedication, Kaplan Schweser could not create the high-quality products demanded by our customers.

Best regards,

Derek Burkett
Derek Burkett, CFA, FRM, CAIA
VP, Product Management
Kaplan Schweser

Suggested Study Schedule

You may already be familiar with some of the material that will be tested on the CAIA® exam. This familiarity will aid you on exam day, but don't let it distract you from a simple truth: to pass the exam, you *must* study *all* the material. Our goal at Kaplan Schweser is to prepare you for the CAIA exam in a disciplined and efficient manner. To that end, we have a few words of wisdom to offer as well as a sample study schedule designed to keep you on the path to success on the CAIA exam.

If you begin your studies early, you should have time to study each reading in detail, review our commentary, and work all of the Concept Checkers in the SchweserNotes. In the week(s) preceding the exam you should devote most of your time to the Practice Exams and the SchweserPro™ Question Bank. While you are working through these questions, you should also clear up any problem areas that you may have with the material by continuing to review the sections of Books 1 and 2 with which you still have trouble. As you study, keep in mind the relative weight of each topic on the exam. Don't spend all of your valuable study time on a topic with little exam weight.

Stay on schedule. The CAIA Association estimates that the average candidate should commit at least 200 total hours of study for the Level I exam. This translates into 20 hours of exam preparation per week over a 10-week period. In addition, you should try to leave the three weeks immediately before the exam for practice exams and final review. Regardless of the exact nature of your study program, approaching the material in a systematic and thorough manner is key to passing the exam. The following is a suggested study schedule.

CAIA Level I Study Schedule	
Week of:	**Topic**
November 27	Ethics & Standards (Topic 1) & Introduction to Alternative Investments (Topic 2.1)
December 4	Introduction to Alternative Investments (Topics 2.2–2.5)
December 11	Introduction to Alternative Investments (Topics 2.6–2.9)
December 18	Real Assets (Topics 3.1–3.3)
December 25	Real Assets (Topics 3.4–3.6)
January 1	Hedge Funds (Topics 4.1–4.3)
January 8	Hedge Funds (Topics 4.4–4.6)

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CAIA Level I Study Schedule	
Week of:	**Topic**
January 15	Private Equity (Topics 5.1–5.3)
January 22	Structured Products (Topics 6.1–6.4)
January 29	Risk Management and Portfolio Management (Topics 7.1–7.4)
February 5	Practice Exam 1 & Initial Review
February 12	Practice Exam 2 & Final Review
February 19	Practice Exam 3 & Final Review
February 26–March 9	CAIA Exam Window

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Readings and Learning Objectives

Readings

Topic 1: Professional Standards and Ethics

Standards of Practice Handbook. 11th edition. Charlottesville, Virginia: CFA Institute, 2014. ISBN: 978-0-938367-85-7.

Topic 2: Introduction to Alternative Investments

Alternative Investments: CAIA Level I. Wiley. Third Edition, 2015. ISBN: 978-1-119-00336-6. Part One, Introduction to Alternative Investments, Chapters 1–9.

Topic 3: Real Assets

Alternative Investments: CAIA Level I. Wiley. Third Edition, 2015. ISBN: 978-1-119-00336-6. Part Two, Real Assets, Chapters 10–15.

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Learning Objectives

Topic 1: Professional Standards and Ethics

A.1: Demonstrate knowledge of Standard I: Professionalism. (p. 5)

For example:
- State and interpret Standard I with respect to knowledge of the law, independence and objectivity, misrepresentation, and misconduct.
- Recognize procedures for compliance with respect to knowledge of the law, independence and objectivity, misrepresentation, and misconduct.

A.2: Demonstrate knowledge of Standard II: Integrity of Capital Markets. (p. 15)

For example:
- State and interpret Standard II with respect to material nonpublic information, and market manipulation.
- Recognize procedures for compliance with respect to material nonpublic information.

A.3: Demonstrate knowledge of Standard III: Duties to Clients. (p. 20)

For example:
- State and interpret Standard III with respect to loyalty, prudence and care, fair dealing, suitability, performance presentation, and preservation of confidentiality.
- Recognize procedures for compliance with respect to loyalty, prudence and care, fair dealing, suitability, performance presentation, and preservation of confidentiality.

A.4: Demonstrate knowledge of Standard IV: Duties to Employers. (p. 31)

For example:
- State and interpret Standard IV with respect to loyalty, additional compensation arrangements, and responsibilities of supervisors.
- Recognize procedures for compliance with respect to additional compensation arrangements, and responsibilities of supervisors.

A.5: Demonstrate knowledge of Standard V: Investments Analysis, Recommendations, and Actions. (p. 38)

For example:
- State and interpret Standard V with respect to diligence and reasonable basis, communication with clients and prospective clients, and record retention.
- Recognize procedures for compliance with respect to diligence and reasonable basis, communication with clients and prospective clients, and record retention.

A.6: Demonstrate knowledge of Standard VI: Conflicts of Interest. (p. 45)

For example:
- State and interpret Standard VI with respect to disclosure of conflicts, priority of transactions, and referral fees.
- Recognize procedures for compliance with respect to disclosure of conflicts, and priority of transactions.

Topic 2: Introduction to Alternative Investments

Topic 2.1: What is an Alternative Investment?

1.1: Demonstrate knowledge of the view of alternative investments by exclusion. (p. 66)

For example:
- Recognize characteristics of institutional quality investments.

1.2: Demonstrate knowledge of various alternative investment types. (p. 67)

For example:
- Describe real assets (i.e., commodities, real estate, intellectual property, and infrastructure), and distinguish real assets from financial assets.
- Describe hedge funds.
- Describe private equity (i.e., venture capital, leveraged buyouts, mezzanine debt, and distressed debt).
- Describe structured products (e.g., collateralized debt obligations [CDOs], credit derivatives).

1.3: Demonstrate knowledge of the concept of structures in investments. (p. 69)

For example:
- Describe how structures help distinguish alternative investments from traditional investments.
- Define the five primary types of structures.
- Recognize how structures influence various alternative asset types.
- Recognize the limits of using structures to categorize alternative investments.

1.4: Demonstrate knowledge of how alternative and traditional investments are distinguished by return characteristics. (p. 71)

For example:
- Recognize the role of absolute return products as diversifiers.
- Define illiquidity, and describe the advantages and risks of illiquid investments.
- Define efficiency and inefficiency, and describe their relationship to competition and transaction costs.
- Recognize normal and non-normal distributions and the structures that cause non-normality of returns.

1.5: Demonstrate knowledge of how alternative and traditional investments are distinguished by methods of analysis. (p. 73)

For example:
- Recognize return computation methods.
- Recognize statistical methods.
- Recognize valuation methods.
- Recognize portfolio management methods.

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1.6: Demonstrate knowledge of other factors that distinguish alternative investments from traditional investments. (p. 74)

For example:
- Recognize factors that contribute to information asymmetries.
- Describe the concept of incomplete markets and the effect of incomplete markets on investors.
- Recognize the prominence of innovation in alternative investments as compared to traditional investments.

1.7: Demonstrate knowledge of the goals of alternative investing. (p. 75)

For example:
- Define active management, and contrast active management and passive investing.
- Recognize the role of benchmarks in managing investments.
- Define active risk and active return.
- Describe the absolute and relative standards for evaluating returns.
- Describe the concept of arbitrage, and the roles of return enhancers and return diversifiers in an investment program.

Topic 2.2: The Environment of Alternative Investments

2.1: Demonstrate knowledge of participants in the alternative investing environment. (p. 82)

For example:
- Identify buy-side participants, and describe their roles in the alternative investing environment.
- Identify sell-side participants (i.e., large dealer banks and brokers), and describe their roles in the alternative investing environment.
- Identify outside service providers (e.g., prime brokers, accountants and auditors, attorneys, fund administrators, hedge fund infrastructures, consultants, depositories and custodians, and banks), and describe their roles in the alternative investing environment.

2.2: Demonstrate knowledge of the financial markets involved in alternative investments. (p. 87)

For example:
- Define primary capital markets, and describe their roles in alternative investments.
- Define secondary capital markets, and describe their roles in alternative investments.
- Define third, fourth, and private markets, and describe their roles in alternative investments.

2.3: Demonstrate knowledge of regulatory environment as it applies to alternative investments. (p. 89)

For example:
- Define and explain the concept of systemic risk.
- Recognize the four primary forms of hedge fund regulation.
- Describe key components of U.S. regulations affecting securities issued to the public (e.g., the '40 Act, the U.S. Securities Act), including exemptions commonly applied to hedge funds.

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- Describe key components of European regulations affecting hedge funds (e.g., Undertakings for Collective Investment in Transferable Securities [UCITS], Markets in Financial Instruments Directive [MiFID]), and recognize major European regulatory institutions.
- Describe key components of hedge fund regulations outside the United States and European Union (e.g., Australia, Brazil, Canada, Japan, Singapore, South Africa, the United Arab Emirates), and recognize major regulatory institutions in these regions.

2.4: Demonstrate knowledge of liquid alternative investments. (p. 94)

For example:
- Define liquid alternative investments.
- Recognize the five distinct types of liquid alternative investments.
- Describe the factors driving the growth of liquid alternative investments.
- Recognize regulatory constraints that affect liquid alternative investments.
- Recognize the main reasons that contribute to differences between the returns of private placement vehicles and those of liquid alternatives.

2.5: Demonstrate knowledge of taxation of investments. (p. 96)

For example:
- Recognize income tax conventions (e.g., taxes on capital gains, dividends, interest).
- Recognize non–income tax conventions (e.g., real estate tax, estate tax, value-added tax).
- Recognize how variations in income tax conventions around the world affect investments and investment decisions.

Topic 2.3: Quantitative Foundations

3.1: Demonstrate knowledge of return and rate mathematics. (p. 106)

For example:
- Define and apply return compounding.
- Define and calculate logarithmic returns.
- Define and apply the return computation interval.
- Aggregate returns over different time intervals.
- Define and calculate arithmetic mean log returns and geometric mean returns.

3.2: Demonstrate knowledge of returns based on notional principal. (p. 110)

For example:
- Recognize and apply the concept of forward contracts.
- Define and apply the concepts of notional principal and full collateralization for forward contracts.
- Calculate the log return to a fully collateralized derivatives position.
- Calculate the log return to a partially collateralized derivatives position.

3.3: Demonstrate knowledge of the internal rate of return (IRR) approach to alternative investment analysis. (p. 112)

For example:
- Define and calculate the IRR.
- Define and calculate the four types of IRR based on time periods for which cash flows are available (i.e., lifetime, since inception, interim, and point-to-point) and their relationship to valuation of alternative investments.

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3.4: Demonstrate knowledge of problems with the use of IRR in alternative investment analysis. (p. 116)

For example:

- Recognize complex cash flow patterns, and discuss their effect on the computation and interpretation of IRRs.
- Discuss the challenges (e.g., scale differences) of comparing investments based on IRRs.
- Discuss the difficulties of aggregating IRRs.
- Discuss the reinvestment assumption inherent in the IRR and how it is addressed by the modified IRR.
- Compare and calculate time-weighted and dollar-weighted returns.

3.5: Demonstrate knowledge of the distribution of cash waterfall. (p. 122)

For example:

- Explain the distribution of cash waterfall provision of a limited partnership agreement.
- Recognize terminology associated with the cash waterfall provision (e.g., carried interest, hurdle rate, catch-up provision, vesting, clawback clause).
- Discuss factors (e.g., management fees, incentive-based fees) to consider in a fund's compensation structure and the potential effects of decisions regarding compensation structure.
- Discuss and calculate fund-as-a-whole carried interest and deal-by-deal carried interest.
- Define and apply clawback provisions.
- Compare and apply hard and soft hurdle rates and their sequences of distribution.
- Discuss the potential effects of incentive fees on decision-making, and their optionlike nature.

Topic 2.4: Statistical Foundations

4.1: Demonstrate knowledge of the characteristics of return distributions. (p. 131)

For example:

- Recognize ex ante and ex post return distributions.
- Recognize the importance of the normal distribution in statistical analysis.
- Describe the characteristics of lognormal distributions.

4.2: Demonstrate knowledge of moments of return distributions (i.e., mean, variance, skewness, and kurtosis). (p. 134)

For example:

- Explain the first four raw moments of return distributions.
- Explain the central moments of return distributions.
- Explain skewness of return distributions.
- Explain kurtosis and excess kurtosis of return distributions.
- Describe the characteristics of platykurtic, mesokurtic, and leptokurtic distributions.

4.3: Demonstrate knowledge of various measures of correlation of returns. (p. 140)

For example:

- Recognize the importance of correlation in alternative investment portfolio management.

- Define and calculate covariance.
- Define and calculate correlation coefficient.
- Define and calculate the Spearman rank correlation coefficient.
- Discuss the role of correlation in portfolio diversification.
- Define and calculate beta in the context of the CAPM.
- Define and calculate autocorrelation.
- Define and apply the Durbin-Watson test.

4.4: Demonstrate knowledge of standard deviation (volatility) and variance. (p. 151)

For example:
- Define and explain return standard deviation (volatility).
- Describe the properties of return variance and standard deviation.
- Calculate return variance and standard deviation.

4.5: Demonstrate knowledge of methods used to test for normality of distributions. (p. 154)

For example:
- Recognize the three main reasons for non-normality observed in alternative investment returns (i.e., autocorrelation, illiquidity, and nonlinearity), and discuss the effect of each on returns.
- Discuss tests for normality that use sample moments.
- Recognize and apply the Jarque-Bera test.

4.6: Demonstrate knowledge of time-series return volatility models. (p. 156)

For example:
- Identify various measures used in time-series models (e.g., price levels, price variation, risk).
- Define the concepts of heteroskedasticity and homoskedasticity.
- Recognize the key components of the generalized autoregressive conditional heteroskedasticity (GARCH) method.
- Describe how the GARCH method is used to model risk evolution through time.
- Contrast the GARCH method with the autoregressive conditional heteroskedasticity (ARCH) method.

Topic 2.5: Measures of Risk and Performance

5.1: Demonstrate knowledge of measures of financial risk. (p. 165)

For example:
- Define and calculate semivariance and semistandard deviation.
- Describe shortfall risk, target semivariance, and target semistandard deviation.
- Define and calculate tracking error.
- Describe and calculate drawdown.
- Define and interpret value at risk (VaR), and discuss its strengths and weaknesses as a risk measure.
- Define and interpret conditional value-at-risk (CVaR).

5.2: Demonstrate knowledge of methods for estimating value at risk (VaR). (p. 168)

For example:
- Apply a parametric approach to estimate VaR with normally distributed returns or with normally distributed underlying factors.
- Describe methods for estimating volatility as an input for VaR calculations.

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- Describe methods for estimating VaR for leptokurtic positions.
- Describe methods for estimating VaR directly from historical data.
- Describe how the Monte Carlo analysis can be used to estimate VaR.
- Discuss and apply the aggregation of portfolio-component VaRs to determine the VaR for a portfolio under various assumptions (i.e., perfect correlation, zero correlation, and perfect negative correlation).

5.3: Demonstrate knowledge of ratio-based performance measures used in alternative investment analysis. (p. 171)

For example:

- Define the ratio-based performance measure type.
- Define and calculate the Sharpe ratio.
- Define and calculate the Treynor ratio.
- Recognize and calculate the Sortino ratio, the information ratio, and return on VaR.

5.4: Demonstrate knowledge of risk-adjusted performance measures used in alternative investment analysis. (p. 175)

For example:

- Define the risk-adjusted performance measure type.
- Recognize and calculate Jensen's alpha, M^2 (M-squared), and average tracking error.

Topic 2.6: Foundations of Financial Economics

6.1: Demonstrate knowledge of the concept of informational market efficiency. (p. 183)

For example:

- Define informational market efficiency.
- Recognize various forms of informational market efficiency.
- Identify factors driving informational market efficiency.
- Discuss the differences between informational market efficiency in traditional and alternative asset markets.

6.2: Demonstrate knowledge of single-factor asset pricing models and ex ante pricing. (p. 185)

For example:

- Describe the key characteristics of single-factor asset pricing models.
- Recognize the capital asset pricing model (CAPM).
- Describe the key characteristics of ex ante and ex post asset pricing models.
- Recognize the distinctions between ex ante asset pricing and ex post asset pricing.
- Apply ex ante and ex post pricing in a single-factor framework.
- Define systematic and idiosyncratic risk and return.

6.3: Demonstrate knowledge of multifactor and empirical asset pricing models. (p. 188)

For example:

- Apply and interpret equations representing ex ante and ex post forms of multifactor asset pricing models.

- Distinguish between theoretically derived and empirically identified return factors.
- Describe the steps typically involved in empirical modeling of returns.
- Recognize the key components of the Fama-French and Fama-French-Carhart models, and discuss the appropriate application of these models in alternative investing.
- Discuss three key issues analysts should consider when using empirical multifactor models.

6.4: Demonstrate knowledge of arbitrage-free financial models. (p. 191)

For example:
- Describe arbitrage-free models.
- Discuss applications of arbitrage-free models.
- Describe arbitrage-free pricing in spot markets.
- Describe hedged and unhedged carry trades.
- Define forward contracts, and recognize their uses in hedging.
- Recognize and apply cost-of-carry models.
- Discuss and apply binomial tree models.

6.5: Demonstrate knowledge of the term structure of forward contracts. (p. 196)

For example:
- Identify the two determinants of forward prices on a risky financial security.
- Compare the pricing of forward contracts on financial securities and commodities.
- Apply the cost-of-carry model for pricing forward contracts on financial securities.

6.6: Demonstrate knowledge of option exposures. (p. 198)

For example:
- Recognize the key characteristics of long and short positions in an underlying asset.
- Recognize the key characteristics of call and put exposures.
- Discuss characteristics of option spreads.
- Define bull and bear spreads.
- Discuss option combinations.
- Define and apply the concept of put-call parity.

6.7: Demonstrate knowledge of option pricing models. (p. 205)

For example:
- Recognize and apply the Black-Scholes call option formula.
- Recognize and apply the Black forward option pricing model.
- Recognize and apply the currency option pricing model.

6.8: Demonstrate knowledge of option sensitivities. (p. 207)

For example:
- Recognize and describe the five most popular option sensitivities (i.e., delta, vega, theta, rho, and gamma).
- Discuss option sensitivities.
- Discuss the uses of option sensitivities in risk management.

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Topic 2.7: Benchmarking and Performance Attribution

7.1: Demonstrate knowledge of benchmarking and its role in the analysis of risk and return of investments. (p. 215)

For example:
- Define benchmarking in the context of investing.
- Recognize various types of benchmarks (i.e., peer returns and index returns).
- Apply the concept of benchmarking.
- Discuss considerations in benchmarking (appropriateness of the benchmark selected, statistical significance of performance differences relative to a benchmark, reasons behind performance differences relative to a benchmark).

7.2: Demonstrate knowledge of various types of asset pricing models. (p. 216)

For example:
- Define normative and positive models, and compare their key characteristics.
- Define theoretical and empirical models, and compare their key characteristics.
- Define applied and abstract models, and compare their key characteristics.
- Describe the advantages and disadvantages of various types of models in the context of alternative investments.
- Define cross-sectional and time-series approaches, and compare their key characteristics.

7.3: Demonstrate knowledge of various approaches to performance attribution. (p. 217)

For example:
- Describe the characteristics of single-factor models.
- Apply single-factor models to benchmarking.
- Interpret the results of single-factor benchmarking analysis.
- Discuss multifactor benchmarking.

7.4: Demonstrate knowledge of the limitations of the CAPM approach for analysis of alternative investments. (p. 221)

For example:
- Recognize and describe multiperiod issues in CAPM analysis.
- Recognize and describe the limitations of CAPM analysis when applied to non-normal return distributions in alternative investments.
- Describe the potential effect of illiquidity on returns of alternative investments.

Topic 2.8: Alpha, Beta, and Hypothesis Testing

8.1: Demonstrate knowledge of beta and alpha. (p. 227)

For example:
- Recognize the role of beta in the analysis of traditional and alternative investments.
- Recognize the role of alpha in the analysis of traditional and alternative investments.

8.2: Demonstrate knowledge of the concepts of ex ante and ex post alpha. (p. 228)

For example:
- Define and apply the concept of ex ante alpha, and identify its key characteristics.

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- Define and apply the concept of ex post alpha, and identify its key characteristics.
- Distinguish between ex ante and ex post alpha.

8.3: Demonstrate knowledge of empirical approaches to inferring ex ante alpha from ex post alpha. (p. 231)

For example:
- Identify the steps involved in estimating ex ante alpha from historical performance.
- Discuss challenges to empirical analysis of manager skill.

8.4: Demonstrate knowledge of return attribution. (p. 232)

For example:
- Calculate beta, ex ante, and ex post alpha.
- Recognize the three primary types of model misspecification (i.e., omitted systematic return factors, misestimated betas, and nonlinear risk-return relationships) and their effects on return attribution.
- Describe various types of beta nonstationarity (i.e., beta creep, beta expansion, and market timing) and their effects on return attribution.
- Discuss how alpha and beta can become commingled.

8.5: Demonstrate knowledge of ex ante alpha estimation and return persistence. (p. 235)

For example:
- Recognize the characteristics of return persistence.
- Define abnormal return persistence.
- Discuss attribution of idiosyncratic returns to luck or skill.

8.6: Demonstrate knowledge of return drivers. (p. 236)

For example:
- Discuss the classification of assets into beta drivers and alpha drivers.
- Discuss the characteristics of beta drivers and their behavior over time.
- Discuss passive beta drivers as pure plays on beta.
- Discuss the characteristics of alpha drivers.
- Discuss product innovators and process drivers.

8.7: Demonstrate knowledge of statistical methods for locating alpha. (p. 238)

For example:
- Identify the four steps of hypothesis testing (i.e., state the hypothesis, formulate an analysis plan, analyze sample data, and interpret results).
- Recognize the components of hypothesis statements (i.e., null hypothesis and alternative hypothesis).
- Describe the process of designing hypothesis tests.
- Describe the process of creating test statistics for use in analyzing sample data.
- Explain the decision-making process for rejecting or failing to reject the null hypothesis.
- Recognize the four common problems with using inferential statistics (i.e., misinterpretation of high p-values, failure to distinguish between statistical significance and economic significance, violation of distributional assumptions, and misinterpretation of level of confidence).
- Define and discuss type I and type II errors in hypothesis testing.

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8.8: Demonstrate knowledge of sampling and testing problems. (p. 242)

For example:

- Recognize the characteristics of unrepresentative data sets (e.g., selection bias, self-selection bias, survivorship bias) and their effects on test results.
- Discuss data mining and data dredging, and recognize their effects on test results.
- Discuss backtesting and backfilling, and recognize their effects on test results.
- Discuss cherry-picking and chumming, and recognize their effects on test results.

8.9: Demonstrate knowledge of statistical issues in analyzing alpha and beta. (p. 244)

For example:

- Recognize the effect of non-normality on the cross-sectional search for alpha.
- Identify the potential effects of outliers on reported results.
- Recognize issues involving biased testing in the search for alpha.
- Discuss the challenges of spurious correlation in beta estimation.
- Compare causality of values with true correlation of values.
- Recognize three major fallacies of alpha estimation and the lessons that arise from them.
- Recognize two major fallacies of beta estimation and the lessons that arise from them.

Topic 2.9: Regression, Multivariate, and Nonlinear Methods

9.1: Demonstrate knowledge of single-factor regression models. (p. 254)

For example:

- Explain the use of ordinary least squares to estimate regression parameters.
- Describe the problem outliers pose to regression analysis.
- Describe the problem autocorrelation poses to regression analysis.
- Describe the problem heteroskedasticity poses to regression analysis.
- Interpret a regression's goodness of fit.
- Evaluate the statistical significance of regression parameter estimates.
- Calculate the t-statistic.

9.2: Demonstrate knowledge of multifactor regression models. (p. 259)

For example:

- Describe the ex post version of the Fama-French model.
- Describe the problem that multicollinearity poses to multifactor regression analysis.
- Discuss the selection process of independent variables for multifactor regression analysis and the potential shortcomings to the stepwise regression technique.

9.3: Demonstrate knowledge of dynamic risk exposure models. (p. 261)

For example:

- Define nonlinear exposure.
- Discuss and apply the dummy variable approach to analyzing market-timing strategies.
- Discuss the separate regression approach to analyzing market-timing strategies.
- Discuss and apply the quadratic approach to analyzing market-timing strategies.

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9.4: Demonstrate knowledge of methods for modeling changing correlation. (p. 265)

For example:
- Recognize and describe the concept of conditional correlation.
- Describe the rolling window approach to modeling changing correlation.

9.5: Demonstrate knowledge of approaches to analyzing hedge fund returns using multifactor models. (p. 266)

For example:
- Describe how style analysis and asset class groupings can be used to analyze fund performance.
- Describe how performance of a fund can be analyzed using returns of funds with similar strategies.
- Describe how marketwide factors can be used to analyze performance of a fund.
- Describe how specialized market factors can be used in hedge fund replication.

9.6: Demonstrate knowledge of estimating hedge fund performance persistence. (p. 269)

For example:
- Discuss approaches to estimating hedge fund performance persistence.

Topic 3: Real Assets

Topic 3.1: Natural Resources and Land

10.1: Demonstrate knowledge of natural resources other than land. (p. 276)

For example:
- Discuss natural resources as an exchange option.
- Discuss the concept of moneyness as it pertains to the development of natural resources.
- Discuss why some in-the-money options should not be immediately exercised.
- Describe the relationship between the moneyness of natural resource options and short-term financial risks.

10.2: Demonstrate knowledge of land as an alternative asset. (p. 279)

For example:
- Define land banking.
- Describe the three types of land lots (i.e., paper lots, blue top lots, and finished lots).
- Discuss investment in undeveloped land as a call option.
- Apply the binomial option pricing model approach for valuing land as a call option.
- Describe the risks and returns of investing in land.
- Calculate the expected return of land investments.

10.3: Demonstrate knowledge of timber and timberland as alternative assets. (p. 284)

For example:
- Discuss the characteristics of timber and timberland.
- Discuss the role of timberland investment management organizations (TIMOs).
- Describe the risks and returns of timberland investments.
- Identify methods of timberland ownership.

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10.4: Demonstrate knowledge of farmland as an alternative asset. (p. 286)

For example:
- Discuss the characteristics of farmland investments.
- Calculate the value of farmland based on annual operating income and the cap rate.
- Discuss financial analysis of farmland investments.
- Discuss factors that affect farmland prices and returns.
- Describe farmland as a multiple use option.
- Identify methods of obtaining exposure to farmland.

10.5: Demonstrate knowledge of valuation and volatility of real assets. (p. 289)

For example:
- Discuss the smoothing of prices and returns.
- Determine the effect of smoothing on observed volatility.
- Describe how values and returns are managed.
- Discuss how appraisals contribute to smoothing of real asset prices.
- Compare smoothed returns with market returns.

10.6: Demonstrate knowledge of historical performance of timber and farmland. (p. 290)

For example:
- Recognize inferences that can be drawn from comparing definable characteristics of timber and farmland investing with their historical stand-alone and portfolio performance.

Topic 3.2: Commodity Forward Pricing

11.1: Demonstrate knowledge of forward and futures contracts. (p. 298)

For example:
- Describe the trading differences between forward and futures contracts.
- Describe and apply the marking-to-market process for futures positions.
- Discuss the effect of marking-to-market on counterparty risk.
- Recognize the effect of marking-to-market and the time value of money on risk and prices.
- Define and calculate initial margin for futures positions.
- Define and calculate maintenance margin for futures positions.

11.2: Demonstrate knowledge of the rolling futures contracts. (p. 302)

For example:
- Explain the process of maintaining long-term futures exposures through short-term futures positions.
- Discuss the effects of rollover decisions on the returns of long-term futures exposures.

11.3: Demonstrate knowledge of the term structure of forward prices on commodities. (p. 304)

For example:
- Recognize the cost-of-carry model for commodity futures contracts.
- Calculate cost of carry for commodity futures contracts.
- Recognize arbitrage-free forward pricing for physical assets.
- Calculate arbitrage-free forward prices for physical assets.

- Recognize limitations to arbitrage-free forward pricing for physical assets.
- Discuss the effect of harvests, supply elasticity, and shifts in supply and demand on the term structure of forward prices.

11.4: Demonstrate knowledge of the concepts of backwardation, normal backwardation, contango, and normal contango. (p. 310)

For example:
- Define and compare backwardated markets and markets in contango.
- Discuss backwardation and contango in informationally efficient markets.
- Define and compare normal backwardation and normal contango.
- Discuss normal backwardation and normal contango in informationally efficient and inefficient markets.

11.5: Demonstrate knowledge of the characteristics of returns on forward and futures contracts. (p. 314)

For example:
- Discuss futures and forward contracts as alpha and beta drivers.
- Define the law of one price.
- Describe the relationship between ex ante alpha and the shape of the term structure of forward prices.
- Discuss informationally inefficient term structures of forward curves.
- Define and determine the basis of forward contracts.
- Describe calendar spreads, and discuss their risks and returns.
- Calculate returns to calendar spread positions.

Topic 3.3: Commodities: Applications and Evidence

12.1: Demonstrate knowledge of the diversification benefits of commodities. (p. 325)

For example:
- Explain the sources of potential diversification benefits offered by commodities.
- Discuss commodities in the context of equilibrium diversification.
- Discuss how market imperfections relate to determining allocations to commodities.
- Discuss commodities as a diversifier of inflation risk.

12.2: Demonstrate knowledge of commodities as potential return enhancers. (p. 328)

For example:
- Discuss potential return enhancement from idiosyncratic returns.
- Discuss potential return enhancement from systematic returns in efficient markets.
- Discuss potential return enhancement from systematic returns in inefficient markets.
- Discuss potential return enhancement from providing insurance through commodity futures.

12.3: Demonstrate knowledge of investing in commodities without futures. (p. 329)

For example:
- Recognize characteristics of physical ownership of commodities.
- Recognize investments in commodities through related equity instruments.
- Recognize investments in commodities through exchange-traded funds (ETFs).
- Recognize investments in commodities through commodity-linked notes.
- Apply option valuation methods to price commodity-linked notes.

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12.4: Demonstrate knowledge of commodity investment through futures contracts. (p. 333)

For example:
- Recognize the basis risk and investments in commodities through futures contracts.
- Recognize the components of returns to futures positions (i.e., spot return, roll yield, collateral yield, and excess return).
- Describe roll yield for financial and physical commodity futures.
- Describe the two interpretations of rolling contracts.
- Relate roll yield to the slope of the forward curve.
- Discuss convergence and the relationship between futures and spot prices through time.
- Calculate the aggregated profit or loss for a futures position.
- Recognize rollover strategies and their effect on returns from futures investments.
- Recognize the three propositions regarding roll return.

12.5: Demonstrate knowledge of commodity indices. (p. 339)

For example:
- Discuss the process of construction of commodity futures indices.
- Discuss the characteristics of commodity indices given by S&P GSCI, BCOM, and CRB.

12.6: Demonstrate knowledge of risks associated with commodity investments. (p. 340)

For example:
- Discuss the effect of event risk on returns from investments in commodities.
- Discuss the role of commodities as defensive investments.
- Discuss acceptance of commodity investments by institutional investors.

12.7: Demonstrate knowledge of the return characteristics of commodity investments. (p. 342)

For example:
- Recognize inferences that can be drawn from comparing definable characteristics of commodities with their historical investment performance.

Topic 3.4: Operationally Intensive Real Assets

13.1: Demonstrate knowledge of commodity producers. (p. 352)

For example:
- Describe how commodity prices affect operating performance of firms that transform natural resources into commodities.
- Describe the relationship between commodity prices and equity prices of commodity-producing firms.
- Discuss the empirical evidence on the correlation between commodity prices and the equity prices of commodity-producing firms.

13.2: Demonstrate knowledge of liquid alternative real assets. (p. 354)

For example:
- Discuss the structure of master limited partnerships (MLPs) and characteristics of the MLP sector.
- Identify the tax characteristics of MLPs.
- Discuss valuation of MLPs.

13.3: Demonstrate knowledge of infrastructure as an alternative asset. (p. 355)

For example:
- Recognize the seven characteristics that distinguish investable infrastructure from other assets.
- Contrast economic and social infrastructure.
- Discuss the influence of government on infrastructure investments.
- Describe investment vehicles for investing in infrastructure.
- Describe the risks and rewards of infrastructure investments.

13.4: Demonstrate knowledge of intellectual property as an alternative asset. (p. 359)

For example:
- Discuss intellectual property as an investment.
- Describe characteristics of intellectual property.
- Recognize the factors that contribute to returns of film projects.
- Define and apply the simplified model for valuing intellectual property.

Topic 3.5: Liquid and Fixed-Income Real Estate

14.1: Demonstrate knowledge of real estate as an investment. (p. 369)

For example:
- List five common attributes of real estate that encourage its inclusion in investment portfolios.
- Discuss heterogeneity, lumpiness, and illiquidity of real estate.
- Discuss and contrast core, value-added, and opportunistic real estate investment styles.

14.2: Demonstrate knowledge of residential mortgages in the context of alternative investments. (p. 371)

For example:
- Define mortgages, and differentiate between fixed- and variable-rate mortgages.
- Describe characteristics of fixed-rate mortgages, including amortization.
- Recognize the determinants of the monthly payment on a mortgage loan.
- Calculate monthly payments for fixed-rate and variable-rate mortgages.
- Calculate the outstanding mortgage balance.
- Describe the prepayment option embedded in fixed-rate mortgages.
- Describe characteristics of interest-only mortgages.
- Identify and apply the formula for valuation of interest-only mortgages.
- Describe characteristics of variable-rate mortgages.
- Identify and apply the formula for valuation of variable-rate mortgages.
- Describe other variations of mortgages.
- Calculate the monthly payments for a mortgage with a balloon payment.
- Describe default risk for residential mortgages.

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14.3: Demonstrate knowledge of commercial mortgages in the context of alternative investments. (p. 378)

For example:
- Describe characteristics of commercial mortgages.
- Identify, describe, and apply financial ratios (i.e., loan-to-value ratio, interest coverage ratio, debt service coverage ratio, and fixed charges ratio) employed in the analysis of commercial mortgages.

14.4: Demonstrate knowledge of mortgage-backed securities. (p. 381)

For example:
- Discuss residential mortgages and their prepayment options.
- Discuss and apply methods of measuring unscheduled prepayment rates.
- Describe and apply conditional prepayment rates (CPRs) and the resulting Public Securities Association (PSA) benchmark.
- List prepayment factors not associated with changing interest rates.
- Identify and describe commercial mortgage-backed securities, and compare and contrast them with residential mortgage-backed securities.

14.5: Demonstrate knowledge of real estate investment trusts (REITs). (p. 384)

For example:
- Define a real estate investment trust (REIT).
- List the key advantages of REITs.
- Discuss potential disadvantages of REITs as well as their main income restrictions.

14.6: Demonstrate knowledge of historical performance of mortgage REITs. (p. 386)

For example:
- Recognize inferences that can be drawn from comparing definable characteristics of mortgage REITs with their historical stand-alone and portfolio performance.

Topic 3.6: Real Estate Equity Investments

15.1: Demonstrate knowledge of real estate development in the context of alternative investments. (p. 393)

For example:
- Describe the processes of developing real estate.
- Describe the valuing of real estate development as a string of real options.
- Apply a decision tree and backward induction to value real estate development projects.

15.2: Demonstrate knowledge of valuation and risks of real estate equity. (p. 397)

For example:
- Recognize and apply the discounted cash flow approach (i.e., income approach) to valuing real estate, including the calculation of net operating income and the discount rate.
- Discuss the use of comparable sale prices for valuing real estate.

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15.3: Demonstrate knowledge of alternative real estate investment vehicles. (p. 400)

For example:

- Identify and describe private equity real estate funds.
- Identify and describe commingled real estate funds.
- Identify and describe syndications.
- Identify and describe joint ventures.
- Describe limited partnerships, and apply the concepts of gearing and loan-to-value (LTV) ratios.
- Identify and describe open-end real estate mutual funds.
- Discuss options and futures on real estate indices.
- Identify and describe exchange-traded funds based on real estate indices.
- Identify and describe closed-end real estate mutual funds.
- Discuss equity real estate investment trusts.

15.4: Demonstrate knowledge of depreciation of real estate. (p. 406)

For example:

- Describe and apply various methods of depreciation of real estate (i.e., without income taxation, with depreciation disallowed for tax purposes, with economic depreciation allowed for tax purposes, with accelerated depreciation allowed for tax purposes, and with expensing of capital expenditures for tax purposes) in the analysis of returns.

15.5: Demonstrate knowledge of real estate equity risks and returns as represented by real estate indices. (p. 412)

For example:

- Discuss real estate indices based on appraisals.
- Identify and describe data smoothing and its major effects.
- Discuss real estate indices based on adjusted privately traded prices.
- Discuss real estate indices based on market prices.

15.6: Demonstrate knowledge of historical performance of equity REITs. (p. 414)

For example:

- Recognize inferences that can be drawn from comparing definable characteristics of equity REITs with their historical stand-alone and portfolio performance.

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The following is a review of the Professional Standards and Ethics principles designed to address the learning objectives set forth by the CAIA Association®.

Professional Standards and Ethics

Topic 1

Exam Focus

This topic review begins with a brief introduction to the Standards of Professional Conduct and then focuses on Standards I through VI from the *Standards of Practice Handbook*[1]. Standards I and II encompass ethical responsibilities related to professionalism and integrity of capital markets. Provisions include Knowledge of the Law, Independence and Objectivity, Misrepresentation, Misconduct, Material Nonpublic Information, and Market Manipulation. Standards III and IV encompass ethical responsibilities related to duties to clients and prospective clients and duties to employers. Provisions include Loyalty, Prudence, and Care; Fair Dealing; Suitability; Performance Presentation; Loyalty; Preservation of Confidentiality; Additional Compensation Arrangements; and Responsibilities of Supervisors. Standards V and VI encompass ethical responsibilities related to investment analysis, recommendations, and action and conflicts of interest. Provisions include Diligence and Reasonable Basis, Communication With Clients and Prospective Clients, Record Retention, Disclosure of Conflicts, Priority of Transactions, and Referral Fees.

Warm-Up: Standards of Professional Conduct

For the CAIA exam, you should understand the first six Standards of Professional Conduct:

I. Professionalism.
II. Integrity of Capital Markets.
III. Duties to Clients.
IV. Duties to Employers.
V. Investment Analysis, Recommendations, and Actions.
VI. Conflicts of Interest.

Each Standard contains multiple provisions for which the candidate is responsible. The candidate should be able to identify the ethical responsibilities required by the Standards.

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

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or assist in and must dissociate from any violation of such laws, rules, or regulations.

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.

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 the client's or prospective client's 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.

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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 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 ensure that anyone subject to their supervision or authority complies with applicable laws, rules, regulations, and the Code and Standards.

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V. **Investment Analysis, Recommendations, and Actions.**

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. Disclose to clients and prospective clients significant limitations and risks associated with the investment process.

3. 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.

4. Distinguish between fact and opinion in the presentation of investment analyses 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, 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 from or paid to others for the recommendation of products or services.

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I. Professionalism

LO A.1: Demonstrate knowledge of Standard I: Professionalism.

For example:

- **State and interpret Standard I with respect to knowledge of the law, independence and objectivity, misrepresentation, and misconduct.**
- **Recognize procedures for compliance with respect to knowledge of the law, independence and objectivity, misrepresentation, and misconduct.**

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

I(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 and must dissociate from any violation of such laws, rules, or regulations.

Guidance—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. Always adhere to the most strict rules and requirements (law or CFA Institute Standards) that apply (e.g., do not violate Standards even if the activity is otherwise legal).

Guidance—Participation or Association with Violations by Others

Members should disassociate, or separate themselves, from any ongoing client, employer, or employee activity that is illegal or unethical, even if it involves leaving an employer (an extreme case). While a member may first confront the involved individual, 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 abide by current laws, 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.

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- 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.
- Members are strongly encouraged to report other members' violations of the Code and Standards.

Recommended Procedures for Compliance—Firms

Members should encourage their firms to do all of the following:

- 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.

Members who supervise the creation and maintenance of investment services and products should be aware of and comply with the regulations and laws regarding such services and products both in their country of origin and the countries where they will be sold.

Application of Standard I(A) Knowledge of the Law[2]

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. Washington discovers, however, that the composite omits the performance of accounts that have left the firm during the 10-year period, whereas the description of the composite indicates the inclusion of all firm accounts. 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.

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Comment:

Misrepresenting performance is a violation of the Standards. Although she did not calculate the performance herself, Washington would be assisting in violating this standard if she were to use the inflated performance number when soliciting clients. She must dissociate herself from the activity. If discussing the misleading number with the person responsible is not an option for correcting the problem, she can bring the situation to the attention of 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:

Laura Jameson, a U.S. citizen, works for an investment advisor 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

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.

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, either prior to acceptance if possible, or subsequently.

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.

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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. Portfolio managers have a responsibility to respect and foster intellectual honesty of sell-side research.

Guidance—Fund Manager and Custodial Relationships

Members responsible for selecting outside managers should not accept gifts, entertainment, or travel that might be perceived as impairing their objectivity.

Guidance—Performance Measurement and Attribution

Performance analysts may experience pressure from investment managers who have produced poor results or acted outside their mandate. Members and candidates who analyze performance must not let such influences affect their analysis.

Guidance—Manager Selection

Members and candidates must exercise independence and objectivity when they select investment managers. They should not accept gifts or other compensation that could be seen as influencing their hiring decisions, nor should they offer compensation when seeking to be hired as investment managers. The responsibility to maintain independence and objectivity applies to all of a member or candidate's hiring and firing decisions, not just those that involve investment management.

Guidance—Credit Rating Agencies

Members employed by credit rating firms should make sure that procedures prevent undue influence by the firm issuing the securities. Members who use credit ratings should be aware of this potential conflict of interest and consider whether independent analysis is warranted.

Guidance—Issuer-Paid Research

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.

Guidance—Travel

Best practice is for analysts to pay for their own commercial travel when attending information events or tours sponsored by the firm being analyzed.

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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. Firms should impose clear value limits on gifts.
- Restrict employee investments in equity IPOs and private placements. Require pre-approval of IPO purchases.
- Review procedures—have effective supervisory and review procedures.
- Firms should have formal written policies on independence and objectivity of research.
- Firms should appoint a compliance officer and provide clear procedures for employee reporting of unethical behavior and violations of applicable regulations.

Application of Standard I(B) Independence and Objectivity[3]

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 the company where Adams works 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 upon a member or candidate's independence and objectivity. In this example, the trip was strictly for business, and Taylor was not accepting unnecessary 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) as 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 &

3. Ibid.

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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.

The firm claims compliance with the Global Investment Performance Standards (GIPS) and has been verified. Following the selection of Penguin, a reporter from the *Franklin City Record* calls to ask if there was any connection between this 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 also 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 partly paid 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 firms competing with Penguin Advisors.

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Example 4:

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 arrived at independently. Following the boss's instructions would be a violation if the analyst determined a buy rating is inappropriate.

Example 5:

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 because 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 would have to obtain permission from her 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 6:

A member whose firm is seeking to become an investment manager for a labor union contributes a large sum to the union leader's re-election campaign. After the union hires the member's firm, the member continues to spend significant amounts on entertainment for the union leader and his family.

Comment:

Offering gifts or other compensation to influence a decision to hire an investment manager is a violation of Standard I(B).

Example 7:

A member who is a performance analyst notices that one of her firm's top investment managers has changed his composite construction, removing a poorly performing large account and placing it in a different composite. Knowing that the investment manager is important to the firm and a close friend of the firm's CEO, the member does not disclose this change in her performance report.

Comment:

The member violated Standard I(B) by failing to exercise independence and objectivity in her analysis. Altering composites to conceal poor performance also violates Standard III(D) Performance Presentation and may violate Standard I(C) Misrepresentation.

I(C) Misrepresentation

Members and Candidates must not knowingly make any misrepresentations relating to investment analysis, recommendations, actions, or other professional activities.

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Guidance

Trust is a foundation in the investment profession. Do not make any misrepresentations or give false impressions. This includes oral, electronic, and social media 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. Knowingly omitting information that could affect an investment decision is considered misrepresentation.

Models and analysis developed by others at a member's firm are the property of the firm and can be used without attribution. A report written by another analyst employed by the firm cannot be released as another analyst's work.

Recommended Procedures for Compliance

Firms can avoid misrepresentation by providing employees who deal with clients or prospects with 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.

Members should encourage their firms to establish procedures for verifying marketing claims of third parties whose information the firm provides to clients.

Application of Standard I(C) Misrepresentation[4]

Example 1:

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

Comment:

McGuire has violated Standard I(C) because the internet site is 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(A): Disclosure of Conflicts by not disclosing the existence of an arrangement with the companies through which he receives compensation in exchange for his services.

Example 2:

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

4. Ibid.

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is intrigued by the new concepts. He proceeds to test the model, making some minor mechanical changes but retaining the concepts, 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 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 3:

Paul Ostrowski runs a 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 by smaller firms for those firms' clients. Ostrowski's firm distributes these reports to clients as original work.

Comment:

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 4:

A member describes an interest-only collateralized mortgage obligation as guaranteed by the U.S. government because 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 5:

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.

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Topic 1

I(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.

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[5]

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 in 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.

5. Ibid.

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Example 3:

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

LO A.2: Demonstrate knowledge of Standard II: Integrity of Capital Markets.

For example:
- **State and interpret Standard II with respect to material nonpublic information, and market manipulation.**
- **Recognize procedures for compliance with respect to material nonpublic information.**

II(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.

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. The prohibition against acting on material nonpublic information extends to mutual funds containing the subject securities as well as related swaps and options contracts.

Some members and candidates may be involved in transactions during which they receive material nonpublic information provided by firms (e.g., investment banking transactions). Members and candidates may use the provided nonpublic information for its intended purpose but must not use the information for any other purpose unless it becomes public information.

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.

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Guidance—Social Media

When gathering information from internet or social media sources, members and candidates need to be aware that not all of it is considered public information. Members and candidates should confirm that any material information they receive from these sources is also available from public sources, such as company press releases or regulatory filings.

Guidance—Industry Experts

Members and candidates may seek insight from individuals who have specialized expertise in an industry. However, they may not act or cause others to act on any material nonpublic information obtained from these experts until that information has been publicly disseminated.

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 only take the contra side of unsolicited customer trades.

Application of Standard II(A) Material Nonpublic Information[6]

Example 1:

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

6. Ibid.

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the firm. The salespeople and portfolio managers who traded on the information have also violated Standard II(A) by trading on inside information.

Example 2:

Elizabeth Levenson is based in Taipei and covers the Taiwanese market for her firm, which is based in Singapore. She is invited, together with the other 10 largest shareholders of a manufacturing company, to meet the finance director of that 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.

Example 3:

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

Comment:

Information on quarterly earnings figures is material and nonpublic. 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 4:

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 nonpublic information. The member has violated the Standard.

Example 5:

A member trades based on information he gets by seeing an advance copy of an article that will be published in an influential magazine next week.

Comment:

This is a violation as this is material nonpublic information until the article has been published.

II(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.

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[7]

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. Some of the hedge funds hold short positions on Wirewolf Semiconductor. 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 that will include the following opinion:

- 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.
- 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.

7. Ibid.

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Comment:

Murphy violated Standard II(B) by aiming 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): Diligence and Reasonable Basis.

Example 2:

ACME Futures Exchange is launching a new bond futures contract. 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 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:

The formal liquidity of 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, but they could eventually see the actual liquidity of the contract significantly reduced after the term of the agreement expires. If ACME Futures Exchange 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 the strategy 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.

Topic 1

III. Duties to Clients

LO A.3: Demonstrate knowledge of Standard III: Duties to Clients.

For example:

- **State and interpret Standard III with respect to loyalty, prudence and care, fair dealing, suitability, performance presentation, and preservation of confidentiality.**
- **Recognize procedures for compliance with respect to loyalty, prudence and care, fair dealing, suitability, performance presentation, and preservation of confidentiality.**

III(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.

Guidance

Client interests always come first. Although this Standard does not impose a fiduciary duty on members or candidates where one does not already exist, it does require members and candidates to act in their clients' best interest and recommend products that are suitable for their clients' investment objectives and risk tolerance. Members and candidates must:

- 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.
- Inform clients of any limitations in an advisory relationship (e.g., an advisor who may only recommend her own firm's products).
- 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.
- The "client" may be the investing public as a whole rather than a specific entity or person.

Recommended Procedures of Compliance

At least quarterly, submit to clients 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.

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- Diversify.
- Deal fairly with all clients in regard 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[8]

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 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, which was the trustee for a pension plan, clearly violated Standard III(A). He used the pension 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 have taken precedence over any ties to corporate managers and self-interest. Wiley had a duty to examine the 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 benefitted 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.

8. Ibid.

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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. Rome is placing her own interests before those of her clients.

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 because the member used client brokerage for services that do not benefit clients and failed to get the best price and execution for the 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.

III(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.

Guidance

Do not discriminate against any clients when disseminating recommendations or taking investment action. Fairly does not necessarily mean equally. In the normal course of business, there will be differences in the time emails, faxes, et cetera 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.

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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 the following 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 of new or changed recommendations to all candidates who have expressed an interest or for whom an investment is suitable.
- Maintain a list of clients and holdings—use it 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.
- Prorate oversubscribed security issues to all interested parties on a round-lot basis.
- Establish systematic account review—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[9]

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.

9. Ibid.

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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 five-year period. 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 first sold 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 when they become clients. 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.

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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 Members and Candidates are in an advisory relationship with a client, they must:

    a. Make a reasonable inquiry into a client's or prospective client's 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 only investment actions that are consistent with the stated objectives and constraints of the portfolio.

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, 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, ensure investments are consistent with the stated mandate.

Guidance—Unsolicited Trade Requests

An investment manager might receive a client request to purchase a security that the manager knows is unsuitable, given the client's investment policy statement. The trade may or may not have a material effect on the risk characteristics of the client's total portfolio, and the requirements are different for each case. In either case, however, the manager should not make the trade until he has discussed with the client the reasons (based on the IPS) that the trade is unsuitable for the client's account.

If the manager determines that the effect on the risk/return profile of the client's total portfolio is minimal, the manager, after discussing with the client how the trade does not fit the IPS goals and constraints, may follow his firm's policy with regard to unsuitable trades. Regardless of firm policy, the client must acknowledge the discussion and an understanding of why the trade is unsuitable.

If the trade would have a material impact on the risk/return profile of the client's total portfolio, one option is to update the IPS so that the client accepts the changed risk profile that would permit the trade. If the client will not accept a changed IPS, the manager may follow firm policy, which may allow the trade to be made in a separate client-directed account. In the absence of other options, the manager may need to reconsider whether to maintain the relationship with the client.

Recommended Procedures for Compliance

Members should:

- Put the needs and circumstances of each client and the client's investment objectives into a written IPS.
- Consider the type of client and whether there are separate beneficiaries, investor objectives (return and risk), investor constraints (liquidity needs, expected cash flows, time horizon, tax, and regulatory and legal circumstances), and performance measurement benchmarks.
- Review investor's objectives and constraints periodically to reflect any changes in client circumstances.

Application of Standard III(C) Suitability[10]

Example 1:

Jessica McDowell, an investment advisor, 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. McDowell 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, the characteristics of single securities on an issue-by-issue basis. 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 are those that will affect the characteristics of the total portfolio. In this case, McDowell properly considers the investment in the context of the entire portfolio and thoroughly explains the investment to the client.

10. Ibid.

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Example 2:

Max Gubler, chief investment officer of a property/casualty insurance subsidiary of a large financial conglomerate, wants to improve the diversification of the subsidiary's investment portfolio and increase its returns. The subsidiary's investment policy statement provides for highly liquid investments, such as large-cap equities and government, supranational, and 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 its private equity funds that provide seed capital to ventures. An exit strategy was already contemplated, but investors would have to observe a minimum three-year lock-up period and a subsequent laddered exit option for a maximum of one-third of their shares per year. Gubler does not want to miss this opportunity. After extensive analysis, with the intent to optimize the return on the equity assets within the subsidiary'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 is violating Standard III(A): Loyalty, Prudence, and Care as well as Standard III(C). His new investment locks up part of the subsidiary's assets for at least three years and up to as many as five years and possibly beyond. 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 a lock-up period, an asset class with only an occasional, and thus implicitly illiquid, market may not be suitable for the portfolio. Although an IPS typically describes objectives and constraints in great detail, the manager must also make every effort to understand the client's business and circumstances. Doing so should 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.

III(D) Performance Presentation

When communicating investment performance information, Members and Candidates must make reasonable efforts to ensure that it is 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. For brief presentations, members must make detailed information available on request and indicate that the presentation has offered limited information.

Recommended Procedures for Compliance

Encourage firms to adhere to Global Investment Performance Standards (GIPS). 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 a weighted composite of similar portfolios rather than a single account.
- Including terminated accounts as part of historical performance and clearly stating when they were terminated.
- 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[11]

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, "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 has never averaged that growth for more than one year, however, and the average rate of growth of all of its trust accounts for five years is 5% per year.

Comment:

Taylor's brochure is in violation of Standard III(D). Taylor should have disclosed that the 25% growth occurred only in 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): Misrepresentation, 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 prepares an advertisement that includes the equity investment performance he achieved at G&P Financial. The advertisement for Mastermind does not identify the equity performance as being earned while at G&P. The advertisement is 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.

11. Ibid.

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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.

Example 5:

A member changes his firm's performance attribution method to one he believes is more consistent with the strategies used by the firm's investment managers.

Comment:

To avoid a violation of the Standard, the member must disclose this change to existing and new clients. He should explain the reasons for changing the method and report the managers' performance attribution using both the old and new methods so that clients may compare them.

III(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,
2. Disclosure is required by law, or
3. The client or prospective client permits disclosure of the information.

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. Members should follow firm procedures for

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storage of electronic data and recommend adoption of such procedures if they are not in place.

Application of Standard III(E) Preservation of Confidentiality[12]

Example 1:

Sally 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 a 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 businessman, 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 and some questionable practices of the CFO that Bradford 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 or appropriate legal 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.

12. Ibid.

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IV. Duties to Employers

LO A.4: Demonstrate knowledge of Standard IV: Duties to Employers.

For example:
- **State and interpret Standard IV with respect to loyalty, additional compensation arrangements, and responsibilities of supervisors.**
- **Recognize procedures for compliance with respect to additional compensation arrangements, and responsibilities of supervisors.**

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.

Guidance

Members must not engage in any activities that would injure the firm, deprive it of profit, or deprive it of the advantage of employees' skills and abilities. Members should always place client interests above their employer interests. 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—Employer Responsibility

Members are encouraged to give their employer a copy of the Code and Standards. Employers should not have incentive and compensation systems that encourage unethical behavior.

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 the resignation is effective. Activities that may constitute a violation include the following:

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

- Self-dealing.
- Misappropriation of client lists.

Employer records on any medium (e.g., home computer, PDA, cell phone) are the property of the firm.

Once an employee has left a firm, simple knowledge of names and existence of former clients is generally not confidential. There is also no prohibition on the use of experience or knowledge gained while with a former employer. If an agreement exists among employers (e.g., the U.S. "Protocol for Broker Recruiting") that permits a broker to take certain client information when leaving a firm, a member or candidate may act within the terms of the agreement without violating the Standard.

Guidance—Social Media

Members and candidates must adhere to their employers' policies concerning social media. When planning to leave an employer, members and candidates must ensure that their social media use complies with their employers' policies for notifying clients about employee separations. A best practice is to use separate social media accounts for personal and professional communications.

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[13]

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.

13. Ibid.

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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). Employer records include items stored in hard copy or any other medium (e.g., home computers, portable storage devices, cell phones).

Example 2:

Dennis Elliot 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.

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 Standards do not impose a prohibition on the use of experience or knowledge gained at one employer from being used at another employer. The 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, 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 Standards.

Example 3:

Several employees are planning to depart their current employer within a few weeks 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?

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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 violates Standard IV(A) unless the group of employees receives permission from their employer as well as the entity sending out the RFP.

Example 4:

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 5:

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.

IV(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.

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 email communication. Members and candidates who are hired to work part time should discuss any arrangements that may compete with their employer's interest at the time they are hired and abide by any limitations their employer identifies.

Recommended Procedures for Compliance

Make an immediate written report to employer detailing proposed compensation and services, if in addition to any compensation or benefits provided by employer. Details including any performance incentives should be verified by the offering party.

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Application of Standard IV(B) Additional Compensation Arrangements[14]

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:

Because 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

Members and Candidates must make reasonable efforts to ensure that anyone subject to their supervision or authority complies with applicable laws, rules, regulations, and the Code and Standards.

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

Guidance

Members must make reasonable efforts to *prevent* employees from violating laws, rules, regulations, or the Standards, as well as make reasonable efforts to *detect* violations.

14. Ibid.

Guidance—Compliance Procedures

An adequate compliance system must meet industry standards, regulatory requirements, and the requirements of the 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.

A member or candidate faced with no compliance procedures or with procedures he believes are inadequate must decline supervisory responsibility in writing until adequate procedures are adopted by the firm.

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.
- Structure incentives so that unethical behavior is not rewarded.

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.
- Review procedures and identify changes that are needed to prevent violations in the future.

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

Application of Standard IV(C) Responsibilities of Supervisors[15]

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.

15. Ibid.

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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 has violated Standard IV(C) by failing to reasonably and adequately supervise 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.

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Topic 1

V. Investment Analysis, Recommendations, and Action

LO A.5: Demonstrate knowledge of Standard V: Investments Analysis, Recommendations, and Actions.

For example:

- **State and interpret Standard V with respect to diligence and reasonable basis, communication with clients and prospective clients, and record retention.**
- **Recognize procedures for compliance with respect to diligence and reasonable basis, communication with clients and prospective clients, and record retention.**

V(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.

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—Reasonable Basis

The level of research required to satisfy the requirement for due diligence will differ depending on the product or service offered. A list of some things that should be considered prior to making a recommendation or taking investment action includes:

- Global and national economic conditions.
- A firm's financial results, operating history, and business cycle stage.
- Fees and historical results for a mutual fund.
- Limitations of any quantitative models used.
- A determination of whether peer group comparisons for valuation are appropriate.

Guidance—Using Secondary or Third-Party Research

Members should encourage their firms to adopt a policy for periodic review of the quality of third-party research, if they have not. Examples of criteria to use in judging quality are:

- Review assumptions used.
- Determine how rigorous the analysis was.
- Identify how timely the research is.
- Evaluate objectivity and independence of the recommendations.

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Guidance—Using Quantitative Research

Members must be able to explain the basic nature of the quantitative research and how it is used to make investment decisions. Members should consider scenarios outside those typically used to assess downside risk and the time horizon of the data used for model evaluation to ensure that both positive and negative cycle results have been considered.

Guidance—Developing Quantitative Techniques

The Standard requires greater diligence of members and candidates who create quantitative techniques than of those who use techniques developed by others. Members and candidates must understand the technical details of the products they offer to clients. A member or candidate who has created a quantitative strategy must test it thoroughly, including extreme scenarios with inputs that fall outside the range of historical data, before offering it to clients.

Guidance—External Advisers

Members should make sure their firms have procedures in place to review any external advisers they use or promote to ensure that, among other things, the advisers:

- Have adequate compliance and internal controls.
- Present returns information that is correct.
- Do not deviate from their stated strategies.

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.
- Have written procedures that provide a minimum acceptable level of scenario testing for computer-based models and include standards for the range of scenarios, model accuracy over time, and a measure of the sensitivity of cash flows to model assumptions and inputs.
- Have a policy for evaluating outside providers of information that addresses the reasonableness and accuracy of the information provided and establishes how often the evaluations should be repeated.
- Adopt a set of standards that provides criteria for evaluating external advisers and states how often a review of external advisers will be performed.

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Application of Standard V(A): Diligence and Reasonable Basis[16]

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:

A member screens a database of investment managers and sends a recommendation of five of them to a client. Subsequently, but before the client receives the report, one of the recommended firms loses its head of research and several key portfolio managers. The member does not update her report.

Comment:

This is a violation, as the member should have notified the client of the change in key personnel at the management firm.

Example 3:

A member writes a report in which she estimates mortgage rates. After reviewing it, a majority of the investment committee vote to change the report to reflect a different interest rate forecast. Must the member dissociate herself from the report?

Comment:

The same facts may give rise to different opinions and as long as the committee has a reasonable and adequate basis for their (differing) opinion, the member is under no obligation to ask that her name be removed from the report or to disassociate from issuing the report.

Example 4:

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.

16. Ibid.

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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 5:

A member selects an outside advisor for international equities based solely on the fact that the selected firm has the lowest fees for managing the international equities accounts.

Comment:

This is a violation of Standard V(A). The member must consider performance and service, not just fees, in selecting an outside advisor for client accounts.

V(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 they use to analyze investments, select securities, and construct portfolios and must promptly disclose any changes that might materially affect those processes.

2. Disclose to clients and prospective clients significant limitations and risks associated with the investment process.

3. 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.

4. Distinguish between fact and opinion in the presentation of investment analyses and recommendations.

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.

In preparing recommendations for structured securities, allocation strategies, or any other nontraditional investment, members should communicate those risk factors specific to such investments. In all cases, members should communicate the potential gains and losses on the investment clearly in terms of total returns. Members are required to communicate significant changes in the risk characteristics of an investment or strategy and update clients regularly about changes in the investment process, including risks and limitations that have been newly identified.

When using projections from quantitative models and analysis, members may violate the Standard by not explaining the limitations of the model and the assumptions it uses, which provides a context for judging the uncertainty regarding the estimated investment result.

Members and candidates must inform clients about limitations inherent to an investment. Two examples of such limitations are liquidity and capacity. *Liquidity* refers to the ability to exit an investment readily without experiencing a significant extra cost for doing so. *Capacity* refers to an investment vehicle's ability to absorb additional new investment without reducing the returns it is able to achieve.

Recommended Procedures for Compliance

The 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 requested by the client or other users of the report.

Application of Standard V(B): Communication With Clients and Prospective Clients[17]

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 leave out details of the valuation models and the portfolio-structuring scheme.

Comment:

Williamson's plans for the newsletter violate Standard V(B). Williamson need not describe the investment system in detail in order to implement the advice effectively, but she must inform clients 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

17. Ibid.

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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 U.S. 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:

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 5:

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.

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Example 6:

A member discovers that an error in one of his firm's quantitative models led to a number of trades in one portfolio that should not have been made. The member corrects the error in the model and rebalances the portfolio to reverse the erroneous trades but does not report the issue.

Comment:

The member violated the Standard by failing to disclose the error and the corrective action to clients.

V(C) Record Retention

Members and Candidates must develop and maintain appropriate records to support their investment analyses, recommendations, actions, and other investment-related communications with clients and prospective clients.

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 or firm policies are in place, the Standard recommends a 7-year minimum holding period. All communications with clients through any medium, including emails and text messages, are records that must be retained.

A member who changes firms must recreate the analysis documentation supporting her recommendation using publicly available information or information obtained from the company and must not rely on memory or materials created at her previous firm.

Recommended Procedures for Compliance

This recordkeeping requirement is generally the firm's responsibility.

Application of Standard V(C) Record Retention[18]

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. The client acknowledges that this allocation was appropriate, but over the past three years, technology stocks have suffered severe losses. The client complains to the investment manager that so much money was allocated to this sector.

Comment:

For Lindstrom, having appropriate records is important to show that over the past three years the percentage of technology stocks in the benchmark index was 35% as called for in

18. Ibid.

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the IPS. Lindstrom should also have the IPS for the client stating that the benchmark was appropriate for the client's investment objectives. He should also have records indicating that the investment has been explained appropriately to the client and that the IPS was updated on a regular basis. Taking these actions, Lindstrom would be in compliance with Standard V(C).

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.

VI. Conflicts of Interest

LO A.6: Demonstrate knowledge of Standard VI: Conflicts of Interest.

For example:
- **State and interpret Standard VI with respect to disclosure of conflicts, priority of transactions, and referral fees.**
- **Recognize procedures for compliance with respect to disclosure of conflicts, and priority of transactions.**

VI(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.

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 that requires disclosure is actual ownership of stock in companies that the member recommends or that clients hold.

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Another common source of conflicts of interest is a member's compensation/bonus structure, which can potentially create incentives to take actions that produce immediate gains for the member with little or no concern for longer-term returns for the client. Such conflicts must be disclosed when the member is acting in an advisory capacity and must be updated in the case of significant change in compensation structure.

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[19]

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 entails 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 writer and must be disclosed.

Example 2:

Samantha Snead, a portfolio manager for Thomas Investment Counsel, Inc., specializes in managing public retirement funds and defined-benefit pension plan accounts, all of which have long-term investment objectives. A year ago, Snead'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 to certain benchmark indices. In an attempt to improve the short-term performance of her accounts, Snead changes her investment strategy and purchases several high-beta stocks for client portfolios. These purchases are seemingly contrary to the clients' investment policy statements. Following their purchase, an officer of Griffin Corporation, one of Snead'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 Snead during the year.

19. Ibid.

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Comment:

Snead has violated Standard VI(A) by failing to inform her clients of the changes in her compensation arrangement with her employer, which created a conflict of interest between her compensation and her clients' IPS. 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 Snead'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 directly investing in Russian equity 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 by way of the equity-linked notes. He prepares a write-up on the market that concludes with a recommendation to purchase several of the notes. One note he recommends is linked to the same Russian telecom company that Smith holds in his personal account.

Comment:

Smith has violated Standard VI(A) by failing to disclose his purchase and 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 decide whether his ownership of the security is a conflict of interest that might affect Smith's future recommendations. Then, when he recommended the particular telecom 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'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.

Topic 1

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). Because he will profit personally from these, he must also disclose the extent of his participation in these options.

Example 6:

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 7:

A member who is a portfolio manager participates in her employer's defined contribution pension plan through automatic contributions each pay period. The investment choices in the plan are large, diversified mutual funds, including one fund that is managed by her employer.

Comment:

The Standard does not require the member to disclose her personal investments in diversified funds unless this is her firm's policy, nor does it require preclearance for her automatic payroll deductions. The member should follow her firm's policies with regard to preclearing and disclosing her investments in firm-managed funds.

VI(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.

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 other client accounts; they should not be disadvantaged.

Information about pending trades should not be acted on for personal gain. The overriding considerations with respect to personal trades are that they do not disadvantage any clients.

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Recommended Procedures for Compliance

All firms should have in place basic procedures that address conflicts created by personal investing. Members should encourage their firms to adopt such procedures if they have not. 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[20]

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 violated Standard VI(B) by breaching 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 TV report to her firm's branches around the country. During the broadcast, she includes negative comments about a major company in the insurance 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 insurance company's stocks. Seven minutes after the broadcast, however, Ellen Riley, head of the firm's trading department, had closed out a long "call" position in the stock. Then, shortly thereafter, Riley established a sizable "put" position in the stock. When asked about her

20. Ibid.

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activities, Riley claimed she took the actions to facilitate anticipated sales by institutional clients.

Comment:

Riley 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 may 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).

VI(C) Referral Fees

Members and Candidates must disclose to their employer, clients, and prospective clients, as appropriate, any compensation, consideration, or benefit received from or paid to others for the recommendation of products or 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.

Recommended Procedures for Compliance

Members should encourage their firms to adopt clear procedures regarding compensation for referrals. Firms that do not prohibit such fees should have clear procedures for approval, and members should provide their employers with updates at least quarterly regarding the nature and value of referral compensation received.

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Application of Standard VI(C) Referral Fees[21]

Example 1:

Brady Securities, Inc., a broker/dealer, has established a referral arrangement with Lewis Brothers, Ltd., an investment counseling firm. In 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 has 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. Withholding this information raises the question of a potential lack of objectivity in the recommendation of Overseas by Arrow; this aspect is in addition to questions about the legality of having firms pay to be considered for an allocation.

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 VI(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.

21. Ibid.

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The disclosure should include the nature and the value of the benefit and should be made in writing.

Example 3:

An investment consultant conducts an independent and objective analysis of investment managers for a pension fund and selects the best one. Subsequently, the selected advisor makes a payment to the consultant.

Comment:

This is a violation of the Standard. The potential for a payment should have been disclosed to the pension fund. There are very likely regulatory or legal considerations with regard to such payment as well.

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Concept Checkers

1. Jill Hutchins 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, causing them to fail." Hutchins reports Smith to CFA Institute claiming Smith violated the Standards relating to professionalism. Which of the following statements is *most correct*?
   A. Neither Hutchins nor Smith violated the Standards.
   B. By reporting Smith, Hutchins has violated Standard I(D): Misconduct.
   C. Hutchins' bankruptcy reflects poorly on her professional abilities, so her continuance in the profession violates Standard I(C): Misrepresentation.
   D. Smith's under-investment in Hutchins' stated investment opportunities violated Standard III(A): Loyalty, Prudence, and Care.

2. While working on a new IPO underwriting project, Jean Brayman received information from the client that leads her to believe the client's financial statements are inaccurate. According to Standard I(A): Knowledge of the Law, Brayman should:
   A. report her findings 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.
   D. direct her client to the CFA Institute Standards and refuse to continue working on the IPO until the client brings the statements into compliance.

3. In situations where the laws of a member's country of residence, the local laws of regions where the member does business, and the Code and Standards specify different requirements, the member must abide by the:
   A. local law or his country's laws, whichever is stricter.
   B. local law or the Code and Standards, whichever is stricter.
   C. Code and Standards or his country's laws, whichever are stricter.
   D. strictest of local law, his country's laws, or the Code and Standards.

4. Which phrase *best* completes Standard III(E): Preservation of Confidentiality? "Members and candidates must keep information about current, former, and prospective clients confidential, unless:
   A. disclosure is required by law."
   B. the member or candidate thinks the information might be illegal."
   C. the client or prospective client cannot be located and the information is material."
   D. doing so would violate Standard IV(A): Loyalty to the Client."

5. Carrie Carlson 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. If Carlson has inside information on a publicly traded security, according to Standard II(A): Material Nonpublic Information, she:
   A. can inform her clients in EMC but not NC.
   B. can use the information for her NC clients to the extent permitted by the law.
   C. cannot use the information to trade for clients in EMC or NC or for her own account.
   D. must seek approval for the release of any inside information by governmental agents.

6. Sarah Johnson, a portfolio manager, is offered a bonus directly by a client if Johnson meets certain performance goals. To comply with the Standard that governs additional compensation arrangements, Johnson should:
   A. disclose this arrangement in writing to both her employer and clients.
   B. decline to accept a bonus outside of her compensation from her employer.
   C. disclose this arrangement to her employer in writing and obtain her employer's permission.
   D. disclose this arrangement to her employer only if she actually meets the performance goals and receives the bonus.

7. Which of the following statements is **FALSE**? A member or candidate:
   A. can participate or assist in a violation simply by having knowledge of the violation and not taking action to stop it.
   B. when confronted with potentially illegal activities should consult with her supervisor and her employer's counsel.
   C. must report evidence of legal violations to the appropriate governmental or regulatory organization.
   D. must dissociate from an activity if the member or candidate has reasonable grounds to believe that the activity is illegal.

8. Bill Cooper finds a table of historical bond yields on the website of the U.S. Treasury that supports the work he has done in his analysis and includes the table as part of his report without citing the source. Has Cooper violated the Code and Standards?
   A. Yes, because he did not cite the source of the table.
   B. Yes, because he did not verify the accuracy of the information.
   C. Yes, because he failed to request and receive permission to reproduce the data.
   D. No, because the table is from a recognized source of financial or statistical data.

9. Ed Ingus, equity analyst, visits the headquarters and main plant of Bullitt Company and observes that inventories of unsold goods appear unusually large. From the CFO, he learns that a recent increase in returned items may result in earnings for the current quarter that are below analysts' estimates. Based on his visit, Ingus changes his recommendation on Bullitt to "sell." Has Ingus violated the Standard concerning material nonpublic information?
   A. Yes.
   B. No, because the information he used is not material.
   C. No, because his actions are consistent with the mosaic theory.
   D. No, because Bullitt executives willingly disclosed the information.

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10. Jamie Olson is a trainee with Neuvo Management Corp., a small regional money management firm that opened 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 has Olson **NOT** violated the Standards of Practice?
    A. "We've consistently outperformed the market indices 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."

11. Which of the following actions is *most likely* a violation of the Standard on fair dealing?
    A. A portfolio manager allocates IPO shares to all client accounts, including her brother's fee-based retirement account.
    B. An investment firm routinely begins trading for its own account immediately after announcing recommendation changes to clients.
    C. After releasing a general recommendation to all clients, an analyst calls the firm's largest institutional clients to discuss the recommendation in more detail.
    D. An analyst refuses to include his stock recommendation changes in the company's internal newsletter prior to public release.

12. The Standard regarding suitability *most likely* requires that:
    A. an advisor must analyze an investment's suitability for the client prior to recommending or acting on the investment.
    B. a member must decline to carry out an unsolicited transaction that she believes is unsuitable for the client.
    C. when managing a fund to an index, a manager who is evaluating potential investments must consider their suitability for the fund's shareholders.
    D. an advisor place a higher emphasis on investor objectives (e.g., risk and return) than on investor constraints.

13. According to the Standard on independence and objectivity, members and candidates:
    A. may accept gifts or bonuses from clients.
    B. may not accept compensation from an issuer of securities in return for producing research on those securities.
    C. should consider credit ratings issued by recognized agencies to be objective measures of credit quality.
    D. may not enter independent practice for compensation regardless of notification and consent.

14. Which of the following is *most likely* a recommended procedure for complying with the Standard on performance presentation?
    A. Exclude terminated accounts from past performance history.
    B. Provide a suitable benchmark when providing past performance history.
    C. Present the performance of a representative account to show how a composite has performed.
    D. Consider the level of financial knowledge of the audience to whom the performance is presented.

15. A member or candidate who has supervisory responsibility:
    A. should place particular emphasis on enforcing investment-related compliance policies.
    B. is responsible for instructing those to whom she has delegated authority about methods to detect and prevent violations of the law and the Code and Standards.
    C. has complied with the Standards if she reports employee violations to upper management and provides a written warning to the employee to cease such activities.
    D. should not limit a suspected employee's activities until an ethical violation has been confirmed by an independent party.

16. Cassie Fletcher works for a money management firm, Pension Analytics, which advises pension fund portfolios. Recently, a friend asked her to sit on the board of city employees' pension fund as an unpaid volunteer. As part of the position, the city would grant Fletcher a free parking space in front of Pension Analytics' downtown Chicago office. To avoid violating the Standards, Fletcher should:
    A. do nothing since this is a volunteer position.
    B. inform her current clients in writing, get their permission, and discuss the offer with her employer before taking the position on the board.
    C. disclose the details of the volunteer position to her employer and obtain written permission from her employer before taking the position on the board.
    D. not accept the position.

17. Which if the following is *least likely* to be required by Standard I(A): Knowledge of the Law? Members, candidates, and firms must:
    A. stay informed and review written compliance procedures.
    B. maintain or encourage their employees to maintain current reference copies of applicable statutes, laws, and regulations.
    C. seek the advice of compliance personnel or legal counsel considering legal requirements.
    D. develop a system to promote "whistle-blowing" and to protect whistle-blowers from management retaliation.

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18. Which of the following actions is a *required*, rather than *recommended*, action under the Standard regarding diligence and a reasonable basis for a firm's research recommendations?
    A. Compensate analysts based on a measure of the quality of their research.
    B. Review the assumptions used and evaluate the objectivity of third-party research reports.
    C. Have a policy requiring that research reports and recommendations have a basis that can be substantiated as reasonable and adequate.
    D. Have written procedures that provide a minimum acceptable level of scenario testing for computer-based models.

19. Which of the following does **NOT** violate Standard III(B): Fair Dealing?
    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.

20. Linda Herbst, 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's pension fund is *least likely* to be a breach of her fiduciary duties as prescribed under Standard III(A): Loyalty, Prudence, and Care?
    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's future contributions.
    D. Selectively choosing brokers for the quality of research provided for managing FreeTime's pension.

21. Claire Marlin manages an investment fund specializing in foreign currency trading. Marlin writes a report to investors describing the basic characteristics of her strategy. The strategy is based on an expected appreciation of the euro relative to other major currencies. The report is available to all existing and potential investors via the firm's website. In the report, Marlin shows the projected returns from the strategy if the euro appreciates less than 5%, between 5% and 10%, or more than 10%, while clearly stating that these forecasts are her opinion. Has Marlin violated the Standard related to communication with clients?
    A. Yes.
    B. No, because she disclosed the basic characteristics of the investment.
    C. No, because she distinguished fact from opinion and discussed how the strategy may perform under a range of scenarios.
    D. No, because all existing and potential clients have access to the report.

22. Which of the following statements about the Standard on misconduct is *most accurate*?
    A. Misconduct applies only to a member or candidate's professional activities.
    B. Neglecting to perform due diligence when required is an example of misconduct.
    C. A member or candidate commits misconduct by engaging in any illegal activity.
    D. When possible, a member or candidate must attempt to invest in socially responsible companies.

23. Gail Stefano, CAIA, 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 Standards.
    B. violated the Standards by failing to properly distinguish factual information from opinions.
    C. violated the Standards by recommending an investment that would not be suitable for all of its clients.
    D. violated the Standards by failing to properly identify details related to the operations of South American utilities.

24. Which of the following does **NOT** constitute a violation of Standard VI(B): Priority of Transactions?
    A. An analyst trades for her son's trust account on the same day her firm changes its buy/sell recommendation.
    B. An analyst fails to make or change a recommendation until he trades for his own account.
    C. An analyst trades for the firm's account before handling client trades.
    D. An analyst takes a position in a stock she recommended one week after the recommendation was made public.

25. Eugene Nieder, a candidate in the CAIA Program, 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 Standards as long as he also generates supporting documentation.
    B. Nieder can recreate the model without violating the Standards as long as he obtains permission to do so from his former employer.
    C. Nieder cannot recreate the model without violating the Standards because it is the property of his former employer.
    D. Regardless of whether Nieder is capable of regenerating the model, he does not have the original documentation, so he will violate Standard V(C): Record Retention.

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26. Kate Wilson is an equity analyst. Wilson enters two transactions for her personal account. Wilson sells 500 shares of Tibon, Inc., a stock on which her firm currently has a "buy" recommendation. Wilson buys 200 shares of Hayfield Co. and the following day issues a research report on Hayfield with a "buy" recommendation. Has Wilson violated the Code and Standards?
   A. No.
   B. Yes, both of her actions violate the Code and Standards.
   C. Yes, but only one of her actions violates the Code and Standards.
   D. Yes, unless she has received written approval to trade against her firm's recommendation.

27. Hern Investments provides monthly emerging market research to Baker Brokerage 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 clients with non-discretionary accounts have earned substantial returns on their portfolios. Managers at Hern have also used the research to earn outstanding returns for the firm's discretionary accounts. Hern has *most likely*:
   A. not violated the Code and Standards.
   B. violated the Code and Standards by using third-party research in discretionary accounts.
   C. violated the Code and Standards by failing to disclose the referral agreement with Baker.
   D. violated the Code and Standards by sharing proprietary research with another firm.

28. The first half of Standard IV(A): Loyalty reads, "In matters related to their employment, Members and Candidates must act for the benefit of their employer…" The second half reads:
   A. "and not deprive their employer of the advantage of their skills and abilities, divulge confidential information, or otherwise cause harm to their employer."
   B. "and must not accept gifts, benefits, compensation, or consideration which might reasonably be expected to create a conflict of interest with their employer's interests."
   C. "and take no actions that would violate applicable laws, rules, regulations, or the Standards."
   D. "and exercise diligence, independence, and thoroughness in analyzing investments and making investment recommendations."

29. Chris Lyons, CAIA, 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. In order to avoid violating Standard VI(A): Disclosure of Conflicts, 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. prepare the report without a disclosure, but only after disclosing the situation to his employer.

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Concept Checker Answers

1. **B** Hutchins's 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 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. (LO A.1)

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. (LO A.1)

3. **D** To comply with Standard I(A): Knowledge of the Law, a member must always abide by the strictest applicable law, regulation, or standard. (LO A.1)

4. **A** 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. (LO A.3)

5. **C** 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 Standards, which is the most strict regulation in the scenario. (LO A.2)

6. **C** Johnson should disclose her additional compensation arrangement in writing to her employer and obtain her employer's written consent before accepting this offer, in accordance with Standard IV(B): Additional Compensation Arrangements. (LO A.4)

7. **C** 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). (LO A.1)

8. **D** According to Standard I(C): Misrepresentation, members and candidates must cite the sources of the information they use in their analysis, unless the information is factual data (as opposed to analysis or opinion) from a recognized financial or statistical reporting service. The U.S. Treasury is one example of a recognized source of factual data. (LO A.1)

9. **A** The statement from the CFO about the current quarter's earnings is material nonpublic information. Ingus violated Standard II(A): Material Nonpublic Information by acting or causing others to act on it. (LO A.2)

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10. **B** Olson misrepresents the services that her firm is capable of performing, her qualifications, her academic and professional credentials, and 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 out-performance of the market indices. 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). (LO A.1)

11. **B** The firm must give its clients an opportunity to act on recommendation changes. 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. The portfolio manager's brother's account should be treated the same as any other client account. Analysts should limit the number of people who are aware of stock recommendation changes prior to public release. The inclusion of these changes in a company newsletter would likely be a violation. (LO A.3)

12. **A** According to Standard III(C): Suitability, a member or candidate who is in an advisory relationship with a client is responsible for analyzing the suitability of an investment for the client before taking investment action or making a recommendation. If a member or candidate believes an unsolicited trade is unsuitable for a client, the appropriate action is to discuss the trade with the client. The advisor may follow her firm's policies for obtaining client approval if the requested trade would not affect the risk and return of the client's portfolio materially. If the trade would have a material effect, the advisor should discuss with the client whether the IPS needs to be updated. When managing a fund to an index or stated mandate, the manager is responsible for ensuring that potential investments are consistent with the fund's mandate. Suitability for individuals would be a concern for an advisor who recommends the fund to clients but not for the manager of the fund. The Standard requires advisors to concurrently consider both investor objectives (e.g., risk and return) and investor constraints. (LO A.3)

13. **A** Gifts from clients are acceptable under Standard I(B): Independence and Objectivity, but the Standard requires members and candidates to disclose such gifts to their employers. Standard I(B) allows issuer-paid research as long as the analysis is thorough, independent, unbiased, and has a reasonable and adequate basis for its conclusions, and the compensation from the issuer is disclosed. Members and candidates should consider the potential for conflicts of interest inherent in credit ratings and may need to do independent research to evaluate the soundness of these ratings. Under Standard IV(A): Loyalty, independent practice is allowable if the employer is notified and consent is received. (LO A.1)

14. **D** Recommendations stated in Standard III(D): Performance Presentation, include considering the sophistication and knowledge of the audience when presenting performance data. Other recommendations are to include terminated accounts in past performance history; to present the performance of a composite as a weighted average of the performance of similar portfolios, rather than using a single representative account; and to maintain the records and data that were used to calculate performance. Suitable benchmarks are not a recommended procedure for compliance as not all investments will have a suitable benchmark. (LO A.3)

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15. **B** Members or candidates may delegate supervisory duties to subordinates but remain responsible for instructing them about how to detect and prevent violations. Reporting the violation and warning the employee are not sufficient to comply with Standard IV(C): Responsibilities of Supervisors. The supervisor must also take steps to prevent further violations while she conducts an investigation, such as limiting the employee's activity or increasing her monitoring of the employee. Supervisors should enforce investment-related and non-investment related policies equally. (LO A.4)

16. **C** According to Standard IV(A): Loyalty, 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 considerable compensation in the form of a free parking space (a parking space in downtown Chicago would be very expensive). In light of the circumstances, Fletcher must disclose the details of the position and get written permission before accepting the volunteer position. (LO A.4)

17. **D** Adhering to the Standards can prevent the need for employees to resort to "whistle-blowing." (LO A.1)

18. **B** Standard V(A): Diligence and Reasonable Basis, requires analysts who use third-party research to review its assumptions and evaluate the independence and objectivity of the research. The other choices are recommended procedures for compliance with the Standard. (LO A.5)

19. **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. (LO A.3)

20. **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. (LO A.3)

21. **A** Standard V(B): Communication with Clients and Prospective Clients requires that members and candidates communicate the risk associated with the investment strategy used and how the strategy is expected to perform in a range of scenarios. These scenarios should include those different from the current trend. Marlin should have discussed how her strategy would perform if the euro depreciates instead of appreciating as she expects. (LO A.5)

22. **B** Failing to act when required by one's professional obligations, such as neglecting to perform due diligence related to an investment recommendation, violates Standard I(D): Misconduct. Acts a member commits outside his professional capacity are misconduct if they reflect poorly on the member or candidate's honesty, integrity, or competence (e.g., theft or fraud). Violations of the law that do not reflect on the member or candidate's honesty, integrity, or competence (e.g., an act related to civil disobedience) are not necessarily regarded as misconduct. There is no requirement for members or candidates to invest in socially responsible companies. (LO A.1)

23. **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. (LO A.5)

24. **D** One week is likely an acceptable waiting period. (LO A.6)

25. **A** Nieder must not take models or documents from his previous employer without explicit permission to do so in order to comply with 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. (LO A.4)

26. **C** Only one of these transactions is a violation. Standard VI(B): Priority of Transactions requires members and candidates to give clients an adequate opportunity to act on a recommendation before trading for accounts in which the member or candidate has a beneficial ownership interest. Members and candidates may trade for their own accounts as long as they do not disadvantage clients, benefit personally from client trades, or violate any regulations that apply. The Standard does not prohibit members and candidates from entering personal transactions that are contrary to what their firms are recommending for clients, as long as the transaction does not violate any of these criteria. Written approval for these trades is not required. (LO A.6)

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. The exchange of research itself is not a violation, only the failure to disclose the exchange. (LO A.6)

28. **A** Standard 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." (LO A.4)

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29. **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 also disclosed in the report. (LO A.6)

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The following is a review of the Alternative Investment principles designed to address the learning objectives set forth by the CAIA Association®.

What Is an Alternative Investment?

Topic 2.1

Exam Focus

Investing in traditional assets is facilitated by a deep body of theoretical and empirical research. However, investing in alternative assets requires a deviation from traditional analysis and management techniques. This topic review focuses on developing a framework for differentiating alternative assets from traditional assets. Understand the various categories of alternative assets and the underlying structures that make them unique. Know the distinctive return characteristics of alternative assets as well as the methods of analysis that differ from traditional investments. Finally, be able to explain the goals of alternative investing.

Alternative Assets vs. Traditional Assets

LO 1.1: Demonstrate knowledge of the view of alternative investments by exclusion.

For example:

- **Recognize characteristics of institutional quality investments.**

An investment is defined as an instrument that requires its owners to forgo current consumption in return for expected future benefits. **Traditional investments** include long positions in cash, bonds, and publicly-traded stocks. These investments are well known and widely used by most investors. **Alternative investments** are sometimes defined as any investment that is nontraditional. Later in this topic review, specific categories of alternative investments will be examined.

Institutional-quality investments exhibit risk and return characteristics that are acceptable to institutional investors, including pension funds, foundations, and endowments. Institutional investors have risk and return objectives that prevent them from investing in very small or highly speculative assets. However, not all institutional investors invest in all types of alternative investments, and some financial institutions may be prohibited from utilizing alternative investments by government regulations or may have business objectives that are inconsistent with alternative investments. Note that institutional-quality investments may also be utilized by non-institutional investors (e.g., high net worth individuals).

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Categories of Alternative Investments

LO 1.2: Demonstrate knowledge of various alternative investment types.

For example:
- **Describe real assets (i.e., commodities, real estate, intellectual property, and infrastructure), and distinguish real assets from financial assets.**
- **Describe hedge funds.**
- **Describe private equity (i.e., venture capital, leveraged buyouts, mezzanine debt, and distressed debt).**
- **Describe structured products (e.g., collateralized debt obligations [CDOs], credit derivatives).**

Although some investments (e.g., vintage wines) may be considered alternative, the CAIA curriculum focuses on the four primary categories of institutional-quality alternative investments (i.e., real assets, hedge funds, private equity, and structured products). These categories may overlap for some alternative investments such as a hedge fund that holds real asset investments in its portfolio. The sizes of the four categories in terms of capital allocation are as follows:

- Real Assets: 30%.
- Hedge Funds: 38%.
- Private Equity: 29%.
- Structured Products: 3%.

Real Assets

Real assets are associated with investments that directly control nonfinancial assets and represent actual rights to consumption rather than indirect financial claims (i.e., **financial assets** such as stocks and bonds) to cash flows generated by the tangible and intangible assets of a firm. Real assets include real estate, infrastructure, natural resources, commodities, and intangible assets. **Operationally focused real assets** require more managerial resources than other real asset types and include real estate, infrastructure, and intellectual property.

- **Real estate** includes land and permanent improvements to the land. Historically, real estate has been the primary asset class held by individual investors and therefore can also be considered a traditional asset class. In the last few decades, stocks and bonds have supplanted real estate as the most significant portfolio assets. The term **land** refers to raw (undeveloped) land, timberland, and farmland. **Timberland** includes land and the trees on the land (i.e., timber) used to create forest products (e.g., lumber and paper). **Farmland** includes *row cropland* (i.e., land used to plant annual crops such as soybeans and grains) and *permanent cropland* (i.e., land used for orchards, grapes, coffee, cocoa, and other tree-based crops). The managerial expertise required to properly develop raw land, timberland, and farmland is why these assets are classified as operationally focused real assets.
- **Infrastructure investments** includes government-controlled toll roads, utility companies, airports, seaports, and other real assets. Investments in infrastructure represent claims on the cash flows generated by these assets either through securities created during infrastructure privatization transactions or privately funded new infrastructure projects.

- **Intellectual property** is an *intangible asset* that can be owned. Examples of intellectual property include patents on new technologies and copyrights on written works. Intellectual property is, in its simplest form, ownership rights to ideas and other forms of human creativity.
- **Natural resources** are a form of real assets that are still in their raw form and original location. Examples of natural resources include undeveloped energy and mineral assets, water, and wind.
- **Commodities** are standardized goods (e.g., metals, agricultural products, energy products, and building materials) delivered to markets by many producers in large quantities. Commodities are often created by removing or transforming natural resources (e.g., oil fields are a natural resource and extracted oil is a commodity). Commodity investments provide passive commodity price exposure in the form of physical commodities, forward or futures contracts, securities of commodity producing firms, and exchange-traded funds (ETFs).

Hedge Funds

Hedge funds are private investment vehicles that capitalize on investment opportunities available as a result of minimal regulatory restrictions. Through derivatives, leverage, short positions, and other strategies, hedge funds are able to earn returns unavailable to traditional investments. Hedge funds as a category include *managed futures funds* (i.e., funds that actively trade futures and forward contracts) and can be further differentiated by the investment strategies pursued.

Private Equity

Private equity includes both debt and equity securities that are not publicly traded. Debt investments in this category generally behave like equity investments due to their very high level of cash flow risk. Private equity investments include venture capital, leveraged buyouts (LBOs), mezzanine debt, and distressed debt.

- **Venture capital** investments include equity used to finance startup companies who cannot obtain funds from public equity markets or traditional financial institutions. Companies seeking this type of capital are generally small, high-risk, have unproven operating history, and are willing to offer senior equity positions to venture capitalists in order to grow the business.
- **LBOs** involve taking a publicly-traded company (i.e., the target) private through the purchase of the company's outstanding equity using a small amount of equity capital and a large amount of debt financing. The assets of the firm being taken private serve as collateral for the borrowed funds. LBOs seek to increase the target firm's operating efficiency, utilize tax advantages from debt financing, enhance profitability, and ultimately earn large profits by taking the target public again. Management buy-ins and management buyouts are forms of LBOs. In a *management buy-in*, a new management team from outside the company takes over, while in a *management buyout* the existing management team remains in place and takes the company private.
- **Mezzanine debt** includes privately-held convertible debt, debt with equity options or warrants, and preferred stock. These risky investments are between senior debt and equity in the issuer's capital structure.

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- **Distressed debt** investments involve the purchase of debt issued by companies that are likely to or have already filed for bankruptcy protection. Distressed debt investments behave like equity due to the large cash flow uncertainty and strong dependence on the issuer's long-term financial success. Distressed debt investors generally convert their position to equity in order to profit from the firm's emergence from bankruptcy.

Structured Products

Structured products segment the cash flows of traditional investments or link the product's returns to one or more market values in order to achieve certain risk, return, tax, or other objectives. Debt and equity securities of a firm are technically structured products as each represents a claim on the firm's cash flows with different risk and return expectations. However, these are usually considered traditional investments. Structured products classified as alternative investments include *collateralized debt obligations* (CDOs) and *credit derivatives*. CDOs create tranched securities with different levels of risk and seniority that divide the actual or synthetic returns from a portfolio of collateral. Credit derivatives offer a payoff linked to the credit risk of an underlying reference asset. The term *structured products* has also been recently used to specifically refer to a narrower set of structured investments, which are custom designed to meet an investor's unique risk exposure and return preferences.

Structures of Alternative Investments

LO 1.3: Demonstrate knowledge of the concept of structures in investments.

For example:
- **Describe how structures help distinguish alternative investments from traditional investments.**
- **Define the five primary types of structures.**
- **Recognize how structures influence various alternative asset types.**
- **Recognize the limits of using structures to categorize alternative investments.**

Alternative investments can be described by several interconnected **structures**, which are a set of characteristics that may be used to distinguish alternative investments from traditional investments. Identifying which structures influence an investment provides an organized framework for analyzing both traditional and alternative investments.

Structure Types

The major structures include:

- **Regulatory structures** include government regulation and taxation. Some investments are highly regulated while others are not. In addition, tax implications may shape how some investment vehicles are organized.
- **Securities structures** include methods of cash flow securitization, which creates tradable units linked to an asset. Investments may use simple pass-through structures or may divide cash flows into a broad set of tradable securities with unique risk, tax, or other attributes. The nature of the transformation will dictate any unique methods of analysis.

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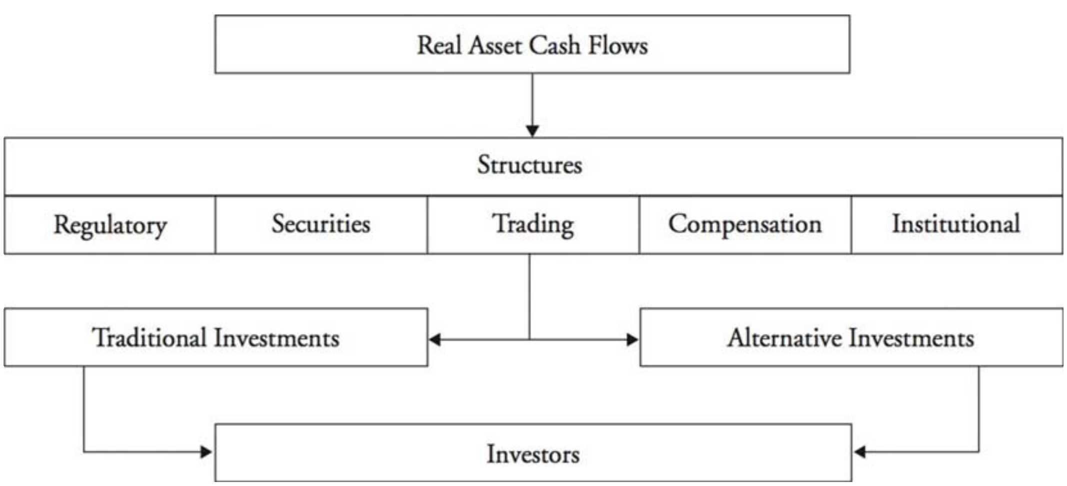
- **Trading structures** include the development and execution of trading strategies utilized by investment managers and the resulting performance impact of the strategies. Highly active trading strategies may cause a large divergence between investment cash flows and those of the underlying assets whereas passive strategies have little impact. Trading structures are often influential on alternative investment returns.
- **Compensation structures** include organizational and compensation arrangements that determine an investment manager's fees, exposure to the investment's performance, and possible conflicts of interest with investors.
- **Institutional structures** include financial institutions and markets that affect the ownership and trading of a particular investment. Institutional structures include public or private listing, trading market activity, and investor composition (e.g., diverse retail investor ownership or large blocks held by institutional investors).

The Influence and Limits of Structures

Investments may be influenced by one or all of the structures. For example, private equity does not trade in public markets and is therefore different from public equity according to the institutional structure. Also, hedge funds and mutual funds both invest in traditional assets, but hedge funds are distinguished by lower regulation and different trading strategies (i.e., different regulatory and trading structure). Analyzing alternative investments thus requires identifying the structures unique to each asset. However, note that not all investments are influenced by all five structures and that some structures may influence an investment in multiple layers.

In Figure 1, we demonstrate how structures impact the classification of an investment as alternative or traditional. Real asset cash flows are generated through economic activity and packaged into investment vehicles. These investments are influenced by various structures, which may characterize whether the investment is traditional or alternative. Ultimately, both alternative and traditional investments flow to investors according to their risk and return preferences.

Figure 1: Structures and Investment Classification



Almost all alternative and traditional investments are influenced by at least one of the five structures to some degree. However, the five structures do not strictly define alternative investments. Some alternative investments (e.g., timberland) are relatively uninfluenced by the structures while some traditional investments (e.g., equity options) are heavily

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influenced by the structures. The five structures are a framework for analyzing the unique characteristics of an investment, not a method to define securities. Figure 2 outlines the major categories of alternative investments and the primary influences of the five structures on each.

Figure 2: Structures of Alternative Investments

	Structures				
	Regulatory	*Securities*	*Trading*	*Compensation*	*Institutional*
Real assets	Natural resources — environmental regulations Infrastructure—regulations have substantial influence	Real estate—securitization of cash flows. Commodities—driven by trading in futures contracts.		Intellectual property—how should owner of rights be compensated	Real estate—often privately held investments
Hedge funds	Exploit differing taxation and regulation among countries		Proprietary active trading strategies (primary differentiator)	Performance-based fees	
Private equity		Moderate influence	Moderate influence	Moderate influence	Not publicly traded (primary differentiator)
Structured products	Moderate influence	Unique cash flow distribution methods (primary differentiator)		Moderate influence	Moderate influence

Return Characteristics of Alternative and Traditional Investments

LO 1.4: Demonstrate knowledge of how alternative and traditional investments are distinguished by return characteristics.

For example:

- **Recognize the role of absolute return products as diversifiers.**
- **Define illiquidity, and describe the advantages and risks of illiquid investments.**
- **Define efficiency and inefficiency, and describe their relationship to competition and transaction costs.**
- **Recognize normal and non-normal distributions and the structures that cause non-normality of returns.**

Alternative investments exhibit different risk and return characteristics than traditional investments. These characteristics are common to alternative investments but are not generally exhibited to the same degree by traditional investments. We will examine these differences in terms of diversification, illiquidity, inefficiency, and return non-normality.

Diversification

Alternative investments are often viewed as diversifiers or absolute return products. **Diversifiers** are investments chosen primarily due to their ability to improve the diversification of a portfolio based on their return correlation with existing portfolio assets. Ideally, diversifiers reduce risk without significantly modifying return expectations. **Absolute return products** are investments with low or no correlation with traditional assets and therefore tend to function well as diversifiers. These investments require absolute return analysis rather than relative return analysis (i.e., returns relative to traditional investments). Not all alternative investments meet this definition (e.g., private equity is moderately correlated with public equity over intermediate- and long-term horizons). Therefore, we cannot consider all alternative investments to be absolute return products.

Illiquidity

Alternative investments are often illiquid, and some can also be classified as lumpy. **Illiquidity** refers to securities with infrequent trading, low volume trading, or both, which causes difficulty in observing returns and potentially allows a small number of market participants to influence prices through trades. **Lumpy assets** are difficult to divide and can only be traded in certain quantities. Illiquidity creates uncertainty in the relationship between recent and expected prices for an asset. Prices for immediate transactions of illiquid assets may be persistently lower than those available to investors able to conduct longer buyer searches. Investors demand higher returns as compensation for undertaking the risk of illiquidity. Some investors seek out this risk premium while others simply avoid illiquid assets.

Inefficiency

Efficiency in markets means all available information is incorporated into asset prices. Efficient market prices reflect the highly competitive bidding process of numerous informed market participants who are able to establish both long and short positions quickly with low transaction costs. **Inefficiency** indicates that prices are different from those expected in an efficient market. Inefficient markets may suffer from fewer participants, lower competition, higher transaction costs, and an inability to establish long or short positions. Many alternative investments trade at inefficient prices and may provide returns related to market inefficiencies.

Non-Normality

The *normal distribution* is a symmetrical bell-shaped distribution defined entirely by the mean and variance. The returns of almost all investments become approximately normally distributed as the return time interval approaches zero. For longer time intervals (i.e., medium- and long-term), the return distributions for many alternative investments are not normal. The non-normality of returns may result from one or more of the following sources:

- *Trading structure*. Many alternative investments trade infrequently, which causes returns to be calculated over longer time intervals. In addition, active trading strategies that dynamically adjust long and short positions can cause returns to be non-normal.

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- *Securities structure*. Some securities (e.g., derivatives) have payoffs that are nonlinearly related to the underlying asset or generate returns using high leverage. Either of these issues may cause returns to deviate from normality.

Non-normal return distributions create problems when utilizing traditional mean-variance portfolio optimization techniques. We will have more to say on this subject in subsequent topics.

Methods of Analyzing Alternative and Traditional Investments

LO 1.5: Demonstrate knowledge of how alternative and traditional investments are distinguished by methods of analysis.

For example:
- **Recognize return computation methods.**
- **Recognize statistical methods.**
- **Recognize valuation methods.**
- **Recognize portfolio management methods.**

We can draw distinctions between alternative and traditional investments based on the method of analysis used to measure and manage risk and returns. These distinctions are driven by differences between the underlying structures of alternative and traditional investments. Traditional investments have well-defined models for analysis (e.g., CAPM and the Fama-French three-factor model). Models for alternative investments are less well defined, and traditional models may be inappropriate. However, there are four types of methods that may be used to analyze alternative investment returns: return computation, statistical, valuation, and portfolio management.

Return Computation Methods

Prices, dividends, and interest payments for many alternative investments are not readily observable in the market due to infrequent trading structures. In some cases, market value can only be determined when the investment is liquidated on the termination date. Therefore, traditional return computations may be inadequate.

Return computations for alternative investments must accommodate the underlying structures. One such measure is the *internal rate of return* (IRR), which calculates return based on the size and timing of cash flows rather than market values. Return computations must also account for leverage inherent in certain alternative investments. For futures contracts, which require no initial outlay, notional principal must be used to value the position size. For private equity, which may involve commitments to provide funds over time, IRR is used.

Statistical Methods

Investments with normally distributed returns may be analyzed utilizing only the mean and standard deviation of returns and well-known statistical models that are widely available. However, institutional structures (e.g., thin trading), securities structures (e.g., tranching), and trading structures (e.g., dynamic risk exposures) cause alternative investment return distributions to be non-normal. Thus, the analysis of alternative investment returns

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requires knowledge of statistical methods designed to accommodate non-normal returns (e.g., downside risk measures for skewed distributions).

Valuation Methods

Traditional investment valuation involves fundamental analysis (e.g., examining financial statements) and technical analysis (e.g., examining trading data) targeted at finding mispriced securities of relatively healthy firms. Alternative investment managers, hedge fund managers in particular, use traditional techniques to find mispriced securities but also incorporate alternative investment specific techniques (e.g., actively trading relatively mispriced securities expected to converge in price over the short term). Alternative investment valuation methods must account for nontraditional attributes associated with this asset class, including:

- Short-term active trading that quickly trade securities based on short-term price changes.
- Transaction-based prices are not continuously observable, making data comparisons extremely challenging.
- Many alternative investments have unique cash flow structures that make forecasting difficult.
- Appraisal-based valuation, which may differ from actual market-based valuation if it were available, is necessary for certain alternative investments.

Portfolio Management Methods

Traditional portfolio management techniques assume that markets are liquid, transaction costs are low, and the mean and variance of returns are the only inputs necessary to optimize portfolios according to risk and return objectives. Alternative investments, however, are subject to illiquidity, inefficient pricing, and non-normal returns. Special portfolio management techniques are needed to address issues such as liquidity management strategies and to incorporate higher moments of the returns distribution (e.g., skewness and kurtosis) into the investment analysis. Alternative investment portfolio management also places greater emphasis on achieving superior returns.

Special Features of Alternative Investments

LO 1.6: Demonstrate knowledge of other factors that distinguish alternative investments from traditional investments.

For example:

- **Recognize factors that contribute to information asymmetries.**
- **Describe the concept of incomplete markets and the effect of incomplete markets on investors.**
- **Recognize the prominence of innovation in alternative investments as compared to traditional investments.**

Alternative investments are also differentiated from traditional investments in regard to information asymmetries, incomplete markets, and innovation.

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Information Asymmetries

Information asymmetries in financial markets occur when different participants have different levels of knowledge regarding market conditions and particular investments. For example, company insiders and managers often possess better information about a firm's performance and prospects than outside investors. Compared to traditional investments, many alternative investments have limited disclosure requirements due to being private placements. This low level of easily available, public information regarding investments increases information asymmetry levels. However, the risk associated with high information asymmetry allows some owners of alternative investments to earn a complexity premium that compensates them for the additional time and expertise required.

Incomplete Markets

Incomplete markets refer to markets where limited investment opportunities fail to satisfy the exact investment options that participants seek. For example, investors in insurance markets often desire payouts linked to a specific risk, but regulations may prevent this or the required cost may be too high due to inefficient markets. The investor may also be unwilling to enter an agreement due to substantial moral hazard. A **moral hazard** refers to the actions one party may take to the detriment of the other. A moral hazard is similar to cheating and can occur whenever there is the opportunity for someone to engage in wrongdoing. Moral hazards exist in insurance markets because the insured may take more risks after being protected against losses, which increases the risk to the insurer. Another example of moral hazard is bank lending. Banks have less incentive to closely monitor loans that are sold to a third party relative to loans that remain with the bank. For alternative investments, incomplete markets and moral hazard are both common due to their trading structures (e.g., limited market participants, private transactions, and large investment sizes).

Innovation

Financial innovation occurs at a more rapid pace in the universe of alternative investments relative to that of traditional markets. Compared to traditional investments, the rapidly evolving nature of the alternative investment universe presents investors and portfolio managers a substantial challenge when analyzing and managing these investments.

Alternative Investing Goals

LO 1.7: Demonstrate knowledge of the goals of alternative investing.

For example:

- **Define active management, and contrast active management and passive investing.**
- **Recognize the role of benchmarks in managing investments.**
- **Define active risk and active return.**
- **Describe the absolute and relative standards for evaluating returns.**
- **Describe the concept of arbitrage, and the roles of return enhancers and return diversifiers in an investment program.**

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The primary goals associated with investing in alternative assets include active management, absolute and relative return generation, arbitrage, return enhancement, and return diversification.

Passive Investing vs. Active Management

Passive investing focuses on buying and holding a mix of securities to meet risk and return objectives, which may be expressed as a benchmark. A **benchmark** is a standardized measure of performance for a portfolio with a certain level of risk and return. A **benchmark return** is used to assess the performance of the investor's portfolio.

Active management is an attempt to create better risk and return combinations by actively buying and selling securities. **Active risk** is the additional risk undertaken to deviate from the benchmark level of risk. **Active return** is the return attributable to active management and is calculated as the difference between average portfolio returns and average benchmark returns. Due to their focus on active returns and risk, alternative investments and managers are evaluated in terms of their active management systems.

Generating Absolute and Relative Returns

Absolute return standards evaluate investment returns against a standard of zero or the risk-free rate. The point is to earn a return in any market environment, independent of the direction of equity, debt, or other asset markets. For example, equity market neutral hedge funds combine undervalued and overvalued securities to earn a return independent of overall equity markets.

Relative return standards evaluate investment returns against a benchmark return with the goal of consistently outperforming the benchmark. For example, a diversified long equity fund that attempts to find underpriced securities earns a benchmark return from the diversified portfolio but attempts to outperform through mispriced security selection.

Arbitrage, Return Enhancement, and Return Diversification

Arbitrage is an attempt to earn absolute returns. **Pure arbitrage** combines long and short positions in identical but differently priced securities to earn a risk-free return. Relative to pure arbitrage, arbitrage is more broadly defined to include strategies that do not eliminate active risk but that attempt to earn superior returns even though long and short positions may not be identical or held for the same time horizon.

Arbitrage is not the only method to increase returns with minimal risk. A **return enhancer** is an investment focused on increasing the average returns of a portfolio. A **return diversifier** is an investment focused on decreasing the risk of a portfolio through low, zero, or negative correlation with existing portfolio assets.

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Key Concepts

LO 1.1

Traditional investments include long positions in cash, bonds, and publicly-traded stocks.

Alternative investments include four categories: real assets, hedge funds, private equity, and structured products.

Institutional-quality alternative investments exhibit risk and return characteristics that are acceptable to institutional investors, including pension funds, foundations, and endowments. Not all institutional investors invest in all types of alternative investments.

LO 1.2

There are four categories of institutional-quality alternative investments:

1. Real assets directly control rights to consumption rather than indirect financial claims to cash flows generated a firm.
    - Real estate includes land and permanent improvements to the land.
    - Infrastructure includes government-controlled toll roads, utility companies, airports, seaports, and other real assets.
    - Intangible assets include intellectual property and the rights to future consumption represented by these assets.
    - Natural resources include undeveloped energy and mineral assets, water, and wind.
    - Commodities include physical commodity ownership, forwards or futures, securities of commodity producing firms, and exchange-traded funds (ETFs).

2. Hedge funds are private investment vehicles that capitalize on investment opportunities available because of minimal regulatory restrictions.

3. Private equity includes debt and equity securities that are not publicly traded.
    - Venture capital includes equity used to finance start-up companies.
    - LBOs involve taking a public company private through the purchase of its outstanding equity, using mostly debt financing.
    - Mezzanine debt includes privately-held convertible debt, debt with equity options or warrants, and preferred stock.
    - Distressed debt involves the debt of companies that are likely to or have already filed for bankruptcy.

4. Structured products segment the cash flows of traditional investments or link the product's returns to one or more market values in order to achieve certain risk, return, tax, or other objectives.

LO 1.3

Alternative investments can be described by several interconnected structures. Identifying influential structures provides a framework for analyzing traditional and alternative investments.

- Regulatory structures include government regulation and taxation.

- Securities structures include methods of cash flow securitization, which creates tradable units linked to an asset.
- Trading structures include the development and execution of trading strategies utilized by investment managers and the resulting performance impact of the strategies.
- Compensation structures include organizational and compensation arrangements that determine an investment manager's fees, exposure to the investment's performance, and possible conflicts of interest with investors.
- Institutional structures include financial institutions and markets that affect the ownership and trading of a particular investment.

LO 1.4

Alternative investments exhibit different risk and return characteristics than traditional investments.

- Diversification—Diversifiers (which often include absolute return products) have low or no correlation with traditional assets and reduce risk without significantly modifying return expectations.
- Illiquidity—Illiquidity creates uncertainty in the relationship between recent and expected prices for an asset, resulting in a liquidity risk premium for investors.
- Inefficiency—Inefficiency means not all available information is incorporated into asset prices. Inefficient markets may have fewer participants, lower competition, higher transaction costs, and an inability to establish long or short positions.
- Return non-normality—Over the medium and long term, return distributions for many alternative investments are not normal. Non-normal return distributions create problems when utilizing traditional mean-variance portfolio optimization techniques.

LO 1.5

There are four types of methods used to analyze alternative investment returns.

- Return computation methods—Prices, dividends, and interest payments for many alternative investments are not readily observable in the market due to infrequent trading structures. Return computations for alternative investments must accommodate the underlying structures, including the size and timing of cash flows and any inherent leverage.
- Statistical methods—Institutional structures, securities structures, and trading structures cause alternative investment return distributions to be non-normal. Thus, the analysis of alternative investment returns requires knowledge of statistical methods designed to accommodate non-normal returns.
- Valuation methods—Alternative investment managers use traditional techniques to find mispriced securities but also incorporate alternative investment specific techniques. Alternative investment valuation methods must account for nontraditional attributes, including short-term active trading, unobservable transaction prices, unique cash flow structures, and appraisal-based valuation.
- Portfolio management methods—Alternative investments are subject to illiquidity, inefficient pricing, and non-normal returns. Special portfolio management techniques are needed to address issues such as liquidity management strategies and incorporating higher moments of the returns distribution.

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LO 1.6

Additional factors that distinguish alternative investments from traditional investments include:

- Information asymmetry—Some market participants possess superior information about an investment's characteristics relative to other participants.
- Incomplete markets—In these markets, investment opportunities fail to satisfy the exact characteristics that an investor is seeking.
- Innovation—In alternative investments, investment types and strategies evolve more rapidly relative to traditional investments.

LO 1.7

Primary goals associated with investing in alternative assets include:

- Active management—Active management is an attempt to create better risk and return combinations by actively buying and selling securities. Active risk is the additional risk undertaken to deviate from the benchmark level of risk. Active return is the return attributable to active management and is calculated as the difference between average portfolio returns and average benchmark returns.
- Generating absolute and relative returns—Absolute return standards evaluate investment returns against a standard of zero or the risk-free rate. The point is to earn a return in any market environment. Relative return standards evaluate investment returns against a benchmark return with the goal of consistently outperforming the benchmark.
- Arbitrage, return enhancement, and return diversification—Arbitrage is an attempt to earn absolute returns by not eliminating active risk. Return enhancers are investments that are intended to increase the average returns of a portfolio. Return diversifiers are investments that are intended to decrease the risk of a portfolio through their low, zero, or negative correlation with other portfolio investments.

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Concept Checkers

1. Which of the following investments is *most likely* to be considered an institutional-quality alternative investment?
   A. Vintage wine collection.
   B. Long/short equity hedge fund.
   C. High-yield corporate bond fund.
   D. Small capitalization equity index fund.

2. Which of the following alternative asset classes would grant an investor with a long position direct control of a nonfinancial asset representing actual consumption rights?
   A. Real assets.
   B. Hedge funds.
   C. Private equity.
   D. Structured products.

3. An alternative investment is distinguished by the method in which it distributes the cash flows of its underlying assets among three different investor levels, which vary by risk tolerance. Which of the following structures *best* describes this particular characteristic of the investment?
   A. Trading structure.
   B. Securities structure.
   C. Institutional structure.
   D. Compensation structure.

4. Which of the following is *least likely* to be a problem related to the return characteristics of alternative investments?
   A. Illiquidity.
   B. Inefficiency.
   C. Absolute returns.
   D. Non-normal returns.

5. An alternative investment has highly variable cash flows that occur at irregular intervals. Which of the following methods of analysis is *most likely* necessary to analyze the investment returns?
   A. Statistical methods.
   B. Valuation methods.
   C. Return computation methods.
   D. Portfolio management methods.

6. Markets that do not offer the specific risk and reward opportunities that an investor is seeking are *best* described as:
   A. incomplete markets.
   B. asymmetric markets.
   C. alternative markets.
   D. distressed markets.

7. Which of the following is *least likely* a goal of alternative investing?
   A. Absolute returns.
   B. Benchmark returns.
   C. Active management.
   D. Return diversification.

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Concept Checker Answers

1. **B** Institutional-quality alternative investments exhibit risk and return characteristics that are acceptable to institutional investors. Institutional investors have risk and return objectives that prevent them from investing in very small or highly speculative assets but, as a group, are generally able to invest in the four categories of alternative investments. A long/short equity hedge fund fits within the requirements of institutional-quality alternative assets. Institutions may also invest in high-yield bonds or small capitalization stocks, but these would be considered traditional rather than alternative investments. (LO 1.1)

2. **A** Real assets are associated with investments that directly control nonfinancial assets and represent actual rights to consumption rather than indirect financial claims to cash flows generated by a firm. Real assets include real estate, infrastructure, intellectual property, natural resources, and commodities. (LO 1.2)

3. **B** Securities structures include methods of cash flow securitization, which creates tradable units linked to an asset. Investments may use simple pass-through structures or may divide cash flows into a broad set of tradable securities with unique risk, tax, or other attributes. (LO 1.3)

4. **C** Alternative investments exhibit different risk and return characteristics than traditional investments in terms of diversification, illiquidity, inefficiency, and return non-normality. Illiquidity creates uncertainty in the relationship between recent and expected prices for an asset. Inefficient markets may suffer from fewer participants, lower competition, higher transaction costs, and an inability to establish long or short positions. Non-normal return distributions create problems when utilizing traditional mean-variance portfolio optimization techniques. Absolute return products often provide uncorrelated returns and serve as diversifiers. This reduces risk without significantly modifying portfolio return expectations, which is a benefit of (not a problem with) alternative investment returns. (LO 1.4)

5. **C** Return computation methods for alternative investments must accommodate the underlying structures, including the size and timing of cash flows and any inherent leverage. (LO 1.5)

6. **A** Incomplete markets offer investment opportunities that do not satisfy the exact characteristics that an investor is seeking. While alternative investments often have incomplete markets, this does not necessarily hold true for all alternative investments. (LO 1.6)

7. **B** The primary goals associated with investing in alternative assets include active management, generating absolute and relative returns, engaging in arbitrage, enhancing returns, and diversifying returns. (LO 1.7)

The following is a review of the Alternative Investment principles designed to address the learning objectives set forth by the CAIA Association®.

The Environment of Alternative Investments

Topic 2.2

Exam Focus

Before we dig too deeply into the particulars of the various alternative investments available, we will spend some time in this topic review looking at the alternative investing environment. Candidates should become familiar with the participants in alternative investment markets as well as the characteristics of the primary, secondary, third, and fourth markets. Candidates are also expected to know how hedge fund regulations vary across countries and the effect of these regulations on hedge funds. The definition, types, and constraints of liquid alternative investments are also discussed. Finally, candidates should understand general taxation principles and consider their expected impact on alternative investments.

Market Participants

LO 2.1: Demonstrate knowledge of participants in the alternative investing environment.

For example:

- **Identify buy-side participants, and describe their roles in the alternative investing environment.**
- **Identify sell-side participants (i.e., large dealer banks and brokers), and describe their roles in the alternative investing environment.**
- **Identify outside service providers (e.g., prime brokers, accountants and auditors, attorneys, fund administrators, hedge fund infrastructures, consultants, depositories and custodians, and banks), and describe their roles in the alternative investing environment.**

In the following sections, the primary participants in the alternative investment market (i.e., buy-side institutions, sell-side institutions, service providers, and regulators) are covered along with a brief examination of their roles.

Professor's Note: While definitional in nature, this type of material is easily testable given the multiple-choice format of the exam. Make sure to spend some time in this section memorizing the role of each type of institution to ensure that you earn these points on the exam.

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Buy-Side Institutions

Buy-side institutions are asset managers that focus on acquiring appropriate securities for their investment portfolios. Institutions that make up the buy side of the investment industry include the following:

- **Plan sponsors.** A plan sponsor is an organization, such as a corporation, government entity, or nonprofit organization, that funds a healthcare or retirement plan for qualified members. The plan sponsor is responsible for managing the plan assets to meet its obligations. The plan sponsor also determines the membership requirements and structure of the plan (e.g., investment options and contribution level of the organization and/or plan members).
- **Foundations and endowments.** A **foundation** is a not-for-profit fund established for charitable purposes to support specific types of activities. A typical foundation's investment objective is to fund its charitable activities on a continuing basis without decreasing the real (i.e., inflation-adjusted) value of the portfolio assets. An **endowment** is a not-for-profit fund that is dedicated to providing financial support in perpetuity for a specific purpose and must maintain its principal on an inflation-adjusted basis. For example, in the United States, many universities have large endowment funds to support their programs. Foundations and endowments typically have long investment horizons, high-risk tolerance, and, aside from their planned spending needs, little need for liquidity.
- **Family office and private wealth institutions**. These firms manage the assets of very high net worth families. **Family offices** are owned by the families themselves and are prohibited from being investment advisers to the general public. The investments of the family are managed by the family office. The level of service offered by family offices varies widely.
- **Sovereign wealth funds.** A sovereign wealth fund refers to a pool of assets owned by a government and typically managed by its central bank. These funds often originate from government surpluses or sales of natural resources. The typical goals of these funds are to stabilize the economy, provide a potential resource for future crises, and provide future goods and services to the country's citizens.
- **Private investment pools**. Private investment pools include hedge funds (including managed futures funds), funds of funds, private equity funds, and commodity trading advisers. These funds are typically structured as limited partnerships. In this format, the investors serve as the limited partners, and the fund managers serve as the general partner. These funds often use sophisticated trading strategies, and performance-based fees are used to reward top-performing general partners. In later topic reviews, each of these fund types will be defined and examined.
- **Separately managed accounts (SMAs).** An SMA is a portfolio that is owned by a single investor and managed according to that investor's preferences by an investment adviser. No shares are issued because a single investor owns the entire account. Characteristics that distinguish SMAs from investment funds include:
    - An investor who owns a SMA directly owns the underlying investments in the portfolio, while an investor in a fund owns a stake of the fund rather than a stake in its underlying investments.
    - Unlike a fund's investment objectives, the investment objectives of a SMA can be tailored to the individuals' situation. For example, SMAs can better utilize tax-loss harvesting to improve an individual's after-tax returns.
    - Relative to funds, SMAs provide investors greater transparency by providing complete information on all positions in the investment account.

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- Unlike a fund, SMAs are immune from the potentially negative impacts of withdrawals by other investors.
- SMAs lack the limited liability offered by funds. This means that SMA investors can actually lose more than their original investment. This is more likely to occur when a trading strategy takes high levels of risk, uses large amounts of leverage, or relies heavily on derivative securities.

- **Mutual funds and '40 Act funds.** These funds fall under the scope of the U.S. Investment Company Act of 1940 (i.e., the '40 Act). The most common type of '40 Act funds are mutual funds. A recent innovation in this category is *alternative '40 Act funds* which utilize alternative investments and alternative investment strategies within the confines of the '40 Act.
- **Private limited partnerships.** These entities operate similar to other limited partnership structures (i.e., general partner has unlimited liability and limited partners have limited liability). Limited partners experience favorable tax treatment as taxes are passed through to each individual partner rather than being taxed at the firm level.
- **Master limited partnerships (MLPs).** This structure is essentially the same as a private limited partnership but offers the advantage of being publicly traded, resulting in a substantial liquidity advantage.

Sell-Side Institutions

Sell-side institutions are less concerned with account management and instead focus on providing (i.e., selling) investment research and transaction execution services to their customers, which may be buy-side institutions. Large dealer banks and retail brokers are the most prominent sell-side institutions in the alternative investment marketplace.

- **Large dealer banks.** Dealer banks refer to a commercial bank that both underwrites and trades investment securities and derivatives. Some of the largest dealer banks are Goldman Sachs and Barclays. The activities of large dealer banks are particularly important as their activities can influence the overall health of the financial markets due to their size. That is, the presence and actions of large dealer banks can cause an increase in systemic risk for a market. Large dealer banks often operate their own funds (i.e., serve as the general partner), which may include hedge funds and private equity funds. These banks also engage in **proprietary trading** (i.e., trade for their own account, known as the *house account*), off-balance sheet financing, and over-the-counter derivatives trading. In addition, large dealer banks offer account management services to buy-side institutions and may serve as prime brokers (this will be covered in the upcoming outside service providers section). Dealer banks have also expanded into roles traditionally reserved for commercial banks, such as providing personal loans, corporate loans, and depository accounts.
- **Retail brokers.** Brokers provide investment research and execute buy, sell, and limit orders for their customers. Brokers often attempt to keep client trades private by breaking up large trades or taking the contra side of a trade and then exiting their position at a later time. Retail brokers also engage in proprietary trading. Departments within a retail brokerage firm include front office, middle office, and back office.
  - **Front office operations** include meeting with clients and deciding which investments to buy, sell, and hold.
  - **Middle office operations** include risk management and serving as a communication link between the front and back offices.
  - **Back office operations** include supportive roles such as account maintenance, information technology, and trade clearance and settlement.

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Outside Service Providers

Outside service providers provide professional services that are vital to the formation and continued operation of alternative investment funds. Relevant outside service providers include the following:

- **Prime brokers.** The prime broker executes trades on behalf of an alternative investment manager, lends securities to sell short, provides research data, provides account statements and other documentation, and provides financing for leverage. Prime brokers allow managers to transact with multiple broker dealers and transact in multiple investment types within a single account.
- **Auditors/accountants.** During fund creation, an outside accounting service will review all documentation for accounting issues and provide tax advice. Once the fund is operating, the accounting service will continue to audit fund records, provide tax and compensation advice, and assist with the preparation of internal and external financial statements.
- **Attorneys.** The fund's legal counsel provides legal advice regarding optimal fund structure and maintains regulatory registrations for the hedge fund manager. Legal documents prepared by attorneys include:
    - **Private-placement memoranda** or **offering documents.** These documents are given to potential investors and explain the potential trading strategies and associated risks. The fund attorneys must ensure that these documents comply with all applicable securities regulations.
    - **Partnership agreement**. This document defines the legal framework for the partnership and describes the terms and conditions for all parties involved with the fund.
    - **Subscription agreement.** This document determines if a potential investor has sufficient funds to satisfy legal requirements (e.g., whether or not the investor is *qualified*) by asking the investor to answer a set of questions.
    - **Management company operating agreement.** This document defines the responsibilities of the limited partnership members and the responsibilities of the fund.
- **Fund administrators**. The fund administrator of an alternative investment fund is responsible for verifying operational controls, assets under management, and performance figures. By relying on a third-party source to complete these bookkeeping functions, fund managers are able to focus on their core job functions, and investors can be more confident that the stated performance results are objective. The fund administrator may also be a key figure with regard to tax issues and audit preparation.
- **Hedge fund infrastructure**. The complexity of modern hedge funds has resulted in fund infrastructure becoming an important component of a fund's success or failure. The complexity and importance of hedge fund infrastructure has caused most funds to rely on outside vendors to provide the infrastructure systems necessary to execute their trading strategy. Fund infrastructure consists of three integrated systems: platforms, software, and data providers.
    - **Financial platforms** refer to the operating system that allows the fund managers to have access to both the internal and external data necessary for strategy execution. Common information present on platforms includes portfolio positions, risk analysis, profit/loss data, accounting data, and financial market information.
    - **Financial software** refers the computer programs used by the fund that work on its chosen platform. Hedge funds may choose to use proprietary or open-source software.

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Topic 2.2

- ◆ **Financial data providers**, such as index and database providers, collect market, fund, and security information and sell it to advisors, institutional investors, consultants, and other investment professionals. Hedge funds that choose to share performance data with index providers benefit because the index is indirectly advertising the fund's performance to potential clients. Top-performing funds may find this marketing quite beneficial as hedge funds are restricted from advertising and soliciting potential clients.

- **Consultants.** Buy-side institutions, such as foundations or family offices, may hire consultants to provide objective advice regarding portfolio allocation decisions and investment manager selection. Consultants may also be asked to help identify a client's investment objectives and provide ongoing monitoring of portfolios and investment managers. In smaller firms, consultants are sometimes tasked with serving as the chief investment officer. Consultants are compensated in the following ways: (1) directly using a fee-based system (e.g., $150 per hour), (2) indirectly using a system in which the consultants receive a portion of fees earned by investment managers they recommend, or (3) by serving as the manager of a fund of funds (FOF) and receiving the associated management and incentive fees. Investors who use the indirect fee system should be aware of the inherent conflict of interest that this system poses (i.e., consultants may select managers who pay them higher fees rather than those that provide the best returns). The FOF approach may improve the alignment of investor and consultant interests by improving manager selection and eliminating hourly fees (which may be inflated by unethical consultants).
- **Depositories/custodians.** These companies hold client assets and provide information services, trade clearance, and trade settlement for investment securities. The **Depository Trust Company** (DTC) is the primary global central securities depository. The DTC is owned by the *Depository Trust and Clearing Corporation* (DTCC), which is the most well-known depository/custodian service due to its large size, long operating history, and global operations.
- **Banks.** Both commercial banks and investment banks are included in this category. **Investment banks** primarily focus on investment activities including managing and underwriting of securities issuances, advising corporations regarding mergers and acquisitions, and providing brokerage services. **Commercial banks** primarily focus on traditional banking services (e.g., loans and deposits) with a reduced focus on investment services. Hedge funds may rely on commercial banks to assist them with capital management, including providing the fund with loans, lines of credit, and external credit enhancement. Keep in mind that hedge funds are global institutions, so hedge funds must also understand non-U.S. bank structures.
  - ◆ *Germany*. In Germany, universal banks are commonplace. **Universal banking** refers to institutions that allow both commercial banking and investment banking. In the United Sates, universal banking is not allowed because commercial banks and investment banks are split by regulation. Compared to the United States, a higher proportion of German firms are privately owned, which increases the importance of the banking structure. In addition, German corporations must use a two-tier board system with a management board (*Vorstand*) and a supervisory board (*Aufsichtrat*).
  - ◆ *United Kingdom*. Similar to the United States, the United Kingdom separates the banking industry into clearing (i.e., commercial) banks and merchant (i.e., investment) banks.

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- *Japan*. Under Japan's corporate structure, multiple corporations are linked together via a cross-ownership structure, termed *keiretsu*. This structure also is characterized by a large percentage ownership of firms by banks and other financial institutions, which reduces the number of public shareholders and allows banks to have considerable authority.

Figure 1: Market Participant Categories

Buy Side	*Sell Side*	*Outside Service Providers*
• Plan sponsors • Foundations and endowments • Family office and private wealth institutions • Sovereign wealth funds • Private investment pools • Separately managed accounts • '40 Act funds (including mutual funds) • Private limited partnerships • Master limited partnerships	• Large dealer banks • Retail brokers	• Prime brokers • Accountants and auditors • Attorneys • Fund administrators • Hedge fund infrastructure • Consultants • Depositories/custodians • Banks

Types of Financial Markets

LO 2.2: Demonstrate knowledge of the financial markets involved in alternative investments.

For example:

- **Define primary capital markets, and describe their roles in alternative investments.**
- **Define secondary capital markets, and describe their roles in alternative investments.**
- **Define third, fourth, and private markets, and describe their roles in alternative investments.**

Alternative investment securities are traded in a variety of financial markets, including the primary, secondary, third, and fourth markets. In this section, we will examine each market and determine which market is appropriate for a variety of transactions.

Primary Capital Markets

Primary markets relate to the sale of new security issues. New equity issues involve the following:

- First-time issues of firms whose shares are not currently trading in the marketplace. These first-time issues are called **initial public offerings (IPOs)**.
- Issues of new shares of firms whose shares are already trading in the marketplace. These existing issues are called **seasoned issues** or **secondary issues**.

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For traditional securities, such as public equity, an investment bank assists with the security issuance by serving as the ***underwriter***. In this capacity, the underwriter is responsible for origination (design, planning, and registration of the issue), risk bearing (underwriter insures or guarantees the price by purchasing the securities), and distribution (sale of the issue). The transaction is said to occur in the primary market because the securities being sold have never been available before, and the issuing firm (rather than another investor) receives the proceeds of the sale. In primary markets, dealer banks and retail brokers play a crucial role in that they both may serve as underwriters, intermediaries, and liquidity providers.

The global nature of financial markets has led to many firms listing their securities on both foreign and domestic security exchanges. Two examples of this are ***American Depository Receipts*** (ADRs) and ***Global Depository Receipts*** (GDRs). ADRs are denominated in U.S. dollars and traded on U.S. markets. However, they represent claims to foreign stocks. GDRs are issued outside the United States and the issuer's home country. Although not listed on U.S. exchanges, GDRs are usually denominated in U.S. dollars and can be sold to U.S. institutional investors. The firm usually chooses to list the GDR in a market where many investors are familiar with the firm.

Primary markets may also create new security issues using a process known as **securitization**. In this process, assets are pooled together and new securities are issued that derive their cash flows from the pool's cash flows. Note that the pool assets may be publicly listed or unlisted and vary in terms of liquidity. For example, mortgage-backed securities and exchange-traded funds are common security issues that rely on securitization. While mortgages are illiquid and unlisted, publicly traded equity securities are liquid and listed.

The role of primary capital markets is often that of an exit strategy for alternative investments. For example, if a new business venture financed with venture capital and mezzanine debt becomes successful enough, the owners will choose to go public with the company via an IPO. At this point, owners will sell part or all of their ownership in the venture.

Secondary Capital Markets

Secondary markets are where securities trade after their initial issuance. Placing a buy order on the London Stock Exchange is an example of an order in the secondary market and will result in the purchase of existing shares from their current owner rather than from the original issuer. Secondary markets are important because they provide liquidity and price/value information. The better the secondary market, the easier it is for firms to raise external capital in the primary market, which results in a lower cost of capital for firms with shares that have adequate liquidity. Secondary markets consist of both physical exchanges and over-the-counter (OTC) market.

In secondary markets, dealer banks again serve as trade intermediaries and trade for their own accounts with other dealer banks and also with brokers/dealers. Dealers generally do not charge commissions on transactions. Instead, they make their profit from the **bid-ask spread** (i.e., the difference between the bid and ask prices). The bid price is always listed first and is the price the dealer will pay to buy the security. The ask price is always listed second. It is the price at which the dealer will sell the security. **Market making** refers to dealers who determine the bid-ask spread by actively trading in the secondary market and posting buy and sell prices. **Market orders** are customer orders to immediately buy or sell

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at the best price available. Customers who place these orders are known as **market takers**, as their orders occur at the stated bid or ask price.

Third and Fourth Capital Markets

Third markets refer to regional exchanges where nonmember investment firms, such as institutions and brokers/dealers, can make markets in and trade exchange-listed securities without going through the secondary market exchange (i.e., by using OTC markets). By avoiding exchange trading, transaction costs are reduced for market participants.

Fourth markets refer to the electronic exchange of securities between investors *without* using the services of a broker as an intermediary. Trades in the fourth market are facilitated by an *electronic communication network* (ECN). An ECN allows members to avoid the bid-ask spread by submitting orders that are matched to other outstanding orders through *crossing*. ECNs are also more private, reduce transaction costs, are anonymous, and allow after-hours trading. Firms using an ECN are less worried that information about a large planned trade will have an adverse impact on prices. This market is generally used by institutions, such as pension funds, which deal in very large volumes of securities. *High-frequency trading* (HFT), which involve trades that are executed in milliseconds and positions that are held for only seconds, typically occurs in fourth markets.

Third and fourth markets are both **private markets.** It is common for alternative assets to be traded in private markets. While these markets offer flexibility, low trading costs, and faster settlement times, the lack of transparency and regulation as well as information asymmetry may be viewed as serious drawbacks for some potential participants.

Regulations

LO 2.3: Demonstrate knowledge of regulatory environment as it applies to alternative investments.

For example:
- **Define and explain the concept of systemic risk.**
- **Recognize the four primary forms of hedge fund regulation.**
- **Describe key components of U.S. regulations affecting securities issued to the public (e.g., the '40s Act, the U.S. Securities Act), including exemptions commonly applied to hedge funds.**
- **Describe key components of European regulations affecting hedge funds (e.g., Undertakings for Collective Investment in Transferable Securities [UCITS], Markets in Financial Instruments Directive [MiFID]), and recognize major European regulatory institutions.**
- **Describe key components of hedge fund regulations outside the United States and European Union (e.g., Australia, Brazil, Canada, Japan, Singapore, South Africa, the United Arab Emirates), and recognize major regulatory institutions in these regions.**

Historically, alternative investments have had lower levels of regulation than traditional investments. However, the 2007 financial crisis prompted industry and regulatory agencies to consider whether the hedge fund market needs increased regulatory measures. This is because the crisis provided evidence that alternative investments such as hedge funds may contribute to increasing levels of systemic risk that financial markets possess. **Systemic risk** refers to the potential market-wide effect of the collapse of a large financial institution, a major market participant, or the collapse of the entire financial market itself. In response to the recognition that alternative investments had reached sufficient size to influence systemic risk, the following forms of regulation have been proposed to help alleviate the risk.

- *Marketing and distribution regulations.* Regulations may include restrictions on the number and type of investors allowed (e.g., retail, accredited, or qualified).
- *Establishment regulations.* These include requirements that must be met to establish a fund such as minimum size, requisite licenses, and registrations.
- *Operational regulations.* These rules include items such as leverage limits, required reports, liquidity requirements, and outside service providers' requirements.
- *Management regulations.* These regulations may include required or prohibited activities on the part of alternative investment fund personnel or investment advisers.
- *Reporting regulations.* These rules refer to hedge funds reporting performance on an ongoing basis.

U.S. Hedge Fund Regulations

Most U.S. hedge funds are located in Delaware. This is because Delaware law provides limited liability protection to limited partners and allows hedge funds to be set up as pass-through entities. This pass-through structure allows the fund to distribute income to the partners without corporate-level federal taxation and significantly benefits tax-exempt investors (e.g., pensions, endowments, and foundations).

In the United States, securities markets are regulated by numerous laws. The Securities Act of 1933, the Investment Company Act of 1940, and the Investment Advisers Act of 1940 are the most relevant laws for U.S. hedge funds.

The **Securities Act of 1933** governs new securities issues and requires the company to disclose relevant information, to register new issues, and to disseminate a prospectus.

The **Investment Company Act of 1940** (often referred to as the '40 Act) was instituted to regulate investment pools, such as mutual funds. It defines an investment company as "any issuer which holds itself out as being engaged primarily in the business of investing, reinvesting, or trading in securities." Mutual funds clearly fall within the definition, but hedge funds may utilize exemptions in Section 3(c)(1) and Section 3(c)(7) to avoid registration.

The **Investment Advisers Act of 1940** requires that investment advisers register with the SEC. This requirement includes advisers to investment pools that are exempt from regulation under the Investment Company Act. However, there are several exemptions to this rule for small advisers. Note that when these exemptions are utilized, the advisers are typically still required to register at the state level. Regardless of whether the investment adviser is required to register with the SEC, all investment advisers are subject to the antifraud provisions found in Section 206 of the Investment Advisers Act of 1940.

In addition, investment advisers must not breach their *fiduciary duties* as stipulated by U.S. laws. These duties include disclosure of relevant information, placing client interests first, obtaining best execution with regard to transactions, and dealing fairly with all clients.

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Professor's Note: The antifraud provisions and fiduciary duty requirements overlap substantially with the duties required by CAIA and CFA charterholders under the Standards of Professional Conduct.

Advisers must also disclose the firm's soft dollar arrangements to current and potential clients. **Soft dollar arrangements** refer to investment research, products and services, and cash credits given to the investment manager by brokers in return for client business. The concern here is that the firm may do business with a more costly broker to benefit the firm at the expense of the investor. Investment managers have a duty to use client brokerage to benefit clients.

Investment advisers must also comply with the **Regulation T margin rule**, which is a Federal Reserve rule concerning leverage. It stipulates that only 50% of the value of a security can be purchased on margin. Alternative investment managers that seek higher levels of leverage must avoid falling under this rule or other leverage rules by registering as a broker-dealer, using a joint back office account, using derivatives, or utilizing repurchase (repo) transactions.

On an institutional level, recent regulation in the U.S. has been passed that focuses on reducing the prevalence of money laundering activities and funding of terrorist organizations. This regulation increased government oversight and expanded fines and penalties for noncompliance.

European Hedge Fund Regulations

The formation of the European Union was crucial to the development of the hedge fund industry in Europe. In the years following its formation, many rules and regulations have been established that facilitate cross-country trading and provide protection for limited partners. In this section, we will briefly cover the most pertinent regulations for European hedge funds.

Under the **Undertakings for Collective Investment of Transferable Securities (UCITS) Directive**, passed in 1985 and with subsequent revisions (UCITS II, III, and IV Directives), investment pools created under the UCITS Directive guidelines could more easily market to retail investors throughout the European Union (EU). UCITS funds (also known simply as UCITS) must meet the following criteria:

- Be approved by the *Commission de Surveillance Du Secteur Financier (CSSF)* for public offering.
- Obtain authorization in their home country.
- Obtain approval from regulators for any external managers used by the fund.
- Create a regulator-approved prospectus and key investor information document.
- Meet a minimum net asset value (NAV) threshold.
- Submit to an annual audit.

The **Markets in Financial Instruments Directive** (**MiFID**) is a European Union law that became effective in 2007. The MiFID was designed to more deeply integrate the financial services of the EU by establishing more uniform regulations. A follow-up to the MiFID, appropriately titled *MiFID II*, corrects some of the deficiencies found with the original MiFID. For example, the original directive allowed for too much opaqueness in financial markets. The new directive will eliminate many of the loopholes that allowed dark pools to exist. **Dark pools** are non-exchange trading systems that do not reveal current client orders.

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In 2011, the Alternative Investment Fund Managers (AIFM) Directive became law. This law is applicable to investment managers who either operate or manage alternative investment funds (e.g., hedge funds, private equity funds, real estate funds, and infrastructure funds) located in the European Union. The AIFM Directive will require fund managers to meet minimum capital requirements and obtain local regulatory approval. However, funds that are covered under the UCITS Directive are excluded from this law.

In addition to the European Union laws and regulation covered above, the following country-specific guidelines exist.

Figure 2: European Regulators and Regulations

Country	*Regulatory Institutions*	*Regulatory Summary*
United Kingdom	Financial Conduct Authority (FCA) and Prudential Regulatory Authority (PRA)	80% of European hedge fund assets are located in the U.K. FCA primarily focuses on large hedge funds, but smaller hedge funds may receive periodic reviews and all hedge funds are required to maintain minimum capital levels.
France	Autorités des Marchés Financiers (AMF)	The AMF allows for funds of hedge funds, unleveraged hedge funds, and leveraged hedge funds.
Germany	Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin)	The BaFin enforces rules related to redemption procedures, subscription limits, custody procedures, and disclosure requirements. In addition, the BaFin allows for funds of funds to be distributed both publicly and privately, while regular hedge funds can only be distributed privately.
Switzerland	Financial Market Supervisory Authority (FINMA)	While few regular hedge funds are located in Switzerland, approximately 33% of all funds of hedge funds assets are located here. This may be attributable to FINMA's minimal regulations for funds of hedge funds.

Finally, due to the 2007 economic crisis, regulations prohibiting or limiting short selling have been put in place by several European countries. Eventually, a comprehensive European Union rule may be drafted that unifies these restrictions. Hedge fund managers who rely on short selling as a component of their investment strategy should pay close attention to current and proposed European legislation.

Additional Country-Specific Hedge Fund Regulations

As hedge funds become more established around the globe, the regulatory institutions of countries have been forced to adapt their regulations to specify how hedge funds should be regulated and how their profits should be taxed. While a comprehensive overview of global hedge fund regulations is beyond the scope of this curriculum, candidates should be aware of the country-specific regulations in the following table.

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Figure 3: Global Regulators and Regulations

Country	*Regulatory Institutions*	*Regulatory Summary*
Australia	Australian Securities and Investment Commission (ASIC)	Hedge funds are subject to the same regulations as managed funds. In general, domestic funds used as unit trust structures and foreign funds are classified as foreign investment funds. Australian taxation policies for hedge funds are complex.
Brazil	Securities Commission (CVM)	Funds are required to adhere to the classification claimed in their investment policy. The CVM regulates investor types, required reporting, and allowable asset valuation methods.
Canada	Canadian Securities Administrators (CSA)	The majority of funds are sold using linked products, such as principal protected notes. Dealers, portfolio managers, and advisers must register with the CSA and are subject to compliance reviews. Most funds can only be sold to accredited investors. Disclosure of audited annual (and in some cases, semiannual) financial statements is required.
Japan	Financial Services Agency (FSA)	The FSA places minimal regulatory requirements on hedge funds.
Singapore	Monetary Authority of Singapore (MAS)	Governmental desire to increase alternative investment trading has caused deregulation and lower taxes for hedge funds.
South Africa	Financial Services Board	As of 2008, hedge fund managers must register as financial service providers and are not allowed to market to retail investors. However, hedge funds remain unregulated. Taxation rules of hedge funds are not yet finalized.
United Arab Emirates	Gulf Cooperation Council; UAE Central Bank; Dubai Financial Services Authority	Hedge funds must register with the UAE Central Bank or the Dubai Financial Services Authority. Funds are subject to marketing limitations, risk assessment requirements, audit requirements, and regulatory oversight. Hedge funds are not currently taxed.

Be aware that many hedge funds seek out locations for their operations based on the relative absence of hedge fund regulations. The lack of regulations in places such as Bermuda and the Cayman Islands allows hedge funds to be established more quickly and less expensively. In addition, the reduced costs of ongoing regulation compliance and greater investment freedom further entice hedge funds to select these countries for their home offices.

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Liquid Alternatives

LO 2.4: Demonstrate knowledge of liquid alternative investments.

For example:
- Define liquid alternative investments.
- Recognize the five distinct types of liquid alternative investments.
- Describe the factors driving the growth of liquid alternative investments.
- Recognize regulatory constraints that affect liquid alternative investments.
- Recognize the main reasons that contribute to differences between the returns of private placement vehicles and those of liquid alternatives.

Traditionally, alternative investments are characterized by illiquidity, a lack of transparency, and inaccessibility due to investment and transaction barriers (e.g., only available to institutions and high net-worth investors, privately traded). **Liquid alternative investments** defy these conventions as they offer the advantage of being more available to retail investors due to the existence of a well-functioning exchange market compared to private placement investments (e.g., hedge funds). In addition, they tend to have lower fees due to a more passive investment approach. This means that both smaller investors and investors unable to hold illiquid investments (e.g., some institutions) are able to invest in liquid alternatives. Real estate investment trusts (REITs) are an example of how small investors can invest in illiquid, indivisible assets. However, due to their widespread popularity, REITs are no longer typically considered liquid alternatives.

Regulatory Constraints

In the U.S., the majority of liquid alternatives are regulated by the '40 Act; while in Europe, they fall under the UCITS Directive. While the premise of liquid alternatives is enticing, these regulations can make strategy implementation challenging. For liquid alternatives, constraints include:

- *Leverage limits*. The '40 Act requires that mutual funds have asset coverage ratio of at least 300%. That is, the fund's total net assets must be at least three times the fund's net borrowing amount. The leverage requirements for UCITS funds are even more stringent.
- *Diversification requirements*. Both the '40 Act and the UCITS Directive restrict the amount of concentration risk a fund can possess. For example, at least 50% of a '40 Act fund's assets must be invested in diversified securities.
- *Liquidity requirements*. Both the '40 Act and the UCITS Directive restrict the amount of illiquid assets a fund can hold. For example, '40 Act funds must limit illiquid holdings to a maximum of 15% of their investment portfolio.

Alternative investments that seek to avoid regulation (e.g., hedge funds) must limit the number of investors, which is why they often have substantial investment minimums. However, because liquid alternatives are regulated they are allowed to accept as many investors as they want and therefore can set lower minimum required investment amounts. Many liquid alternatives utilize a closed-end mutual fund structure. **Closed-end mutual funds** are exchange-traded mutual funds. Unlike open-end funds, they have a fixed number of shares outstanding.

Professor's Note: In later topics, we will examine how hedge funds and managed futures differ from liquid investments such as mutual funds.

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Liquid Alternative Fund Types

Liquid alternatives have a variety of forms and strategies. In terms of strategy, many liquid alternatives pursue a replication or clone strategy. **Hedge fund replication** refers to a strategy that achieves to obtain returns similar to those of hedge funds using simple factor-based approaches or trading systems. **Clones** attempt to mimic the investment strategies utilized by hedge funds or other illiquid alternative investments. Based on a given liquid alternative investment's strategy, a fund can be categorized into one of the following five categories.

1. **Skill-based replication products**. This fund type attempts to earn comparable returns to alternative funds that use a complex investment strategy driven by manager skill by using a more basic version of the strategy that may use a mathematical or system approach.

2. **Liquidity-based replication products**. This fund type ensures that liquidity is present by selecting liquid investments that have similar characteristics to illiquid securities used in illiquid alternative funds.

3. **Constrained clones.** This category is characterized by attempting to follow the same strategy as an existing alternative investment product, but modified due to investment limitations (e.g., liquidity, leverage, diversification). The imposition of limitations ensures that risk levels are capped.

4. **Unconstrained clones**. This category is characterized by attempting to use a near-identical strategy as an existing alternative investment product that is relatively liquid (and therefore the investment strategy requires little modification).

5. **Diversified/absolute return products**. This category focuses on creating returns that have low correlation with traditional investments. Unlike the previous four strategies, this category does not attempt to mimic the investment strategy or risk/return profile of existing alternative investments. These products are often created by firms that specialize in traditional investments and tend to be less reliant on investment skill, short sales, and leverage relative to the other four categories.

Growth Drivers of Liquid Alternatives

From 2007 to 2015, the size of the liquid alternatives market increased from $100 billion to $500 billion. This high growth rate and overall market size can be attributed to the following:

- **Retirement shift.** In recent years, *defined contribution plans* (i.e., plans that require employers to provide a stated contribution to employees) have increased in popularity relative to *defined benefit plans* (i.e., plans that require employers to provide a stated retirement benefit to employees). As a result, investors are now self-managing their retirement portfolios and purchasing liquid alternatives.
- **Market conditions**. Due to low fixed-income returns and a perception that equity investments may be overvalued, investors have sought to diversify their traditional investment portfolios. Liquid alternatives have consistently been used to achieve this goal.

If these two remain unchanged or other growth factors emerge, the liquid alternatives market may continue its rapid growth.

Return Factors

The differences in manager compensation and permissible investment actions can cause liquid alternatives to have returns that diverge substantially from other alternative investments.

1. **Manager compensation**
   - Unlike most alternative investments (e.g., hedge funds), liquid alternatives do not typically have provisions for managers to earn incentive fees if sufficient profits are earned.
   - Liquid alternatives may attract less skilled managers relative to other alternative investments. The most highly skilled managers may be discouraged by the lack of incentive fees and the resulting lower potential compensation.

2. **Investment actions**
   - Many alternative investments earn substantial illiquidity premiums. Liquid alternatives are unable to earn this important source of returns.
   - Liquid alternative investments typically have constraints (e.g., diversification requirements, limits on short positions, and leverage limits) that limit which investment strategies can be effectively implemented.

While the manager compensation and investment restrictions associated with liquid alternatives may result in lower risk-adjusted returns, they still may be suitable for many investor portfolios.

Taxation

LO 2.5: Demonstrate knowledge of taxation of investments.

For example:
- **Recognize income tax conventions (e.g., taxes on capital gains, dividends, interest).**
- **Recognize non–income tax conventions (e.g., real estate tax, estate tax, value-added tax).**
- **Recognize how variations in income tax conventions around the world affect investments and investment decisions.**

While taxation minimization or avoidance is not the primary goal of investing, managers and investors must pay close attention to global tax regulations due to their ability to alter the attractiveness of an investment decision. Note that investment choices (e.g., Treasury bonds versus municipal bonds versus corporate bonds) also influence taxation levels for hedge funds, but this is due to investment selection rather than hedge fund structure.

Income Taxation

Many countries use a progressive taxation system. Under a **progressive taxation** system, the tax rate increases as the level of individual or corporate income increases. In addition to imposing progressive tax rates on *ordinary income*, many countries tax investment returns differently depending on whether they are in the form of interest, dividends, or capital gains. For example, interest and dividends might be taxed at a reduced rate or taxed at ordinary rates after they exceed a set amount. Long-term capital gains are often taxed at a

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lower rate than short-term capital gains, with long-term definitions varying from one to five years or so. In most countries, capital gains taxes are owed only when capital gains are realized (i.e., when the investment is sold). Hedge funds often seek out countries or locales, such as the Cayman Islands, Bermuda, and the British Virgin Islands, that offer income tax relief at the corporate level. While individual investors must still pay personal income taxes on any gains, the ability to avoid paying corporate income tax provides fund managers a strong incentive to operate in these countries.

In the United States, **Section 1256 contracts** experience unique tax treatment as 40% of the contract's profits or losses are treated as short-term and 60% is treated as long-term regardless of the investor's actual holding period. These contracts include regulated futures, foreign currencies, and non-equity options (including equity index options).

Other Taxes and Withholding

In addition to income taxes, all other forms of tax should also be considered by investors during the investment-decision process.

- **Real estate taxes** are often collected by local governments around the world and allow governments to provide local services such as education and law enforcement.
- **Wealth taxes** are assessed in several countries (e.g., Columbia and India) at the national level. Citizens in these countries typically pay an annual tax on their net worth, including their investment portfolios.
- **Estate taxes** are charged on estate's assets at the time they are transferred to the estate's heirs.
- **Transaction taxes** are charged on security transactions in several European countries (e.g., United Kingdom and France, which charges a value-added tax of nearly 20% on commissions) and the United States.
- **Foreign investment income taxes** are frequently charged by countries on foreign investment profits earned by its citizens. However, in order to prevent investors from experiencing double taxation, many countries allow investors to reclaim any withheld taxes on foreign investments and thus pay tax in only one country.

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Topic 2.2

Key Concepts

LO 2.1

Market participants in the alternative investment marketplace include:

- Buy-side institutions are asset managers that focus on acquiring appropriate securities for their investment portfolios. Institutions that make up the buy side of the investment industry include plan sponsors, foundations, endowments, family office institutions, sovereign wealth funds, hedge funds, funds of funds, private equity funds, commodity trading advisors, and separately managed accounts.
- Sell-side institutions are less concerned with account management and instead focus on providing investment research and transaction execution services to their customers. The most prominent sell-side institutions for alternative investments are large dealer banks and retail brokers.
    - Large dealer banks underwrite and trade investment securities and derivatives. Large dealer banks often operate their own hedge funds and private equity funds. These banks also engage in proprietary trading, off-balance sheet financing, and over-the-counter derivatives trading. In addition, large dealer banks may offer account management services, serve as prime brokers, and provide services traditionally reserved for commercial banks.
    - Retail brokers provide investment research and execute buy, sell, and limit orders for their customers. Brokers often attempt to keep the trades of their client private by breaking up large trades or taking the contra side of a trade. Retail brokers also engage in proprietary trading.
- Outside service providers provide professional services that are vital to the formation and continued operation of alternative investment funds. Relevant outside service providers include the following:
    - Prime brokers. The prime broker executes trades on behalf of an alternative investment manager, lends securities to sell short, provides research data, provides account statements and other documentation, and provides financing.
    - Auditors/accountants. During fund creation and operation, an outside accounting service will audit fund records, provide tax and compensation advice, and assist with the preparation of internal and external financial statements.
    - Attorneys. The fund's legal counsel provides legal advice regarding optimal fund structure and maintains regulatory registrations for the hedge fund manager.
    - Fund administrators. The fund administrator of an alternative investment fund is responsible for verifying operational controls, assets under management, and performance figures.
    - Hedge fund infrastructure comprises three integrated systems: platforms, software, and data providers.
    - Consultants provide objective advice regarding portfolio allocation decisions and investment manager selection.
    - Depositories/custodians hold client assets and provide information service, trade clearance, and trade settlement for investment securities.
    - Banks. An investment bank assists hedge funds with capital management, including providing the fund with loans, lines of credit, and external credit enhancement. A commercial bank is used for capital management purposes. Global hedge funds must also understand non-U.S. bank structures, such as Germany's universal banks, Japan's keiretsu structure, and the U.K.'s two-tiered bank structure.

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LO 2.2

Alternative investments can be traded on any of the following four financial markets:

- Primary markets relate to the sale of first-time issues (e.g., IPOs) and additional issues of existing securities (e.g., seasoned or secondary issues). New security issues may also be created through securitization, where assets are pooled together and new securities are issued that derive their cash flows from the pool's cash flows. For alternative investments, primary markets are often used as an exit strategy for successful investments as owners will choose to go public with the company via an initial public offering (IPO).
- Secondary markets are where securities trade after their initial issuance. Secondary markets are important because they provide liquidity and price/value information. Secondary markets consist of both physical exchanges and over-the-counter (OTC) markets. In secondary markets, dealer banks serve as trade intermediaries and trade for their own accounts with other dealer banks and also with brokers/dealers. Dealers generally do not charge commissions on transactions. Instead, they make their profit from market making activities.
- Third markets refer to a subset of the OTC market where nonmember investment firms, such as institutions and brokers/dealers, can make markets in and trade exchange-listed securities without going through the exchange. By avoiding exchange trading, transaction costs are reduced for market participants.
- Fourth markets describe the direct exchange of securities between investors without using the services of a broker as an intermediary. This market is generally used by institutions who deal in very large volumes of securities such as pension funds. Trades in the fourth market are facilitated by the electronic communication network (ECN). ECNs are more private, are anonymous, have lower transaction costs, and allow after-hours trading.

LO 2.3

Pertinent U.S. financial regulations include:

- The Securities Act of 1933 governs new securities issues and requires the company to disclose relevant information, to register new issues, and to disseminate a prospectus. Hedge funds are exempt from this act if they meet two criteria found under Regulation D: (1) the securities must be sold only to U.S.-accredited investors, and (2) the securities must not be marketed to the public.
- The Investment Company Act of 1940 was instituted to regulate investment pools, but hedge funds may be excluded.
- The Investment Advisers Act of 1940 requires that investment advisers register with the SEC. However, there are several exemptions to this rule related to the total value of managed funds, state registration requirements, and the nature of the adviser's investment company. The Advisers Act also subjects advisers to antifraud regulations.

Pertinent European financial regulations include:

- The Undertakings for Collective Investment of Transferable Securities (UCITS) Directive allows hedge funds to be more easily marketed to retail investors throughout the European Union, provided the funds meet UCITS Directive requirements.
- The Markets in Financial Instruments Directive (MiFID) established more uniform regulations throughout the European Union. A follow-up directive, MiFID II, eliminates many of the loopholes that allowed dark pools to exist under the original MiFID.
- The Alternative Investment Fund Managers (AIFM) Directive requires fund managers operating in the European Union to meet minimum capital requirements and obtain local regulatory approval. However, funds covered under the UCITS Directive are excluded from this law.

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LO 2.4

Liquid alternatives utilize private placement investment strategies within a retail fund. Regulatory constraints include leverage limits, diversification requirements, and liquidity requirements. Liquid alternatives can be categorized into one of the following five categories.

1. Skill-based replication products—attempt to earn comparable returns to alternative funds that use a complex investment strategy driven by manager skill by using a more basic version of the strategy that may use a mathematical or system approach.

2. Liquidity-based replication products—utilize liquid investments that have similar characteristics to illiquid securities used in illiquid alternative funds.

3. Constrained clones—attempt to follow similar strategy as an existing alternative investment product but modified due to investment limitations (e.g., liquidity, leverage, diversification).

4. Unconstrained clones—attempt to follow a near-identical strategy as an existing alternative investment product that is relatively liquid (and therefore the investment strategy requires little modification).

5. Diversified/absolute return products—focus on creating returns that have low correlation with traditional investments, but does not pattern its strategy after an existing alternative investment.

This high growth rate and overall market size of liquid alternatives can be attributed to (1) retirement plan shift from defined benefit to defined contribution plans, and (2) the perception that traditional investments are unlikely to provide attractive risk-adjusted returns in the near future.

The factors responsible for the difference in risk-adjusted returns for liquid alternatives and private placements are that liquid alternatives have (1) no incentive fees, (2) less skilled managers, (3) an inability to capture illiquidity premiums, and (4) a narrower set of permissible investment strategies.

LO 2.5

Taxation regulations that should be considered by both hedge fund managers and hedge fund investors include:

- Income tax regulations are the most prevalent type of taxation. In addition to imposing progressive tax rates on ordinary income, many countries tax investment interest, dividends, and capital gains. Hedge funds often seek out countries or locales that offer income tax relief at the corporate level. While individual investors must still pay personal income taxes on any gains, the avoidance of double taxation provides fund managers and fund investors a strong incentive to do business in these countries.
- Real estate taxes are collected by local governments around the world and provide funding for services such as education and law enforcement.
- Wealth taxes are assessed in several countries at the national level. Citizens in these countries pay an annual tax on their net worth, which includes their investment portfolios.

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- Estate taxes are incurred on an estate's assets at the time the assets are transferred to the estate's heirs.
- Transaction taxes are charged on security transactions and are present in several countries. France charges a value-added tax of nearly 20% on commissions, rather than taxing transactions.
- Foreign investment income taxes are often charged on foreign investment profits earned by a country's citizens. However, many countries allow investors to reclaim any withheld taxes on foreign investments to avoid double taxation.

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Concept Checkers

1. Which of the following statements regarding the difference between separately managed accounts (SMAs) and investment funds is *most accurate*?
   A. Hedge fund investors benefit from the opaque nature of hedge fund strategies.
   B. SMA investors are more susceptible to the negative effects related to withdrawals by other investors.
   C. Unlike hedge fund investors, SMA investors may lose more than 100% of their original investment.
   D. While hedge fund investors own stakes in the underlying portfolio investments, SMA investors only own a stake in the investment company that manages the SMA.

2. The functions of which outside service provider are *least likely* to be a service offered by large dealer banks?
   A. Auditor.
   B. Depository.
   C. Prime broker.
   D. Commercial banker.

3. A successful venture capital project is preparing for its initial public offering (IPO). Which of the following statements regarding this process is *most accurate*?
   A. Existing owners of the venture capital project will be forced to liquidate their entire investment prior to the IPO.
   B. Regulations prohibit retail banks, but not dealer banks, from serving as underwriters for the new securities.
   C. If the firm would like to be listed on non-U.S. exchanges, an American Depository Receipt (ADR) would need to be created for the firm's securities.
   D. While the issuing firm receives the proceeds of the securities sale, the underwriter is responsible for origination, risk bearing, and distribution of the securities.

4. The outside service provider responsible for executing trades and providing leverage financing on behalf of a hedge fund is known as the:
   A. clearinghouse.
   B. counterparty.
   C. broker/dealer.
   D. prime broker.

5. Soft dollar practices *most precisely* refer to:
   A. the maximum amount of leverage allowable according to the fund's stated strategy.
   B. a technique used by fund managers to ascertain the likely impacts of forecasted investor withdrawals.
   C. Federal Reserve regulations that stipulate only 50% of the value of a security can be purchased on margin.
   D. a manager's use of client brokerage to obtain certain products and services to aid the manager in the investment decision-making process.

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6. Which of the following financial markets would be *most likely* to facilitate trades using an electronic communications network?
   A. Primary markets.
   B. Secondary markets.
   C. Third markets.
   D. Fourth markets.

7. A liquid alternative fund that focuses on passive positive returns that have a low correlation to U.S. equities and has limited leverage levels is *most likely* to be classified as a(n):
   A. replication fund.
   B. constrained clone.
   C. unconstrained clone.
   D. diversified/absolute return fund.

8. With regard to global tax regulations, which of the following statements is *most accurate*?
   A. In several countries, annual estate taxes are charged on the net worth of their citizens, including all financial assets.
   B. Hedge funds often operate in countries that do not tax corporate income, which allows the funds' investors to avoid paying taxes on any distributed profits.
   C. While investors in foreign investments may suffer from double taxation, many countries allow investors to reclaim any withheld taxes on foreign investments.
   D. In countries with wealth taxes, investors are likely to invest in financial securities rather than real assets such as real estate in order to reduce their required taxes.

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Concept Checker Answers

1. C Characteristics that distinguish SMAs from investment funds include:
   - An investor who owns a SMA directly owns the underlying investments in the portfolio rather than a stake in its underlying investments.
   - The investment objectives of a SMA can be tailored to the individuals' situation.
   - SMAs provide investors greater transparency by providing investors with complete information on all positions in the investment account.
   - SMAs are immune from the potentially negative impacts of withdrawals by other investors.
   - SMAs lack the limited liability offered by funds, so investors may lose more than 100% of their investment. (LO 2.1)

2. A Large dealer banks play many roles in the alternative investing marketplace, including roles traditionally served by outside service providers. These include prime brokerage services, commercial banking services, and depository services. (LO 2.1)

3. D If a venture capital project goes public, owners will sell part or all of their ownership in the venture. For IPOs, an underwriter is responsible for origination (design, planning, and registration of the issue), risk bearing (underwriter insures or guarantees the price by purchasing the securities), and distribution (sale of the issue), while the issuing firm receives the proceeds of the sale. In primary markets, dealer banks and retail brokers play a crucial role in that they both may serve as underwriters, intermediaries, and liquidity providers. Global Depository Receipts (not American Depository Receipts) would be used if the firm chose to list its securities on a non-U.S. exchange. (LO 2.2)

4. D A hedge fund's prime broker is responsible for executing trades on behalf of the fund, lending securities to sell short and providing financing for leverage. (LO 2.1)

5. D 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. Advisers must disclose the firm's soft dollar arrangements to current and potential clients. The concern here is that the firm may do business with a more costly broker to benefit the firm at the expense of the investor. Investment managers have a duty to use client brokerage to benefit clients. (LO 2.3)

6. D Fourth markets describe the direct exchange of securities between investors *without* using the services of a broker or an exchange. An electronic communication network (ECN) facilitates trades in the fourth market. ECNs are private, are anonymous, have lower transaction costs, and allow after-hours trading. (LO 2.2)

7. D A liquid alternative investment fund that focuses on earning positive returns regardless of the investment environment and focuses on ensuring low correlation with traditional investments should be categorized as a diversified/absolute return product. (LO 2.4)

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8. **C** Agreements exist between many countries that prevent foreign investments from being taxed by both the foreign and domestic country. Wealth (not estate) taxes are used to regularly tax the net worth of a country's citizens. The net worth calculation includes both financial and real assets. If an investor receives profits from a fund operating in a country with no corporate tax, the investor must still pay personal income taxes on these distributions. (LO 2.5)

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The following is a review of the Alternative Investment principles designed to address the learning objectives set forth by the CAIA Association®.

Quantitative Foundations

Topic 2.3

Exam Focus

Properly measuring and evaluating asset returns is a key focus of portfolio management. Be aware of how different return and compounding conventions can lead to difficulties comparing returns and why log returns are often utilized. The calculation of alternative investment returns is complicated by unique features such as illiquidity, unusual cash flow patterns, notional principal, and waterfall distributions. Alternative investments often involve derivative positions based on the notional principal of underlying assets. Be able to define and apply the fully collateralized and partially collateralized returns on derivative contracts. Illiquidity leads to the use of the internal rate of return as the preferred method to derive returns for alternative investments. For the exam, know how to apply the internal rate of return approach in the presence of unusual cash flow patterns and when attempting to aggregate across investments. Finally, be familiar with how the structural characteristics of a fund (e.g., soft hurdle rates) can influence the cash waterfall distribution.

Compounded Returns

LO 3.1: Demonstrate knowledge of return and rate mathematics.

For example:

- Define and apply return compounding.
- Define and calculate logarithmic returns.
- Define and apply the return computation interval.
- Aggregate returns over different time intervals.
- Define and calculate arithmetic mean log returns and geometric mean returns.

When we calculate return rates, we can either use simple or compounded returns. **Simple returns** only recognize returns on the original investment, while **compounded returns** recognize returns earned on reinvested returns. Furthermore, compounding can take one of two forms: discrete or continuous. **Discrete compounding** occurs when earnings are reinvested over a finite number of subperiods (e.g., semi-annually, quarterly, daily). **Continuous compounding** refers to the continuous reinvestment of interest. Compounding increases overall return because interest is earned on interest, but when calculating a return for a set beginning and ending dollar amount, the realized compounded return will be lower than the simple interest return.

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The future value of an investment that utilizes discretely compounded returns is calculated using the following formula:

$$PV\left(1+\frac{r}{m}\right)^{m \times N} = FV$$

where:
PV = present value of investment (i.e., initial investment)
r = annual return
FV = future value of investment
m = number of compounding periods per year
N = number of years

For example, consider a \$100 investment that earns 10% per year, compounded semi-annually. After one year, the \$100 investment grows to \$110.25 as seen in the following equation.

$$100\left(1+\frac{0.10}{2}\right)^{2 \times 1} = 100(1.05)^2 = 100(1.1025) = \$110.25$$

The **simple interest** (i.e., no compounding) earned on this investment equals \$10.25. The simple holding period return equals:

$$R = \left(1+\frac{R^{m=2}}{2}\right)^2 - 1 = 10.25\%,$$

where *R* equals the simple interest, *m* equals the number of compounding periods per year, and $R^{m=2}$ = 10% is the semi-annually compounded return. In other words, $R^{m=2}$ is the return upon which semi-annual compounding is applied. Therefore, we can conclude that earning 10.25% (simple interest) over one year is the equivalent of earning 10% compounded semi-annually.

The relationship between simple returns and continuously compounded returns is as follows:

$$R = \left(1+\frac{R^{m\to\infty}}{\infty}\right)^{\infty} - 1$$

where *R* is the simple return and $R^{m\to\infty}$ is the continuously compounded return (i.e., it is the return upon which continuous compounding is applied). This can be simplified to the following:

$$R = e^{R^{m\to\infty}} - 1$$

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Example: Simple rate

Calculate the simple rate if a 6% interest rate is compounded continuously.

Answer:

$$R = e^{R^{m\to\infty}} - 1 = e^{0.06} - 1 = 6.18\%$$

Using the Texas Instruments BA II Plus Calculator, the keystrokes are as follows:

0.06 [2nd] [e^x] [–] 1 [=] 0.0618.

Extending this example, consider an investment that grows from $100,000 to $106,180 in one year. The investment has a simple holding period return of 6.18%.

Log Returns

Logarithms can be used to calculate the continuously compounded rate. For instance, in the example above, we are told that the investment grew from $100,000 to $106,180. We can solve for $R^{m\to\infty}$ (i.e., continuously compounded rate) by using one of the properties of natural logarithms that for any value X the following must hold true:

$$\ln(e^X) = X$$

where *ln* equals the natural log and e^X equals the exponential function.

Therefore, as already shown, the simple return, *R*, equals:

$$R = e^{R^{m\to\infty}} - 1$$

Equivalently:

$$1 + R = e^{R^{m\to\infty}}$$

Taking the natural logarithm of both sides of the equation and using the property of natural logarithms:

$$\ln(1 + R) = \ln(e^{R^{m\to\infty}}) = R^{m\to\infty}$$

where ln(1+R) is the **log return** or a *continuously compounded return*.

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Example: Continuously compounded rate

Assuming that the simple rate of return equals 6.18%, **calculate** the continuously compounded rate.

Answer:

$$R^{m\to\infty} = \ln(1.0618) = 6\%$$

Using the Texas Instruments BA II Plus Calculator, the keystrokes are as follows:

1.0618 [LN] = 0.06

Log returns are useful when modeling investment returns. For example, the simple return equals:

$$1 + R_{0,T} = (1 + R_1)(1 + R_2)\ldots(1 + R_T)$$

where 0,T is the **return computation interval** (i.e., period 0 through period T) and R_1, R_2, ..., R_T are the intermediate or subperiod returns within the investment period. Note that this equation requires multiplication to obtain the aggregated return.

For investment modeling, we only need to use addition to aggregate log returns. This is a substantial advantage.

$$\ln(1 + R_{0,T}) = \ln(1 + R_1) + \ln(1 + R_2) + \ldots + \ln(1 + R_T)$$

Professor's Note: In the Statistical Foundations topic review, we will explore how the lognormal distribution is used to analyze investment returns.

Also, note that log returns greatly facilitate the calculation of the **geometric mean return**. For example, consider the following series of periodic simple returns: 5%, 10%, 30%, and –20%. The geometric mean return is calculated as follows:

$$\text{geometric mean} = \left(\prod_{t=1}^{T}(1+R_t)\right)^{1/T} - 1$$
$$= [(1+0.05)(1+0.10)(1+0.30)(1-0.20)]^{1/4} - 1 = 4.69\%$$

Another method is to use log returns, in which case the geometric mean return is calculated as:

$$\text{geometric mean} = e^{M} - 1$$

where M is the **arithmetic mean log return**:

$$M = \frac{\ln(1+R_1)+\ln(1+R_2)+\ln(1+R_3)+\ln(1+R_4)}{4}$$

$$M = \frac{0.0488+0.0953+0.2624-0.2231}{4} = 4.59\%$$

We can obtain the geometric mean return by converting the arithmetic mean log return into a simple return:

$$R = e^{M} - 1$$

$$\text{geometric mean return} = e^{0.0459} - 1 = 4.69\%$$

Therefore, if the log returns are provided, the calculation of the geometric mean return is very straightforward and easy.

Returns Based on Notional Principal

LO 3.2: Demonstrate knowledge of returns based on notional principal.

For example:

- Recognize and apply the concept of forward contracts.
- Define and apply the concepts of notional principal and full collateralization for forward contracts.
- Calculate the log return to a fully collateralized derivatives position.
- Calculate the log return to a partially collateralized derivatives position.

A forward contract is a bilateral contract that obligates one party to buy and one party to sell a specific quantity of an asset, at a set price, on a specific date in the future. The initial value of a forward contract is zero to both parties at contract initiation. This initial zero value creates a problem, as this value is typically used to determine investment returns. Next, we look at how notional principal can be used to solve this issue and determine returns on these types of investments.

Notional principal is the face amount on the underlying asset upon which cash flows on a derivative instrument (e.g., forward or swap) are based. The **return on notional principal** equals the gain or loss on the derivative instrument divided by the notional principal. For instance, assume a gain of 50,000 euros is realized on a euro forward contract with notional principal of 1 million euros. The return on notional principal would be €50,000 / €1,000,000 = 5%. The return on notional principal may be misleading because the initial cash outflow does not equal the notional principal. In many alternative investments, there is no cash outflow at the initiation of the investment.

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Therefore, the return on notional principal is often expressed on a **fully collateralized basis, in which the forward contract is matched with capital equal to the forward contract's notional principal**. The return on a fully collateralized position consists of two components: the risk-free return on the collateral and the percent change in the derivative value. Using continuous compounding, the return (i.e., the log return) on the fully collateralized position, R_{fcoll}, equals:

$$R_{fcoll} = \ln(1 + R) + R_f$$

Provided on Exam

Alternatively, the return can be expressed on a **partially collateralized basis,** in which the forward contract is matched with capital equal to a percentage, *p*, of the forward contract's notional principal. A partially collateralized return is a leveraged return, where the leverage factor equals 1 / p, where *p* is the percent of the notional principal set aside as collateral. Therefore, returns on the partially collateralized investment are magnified by 1 / p. Formally, the log return on a partially collateralized position, R_{pcoll}, equals:

$$R_{pcoll} = [L \times \ln(1 + R)] + R_f$$

Provided on Exam

where:
L = leverage factor =1 / p

The notional principal equals L multiplied by the collateral amount. For example, if the collateral amount equals 20% of the notional principal (e.g., p = 20%), then the notional principal equals 1 / 0.20 or 5 multiplied by the amount of collateral.

Example: Calculation of a partially collateralized return

Assume the risk-free rate equals 2% and the return on the derivative instrument equals 5%. **Calculate** the partially collateralized return for a position with 30% collateral.

Answer:

The partially collateralized return equals:

$$R_{pcoll} = [1/0.30 \times \ln(1.05)] + 0.02 = 0.183 = 18.3\%$$

Professor's Note: The risk-free return will be lower for the partially collateralized formula relative to the fully collateralized formula due to the lower level of collateral that earns the risk-free rate.

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Internal Rate of Return

LO 3.3: Demonstrate knowledge of the internal rate of return (IRR) approach to alternative investment analysis.

For example:
- **Define and calculate the IRR.**
- **Define and calculate the four types of IRR based on time periods for which cash flows are available (i.e., lifetime, since inception, interim, and point-to-point) and their relationship to valuation of alternative investments.**

The performance of a series of cash flows generated from an investment can be measured using the internal rate of return (IRR). The **internal rate of return (IRR)** is the discount rate that equates the present value of an investment's cash inflows with the present value of the investment's cash outflows. In other words, the IRR is the return associated with a zero net present value (NPV). We can state the IRR mathematically as follows:

$$CF_0 + \frac{CF_1}{(1+IRR)} + \frac{CF_2}{(1+IRR)^2} + \ldots + \frac{CF_T}{(1+IRR)^T} = 0$$

where:
CF_t = cash flow at time t

The IRR is the standard measure of performance in the private equity and private real estate markets in which regular valuations of assets (e.g., daily market prices) are not available. The IRR accounts for both the timing and magnitude of cash flows into and out of the investment.

If the interim cash flows are identical, then the IRR can be solved as the interest rate that equates the present value of an annuity to the cost of the investment. If the cash flows are uneven, the IRR can be determined using trial and error, which is straightforward but time-consuming. Usually, interim cash flows are uneven, and the IRR is determined using a financial calculator or computer spreadsheet.

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Example: Solving for the IRR

Cash flows for an investment are expected to equal $1,000 at time 1, $8,000 at time 2, and zero thereafter. The cost of the investment today is $5,000. **Calculate** the IRR.

Answer:

The cash flows are $CF_0 = -5{,}000$, $CF_1 = 1{,}000$, and $CF_2 = 8{,}000$. Using the Texas Instruments BA II Plus Calculator, the steps are as follows:

1. [CF]	Opens the cash flow worksheet
2. [2ND] [CLR WORK]	Clears the cash flow worksheet (CF0 should be onscreen)
3. CF0 = [5,000] [+\–] [ENTER]	Enters –5,000 as the time zero cash flow
4. [↓] C01 [1,000] [ENTER]	Enters cash flow of 1,000 for time period 1
5. [↓] [↓] C02 [8,000] [ENTER]	Enters cash flow of 8,000 for time period 2
6. [IRR] [CPT] = 36.89%	Computes IRR for the cash flow series

Note that these calculator steps can easily be extended for any number of cash flows. Simply repeat Step 5 until all cash flows have been entered into the cash flow worksheet in the calculator. After entering each cash flow, Step 6 will determine the IRR for the series of cash flows.

The answer can be verified by substituting an IRR of 36.89% in the following equation:

$$-5{,}000 + \frac{1{,}000}{(1+\text{IRR})} + \frac{8{,}000}{(1+\text{IRR})^2} = 0$$

IRR Types

There are four types of IRRs:

1. **Lifetime IRR** is the IRR if all of the cash flows are available from start to finish of the investment. In a lifetime IRR, there is no terminal appraised value (often called a *residual value*). In a lifetime IRR calculation, period *T* signifies the end of the investment. Sometimes the lifetime IRR is called the "overall" IRR.

2. **Interim IRR** is the IRR that assumes an appraised terminal value. In an interim IRR, period *T* occurs prior to the end of the investment (and an appraised value is used for the period *T* cash flow).

3. **Point-to-Point IRR** is the IRR if the time 0 and time *T* cash flows are appraised values or are other cash flows during the investment's lifetime. Figure 1 demonstrates point-to-point IRRs relative to a lifetime IRR.

4. **Since-Inception IRR** is the IRR used to assess the performance of a fund (rather than an investment) since the date of its formation. The cash flows used for each period would be the aggregate cash flows of all portfolio holdings to the fund. Similar to the interim IRR, an appraised portfolio value would be used for time T.

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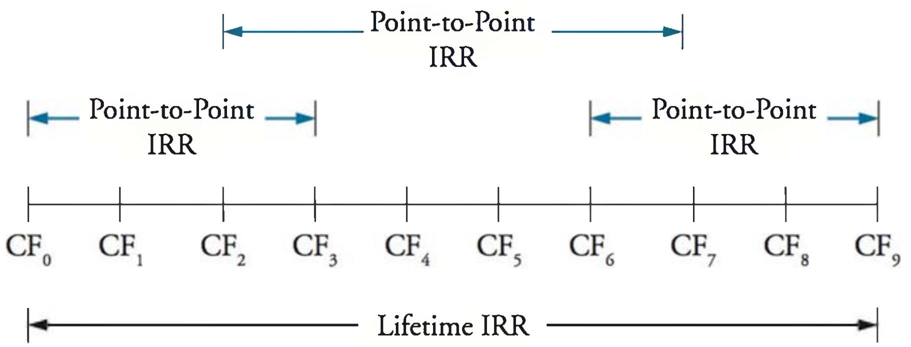
Figure 1: Point-To-Point IRR vs. Lifetime IRR



Example: Lifetime IRR

Assume the cash flows for a $1 million investment are expected to equal $500,000 in year 1, $400,000 in year 2, $300,000 in year 3, $100,000 in year 4, and zero thereafter. **Calculate** the lifetime IRR.

Answer:

CF_0 = –$1,000,000

CF_1 = $500,000

CF_2 = $400,000

CF_3 = $300,000

CF_4 = $100,000

Using the calculator steps described in the previous example, the IRR equals 14.49%. This is an example of a lifetime IRR because all the investment's cash flows are available, or, stated differently, there is no terminal appraised value.

Example: Interim IRR

Assume the cash flows for a $1 million investment are expected to equal $500,000 in year 1, $400,000 in year 2, and $300,000 in year 3. The appraised value for the investment for year 4 equals $600,000. **Calculate** the interim IRR.

Answer:

CF_0 = –$1,000,000

CF_1 = $500,000

CF_2 = $400,000

CF_3 = $300,000

CF_4 = $600,000

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The IRR equals 28.07%. This is an example of an interim IRR because not all of the investment's cash flows (through the end of the investment) are available, or, stated differently, the example assumes a terminal appraised value.

Example: Point-to-point IRR

Assume an investment began 4 years ago, when it was purchased by a private equity fund at a value of \$600,000. Cash inflows equaled \$300,000 in year 1, \$200,000 in year 2, and \$100,000 in year 3. At year 4, the investment is appraised at \$300,000. **Calculate** the point-to-point IRR.

Answer:

CF_0 = –\$600,000

CF_1 = \$300,000

CF_2 = \$200,000

CF_3 = \$100,000

CF_4 = \$300,000

The IRR equals 19.21%. This is an example of a point-to-point IRR because the cash flows at time 0 and time 4 are appraised values.

Example: Since-Inception IRR

Assume a private equity fund was started 5 years ago, with an initial portfolio valuation of \$6 million. Distributions equaled \$100,000 in year 1, \$300,000 in year 2, and \$200,000 in year 3. At year 4, the portfolio is appraised at \$7 million. **Calculate** the since-inception IRR for the fund.

Answer:

CF_0 = –\$6,000,000

CF_1 = \$100,000

CF_2 = \$300,000

CF_3 = \$200,000

CF_4 = \$7,000,000

The IRR equals 6.34%. This is an example of a since-inception IRR because we are calculating the returns for a fund (rather than an investment) since its inception.

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Issues with IRR

LO 3.4: Demonstrate knowledge of problems with the use of IRR in alternative investment analysis.

For example:

- **Recognize complex cash flow patterns, and discuss their effect on the computation and interpretation of IRRs.**
- **Discuss the challenges (e.g., scale differences) of comparing investments based on IRRs.**
- **Discuss the difficulties of aggregating IRRs.**
- **Discuss the reinvestment assumption inherent in the IRR and how it is addressed by the modified IRR.**
- **Compare and calculate time-weighted and dollar-weighted returns.**

Complex cash flow patterns involve one or both of the following:

1. Borrowing type cash flow patterns.
2. Multiple sign change cash flow patterns.

In **borrowing type cash flow patterns**, the time 0 cash flow is positive (a cash inflow), and the remaining cash flows are negative (cash outflows). For example, the investment might be a real estate sale/lease back arrangement in which there is an initial cash inflow (e.g., sale receipt) followed by cash outflows (e.g., lease payments). The effect of a borrowing type cash flow pattern is that it changes the interpretation of the IRR; namely that in a borrowing type cash flow pattern, a high IRR is not desirable because it reflects the effective cost of borrowing, not the return on investment.

In **multiple sign change cash flow patterns**, cash flows switch between positive and negative more than once. In this case, there might be multiple IRR solutions and the number of solutions may equal the number of sign changes.

Of the two aforementioned complexities, the multiple sign change cash flow pattern is more serious. None of the IRR solutions should be used when cash flows change sign more than once.

Difficulties also arise when comparing IRRs when investments have **scale differences**, which are differences in the timing of cash flows, differences in investment size, or both. Differences in timing arise when one investment lasts longer than another investment.

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Example: IRRs for investments of different size

Consider two equally risky investments with a cost of capital of 10%.

1. Investment A with a $100 cost today with cash flows of $50 for three years and zero cash flows thereafter. The IRR for Investment A is 23.38%.

2. Investment B with a $1 million cost today with cash flows of $450,000 for three years and zero cash flows thereafter. The IRR for Investment B is 16.65%.

Discuss why the IRR is misleading when comparing these investments.

Answer:

Based on a comparison solely on IRRs, Investment A seems better than Investment B. However, the net present value (NPV) for Investment A is only $24.34, whereas the NPV for Investment B is $119,083. On the basis of share value maximization, Investment B is preferred even though its IRR was lower.

Note that the NPV of an investment asset is the present value of expected cash inflows associated with the investment less the present value of the investment's expected cash outflows, discounted at the appropriate cost of capital. On the Texas Instruments BA II Plus, the NPV is computed after inputting all cash flows into the cash flow worksheet. After all cash flows are entered, the NPV is found by pressing the *[NPV]* key, entering the cost of capital for "*I*" (10% in this example), pressing *[ENTER]*, and then pressing *[↓] [CPT]*.

Example: IRRs for investments with different timing of cash flows

Consider two equally risk investments with a cost of capital of 10%. The cost for both investments is $1 million today. Cash flows for Investment A are $300,000 each year for six years, $350,000 in year 7, and zero thereafter. Cash flows for Investment B are $500,000 for three years and zero thereafter. **Determine** the IRRs and NPVs of both investments.

Answer:

The IRRs for the two investments equal 23.4%, but the NPVs are $486,184 for Investment A and $243,426 for Investment B. According to the IRRs, the investments are equally preferred, but the NPV for Investment A is double that of Investment B.

IRRs also are problematic when aggregating the results of several investments. **Aggregation of IRRs** refers to the relationship between the IRRs for individual investments and the IRR of the combined investments. The combined IRR of two investments might not equal the average of the two individual investment IRRs.

Example: Aggregation of IRRs

Consider Investment A, with an initial cash outflow of $1 million and a one-time cash inflow of $1,200,000 at the end of year 1, and Investment B, with an initial cash inflow of $2 million and a one-time cash outflow of $2 million at the end of year 1.

	CF at time 0	*CF at year 1*
Investment A	–$1 million	+$1.2 million
Investment B	+$2 million	–$2 million
Combined Investment	+$1 million	–$800,000

Explain why the individual IRRs are misleading if used to estimate the combined IRR of both investments.

Answer:

The IRRs are 20% and 0% for Investments A and B, respectively, which might lead us to expect the IRR of the combined investment to lie between 0 and 20%. However, consider the combined investment, which is an aggregation of Investments A and B with initial cash inflow of $1 million and a one-time cash outflow of $800,000 at the end of year 1. The IRR for the combined investment equals –20%. Therefore, the IRR of the combined investment is not simply a weighted average of the individual investment IRRs.

The IRR can be very sensitive to changes in cash flows, especially distant, large cash flows such as a terminal value that is not expected to be realized for several periods. Therefore, IRR sensitivity is partially determined on the magnitude of the IRR and on the length of cash flow period. It is important to remember that, for many alternative investments, terminal values are appraised values. Therefore, depending on the magnitude of the IRR, the IRR can change dramatically relative to changes in the appraised terminal value. From the properties of the time value of money, high positive IRRs are less sensitive to changes in terminal period cash flows. In contrast, high negative IRRs are highly sensitive to changes in terminal period cash flows.

The **reinvestment rate assumption** of the IRR refers to the assumption that all cash flows are reinvested in the original investment and earn a return equal to the original investment's IRR. In cases where the reinvestment assumption is invalid, the **modified IRR** can be used, in which the investment's cash inflows are compounded at an assumed reinvestment rate (e.g., the investment's cost of capital) and the investment's cash outflows are discounted at an assumed financing rate. In this way, the modified IRR better reflects the actual or expected performance of the investment.

The IRR is also known as the **dollar-weighted return** (or *money-weighted return*), in which returns are averaged over the investment's life depending on the timing of cash distributions and withdrawals. The dollar-weighted return is the investment's IRR, taking into account all cash inflows and outflows.

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Example: Money-weighted rate of return

Assume an investor buys a share of stock for $100 at t = 0 and at the end of the next year (t = 1), she buys an additional share for $120. At the end of year 2, the investor sells both shares for $130 each. At the end of each year in the holding period, the stock paid a $2.00 per share dividend. What is the investor's money-weighted rate of return?

Answer:

Step 1: Determine the timing of each cash flow and whether the cash flow is an inflow (+) into the account, or an outflow (–).

t = 0:	purchase of first share	= –$100.00
t = 1:	purchase of second share	= –$120.00
	dividend from first share	= +$2.00
	Subtotal, t = 1	–$118.00
t = 2:	dividend from two shares	= +$4.00
	proceeds from selling shares	= +$260.00
	Subtotal, t = 2	+$264.00

Step 2: Net the cash flows for each time period and set the PV of cash inflows equal to the present value of cash outflows.

$$PV_{inflows} = PV_{outflows}$$

$$\$100 + \frac{\$118}{(1+r)} = \frac{\$264}{(1+r)^2}$$

Step 3: Solve for *r* to find the money-weighted rate of return. This can be done using trial and error or by using the IRR function on a financial calculator or spreadsheet.

The intuition here is that we deposited $100 into the account at t = 0, then added $118 to the account at t = 1 (which, with the $2 dividend, funded the purchase of one more share at $120), and ended with a total value of $264.

To compute this value with a financial calculator, use these net cash flows and follow the procedure(s) described to calculate the IRR.

Net cash flows: CF_0 = –100; CF_1 = –120 + 2 = –118; CF_2 = 260 + 4 = +264

Calculating money-weighted return with the TI BA II Plus®

Note that the values for F01, F02, et cetera are all equal to one.

Key Strokes	*Explanation*	*Display*
[CF] [2nd][CLR WORK]	Clear Cash Flow Registers	CF0 = 0.00000
100 [ENTER]	Initial Cash Outlay	CF0 = +100.00000
[↓] 118 [ENTER]	Period 1 Cash Flow	C01 = +118.00000
[↓] [↓] 264 [+/–] [ENTER]	Period 2 Cash Flow	C02 = –264.00000
[IRR] [CPT]	Calculate IRR	IRR = 13.86122

In contrast to the dollar-weighted return, a **time-weighted return** is an averaged return that ignores the effects of the timing of cash distributions or withdrawals. Time weighting is the process of averaging a set of values over time. The time-weighted return measures compound growth of a lump sum investment (e.g., the compound growth of $1 over a stated measurement period). In the investment management industry, the time-weighted rate of return is the preferred method of performance measurement because it is not affected by the timing of cash inflows and outflows.

The time-weighted return also is known as the *geometric mean return*. The *annual* time-weighted return for an investment may be computed by performing the following steps:

Step 1: Value the portfolio immediately preceding significant additions or withdrawals. Form subperiods over the evaluation period that correspond to the dates of deposits and withdrawals.
Step 2: Compute the holding period return (HPR) of the portfolio for each subperiod.
Step 3: Compute the product of (1 + HPR) for each subperiod to obtain a total return for the entire measurement period [i.e., $(1 + HPR_1) \times (1 + HPR_2) \ldots (1 + HPR_T)$]. If the total investment period is greater than one year, we must calculate the geometric mean of the measurement period return to find the annual time-weighted rate of return.

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Example: Time-weighted rate of return

A share of stock is purchased at t = 0 for $100, and at the end of the next year, t = 1, another share is purchased for $120. At the end of year 2, both shares are sold for $130 each. At the end of both years 1 and 2, the stock paid a $2 per share dividend. What is the annual time-weighted rate of return for this investment? (This is the same investment as the preceding example.)

Answer:

Step 1: Break the evaluation period into two subperiods based on timing of cash flows.

Holding period 1:	Beginning value	= $100
	Dividends paid	= $2
	Ending value	= $120
Holding period 2:	Beginning value	= $240 (2 shares)
	Dividends paid	= $4 ($2 per share)
Ending value		= $260 (2 shares)

Step 2: Calculate the HPR for each holding period.

$$HPR_1 = [(\$120 + 2) / \$100] - 1 = 22\%$$

$$HPR_2 = [(\$260 + 4) / \$240] - 1 = 10\%$$

Step 3: Find the compound annual rate that would have produced a total return equal to the return on the account over the 2-year period.

$$(1 + \text{time-weighted rate of return})^2 = (1.22)(1.10)$$

$$\text{time-weighted rate of return} = \sqrt{(1.22)(1.10)} - 1 = 15.84\%$$

In the preceding examples, the time-weighted rate of return for the portfolio was 15.84%, while the money-weighted rate of return for the same portfolio was 13.86%. The results are different because the money-weighted rate of return gave a larger weight to the year 2 HPR, which was 10%, versus the 22% HPR for year 1. This is because there was more money in the account at the beginning of the second period.

If funds are contributed to a portfolio just before a period of relatively poor performance, then the money-weighted return will be lower than the time-weighted return. If funds are contributed at a favorable time (just prior to a period of relatively high returns), then the money-weighted return will exceed the time-weighted return. The use of the time-weighted return removes these distortions and thus provides a better measure of a manager's ability to select investments over the period. Conversely, the money-weighted return is the more appropriate performance for investors as they have complete control over their money flows.

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Topic 2.3

Cash Waterfall Distribution

LO 3.5: Demonstrate knowledge of the distribution of cash waterfall.

For example:
- **Explain the distribution of cash waterfall provision of a limited partnership agreement.**
- **Recognize terminology associated with the cash waterfall provision (e.g., carried interest, hurdle rate, catch-up provision, vesting, clawback clause).**
- **Discuss factors (e.g., management fees, incentive-based fees) to consider in a fund's compensation structure and the potential effects of decisions regarding compensation structure.**
- **Discuss and calculate fund-as-a-whole carried interest and deal-by-deal carried interest.**
- **Define and apply clawback provisions.**
- **Compare and apply hard and soft hurdle rates and their sequences of distribution.**
- **Discuss the potential effects of incentive fees on decision-making, and their optionlike nature.**

The **cash waterfall** is the provision describing how capital is distributed to the fund's investors. For example, the returns to a limited partnership often are split between the providers of capital (i.e., investors or limited partners) and decision makers (i.e., the managers or general partner). The waterfall sets the rules and procedures for the distribution of profits. When applied to private equity, the general partners (GPs) are the fund managers and the limited partners (LPs) are the investors—usually high net worth and institutional clients.

The **compensation scheme** contains the structure of how general partners will be compensated for their efforts. It includes organizational and compensation arrangements that determine an investment manager's fees, exposure to the investment's performance, and possible conflicts of interest with investors.

The **hurdle rate, or preferred return**, is the rate of return that must be distributed to the LPs before general GPs can earn any **incentive fees, also called carried interest** or **performance-based fees**, discussed in the following paragraphs. For example, a fund that invests $100 million over a two-year period with a hurdle rate of 10% will need to distribute $120 million to LPs before GPs are entitled to any carried interest.

Hurdle rates are typically set between 5% and 10%. A **soft hurdle rate** allows the GP to share in all profits if the performance of the fund is above the hurdle rate. A **hard hurdle rate** (also known as a "true preferred return" or a "floor") allows the GP to share only in profits in excess of the hurdle rate.

Carried interest is the percentage split of profits the fund managers earn after meeting the minimum hurdle rate, and it is paid on top of management fees. Unlike management fees, which are paid independent of fund performance, carried interest depends critically on the performance of the investments. The typical carried interest is up to 20% of the profits of the fund and is paid to the GPs once the LPs have been paid (the LP payment equals the repayment of their capital plus the hurdle rate amount). **Catch-up provisions** give the GP a larger distribution of the profits upon passing the hurdle rate. With a catch-up provision,

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the GP receives a large portion of all profits, not just the amount of profits above the hurdle rate, until the predetermined profit split is reached. The **catch-up rate** is the percentage of profits that will be distributed to the GP to "catch up" to the incentive fee once the hurdle rate is surpassed. The catch-up rate must exceed the hurdle rate.

Example: Hurdle rates and catch-up rates

An investment fund had an initial value of $30 million. The fund has a hurdle rate of 14% and an incentive fee of 20%. After one year, the fund is liquidated at a value of $40 million.

1. **Determine** the distribution of capital to the limited partners and general partner assuming this is a hard hurdle rate.

2. **Determine** the distribution of capital to the limited partners and general partner assuming this is a soft hurdle rate with a 30% catch-up rate.

Answer:

Hard hurdle rate

At the end of year 1, the limited partners receive their $30 million initial investment, leaving $10 million of profits to be split between the general and limited partners.

Next, the limited partners receive $4.2 million (= 14% × $30 million). This meets the hurdle rate requirement.

The remaining $5.8 million is then split based on the incentive fee of 20%.

General partner: 20% × $5.8 million = $1.16 million

Limited partners: 80% × $5.8 million = $4.64 million

In total, the limited partners have received their original $30 million investment plus an $8.84 million profit. The general partners have received $1.16 million in incentive fees.

Soft hurdle rate

At the end of year 1, the limited partners receive their $30 million initial investment, leaving $10 million of profits to be split between the general and limited partners.

Next, the limited partners receive $4.2 million (= 14% × $30 million). This meets the hurdle rate requirement.

The remaining $5.8 million is then split based on the incentive fee of 20% and the catch-up rate of 30%. The general partner receives the 30% catch-up rate on the remaining profits up to the point where the 20% split is achieved. (Note that after general partner is caught up, all profits are split based on the incentive fee percentage.) In this example, the 20% threshold is not reached.

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Catch-up rate to general partners: 30% × $5.8 million = $1.74 million

Limited partners: $5.8 million – $1.74 million = $4.06 million

In total, the limited partners, have received their original $30 million investment plus $8.26 million in profits. The general partners have received a total of $1.74 million

Professor's Note: In practice, performance-based fees for managers are typically called incentive fees in the hedge fund sector and carried interest in the real estate and private equity sectors.

Carried interest can be computed on a deal-by-deal basis or fund-as-a-whole basis. The **fund-as-a-whole carried interest** arrangement calculates the carried interest on the performance of the entire fund. In a **deal-by-deal carried interest** arrangement, the GP receives profit on each investment independent of the performance of other investments. A deal-by-deal arrangement is advantageous for the GP but not for the LP. The GP shares in the profits of the profitable deals, with little exposure to the non-profitable deals. A fund-as-a-whole carried interest arrangement is more protective of the LPs but might dilute the ability of the firm to attract talented GPs.

Incentive fees are similar to the payoffs of a long call option. The value of call options increases dramatically as the call option moves from out-of-the-money to in-the-money. The GP can earn extremely high returns, similar to the payoff of a deep in-the-money option. The hurdle rate is analogous to the "strike price." On the other hand, if the investment returns do not exceed the hurdle rate, then the option is out-of-the-money and will expire worthless and unexercised. The higher the hurdle rate, the lower the value of the call option. Incentive fees, like call options, become more valuable as greater risk is experienced by the underlying asset (e.g., the fund). Therefore, incentive fees can create perverse incentives for fund managers.

Management fees are fees paid to the GPs to cover the basic fund operating costs such as salaries, research, travel, rent, and utilities. Management fees are calculated as a percentage (generally 1.0–2.5%) of the fund size and are received regardless of fund performance.

Vesting denotes the process and timetable by which incentive payments are legally transferred to the GPs. Funds that have a fund-as-a-whole carried interest structure may also have a clawback clause. A **clawback clause** is a provision whereby LPs have the right to reclaim (i.e., clawback) incentive fees from GPs. Clawbacks are likely to happen if the fund experiences profits early and losses later. A clawback is the opposite of vesting.

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Example: Carried interest and clawback calculations

Fund A acquires asset X for $170 million and asset Y for $30 million. At the end of year 1, X is sold for $200 million. Y is sold at the end of year 2 for $10 million. Assume standard 80/20 carried interest split and a fund-as-a-whole carried interest arrangement. **Determine** the carried interest at the end of year 1 and year 2 and the clawback, if any. Ignore any catch-up effects.

Answer:

At the end of year 1, X has generated $30 million in profit. The carried interest distribution is (20%) × ($30 million) = $6 million to managers and $24 million to investors.

At the end of year 2, Y is sold for $10 million, all of which accrues to limited partners. At the termination of the fund, limited partners have received $170 million (return of capital) + $24 million (gain on sale based on 80/20 split) + $10 million (liquidation of Y) = $204 million.

Therefore, limited partners are entitled to a clawback of $4 million, as the fund earned a net profit of $10 million and the general partners should only receive $2 million.

In principle, clawback provisions guarantee that the LPs do not reward the GPs erroneously. In practice, however, there are several important limitations including:

- The guarantee to repay the LPs is unenforceable if the fund does not contain liquid assets. Therefore, any expected compensatory payment is based on the GP's creditworthiness.
- The GP may string out the life of the investment so the fund does not technically end and a clawback cannot be claimed (or calculated).
- The practical limitations of litigation reduce the incentive to seek the clawback.

Ideally, the GPs would not receive any profits until LPs receive their contributed capital and preferred return. The disadvantage is that delaying the carried interest can reduce motivation on the part of the GPs.

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Topic 2.3

Key Concepts

LO 3.1

Continuous compounding refers to the continuous reinvestment of interest, in which case the simple return will equal $R = e^{R^{m\to\infty}} - 1$, where $R^{m\to\infty}$ is the continuously compounded return (i.e., the return upon which continuous compounding is applied). The continuously compounded return (i.e., log return) equals ln(1 + R).

Compounding in which interest is not continuously reinvested is known as discrete compounding.

The geometric mean return can be calculated using log returns: $e^M - 1$, where M is the arithmetic average log return.

LO 3.2

A forward contract is a bilateral contract that obligates one party to buy and one party to sell a specific quantity of an asset, at a set price, on a specific date in the future. The initial value of a forward contract is zero to both parties at contract initiation.

Notional principal is the face amount on the underlying asset, upon which cash flows on a derivative instrument are based.

The return on notional principal equals the gain or loss on the derivative instrument divided by the notional principal. The return on notional principal is misleading because the initial cash outflow does not equal the notional principal. In many alternative investments (e.g., forwards), there is no cash outflow at the initiation of the investment.

Using a fully collateralized basis, the return is calculated by matching a collateral amount equal to the notional principal. Assuming continuous compounding, the return on the fully collateralized position equals $\ln(1 + R) + R_f$, where R_f is the risk-free rate and R is the return on the derivative instrument.

Alternatively, the return can be expressed on a partially collateralized basis, in which the forward contract is matched with capital equal to a percentage, p, of the forward contract's notional principal. The return on a partially collateralized position equals $[L \times \ln(1 + R)] + R_f$, where L equals the leverage factor 1 / p.

LO 3.3

The internal rate of return (IRR) is the discount rate that equates the present value of an investment's cash inflows to the present value of the investment's cash outflows. There are four types of IRRs.

1. The lifetime IRR is the IRR if all of the cash flows are available from start to finish during the investment.

2. The interim IRR is the IRR that assumes an appraised terminal value for investments.

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3. The point-to-point IRR is the IRR if the time 0 and time T cash flows are appraised values or other cash flows during the investment's lifetime.

4. The since-inception IRR is used to determine the performance of funds rather than investments.

LO 3.4

The IRR may not be correct when examining complex cash flow patterns that involve borrowing type cash flow patterns or multiple sign change cash flow patterns. Difficulties also arise when comparing IRRs across investments with scale differences, which are differences in timing of cash flows, differences in investment size, or both. IRRs also are problematic when aggregating the results of several funds because the portfolio IRR is not simply a weighted average of the component IRRs.

The IRR calculation assumes all cash flows are reinvested in the original investment and earn a return equal to the original investment's IRR. In contrast, in the modified IRR calculation, the investment's cash inflows are compounded at an assumed reinvestment rate, and the investment's cash outflows are discounted at an assumed financing rate, which offers a more realistic measure of the performance of the investment.

The dollar-weighted return is the investment's IRR, taking into account all cash inflows and outflows. In contrast, the time-weighted return is an averaged return that ignores the effects of the timing of cash distributions or withdrawals.

LO 3.5

The cash distribution waterfall is the provision describing how capital is distributed to the providers of capital (i.e., investors or limited partners) and decision makers (i.e., the managers or general partners). The distribution waterfall sets the rules and procedures for the distribution of profits.

The hurdle rate, or preferred return, is the rate of return that must be distributed to the limited partners before general partners can earn any incentive fees.

- A soft hurdle rate allows the general partner to share in all profits if the performance of the fund is above the hurdle rate.
- A hard hurdle rate allows the general partner to share only in profits in excess of the hurdle rate.

Carried interest is an incentive fee equal to the percentage split of profits that general partners earn after meeting the minimum hurdle rate and is paid on top of management fees. Catch-up provisions give the general partner a larger distribution of the profits upon passing the hurdle rate. The catch-up rate is the percentage of profits that will be distributed to the general partner to catch up to the incentive fee once the hurdle rate is surpassed.

- The fund-as-a-whole carried interest arrangement calculates the carried interest on the performance of the entire fund. In contrast, a deal-by-deal carried interest arrangement pays the general partner profits on each investment, independent of the performance of other investments.

- A deal-by-deal carried interest arrangement is advantageous for the general partners but not for the limited partners. A fund-as-a-whole carried interest arrangement is more protective of the limited partners but might dilute the ability of the firm to attract talented general partners.

Incentive fees are similar to the payoffs of a long call option. The general partner can earn extremely high returns, similar to the payoffs of a deep in-the-money option. The hurdle rate is analogous to the "strike price." The higher the hurdle rate, the lower the value of the call option. Incentive fees, like call options, become more valuable as greater risk is experienced by the fund. Therefore, incentive fees can create perverse incentives for the management of the fund.

Vesting denotes the process and timetable by which the general partners are legally transferred their incentive payments. A clawback clause is a provision whereby limited partners have the right to reclaim incentive fees from the general partner. A clawback is the opposite of vesting.

Management fees are fees paid to the general partner to cover basic fund operating costs such as salaries, research, travel, rent, and utilities and are paid regardless of the performance of the fund.

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Concept Checkers

1. If a stock doubled in value last year, what is its continuously compounded return over this period?
   A. 18.2%.
   B. 50.0%.
   C. 69.3%.
   D. 100.0%.

2. Assume the risk-free rate equals 4% and the return on the derivative instrument equals 2%. Assuming continuous compounding, the partially collateralized return for a position with 20% collateral is *closest* to:
   A. 6%.
   B. 14%.
   C. 34%.
   D. 44%.

3. The IRR calculation for cash flows in which the first and last reported cash flows are appraised values for an investment is the:
   A. overall IRR.
   B. lifetime IRR.
   C. interim IRR.
   D. point-to-point IRR.

4. Which of the following statements regarding the time-weighted rate of return is *least accurate*?
   A. It is not affected by the timing of cash flows.
   B. It is the industry's preferred method for performance measurement.
   C. It is used to measure the compound rate of growth of $1 over a stated measurement period.
   D. It is defined as the internal rate of return on an investment portfolio, taking into account all inflows and outflows.

5. The majority of general partner compensation is tied to performance and is defined as the:
   A. carried interest.
   B. preferred return.
   C. hurdle rate.
   D. distribution waterfall.

Concept Checker Answers

1. **C** The simple rate of return on a stock that doubles in one year is 100%. The formula to calculate the continuously compounded rate of return is:

   $\ln(1 + 100\%) = \ln(2) = 0.6931 = 69.3\%$
   (LO 3.1)

2. **B** The partially collateralized return is: $R_{pcoll} = [(1 / 0.2) \times \ln(1.02)] + 0.04 = 0.139 =$ 13.9%. (LO 3.2)

3. **D** The point-to-point IRR assumes the time 0 and time *T* cash flows are appraised values. The lifetime IRR, also known as the overall IRR, assumes all of the cash flows are available from start to finish of the investment. The interim IRRs assume an appraised terminal value. The since-inception IRR is used for funds rather than investments. (LO 3.3)

4. **D** The money-weighted rate of return is the IRR of an investment's net cash flows. (LO 3.4)

5. **A** The majority of general partner compensation is tied to performance through carried interest. The carried interest is only rewarded after a preferred return or hurdle rate is met. (LO 3.5)

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The following is a review of the Alternative Investment principles designed to address the learning objectives set forth by the CAIA Association®.

Statistical Foundations

Topic 2.4

Exam Focus

Proper interpretation of returns often depends on the distribution of the data. For the exam, understand the features of both normal and lognormal distributions. In addition, be able to calculate and interpret the four moments of the distribution (i.e., mean, variance, skewness, and kurtosis). The relationship among asset returns is a key focus of portfolio management. Four related statistical measures of relationship are discussed in this topic review: correlation, covariance, beta, and autocorrelation. Know how to define and apply all four measures. In addition, understand how to test the normality of a distribution and how autocorrelation, illiquidity, and nonlinearity might cause a distribution to be non-normal. Finally, understand how ARCH and GARCH time-series models are used to forecast future return volatility.

Summarizing Data

LO 4.1: Demonstrate knowledge of the characteristics of return distributions.

For example:

- **Recognize ex ante and ex post return distributions.**
- **Recognize the importance of the normal distribution in statistical analysis.**
- **Describe the characteristics of lognormal distributions.**

Ex post returns are historical, or "after the fact," returns. An **ex post distribution** is a function that assigns relative frequencies to ranges of values of the random variable.

Ex ante returns are future, or "before the fact," returns. An **ex ante distribution** is a function that assigns probabilities to ranges of future possible values of the random variable.

Therefore, ex post distributions summarize historical or realized values of the random variable, whereas ex ante distributions summarize possible future values of the random variable.

Ex post distributions can be used to approximate ex ante distributions, so long as (1) the distribution is stationary (i.e., mean and variance are constant over time), and (2) a large number of historical observations are available from which a proper representation of the distribution can be derived. For example, ex post inflation rates can be used to forecast future inflation rates, as long as the mean and variance of the inflation rate remain stable over time and as long as a sufficient number of historical inflation observations are available.

The **normal distribution**, or *Gaussian distribution*, is the well-known "bell-shaped" probability distribution. Figure 1 shows the normal distribution. As shown in Figure 1, the normal distribution is perfectly symmetrical. In other words, the two halves of the

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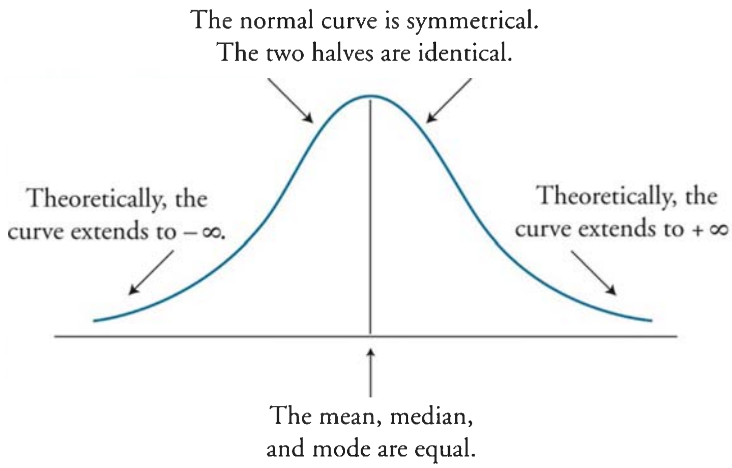
distribution are identical. Because the distribution is symmetrical, the mean, median, and mode are all equal. In addition, the distribution possesses asymptotic tails (i.e., the tails of the distribution gently slope downward toward the x-axis) and is continuous (i.e., the number of possible values for a random variable are infinite).

One of the features that makes the normal distribution popular is that it can be fully described by its first two moments, which are the mean and standard deviation.

Figure 1: The Normal Distribution



The bell shape of the normal distribution makes it very useful for statistical analysis from both an empirical and theoretical point of view. Empirical tests show that the normal distribution approximates real world data very well.

An advantage of continuous compounding is that continuously compounded returns (i.e., log returns) follow a normal distribution. In contrast, simple returns do *not* follow a normal distribution when discrete compounding is used.

For example, if monthly returns are normally distributed, simple quarterly returns are *not* normally distributed because the normal distribution does not apply multiplicatively. In other words, if $1 + R_1$, $1 + R_2$, and $1 + R_3$ each follow a normal distribution, the product, $(1 + R_1)(1 + R_2)(1 + R_3)$, does *not* follow a normal distribution. Therefore, $R_{0,3}$, does *not* follow a normal distribution.

Fortunately, however, the normal distribution is additive. Therefore, if the log returns, $\ln(1 + R_1)$, $\ln(1 + R_2)$, $\ln(1 + R_3)$, are normally distributed, then the continuously compounded return for the quarter, $\ln(1 + R_{0,3}) = \ln(1 + R_1) + \ln(1 + R_2) + \ln(1 + R_3)$, is also normally distributed.

To summarize, if monthly returns are normally distributed, the quarterly returns using discrete compounding are *not* normally distributed. Conversely, if monthly log returns are normally distributed, the quarterly log returns are also normally distributed.

The **lognormal distribution** is generated by the function e^x, where x is normally distributed. Since the natural logarithm, ln, of e^x is x, the logarithms of lognormally distributed

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random variables are normally distributed, thus the name. Characteristics of the **lognormal** distribution include:

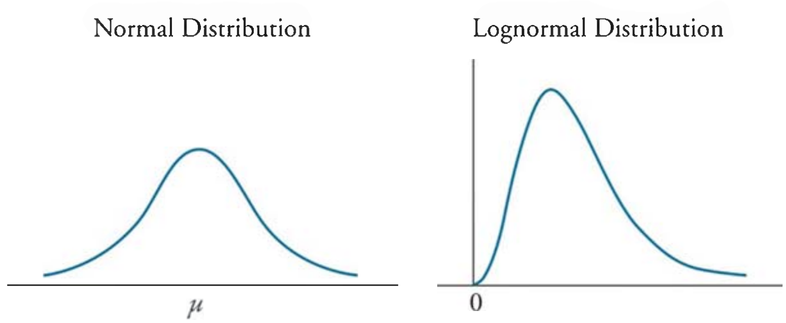
- Log returns, ln(1 + R), are normally distributed, or, equivalently, (1 + R) are lognormally distributed.
- The distribution is continuous.
- The distribution is skewed to the right.
- The distribution is bounded from below by zero so that it is useful for modeling asset prices which never take negative values.

Note that while the upper bound of a simple return, R, is $+\infty$, the lower bound of R is only –100%. But, if R = –100%, the natural logarithm of (1 + R), or ln(0), equals $-\infty$. Therefore, ln(1 + R) ranges from $-\infty$ to $+\infty$.

Finally, it should be noted that the Central Limit Theorem states that even if ln(1 + R) does *not* follow a normal distribution, the sum of the logs can be closely approximated by the normal distribution as the number of observations in the summation increases, assuming the log returns are uncorrelated over time. Therefore, even if ln(1 + R) is *not* normally distributed, the sum of the ln(1 + R) terms, which equals the continuously compounded return over longer periods of time, is approximately normally distributed. This is a very important result.

Figure 2 illustrates the differences between a normal distribution and a lognormal distribution.

Figure 2: Normal vs. Lognormal Distributions



If we used a normal distribution of returns to model asset prices over time, we would admit the possibility of returns less than –100%, which would admit the possibility of asset prices less than zero. Using a lognormal distribution to model price relatives avoids this problem. A price relative is just the end-of-period price of the asset divided by the beginning price (S_1/S_0) and is equal to (1 + the holding period return). To get the end-of-period asset price, we can simply multiply the price relative times the beginning-of-period asset price. Since a lognormal distribution takes a minimum value of zero, end-of-period asset prices cannot be less than zero. A price relative of zero corresponds to a holding period return of –100% (i.e., the asset price has gone to zero).

Topic 2.4

The Moments of a Distribution

LO 4.2: Demonstrate knowledge of moments of return distributions (i.e., mean, variance, skewness, and kurtosis).

For example:
- **Explain the first four raw moments of return distributions.**
- **Explain the central moments of return distributions.**
- **Explain skewness of return distributions.**
- **Explain kurtosis and excess kurtosis of return distributions.**
- **Describe the characteristics of platykurtic, mesokurtic, and leptokurtic distributions.**

The shapes of probability distributions are described by the *moments* of the distribution. **Raw moments** are measured relative to an expected value raised to the appropriate power.

The first raw moment is the **mean** of the distribution, which is the expected value of the returns:

$$E(R) = \mu = \sum_{i=1}^{n} p_i R_i^1$$

where:
p_i = probability of event i
R_i = return associated with event i

Generalizing, the k^{th} raw moment is the expected value of R^k:

$$E(R^k) = \sum_{i=1}^{n} p_i R_i^k$$

Raw moments for k > 1 are not very useful for our purposes, but central moments for k > 1 are very important.

Central moments are measured relative to the mean. The k^{th} central moment is defined as:

$$E(R - \mu)^k = \sum_{i=1}^{n} p_i (R_i - \mu)^k$$

Professor's Note: Because central moments are measured relative to the mean, the first central moment equals zero and is therefore not typically utilized.

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The second central moment is the **variance**, σ^2, of the distribution, which measures the dispersion of the data. If equally weighted values are used, the formulas for variance are as follows:

$$\text{variance} = \sigma^2 = E[(R_i - \mu)^2]$$

$$\sigma_p^2 = \frac{\sum_{i=1}^{n}(R_i - \bar{R})^2}{n}$$

Example: Variance, σ^2

Assume the following five-year annualized total returns represent all of the managers at a small investment firm (30%, 12%, 25%, 20%, 23%). What is the variance of these returns?

Answer:

$$\mu = \frac{30 + 12 + 25 + 20 + 23}{5} = 22\%$$

$$\sigma^2 = \frac{\left[(30-22)^2 + (12-22)^2 + (25-22)^2 + (20-22)^2 + (23-22)^2\right]}{5} = 35.60(\%^2)$$

Interpreting this result, we can say that the average variation from the mean return is 35.60% squared. Had we done the calculation using decimals instead of whole percents, the variance would be 0.00356.

If unequal weights are used (e.g., portfolio is not equally weighted) a slightly altered formula must be used:

$$\sigma_p^2 = \sum_{i=1}^{n} \text{prob}_i \times (R_i - \bar{R})^2$$

The major problem with using the variance is the difficulty of interpreting it. The computed variance, unlike the mean, is in terms of squared units of measurement. How does one interpret squared percents, squared dollars, or squared yen? This problem is mitigated through the use of the standard deviation, which is the measure used when referring to the **volatility** of the data. The **standard deviation,** σ, is the square root of the variance and is calculated as follows:

$$\text{standard deviation} = \sigma = \sqrt{\sigma^2}$$

In the world of finance, we are typically analyzing only a sample of returns data, rather than the entire population. If a sample is used rather than a whole population, sample moments and their associated formulas must be used. The **sample variance** measures the extent to which sampled returns deviate from the sample mean. While the sample mean is calculated in the same way as the mean, sample variance requires the use of n – 1 in the denominator. Using n – 1, instead of n, in the denominator improves the statistical properties of the sample variance as an estimator of variance. Thus, sample variance is considered to be an unbiased estimator of variance. The formula for the sample variance, s^2, is as follows (assuming equally weighted outcomes):

$$s_P^2 = \frac{\sum_{i=1}^{n}(R_i - \bar{R})^2}{n-1}$$

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The **sample standard deviation,** s, equals the square root of the sample variance.

$$s_P = \sqrt{\frac{\sum_{i=1}^{n}(R_i - \bar{R})^2}{n-1}}$$

Example: Sample variance and sample standard deviation calculation

Calculate the sample variance and sample standard deviation from the following set of returns.

Period	*Return*
1	0.10
2	0.06
3	–0.10

Answer:

The arithmetic average, $\bar{R}$, equals 0.02. The sample variance computations are summarized in the following table.

Period	R_i	$R_i - \bar{R}$	$(R_i - \bar{R})^2$
1	0.10	0.08	0.0064
2	0.06	0.04	0.0016
3	–0.10	–0.12	0.0144

The sum of squared deviations equals 0.0224. The sample variance equals the sum of squared deviations divided by n – 1:

$$s_P^2 = \frac{0.0224}{2} = 0.0112$$

The standard deviation of returns equals the square root of 0.0112.

$$s_P = \sqrt{0.0112} = 10.58\%$$

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Professor's Note: Because moments higher than the second central moment can be difficult to interpret, they are typically standardized (or normalized or scaled) by dividing the central moment by σ^k.

The **third central moment** measures the departure from symmetry in the distribution. The third central moment will equal zero for a symmetric distribution (such as the normal distribution).

$$3^{\text{rd}} \text{ central moment} = E\left[(R-\mu)^3\right]$$

The **skewness statistic** is the standardized third central moment. Skewness (sometimes called *relative skewness*) refers to the extent to which the distribution of data is not symmetric about its mean and is calculated as:

$$\text{skewness} = \frac{E\left[(R-\mu)^3\right]}{\sigma^3}$$

The tails of a skewed distribution will be elongated to the right for a positively skewed distribution and elongated to the left for a negatively skewed distribution. For positively skewed distributions, there are more outliers to the right of the mean than to the left of the mean. For negatively skewed distributions, there are more outliers to the left of the mean than to the right of the mean.

Unlike a symmetrical distribution, where the mean, median, and mode are identical, a skewed distribution will have different values for the measures of central tendency. For example, in a positively skewed distribution, mean > median. In a negatively skewed distribution, median > mean. The following three figures illustrate the relationships:

Figure 3: Symmetric Distribution

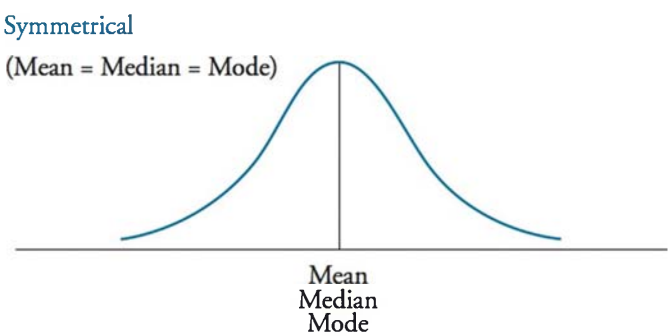

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Figure 4: Positively Skewed Distribution

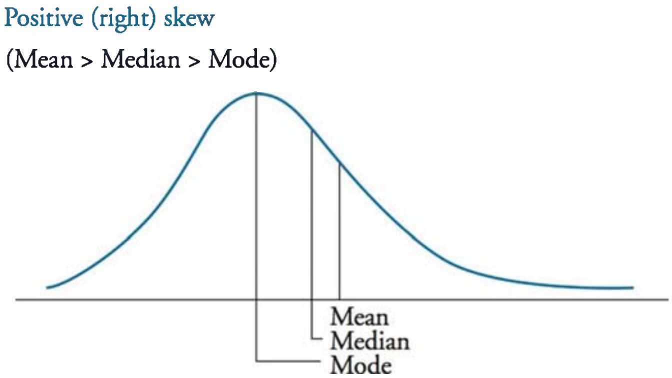
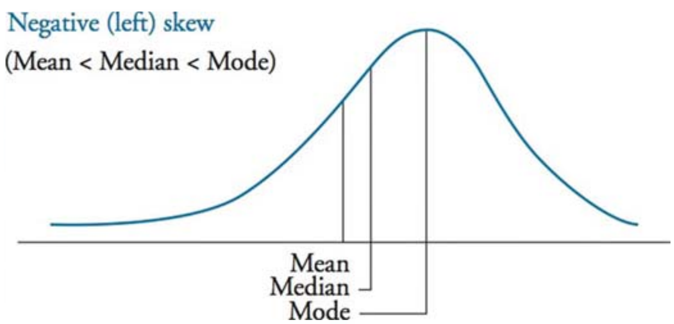


Figure 5: Negatively Skewed Distribution



The fourth central moment measures the degree of clustering in the distribution.

$$4^{\text{th}} \text{ central moment} = E\left[(R-\mu)^4\right]$$

The **kurtosis statistic** is the standardized fourth central moment of the distribution. Kurtosis refers to the degree of peakedness or clustering in the data distribution and is calculated as:

$$\text{kurtosis} = \frac{E\left[(R-\mu)^4\right]}{\sigma^4}$$

Kurtosis for the normal distribution equals 3. Therefore, the **excess kurtosis** for any distribution equals:

$$\frac{E\left[(R-\mu)^4\right]}{\sigma^4} - 3$$

A distribution with zero excess kurtosis is said to be **mesokurtic**. A distribution is said to be **leptokurtic** if it has a peak that extends above that of a normal distribution and tails that are fatter than those of a normal distribution. Therefore, leptokurtic distributions have a greater percentage of small deviations from the mean and a greater percentage of extremely large deviations from the mean compared to a normal distribution. Notice that investments with

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leptokurtic returns have a higher chance of large loss versus otherwise identical investments with normally distributed returns.

In contrast, a distribution is said to be **platykurtic** if it has a peak that lies beneath that of a normal distribution, implying a smaller percentage of small deviations from the mean compared to the normal distribution.

The following figures illustrate leptokurtic and platykurtic distributions:

Figure 6: Leptokurtic Distribution

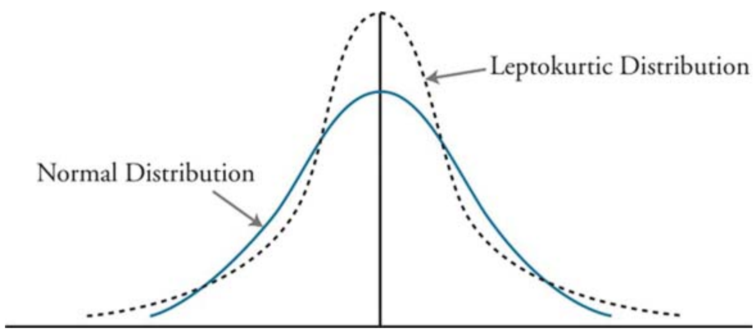
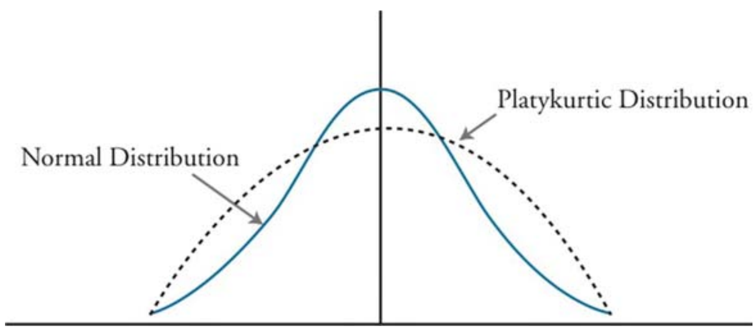


Figure 7: Platykurtic Distribution



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Covariance and Correlation

LO 4.3: Demonstrate knowledge of various measures of correlation of returns.

For example:

- Recognize the importance of correlation in alternative investment portfolio management.
- Define and calculate covariance.
- Define and calculate correlation coefficient.
- Define and calculate the Spearman rank correlation coefficient.
- Discuss the role of correlation in portfolio diversification.
- Define and calculate beta in the context of the CAPM.
- Define and calculate autocorrelation.
- Define and apply the Durbin-Watson test.

Covariance

Covariance is an unscaled statistical measure of how two assets move together. It is the expected value of the product of the deviations of the two random variables from their respective mean values. Because we will be mostly concerned with the covariance of asset returns, the following formula has been written in terms of the covariance of asset returns:

$$\text{Cov}(R_i, R_j) = \sigma_{i,j} = E[(R_i - \mu_i)(R_j - \mu_j)]$$

where:
R_i = return of asset *i*
R_j = return of asset *j*
μ_i = population mean return for asset *i*
μ_j = population mean return for asset *j*

If the covariance is calculated from a sample, the formula becomes:

$$\text{Cov}(R_i, R_j) = \frac{\sum_{t=1}^{T}(R_{i,t} - \bar{R}_i)(R_{j,t} - \bar{R}_j)}{T-1}$$

where:
$\bar{R}_i$ = sample mean return for asset *i*
$\bar{R}_j$ = sample mean return for asset *j*
T = total number of observations in the sample for each asset

The key component of the covariance is the cross-product: $(R_i - \bar{R}_i)(R_j - \bar{R}_j)$. The cross-product is positive if both assets perform well at the same time (i.e., $R_i > \bar{R}_i$ and $R_j > \bar{R}_j$) or perform poorly at the same time (i.e., $R_i < \bar{R}_i$ and $R_j < \bar{R}_j$). Otherwise, the cross-product will be negative (i.e., asset *i* performs well at the same time asset *j* performs poorly, and vice versa).

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The Correlation Coefficient

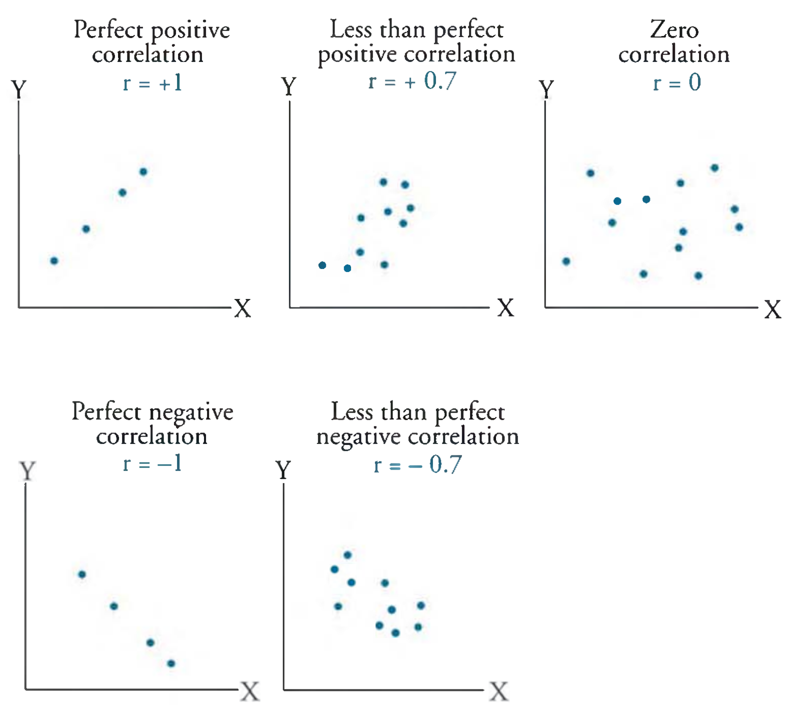
Proper management of alternative investment portfolios requires a sound understanding of the correlations of asset returns. The **correlation coefficient** (sometimes referred to as the *Pearson correlation coefficient*) is a statistical measure of the linear relationship between two variables. When applied to asset returns, the correlation measures the strength of the relationship of the returns for two assets. The formula for the correlation is:

$$\rho_{i,j} = \frac{\text{Cov}(R_i, R_j)}{\sigma_i \sigma_j}$$

where:
$\rho_{i,j}$ = correlation of returns between assets *i* and *j*
$\text{Cov}(R_i, R_j)$ = covariance of returns between assets *i* and *j*
σ_i = standard deviation of returns for asset *i*
σ_j = standard deviation of returns for asset *j*

The correlation of returns, $\rho_{i,j}$, is a scaled version of the covariance. While the covariance ranges from negative infinity to positive infinity, correlation ranges from –1 to +1. A correlation equal to +1 is indicative of **perfect positive linear correlation** and a correlation equal to –1 is indicative of **perfect negative linear correlation**. Figure 8 illustrates various correlation scenarios:

Figure 8: Interpretations of Correlations



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Because it is scaled to range from –1 to +1, correlation provides helpful information about the relationship between the returns of two assets.

- If $\rho_{i,j} = 1.0$, the assets are perfectly and positively correlated, implying that movement in one asset's returns is associated with a proportional same direction movement in the other asset's returns.
- If $\rho_{i,j} = -1.0$, the assets are perfectly and negatively correlated, implying that movement in one asset's returns is associated with a proportional opposite direction movement in the other asset's returns.
- If $\rho_{i,j} = 0$, the assets are independent, implying there is no relation in the movements of the returns of the two assets.

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Example: Calculate the covariance and correlation between two assets

Returns for a stock market index (asset i) and a commodity traders index (asset j) are provided below.

Part 1: **Derive** the sample covariance between the two sets of returns.

Outcome	R_i	R_j
1	0.00	0.20
2	0.10	0.10
3	0.20	0.00

Answer:

The mean (average) for both assets equals 0.10. The calculations for the covariance are provided below:

Outcome	R_i	R_j	$R_i - \bar{R}_i$	$R_j - \bar{R}_j$	$(R_i - \bar{R}_i)(R_j - \bar{R}_j)$
1	0.00	0.20	–0.10	+0.10	–0.01
2	0.10	0.10	0.00	0.00	0.00
3	0.20	0.00	+0.10	–0.10	–0.01

$$\text{Cov}(R_i, R_j) = \frac{\sum_{t=1}^{3}(R_{i,t} - \bar{R}_i)(R_{j,t} - \bar{R}_j)}{2} = \frac{(-0.01 + 0 - 0.01)}{2} = -0.01$$

Notice that the stock market index and the commodity traders index move counter to each other (as indicated by the negative cross-products). The covariance equals –0.01 which indicates that, on average, the returns for the two indices are negatively related.

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Part 2: **Calculate** the correlation between the two assets.

Answer:

The correlation equals the covariance scaled by the two standard deviations. The sample standard deviation for the stock market index uses the following formula.

$$s_i = \sqrt{\frac{\sum_{t=1}^{3}(R_{i,t} - \bar{R}_i)^2}{3-1}}$$

The standard deviation for the stock market index is calculated below:

Outcome	R_i	$(R_i - \bar{R}_i)^2$
1	0.00	0.01
2	0.10	0.00
3	0.20	0.01

Therefore, the standard deviation equals:

$$\sqrt{\frac{0.02}{2}} = 0.10$$

The standard deviation for the commodity traders index also equals 0.10 in this example.

We now have all we need to calculate the correlation of returns between the stock market index and the commodity traders index: the covariance equals –0.01 and each standard deviation equals 0.10. The correlation equals:

$$\rho_{ij} = \frac{\text{Cov}(R_i, R_j)}{\sigma_i \sigma_j} = \frac{-0.01}{(0.10)(0.10)} = -1.0$$

This indicates that the returns for the two assets are perfectly negatively correlated.

To aid in the interpretation of correlation, consider the returns of a stock and of an in-the-money put option on the same stock. These two returns will have a negative covariance and correlation because the two sets of returns move in opposite directions. The returns of two automotive stocks would likely have a positive covariance and correlation.

The Role of Correlation in Portfolio Diversification

Correlation plays a very important role in portfolio diversification. For example, portfolio risk equals:

$$\sigma_p = \sqrt{w_i^2\sigma_i^2 + w_j^2\sigma_j^2 + 2w_i w_j \rho_{i,j}\sigma_i\sigma_j}$$

where:
w_i = percentage weights allocated to asset *i*
w_j = percentage weights allocated to asset *j*
σ_i = standard deviation of asset *i*
σ_j = standard deviation of asset *j*

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If the correlation of returns between assets i and j equals one, then:

$$\sigma_p = w_i\sigma_i + w_j\sigma_j$$

If the correlation is less than one, then:

$$\sigma_p < w_i\sigma_i + w_j\sigma_j$$

The portfolio risk falls as the correlations drops, as illustrated in the example and in Figure 9.

	Expected Return	*Standard Deviation*
Domestic Stocks (DS)	0.20	0.30
Domestic Bonds (DB)	0.10	0.15

The portfolio expected return and risk for various combinations of stocks and bonds for different assumptions about the correlation between stocks and bonds follow.

Correlation	w_{DS}	w_{DB}	$E(R_p)$	σ_p
+1	100	0	0.20	0.30
	66.67	33.33	0.167	0.25
	50	50	0.15	0.225
	33.33	66.67	0.133	0.20
	0	100	0.10	0.15
0	100	0	0.20	0.30
	66.67	33.33	0.167	0.206
	50	50	0.15	0.168
	33.33	66.67	0.133	0.141
	0	100	0.10	0.15
–1	100	0	0.20	0.30
	66.67	33.33	0.167	0.15
	50	50	0.15	0.075
	33.33	66.67	0.133	0
	0	100	0.10	0.15

The plot of the portfolio expected returns and standard deviations for each of the three correlations is provided in the following figure.

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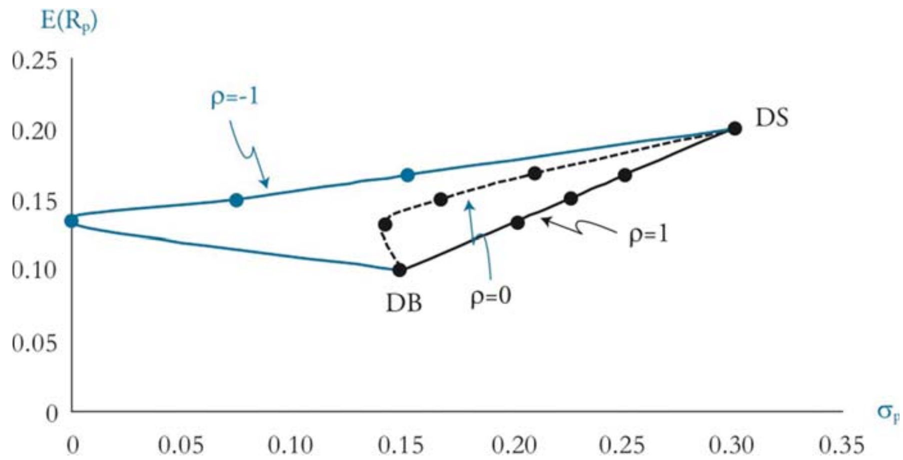
Figure 9: Effects of Correlation on Portfolio Risk



The graph illustrates that the further the correlation moves from +1, the lower the portfolio risk. Portfolio risk reduction is greatest when the correlation equals –1. The concept of correlation is a central focus of portfolio management.

The Spearman Rank Correlation

Sometimes we might not want to calculate the correlation using raw data, especially if the raw data contain outliers (extreme outcomes). Outliers have a large effect on the correlation and will drive the correlation estimate away from its true value. To address the outlier problem, we can calculate the **Spearman rank correlation**, which is the correlation of the asset returns *ranks*. By examining ranks, instead of the raw data, the effects of outliers are reduced.

The Spearman rank correlation coefficient is computed as follows:

Step 1: Rank the observations for each variable [from largest to smallest and assign a label to each observation from the largest being one to the smallest being *N* (i.e., the sample size)].

Step 2: Compute the difference in the ranks of each paired observation X_i ,Y_i as $d_i = X_i - Y_i$ (i.e., X and Y are ranks of the original observations).

Step 3: Calculate the Spearman rank correlation coefficient as:

$$\rho_s = 1 - \frac{6\sum d_i^2}{n(n^2 - 1)}$$

Provided on Exam

Example: Spearman rank correlation coefficient

Jason Gonzalez is examining the cross-sectional relationship between firm size and earnings per share. He has collected an initial sample of 10 firms.

Company Data for EPS and Market Value

Company	*EPS*	*Market Value (in millions of dollars)*
A	–0.38	705.6420
B	–0.62	5.0201
C	–7.98	2,976.3858
D	0.34	34.6617
E	0.47	1,547.0867
F	2.12	3,241.5314
G	1.61	1,389.3320
H	3.06	82,853.3492
I	0.55	186.7674
J	1.19	38.4080

Calculate the Spearman rank correlation coefficient.

Answer:

Step 1: Determine ranks.
Step 2: Compute the difference in ranks for each observation.

Company Data for EPS and Market Value with Steps 1 and 2 Complete

Company	*EPS*	*Market Value (in millions of dollars)*	*EPS Rank*	*Market Value Rank*	d_i
A	*–0.38*	*705.642*	*8*	*6*	*2*
B	*–0.62*	*5.0201*	*9*	*10*	*–1*
C	*–7.98*	*2,976.39*	*10*	*3*	*7*
D	*0.34*	*34.6617*	*7*	*9*	*–2*
E	*0.47*	*1,547.09*	*6*	*4*	*2*
F	*2.12*	*3,241.53*	*2*	*2*	*0*
G	*1.61*	*1,389.33*	*3*	*5*	*–2*
H	*3.06*	*82,853.35*	*1*	*1*	*0*
I	*0.55*	*186.7674*	*5*	*7*	*–2*
J	*1.19*	*38.408*	*4*	*8*	*–4*

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Step 3: Calculate the Spearman rank correlation coefficient as follows:

$$\rho_s = 1 - \frac{6\sum d_i^2}{n\left(n^2-1\right)} = 1 - \frac{6\begin{bmatrix}2^2+(-1)^2+7^2+(-2)^2+2^2+0^2\\+(-2)^2+0^2+(-2)^2+(-4)^2\end{bmatrix}}{10\left(10^2-1\right)}$$

$\rho_s = 0.4788$

The Beta

Beta is closely related to the correlation. As explained earlier, the correlation measures the strength of linear relationship between two assets. The beta measures the slope of the linear relationship and is a key component of the capital asset pricing model (CAPM).

The **CAPM** is one of the most celebrated models in all of finance and describes the relationship we should expect to see between risk and return for individual assets. Specifically, the CAPM provides a way to calculate an asset's return based on its level of systematic (or market-related) risk.

In the context of the CAPM, beta measures the sensitivity of an asset's returns to changes in the broad market return. The following two figures illustrate the estimation of beta in a regression of asset returns against the market index returns.

Figure 10: Regression with Correlation = 0.90 and Beta = 1.5

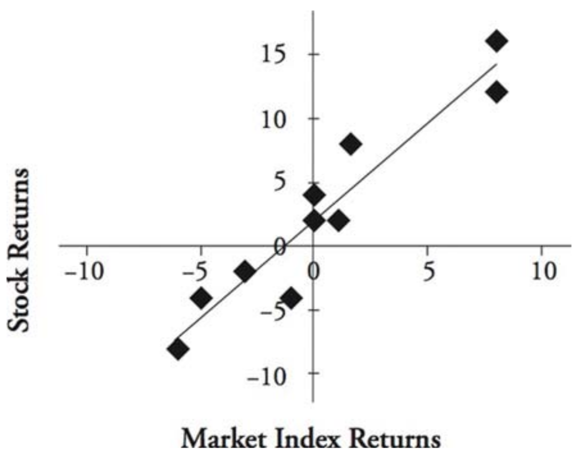
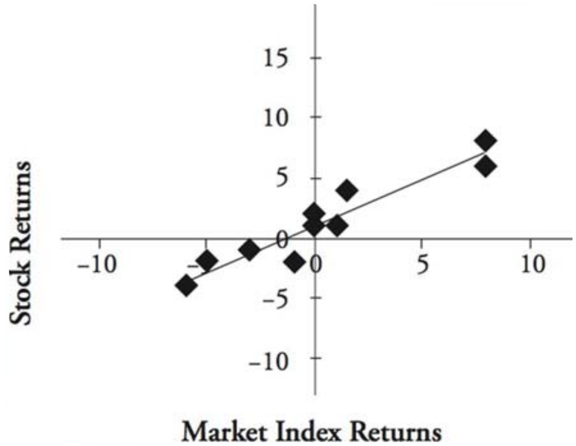


Figure 11: Regression with Correlation = 0.90 and Beta = 0.75



As illustrated in the figures, the correlation measures how closely the data scatter around the line, whereas beta measures the slope of the line. The slope is much steeper in Figure 10 than in Figure 11, even though the correlation is identical in the two figures.

In the context of the CAPM, the formula for the beta is:

$$\beta_i = \frac{Cov(R_i, R_m)}{Var(R_m)} = \frac{\sigma_{i,m}}{\sigma_m^2}$$

where:
$Cov(R_i, R_m)$ = covariance of returns for asset *i* and the market portfolio *m*
$Var(R_m)$ = variance of returns for the market portfolio

Note that the covariance is also the product of the correlation and the two standard deviations. Therefore, the beta also can be written as:

$$\beta_i = \frac{\rho_{i,m}\sigma_i\sigma_m}{\sigma_m^2} = \rho_{i,m}\frac{\sigma_i}{\sigma_m}$$

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Example: Calculation of beta

The covariance of returns between the RE Fund and the market portfolio equals 0.20, and the standard deviation of returns equal 0.80 and 0.40 for the RE Fund and the market portfolio, respectively. **Calculate** the correlation between the RE Fund and the market portfolio. Next, **calculate** the beta for the RE Fund.

Answer:

$$\rho_{RE,m} = \frac{Cov(R_{RE},R_m)}{\sigma_{RE}\sigma_m} = \frac{0.20}{(0.80)(0.40)} = 0.625$$

$$\beta_{RE} = \rho_{RE,m}\frac{\sigma_{RE}}{\sigma_m} = 0.625 \times \frac{0.80}{0.40} = 1.25$$

$$\beta_{RE} = \frac{\sigma_{RE,m}}{\sigma_m^2} = \frac{0.20}{0.16} = 1.25$$

Therefore, on average, the returns for the RE Fund change by 1.25 units for every 1-unit change in the market portfolio return.

Autocorrelation

So far, we have discussed correlations *across assets*. Correlations also are important when calculated *over time*, for a single asset. The correlation over time for an asset is called **autocorrelation**. If an asset's returns are correlated over time, we can conclude there is predictability in the returns. Returns that are autocorrelated are said to follow an **autoregressive** process.

If the sampled data are trending (either upward or downward), the autocorrelation will be positive, and if the sampled data are mean reverting, the autocorrelation will be negative. If the data are independent over time, then the autocorrelations will equal zero. This is an important requirement of the normal distribution. Non-zero autocorrelation will cause sampled data to be non-normally distributed.

Autocorrelation may be prevalent in markets where trading barriers exist (e.g., trading costs, trading restrictions, stale prices), in which case the actions of arbitrageurs might be restricted to the point where trends in the data persist.

The formula for the *k*-order autocorrelation is:

$$k\text{-order autocorrelation} = \frac{E[(R_t - \mu)(R_{t-k} - \mu)]}{\sigma_t\sigma_{t-k}}$$

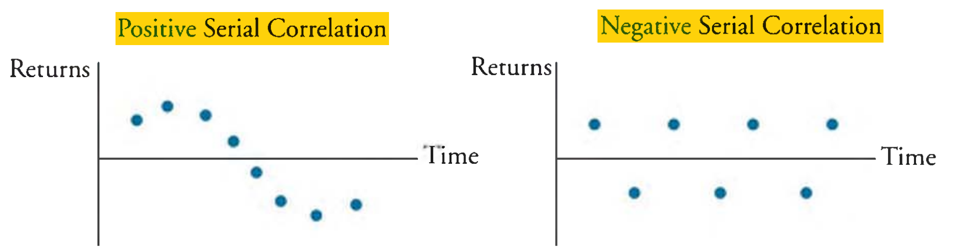
where:
R_t = asset's return in period t with mean μ and standard deviation σ_t
R_{t-k} = asset's return in period $t - k$ with mean μ and standard deviation σ_{t-k}

The **first-order autocorrelation** (or *serial correlation*) is the correlation between the current period and the previous period. The first-order autocorrelation is important because it indicates if the previous period return is helpful in predicting the current period return. If a security or market exhibits *positive* first-order autocorrelation, outperformance (underperformance) in one period is likely to be followed by outperformance (underperformance) in the next period. If a security or market exhibits *negative* first-order autocorrelation, outperformance (underperformance) in one period is likely to be followed by underperformance (outperformance) in the next period.

$$\text{first-order autocorrelation} = \rho_{t,t-1} = \frac{E[(R_t - \mu)(R_{t-1} - \mu)]}{\sigma_t \times \sigma_{t-1}}$$

Figure 12 illustrates positive and negative serial correlation.

Figure 12: Positive and Negative Serial Correlation



Durbin-Watson Statistic

A test for the existence of first-order autocorrelation can be conducted using the **Durbin-Watson statistic**, which tests the hypothesis:

H_o: $\rho_{t,t-1} = 0$.
H_A: $\rho_{t,t-1} \neq 0$.

The formula for the Durbin-Watson statistic is:

$$DW = \frac{\sum_{t=2}^{T}(e_t - e_{t-1})^2}{\sum_{t=1}^{T} e_t^2}$$

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where:
e = variable being examined (e.g., rates of return, active return).

If the sample is large, the Durbin-Watson statistic is:

$$DW \approx 2(1 - \rho_{t,t-1})$$

where:
$\rho_{t,t-1}$ = correlation between successive residuals

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Therefore:

If	*Then*	*Decision*
$\hat{\rho}_{t,t-1} = 0$	DW = 2	Cannot reject null hypothesis
$\hat{\rho}_{t,t-1} = 1$	DW = 0	Reject null hypothesis
$\hat{\rho}_{t,t-1} = -1$	DW = 4	Reject null hypothesis

Generally speaking, for large samples, we should reject the null hypothesis if the Durbin-Watson statistic is less than 1 (indicative of positive serial correlation) or greater than 3 (indicative of negative serial correlation).

Example: The Durbin-Watson statistic

Assume a large sample of returns is examined for a private equity fund. The correlation of successive returns equals 0.6 (i.e., the serial correlation equals 0.60). **Compute** and **interpret** the Durbin-Watson statistic.

Answer:

If the correlation of successive returns equals 0.60, then the DW is approximately equal to 2(1 – 0.60) = 0.80. We should reject the null hypothesis of no serial correlation and conclude that the returns exhibit serial correlation because the DW statistic is less than its acceptable lower bound. In this example, the returns exhibit significantly positive serial correlation (indicative of predictability in returns).

Standard Deviation and Variance

LO 4.4: Demonstrate knowledge of standard deviation (volatility) and variance.

For example:
- **Define and explain return standard deviation (volatility).**
- **Describe the properties of return variance and standard deviation.**
- **Calculate return variance and standard deviation.**

Assuming data are normally distributed, the **return standard deviation** (or **volatility**) can be interpreted approximately as the typical deviation of the data from the mean. For instance, if the standard deviation of investment returns equals 5%, we can conclude that most of the investment returns will lie within 5 percentage points of the mean. It might be helpful to know that in a normal distribution, the standard deviation is approximately equal to 1.25 times the mean absolute deviation. The mean absolute deviation equals the average distance of the data points from the mean and can be viewed as the “typical deviation.” Therefore, when examining distributions that are approximately symmetric, the standard deviation can be viewed approximately as the typical deviation within the data.

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A helpful property of the standard deviation relates to the normal distribution. The property is sometimes referred to as the empirical rule. In the normal distribution, approximately:

- 68% of the data lie within plus or minus one standard deviation of the mean.
- 95% of the data lie within plus or minus two standard deviations of the mean.
- 99% of the data lie within plus or minus three standard deviations of the mean.

The above relates to a two-tailed test. However, if we wanted to examine how much of the data falls in a single tail, the information above can also be utilized to provide us this information. For example, assume we wanted to identify how many returns appear in the left tail of a normal distribution (i.e., examine the extreme losses) using two standard deviations. Using the following calculation (100% – 95%)/2, we conclude approximately 2.5% of the returns appear in the left tail.

Unfortunately, the assumption of a normal distribution is most problematic when we examine the outliers of a return distribution as the estimated probability of an extreme event for a non-normal distribution can be orders of magnitude higher than expected under the assumption of normality.

Variance and Standard Deviation Properties

The variance of returns of an *n*-asset portfolio equals:

$$\text{Var}(R_p) = \sum_{i=1}^{n}\sum_{j=1}^{n} w_i w_j \text{Cov}(R_i, R_j)$$

where:
w_i = allocation weights for asset *i*
w_j = allocation weights for asset *j*
$\text{Cov}(R_i, R_j)$ = covariance of returns between assets *i* and *j*

Note that $\text{Cov}(R_i, R_j) = \rho_{i,j}\sigma_i\sigma_j$, where $\rho_{i,j}$ is the correlation of returns between assets i and j, and σ_i and σ_j are the standard deviations of returns for assets i and j, respectively. Also, note that if i = j, then $\text{Cov}(R_i, R_i) = \sigma_i^2$, which is the variance of returns for asset i.

Therefore, the portfolio variance can also be written:

$$\text{Var}(R_p) = \sum_{i=1}^{n}\sum_{j=1}^{n} w_i w_j \rho_{i,j}\sigma_i\sigma_j$$

The formula for the portfolio simplifies considerably when returns are uncorrelated across assets, in which case $\text{Cov}(R_i, R_j) = 0$ for $i \neq j$. So, if all assets in the portfolio are uncorrelated, the portfolio variance becomes:

$$\text{Var}(R_p) = \sum_{i=1}^{n} w_i^2 \text{Var}(R_i), \text{ if } \rho_{i,j} = 0 \text{ for all pairs of assets.}$$

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On the other hand, if returns are perfectly correlated across assets, in which case $Cov(R_i, R_j) = 1$ for $i \neq j$, then the portfolio standard deviation is simply the weighted average of the standard deviations of the individual asset returns:

$$\sigma_p = \sum_{i=1}^{n} w_i \sigma_i, \text{ if } \rho_{i,j} = 1 \text{ for all pairs of assets.}$$

The variance of returns for a two-asset portfolio equals:

$$Var(R_p) = w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\rho_{1,2}\sigma_1\sigma_2$$

If the second asset is risk-free, then $\sigma_2 = 0$, and the portfolio variance becomes:

$$Var(R_p) = w_1^2\sigma_1^2$$

Therefore, the standard deviation of the returns for a two-asset portfolio in which the second asset is risk-free equals:

$$\sigma_p = w_1\sigma_1$$

Recall from our earlier discussion of continuous compounding that the continuously compounded multiperiod return equals the sum of the continuously compounded subperiod returns:

$$\ln(1 + R_{0,T}) = \ln(1 + R_1) + \ln(1 + R_2) + \ldots + \ln(1 + R_T)$$

If log returns are uncorrelated over time, then the variance of a multiperiod log return simply equals the sum of the inter-period log-return variances. For example, assuming daily log returns are uncorrelated, the variance of a *T*-day log return is simply:

$$Var[\ln(1 + R_{0,T})] = Var[\ln(1 + R_1)] + Var[\ln(1 + R_2)] + \ldots + Var[\ln(1 + R_T)]$$

Taking this one step further, if the variances of daily log returns are identical, and if returns are independent (zero autocorrelation), then the *T*-period log-return variance is simply *T* times the variance of a daily log return.

$$Var[\ln(1 + R_{0,T})] = T \times Var[\ln(1 + R_t)]$$

Therefore, the standard deviation of a multiperiod log return equals the square root of *T* times the standard deviation of one period log returns. For example, the annualized standard deviation equals $\sqrt{12}$ multiplied by the standard deviation of monthly returns, assuming returns are **homoskedastic** (i.e., variances of returns are constant over time) and independently distributed.

Example: Calculating the standard deviation (Part 1)

Assuming the monthly log returns have a standard deviation of 10% and that returns are homoskedastic and uncorrelated over time, **calculate** the annualized standard deviation.

Answer:

$$\sqrt{12} \times 0.10 = 0.3464 = 34.64\%$$

Example: Calculating the standard deviation (Part 2)

Assuming the annual log returns have a standard deviation of 10% and that returns are homoskedastic and uncorrelated over time, **calculate** the three-month standard deviation.

Answer:

$$\frac{0.10}{\sqrt{(12/3)}} = 0.05 = 5.0\%$$

If inter-period returns are homoskedastic but have correlations less than zero (which would signify mean-reverting returns), then the annualized standard deviation would be lower than $\sqrt{12}$ multiplied by the standard deviation on monthly returns.

If interperiod returns are homoskedastic but have correlations equal to one (which would signify trending returns), then the multiperiod standard deviation equals T times the standard deviation of inter-period returns. For example, assuming homoskedastic, perfectly correlated returns, the annualized standard deviation equals 12 multiplied by the standard deviation of monthly returns. In reality, this is an upper bound on standard deviation as it is unlikely that perfect correlation would occur.

Tests of Normality

LO 4.5: Demonstrate knowledge of methods used to test for normality of distributions.

For example:

- **Recognize the three main reasons for non-normality observed in alternative investment returns (i.e., autocorrelation, illiquidity, and nonlinearity), and discuss the effect of each on returns.**
- **Discuss tests for normality that use sample moments.**
- **Recognize and apply the Jarque-Bera test.**

Causes of Non-Normality

Main causes of non-normality include autocorrelation, illiquidity, and nonlinearity. Autocorrelation will cause more extreme outcomes than predicted by the normal distribution. For example, if short-term returns are positively correlated, the longer-term returns will exhibit greater extremes because the short-term “extreme” returns are compounded.

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Many alternative investments suffer from **illiquidity**, in which transactions occur infrequently. For instance, real estate properties do not trade regularly. Therefore, values are estimated using professional appraisals, which often exhibit positive autocorrelation that produces non-normal returns.

Perhaps the best example of **nonlinearity** is the distribution of returns associated with a call option. The return earned on a call option depends on proximity of the call option exercise price and the underlying asset price. As the call option becomes deep out-of-the-money (exercise price is far above the underlying asset price), the price of the call option is very stable (small standard deviation), but as the call option becomes in-the-money (exercise price is below the underlying asset price), the price of the call option changes approximately 1-for-1 with the underlying asset price. Therefore, over long periods of time, the distribution of call option returns is non-symmetric and, thus, non-normal.

Sample Moments

Recall that the normal distribution has zero skewness and zero excess kurtosis. Therefore, it is tempting to conclude that a sample that has either skewness or excess kurtosis is indicative of a non-normal distribution. However, because a sample, by definition, is an incomplete set of data, this is an incorrect conclusion. Therefore, we need to utilize a normality test that utilizes the sample size, sample skewness, excess kurtosis, and a confidence level. In the next section, a test that fulfills these criteria is introduced.

Jarque-Bera Test

The **Jarque-Bera statistic** (or *Jarque-Bera test*) is used to test data for departures from the normal distribution using a null hypothesis (H_0) and an alternative hypothesis (H_A):

H_0: data are normally distributed.
H_A: data are not normally distributed.

Alternatively, the Jarque-Bera statistic tests the null hypothesis that the skewness and excess kurtosis for the data distribution jointly equal zero. The formula for the Jarque-Bera statistic is:

$$JB = \frac{n}{6}\left(S^2 + \frac{K^2}{4}\right)$$

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where:
S = skewness for the sampled data
K = excess kurtosis for the sampled data

If the data follow a normal distribution, S equals 0 and K equals 0, and the Jarque-Bera statistic also equals zero. Therefore, the hypothesis that the data follow a normal distribution is rejected if the Jarque-Bera statistic significantly exceeds zero (i.e., the test statistic lies in the rejection area of the hypothesized distribution).

The Jarque-Bera statistic is used to test the hypothesis that a set of returns follows a normal distribution. The statistic follows a chi-square distribution with 2 degrees of freedom. The chi-squared distribution is asymmetrical, bounded below by zero, and approaches the normal distribution in shape as the degrees of freedom increase. The hypothesis of normality is rejected if the Jarque-Bera statistic for the sampled data exceeds the critical value.

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Example: Test the hypothesis that a fund's returns follow a normal distribution

Assume 60 monthly returns are sampled for a fund with skewness equal to 0.30 (slight positive skewness) and excess kurtosis equal to 0.50 (slight leptokurtosis). Using a 95% confidence interval, the critical value for the chi-square distribution with 2 degrees of freedom equals 5.99 (i.e., corresponds to the 95th percentile of the chi-square distribution).

Conduct a test of the hypothesis that the fund's returns follow a normal distribution.

Answer:

The Jarque-Bera statistic for this fund equals:

$$JB = \frac{n}{6}\left(S^2 + \frac{K^2}{4}\right) = \frac{60}{6}\left(0.30^2 + \frac{0.50^2}{4}\right)$$
$$= 10(0.09 + 0.0625) = 1.525$$

The Jarque-Bera statistic for this fund (1.525) is less than the critical value (5.99). The statistic does not lie in the rejection area to the right of 5.99. Therefore, we would not reject the hypothesis that this fund's returns follow a normal distribution. This is a good result. We hope our data are normally distributed, so therefore we hope to not reject the null hypothesis.

Professor's Note: On the actual exam, you will either be given the critical values within the question or given an abridged version of the chi-squared table that contains the critical values for several confidence intervals.

Forecasts of Future Return Volatility

LO 4.6: Demonstrate knowledge of time-series return volatility models.

For example:
- **Identify various measures used in time-series models (e.g., price levels, price variation, risk).**
- **Define the concepts of heteroskedasticity and homoskedasticity.**
- **Recognize the key components of the generalized autoregressive conditional heteroskedasticity (GARCH) method.**
- **Describe how the GARCH method is used to model risk evolution through time.**
- **Contrast the GARCH method with the autoregressive conditional heteroskedasticity (ARCH) method.**

In many instances, variances of financial data are not constant over time (i.e., the variances are **heteroskedastic**). Therefore, the historical standard deviation might not be a good forecast of the future variance. Time-series models can be used to derive forecasts of future variances. Time-series models often are used to forecast price *levels*, but also are used to forecast price *variations*.

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A variable is **conditionally heteroskedastic** if its variance is not constant, even though conditions, such as the variable's price level, remains the same. For instance, the S&P 500 stock market index might hit the same price level multiple times during the year, but the variance of the S&P 500 price might not be same each time. In this case, the S&P 500 market price is conditionally heteroskedastic.

Autoregression refers to the process of regressing a variable on lagged or past values of itself. When the dependent variable for a time series is regressed against one or more lagged values of itself, the resultant model is called as an **autoregressive (AR) model**. For example, the sales for a firm could be regressed against the sales for the firm in the previous month. Thus, in an autoregressive time series, past values of a variable are used to predict the current (and hence future) value of the variable.

Two popular time-series models used to forecast risk are the ARCH (autoregressive conditional heteroskedasticity) and GARCH (generalized autoregressive conditional heteroskedasticity) models.

ARCH models are used to forecast variances based on recent volatility. An example of an ARCH(1) model where ε is the random error, or disturbance, derived from an autoregressive model for the variable being examined is:

$$\text{variance forecast in period } t+1 = a_0 + a_1\varepsilon_t^2$$

The disturbance equals the difference between the value of the variable and its expected value. Therefore, the disturbance is the unexpected value of the variable. The squared error is called the "ARCH term." Therefore, the ARCH model's forecast of the conditional variance relies on recent unexpected returns (the squared unexpected return). For example, if today's unexpected return is large, the variance forecast for tomorrow is likely to increase. In general, in an ARCH(p) model, there are p ARCH terms $(\varepsilon_t^2, \varepsilon_{t-1}^2, \ldots, \varepsilon_{t-p}^2)$.

In contrast, **GARCH models** are used to forecast variances based on past unexpected returns and past variances. GARCH is a more robust method for forecasting volatility than ARCH. GARCH allows volatility to change based on the past history of the variable, even if the price level for the variable has not changed.

An example of a GARCH(1,1) model where σ_t^2 is the prior period variance (i.e., the GARCH term) is:

$$\text{variance forecast in period } t+1 = \alpha_0 + \alpha_1\varepsilon_t^2 + \alpha_2\sigma_t^2$$

In general, in a GARCH(p,q) model, the *p* stands for the number of lagged terms on historical returns squared, and the *q* stands for the number of lagged terms on historical volatility.

Professor's Note: The financial series, X, can be forecast using an autoregressive process:

$$X_{t+1} = b_0 + b_1X_t + \varepsilon_{t+1}$$

The "conditional variance" of X_{t+1} is:

$$Var(X_{t+1}|X_t) = E[X_{t+1} - E(X_{t+1})]^2 = E[X_{t+1} - (b_0 + b_1X_t)]^2 = E(\varepsilon_{t+1}^2)$$

If $E(\varepsilon_{t+1})^2$ is not constant over time, then the conditional variance of X is heteroskedastic (i.e., the conditional variance is not constant). The variance forecast in the ARCH and GARCH models, therefore, are forecasts of the conditional variance.

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Key Concepts

LO 4.1

An ex post distribution refers to frequencies associated with historical data. An ex ante distribution refers to frequencies associated with anticipated future data.

The normal distribution is the familiar bell-shaped function that is used to calculate probabilities and assess risks. The normal distribution is symmetric, has no skewness, and its kurtosis equals 3 (i.e., zero excess kurtosis).

Characteristics of the lognormal distribution include:

- Log returns, $\ln(1 + R)$, are normally distributed, or, equivalently, $(1 + R)$ are lognormally distributed.
- The distribution is continuous.
- The distribution is skewed to the right.
- The distribution is bounded from below by zero so it is useful for modeling asset prices which never take negative values.

LO 4.2

The shape of a probability distribution is characterized by its raw moments and central moments. The first raw moment is the mean of the distribution. The second central moment is the variance. The third central moment divided by the cube of the standard deviation measures the skewness of the distribution, and the fourth central moment divided by the fourth power of the standard deviation measures the kurtosis of the distribution.

Skewness for the normal distribution equals zero. If skewness is positive, then the distribution is elongated to the right. If skewness is negative, then the distribution is elongated to the left.

Kurtosis of the normal distribution equals 3. Positive values of excess kurtosis indicate a distribution that is leptokurtic (i.e., more peaked with fat tails), whereas negative values indicate a platykurtic distribution (i.e., less peaked with thin tails).

LO 4.3

Correlation measures the strength of the linear relationship between the returns of two assets. The correlation equals the covariance of returns for the two assets divided by the product of the standard deviations of returns for the two assets. The correlation ranges from –1 to +1. Portfolio diversification improves as the correlation moves toward –1.

The Spearman rank correlation is the correlation of the rankings of the asset returns and is the preferred correlation measure when the data series contains outliers.

In the context of the CAPM, the beta measures the sensitivity of an asset's returns to changes in the broad market return. The formula for the beta is the covariance of returns between the asset and the market portfolio divided by the variance of market portfolio returns.

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The correlation over time for an asset is called autocorrelation. The k-order autocorrelation is defined as:

$$k\text{-order autocorrelation} = \frac{E[(R_t - \mu)(R_{t-k} - \mu)]}{\sigma_t \sigma_{t-k}}$$

First-order autocorrelation (or serial correlation) is tested using the Durbin-Watson statistic, which can be approximated by: DW $\approx$ 2(1 – correlation). The Durbin-Watson statistic will be close to 4 in the presence of strong negative serial correlation, close to 0 in the presence of strong positive serial correlation, and close to 2 in the presence of no serial correlation.

LO 4.4

Assuming portfolio returns are normally distributed, the standard deviation can be viewed approximately as the typical deviation of the portfolio return from the mean.

The variance of an *n*-asset portfolio equals:

$$\mathrm{Var}(R_p) = \sum_{i=1}^{n}\sum_{j=1}^{n} w_i w_j \mathrm{Cov}(R_i, R_j),$$

where w_i and w_j are the allocation weights for assets *i* and *j*, respectively, and $\mathrm{Cov}(R_i, R_j)$ is the covariance of returns between assets i and j. If returns are uncorrelated across assets, then

$$\mathrm{Var}(R_p) = \sum_{i=1}^{n} w_i^2 \mathrm{Var}(R_i).$$

If returns are perfectly correlated across assets, then the portfolio standard deviation is simply the weighted average of the standard deviations of the individual asset returns:

$$\sigma_p = \sum_{i=1}^{n} w_i \sigma_i.$$

If the second asset is risk-free, then $\sigma_2 = 0$, the portfolio variance equals $w_1^2 \sigma_1^2$, and the standard deviation equals $w_1 \sigma_1$.

If returns are uncorrelated over time, then the variance of a multiperiod log return equals the sum of the inter-period log-return variances. In addition, if the variances of daily log returns are identical (homoskedastic), then the *T*-period log-return variance equals *T* multiplied by the variance of the daily log return. This also implies that the *T*-period log-return standard deviation equals the square root of *T* multiplied by the standard deviation of the daily log return.

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LO 4.5

Autocorrelation, illiquidity, and nonlinearity cause data to be non-normal. Autocorrelation refers to the correlation among lagged values of a random variable, which might cause outcomes to be more extreme than predicted by the normal distribution. Prices of illiquid assets are often estimated using appraisals, which frequently exhibit positive autocorrelation. Nonlinearities in returns often introduce skewness into the distribution.

The Jarque-Bera statistic is used to test data for departures from the normal distribution. The Jarque-Bera statistic tests the null hypothesis that the skewness and excess kurtosis for the data distribution jointly equal zero.

LO 4.6

ARCH models are used to forecast variances based on historical unexpected outcomes. In contrast, GARCH models are used to forecast variances based on historical unexpected outcomes and historical variances.

Concept Checkers

1. Which of the following statements about the lognormal distribution is *most accurate*? The lognormal distribution:
   A. is symmetrical.
   B. is skewed to the right.
   C. includes both positive and negative values.
   D. is useful for leveraged investments due to its range from negative infinity to positive infinity.

2. A distribution of returns that has a greater percentage of small deviations from the mean and a greater percentage of extremely large deviations from the mean compared to a normal distribution:
   A. is positively skewed.
   B. is negatively skewed.
   C. has positive excess kurtosis.
   D. has negative excess kurtosis.

3. A sample skewness value of 3 indicates that the:
   A. distribution is similar to the normal distribution.
   B. sample's excess skewness equals zero.
   C. sample mean exceeds the sample median.
   D. sample standard deviation is 3 multiplied by the sample mean.

4. A downward trending financial series *most likely* exhibits:
   A. positive autocorrelation.
   B. negative autocorrelation.
   C. illiquidity.
   D. nonlinearities.

5. An analyst finds that the Durbin-Watson statistic for a large sample of returns equals 3.50. The analyst should:
   A. reject the null hypothesis of no serial correlation and conclude that returns are positively serially correlated.
   B. not reject the null hypothesis of no serial correlation and conclude that returns are positively serially correlated.
   C. reject the null hypothesis of no serial correlation and conclude that returns are negatively serially correlated.
   D. not reject the null hypothesis of no serial correlation and conclude that returns are negatively serially correlated.

6. In a normal distribution, the standard deviation is approximately equal to:
   A. the mean absolute deviation.
   B. 1.25 multiplied by the mean absolute deviation.
   C. 1.65 multiplied by the mean absolute deviation.
   D. 2 multiplied by the mean absolute deviation.

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7. Two researchers, Monique Frombe and Jessica Hart, recently examined the behavior of hedge fund returns. Frombe states that the Jarque-Bera statistic for approximately normally distributed data will be close to zero. Hart argues that the Jarque-Bera statistic will be negative for a fund with returns exhibiting negative excess kurtosis.

   Regarding the statements made by Frombe and Hart:
   A. Frombe is correct; Hart is correct.
   B. Frombe is correct; Hart is incorrect.
   C. Frombe is incorrect; Hart is correct.
   D. Frombe is incorrect; Hart is incorrect.

8. GARCH models allow future variation to rely on:
   A. past unexpected returns and past variances.
   B. past unexpected returns, but not on past variances.
   C. past variances, but not past unexpected returns.
   D. neither past variances nor past unexpected returns.

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Concept Checker Answers

1. **B** The lognormal distribution is skewed to the right (and therefore not symmetrical). It contains only positive investment values (i.e., simple returns of –100% are largest possible loss). (LO 4.1)

2. **C** A distribution that has a greater percentage of small deviations from the mean and a greater percentage of extremely large deviations from the mean will be leptokurtic and will exhibit excess kurtosis (positive). The distribution will be more peaked and have fatter tails than a normal distribution. (LO 4.2)

3. **C** If the sample skewness exceeds zero, the distribution is positively skewed. In positively skewed distributions, the mean exceeds the median. (LO 4.2)

4. **A** Data that trend downward exhibit positive autocorrelation (i.e., today's value is positively related to yesterday's value). The same is true for data that trend upward. Note that data that revert to the mean exhibit negative autocorrelation. (LO 4.3)

5. **C** For large samples, we should reject the null hypothesis if the Durbin-Watson statistic is less than 1 (indicative of positive serial correlation), or greater than 3 (indicative of negative serial correlation). (LO 4.3)

6. **B** In a normal distribution, the standard deviation is approximately equal to 1.25 multiplied by the mean absolute deviation. (LO 4.4)

7. **B** The Jarque-Bera statistic equals:

$$JB = \frac{n}{6}\left(S^2 + \frac{K^2}{4}\right)$$

where *S* is the skewness for the data and *K* is the excess kurtosis for the data. If the data are approximately normally distributed, both *S* and *K* will be close to zero, and therefore, the test statistic will be close to zero. Thus, Frombe is correct. Since both *S* and *K* are squared in the formula, the statistic can never be negative. Hence, Hart is not correct. (LO 4.5)

8. **A** GARCH models allow volatility to rely on past disturbances and past variances:

$$\text{variance forecast in period } t+1 = \alpha_0 + \alpha_1\varepsilon_t^2 + \alpha_2\sigma_t^2$$

where ε is the disturbance (random error) from an autoregressive model, and σ_t^2 is the variance in period *t*. (LO 4.6)

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The following is a review of the Alternative Investment principles designed to address the learning objectives set forth by the CAIA Association®.

Measures of Risk and Performance

Topic 2.5

Exam Focus

In this topic review, we examine several of the methods available to measure risk. For the exam, understand how risk can be assessed using downside risk measures such as target semivariance, shortfall risk, semistandard deviation, drawdown, and value at risk (VaR). You should understand the three basic ways to measure VaR: parametric, historical, and Monte Carlo analysis. Finally, know how to apply formulas for ratio-based performance measures such as the Sharpe ratio, Treynor ratio, Sortino ratio, information ratio, and return on VaR, and for risk-adjusted performance measures such as the Jensen's alpha, M^2, and average tracking error.

Alternative Measures of Risk

LO 5.1: Demonstrate knowledge of measures of financial risk.

For example:

- **Define and calculate semivariance and semistandard deviation.**
- **Describe shortfall risk, target semivariance, and target semistandard deviation.**
- **Define and calculate tracking error.**
- **Describe and calculate drawdown.**
- **Define and interpret value at risk (VaR), and discuss its strengths and weaknesses as a risk measure.**
- **Define and interpret conditional value-at-risk (CVaR).**

While variance and standard deviation measure the dispersion of a distribution about both sides of the mean (above and below the mean), an investor may be more concerned about downside risk, or the deviations below the mean. **Semivariance** measures only the downside risk and is computed as the average squared deviations below the mean. **Semistandard deviation** (or *semideviation*) then is the square root of semivariance.

The formulas to compute semivariance and sample semivariance are as follows:

$$\text{semivariance} = \frac{\displaystyle\sum_{\text{for } R_t < E(R)} \left[R_t - E(R)\right]^2}{T}$$

$$\text{sample semivariance} = \frac{\displaystyle\sum_{\text{for } R_t < E(R)} \left[R_t - E(R)\right]^2}{T-1}$$

where:
R_t = asset's return in period t
$E(R)$ = expected return
T = total observations

Topic 2.5

Semistandard deviation and sample semistandard deviation are computed as follows:

$$\text{semistandard deviation} = \sqrt{\frac{\sum_{\text{for } R_t<E(R)} [R_t - E(R)]^2}{T}}$$

$$\text{sample semistandard deviation} = \sqrt{\frac{\sum_{\text{for } R_t<E(R)} (R_t - E(R))^2}{T-1}}$$

Investors may be concerned about returns that fall below a threshold that is different from the mean. For example, an investor may have an annual target return of 8%; therefore, the investor may wish to measure the risk of returns falling below that level. Target semivariance and target semideviation are two measures that do just that. **Target semivariance** measures the average squared deviations below a target level (rather than the mean), while **target semistandard deviation** is the square root of target semivariance. The probability that the investment return will fall below the target return is called **shortfall risk**.

Professor's Note: In some texts, T is defined as the number of negative observations for these "semi-measures" rather than the total number of observations in order to better compare the results to standard deviation and variance.

Tracking error measures the extent to which the investment returns deviate from the benchmark returns over time. Therefore, tracking error quantifies the uncertainty (risk) regarding deviations of the investment return from the benchmark return. A low tracking error indicates that the investment performance closely resembles that of the benchmark. The tracking error is especially useful for a manager with a relative return mandate.

$$\text{tracking error} = \sqrt{\frac{\sum_{t=1}^{T}(R_t - R_B - M)^2}{T-1}}$$

where:
R_B = benchmark return
M = mean difference between the investment return and the benchmark return (often assumed to equal zero)
t = number of observations

Drawdown equals the percentage decline in asset value from its previous high. In determining the drawdown, the high point is referred to as the peak and the low point is referred to as the trough. For example, assume the fund value recently peaked at 100 and now equals 80 at the trough. The drawdown equals 20%. **Maximum drawdown** is the worst percent loss experienced from peak to trough over a specified period of time. Drawdowns are more intuitive than volatility risk measures. Investors might not fully understand the implications of a fund with a standard deviation of 20% (especially if the fund returns are skewed), but percent losses are very easy to understand.

Value at risk (VaR) is a measure of potential loss. VaR is interpreted as the worst possible loss under normal conditions over a specified period for a given confidence level. If an analyst says, "For a given month, the VaR is $1 million at a 95% level of confidence," then this translates to mean "under normal conditions in 95% of the months (e.g., 19 out of

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20 months), we expect the fund to either lose no more than $1 million or earn a profit." Analysts may also use other standard confidence levels (e.g., 90% and 99%).

Professor's Note: VaR is a measure of expected loss at a given confidence level. In some cases, you may see VaR expressed as a dollar or percentage return, such as a 95% VaR of –30%, which would be the same as stating the 95% VaR is a loss of 30%. Whether or not the VaR measure is written with a positive or negative sign will depend on the context, but in all cases VaR is a measure of a loss.

Example: Calculating value at risk

Using the data provided below, **determine** the one-day VaR using a 95% confidence level. Assume the investment account value equals $500,000.

Probability	*Next Day Investment Account Value*
95%	> $495,000
90%	> $499,000
50%	> $501,000
10%	> $505,000
5%	> $515,000

Answer:

The first row of the table indicates that there is a 95% chance that the account value will be higher than $495,000, or, alternatively, that there is a 5% chance the account value will be $495,000 or worse. Therefore, the total one-day VaR using a 95% confidence level equals $5,000 (equal to $500,000 – $495,000). Stated as a percentage of the investment account value, the VaR = 5,000 / $500,000 = 1%.

The strengths of VaR are that it is simple to apply, can be applied across segments within a fund or across funds, and is useful when examining the worst-case scenario is unnecessary. A major weakness of VaR is that it can be misleading for non-normal distributions. For example, consider a fund with a 98% probability that its annual profit will equal $50,000, but with a 2% probability that it will lose $1 million. A manager using a 95% VaR will reach a much different conclusion than a manager using a 99% VaR.

Conditional VaR (CVaR), also known as *expected shortfall* or *expected tail loss*, is the expected loss given that the portfolio return already lies below the pre-specified "worst case" quantile return (i.e., below the 5th percentile return). In other words, expected shortfall is the mean loss among the losses falling below the *q*-quantile. For example, assume an investor is interested in knowing the 95% VaR (i.e., the 95% VaR is equivalent to the 5th percentile return) for a fund. Further, assume the 5th percentile return for the fund equals –20%. Therefore, the fund is expected to lose 20% or more 5% of the time. The VaR is 20%. However, VaR does not provide good information regarding the expected size of the loss if the fund performs in the lower 5% of the possible outcomes. That question is answered by the conditional VaR, which in this case is the expected value of all returns falling below the 5th percentile return (i.e., below a 20% loss outcome). Therefore, the conditional VaR will equal a larger loss than the VaR.

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Topic 2.5

Estimation of Value At Risk

LO 5.2: Demonstrate knowledge of methods for estimating value at risk (VaR).

For example:

- Apply a parametric approach to estimate VaR with normally distributed returns or with normally distributed underlying factors.
- Describe methods for estimating volatility as an input for VaR calculations.
- Describe methods for estimating VaR for leptokurtic positions.
- Describe methods for estimating VaR directly from historical data.
- Describe how the Monte Carlo analysis can be used to estimate VaR.
- Discuss and apply the aggregation of portfolio-component VaRs to determine the VaR for a portfolio under various assumptions (i.e., perfect correlation, zero correlation, and perfect negative correlation).

Parametric VaR is a specific form of VaR that assumes returns are normally distributed. By using the properties associated with the normal distribution, the VaR for a given confidence level can be calculated relatively easily. In formula terms, parametric VaR can be illustrated as follows:

$$\text{parametric VaR} = z \times \sigma \times \sqrt{\text{days}} \times \text{value}$$

where:
z = critical z-value for one-tailed test
σ = standard deviation of daily returns
$\sqrt{\text{days}}$ = square root of the number of days specified
value = value of investment portfolio

The selected z-value used in the previous equation is dependent on the confidence level desired. The most frequent confidence levels and associated critical z-values are as follows:

90% VaR: Use a z-value of 1.28.
95% VaR: Use a z-value of 1.65.
99% VaR: Use a z-value of 2.33.

Note that we use the z-values for a one-tailed test because we are only concerned about the values in the lower tail.

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Example: Calculate the parametric VaR for a portfolio

Calculate the 100-day, 95% parametric VaR in dollars for a $100 million portfolio with a daily standard deviation estimated at 2%.

Answer:

$$\text{parametric VaR} = 1.65 \times 0.02 \times \sqrt{100} \times \$100 \text{ million} = \$33 \text{ million}$$

In this example, there is a 5% chance that the portfolio's value could fall 33% or more in a 100-day period. This percentage loss is multiplied by the dollar amount of the portfolio to determine the VaR in dollar terms. For this example, the 33% loss on the $100 million dollar portfolio produces a VaR of $33 million.

We can also estimate VaR under the more complex assumption that security returns are generated by normally distributed economic factors. Using a factor model, VaR is calculated as a function of variances and covariances of the factors and of the exposures of the security returns to the factors.

Volatility Estimation

A key statistical input used to calculate the parametric VaR is the volatility of the asset. There are two approaches:

- **Historical volatility.** The volatility figure most often used for VaR is historical standard deviation. Other historical volatility methods include the ARCH and GARCH models (discussed in the Statistical Foundations topic review) that estimate volatility by placing greater weight on more recent data than older data.
- **Implied option volatility.** This volatility approach utilizes the implied volatility derived from option pricing models. If option volatility is accessible, this volatility estimate is usually preferable as it inherently includes expected future drivers of volatility (some of which may not be found in historical data) and can be immediately adjusted for changing market conditions.

Leptokurtic Distributions

A warning for the use of VaR applies to the examination of leptokurtic distributions, in which there is greater chance of a large loss relative to the normal distribution (i.e., leptokurtic distribution are "fat tailed" with greater frequency of extreme outcomes). In these cases, the suggestion is to use a distribution that allows for fat tails, such as a mixed distribution or the Student *t*-distribution. An alternative and simpler solution is to increase the number of standard deviations. For example, for a 95% confidence level, use a number greater than the z-statistic of 1.65. The magnitude of the number depends on the perceived size of the tails of the empirical distribution.

Historical and Monte Carlo Analysis Methods for VaR

The **historical method for estimating VaR** is often utilized due to its simplicity. The easiest way to calculate the 5% daily VaR using the historical method is to accumulate a number of past daily returns, rank the returns from highest to lowest, and identify the lowest 5% of returns. The highest of these lowest 5% of returns is the one-day, 5% VaR.

Example: Historical VaR

You have accumulated 100 daily returns for your $100,000,000 portfolio. After ranking the returns from highest to lowest, you identify the lowest six returns:

–0.11%, –0.19%, –0.25%, –0.34%, –0.96%, –1.01%

Calculate daily value at risk (VaR) at 5% significance using the historical method.

Answer:

The lowest five returns represent the 5% lower tail of the "distribution" of 100 historical returns. The fifth lowest return (–0.0019) is the 5% daily VaR. We would say there is a 5% chance of a daily loss exceeding 0.19%, or $190,000.

In a **Monte Carlo analysis**, a model is developed that simulates values for risk factors (e.g., interest rates) and estimates how changes in risk factors affect the fund's returns. The simulation randomly generates thousands of possible outcomes for the fund, and those simulated outcomes indicate what types of losses are possible for the fund. Computing VaR using Monte Carlo analysis (i.e., computing Monte Carlo VaR) is more complex than other methods, but will generally lead to more accurate estimates of risk.

Aggregate VaR

If VaRs have been determined for individual assets, the individual asset VaRs must be aggregated to reflect the VaR of the portfolio. Let's examine three possibilities for a two-asset portfolio:

- **Perfect positive correlation**. Individual asset outcomes are perfectly positively correlated, in which case the VaR for the portfolio is determined as follows:

  VaR assuming perfect positive correlation: $\text{VaR}_p = \text{VaR}_1 + \text{VaR}_2$

- **Perfect negative correlation**. Individual asset outcomes are perfectly negatively correlated, in which case the VaR for the portfolio is determined as follows:

  VaR assuming perfect negative correlation: $\text{VaR}_p = |\text{VaR}_1 - \text{VaR}_2|$

- **Zero correlation**. Individual asset outcomes are completely uncorrelated, in which case the portfolio VaR will lie between the perfect positive and perfect negative correlation cases.

  VaR assuming zero correlation: $\text{VaR}_p = \sqrt{\text{VaR}_1^2 + \text{VaR}_2^2}$

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Example: Computing portfolio VaR

An analyst computes the VaR for the two positions in her portfolio. The VaRs are as follows: VaR_1 = \$1.6 million and VaR_2 = \$1.6 million. **Compute** VaR_P if the returns of the two assets under the assumption of:

- Perfect positive correlation.
- Perfect negative correlation.
- Zero correlation.

Answer:

Perfect positive correlation:

$$\text{VaR}_\text{P} = \$1.6 \text{ million} + \$1.6 \text{ million} = \$3.2 \text{ million}$$

Perfect negative correlation:

$$\text{VaR}_\text{P} = |\$1.6 \text{ million} - \$1.6 \text{ million}| = \$0$$

Zero correlation:

$$\text{VaR}_\text{P} = \sqrt{\$1.6 \text{ million}^2 + \$1.6 \text{ million}^2} = \$2.26 \text{ million}$$

Ratio-Based Performance Measures

LO 5.3: Demonstrate knowledge of ratio-based performance measures used in alternative investment analysis.

For example:
- **Define the ratio-based performance measure type.**
- **Define and calculate the Sharpe ratio.**
- **Define and calculate the Treynor ratio.**
- **Recognize and calculate the Sortino ratio, the information ratio, and return on VaR.**

Ratio-based performance measures can be useful for investors and managers to summarize the risk and return characteristics of an investment. These performance measures are created by dividing a return measurement (e.g., expected return) by a risk measurement (e.g., VaR). In this section, we examine the following ratio-based performance measures: Sharpe ratio, Treynor ratio, Sortino ratio, information ratio, and return on VaR.

Sharpe Ratio

The **Sharpe ratio** equals the expected excess return (defined as the difference between the mean return for the portfolio and the risk-free rate) earned per unit of *total risk* (defined as the portfolio standard deviation):

$$SR_p = \frac{E(R_p) - R_f}{\sigma_p}$$

where:
$E(R_p)$ = expected return for portfolio *p*
R_f = risk-free rate
σ_p = standard deviation of returns for portfolio *p*

The Sharpe ratio (SR) is the appropriate performance measure if portfolio *p* is the total (or "standalone") portfolio owned by the investor. The SR should not be used for components of the total portfolio, unless the components themselves are well-diversified portfolios. A **well-diversified portfolio** is a portfolio that contains very little diversifiable risk. For well-diversified portfolios, the ranking of portfolios based on standard deviation is identical to the ranking of portfolios based on systematic risk. Note that the use of options by a portfolio may lead to a Sharpe ratio that is artificially high as the Sharpe ratio assumes a normal distribution of returns.

The Sharpe ratio is sensitive to the return computation interval. For example, assuming independent and homoskedastic (constant variance) returns, the standard deviation of annualized returns equals $\sqrt{12}$ multiplied by the standard deviation of monthly returns. Therefore, when examining annual returns (e.g., assume $E(R_p)$ and R_f are annual returns and σ_p is the annualized standard deviation), the monthly Sharpe ratio is calculated as follows:

$$\text{Monthly SR} = \frac{[E(R_p) - R_f]/12}{\sigma_p/\sqrt{12}}$$

This indicates that the SR is sensitive to the time dimension used for the return computation interval (e.g., monthly SR < quarterly SR < annual SR).

The Sharpe ratio has four key properties:

1. Intuitively appealing measure of performance.
2. Based on total risk, rather than on systematic risk alone.
3. Loses usefulness when comparing portfolios with different skew and kurtosis.
4. Sensitive to return computation interval.

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Professor's Note: The standard deviation of multiperiod returns was discussed in the Statistical Foundations topic review; we showed that if returns have zero serial correlation and if the variance of returns is constant over time, then the standard deviation of T-period returns equals $\sqrt{T}\sigma_t$, where σ_t is the standard deviation of the single-period return. We also showed that if returns were perfectly positively serially correlated, then the standard deviation of T-period returns equals $T\sigma_t$. If the serial correlation of returns equals +1, then the SR is not sensitive to the time dimension used for the return computation interval. For example, if the serial correlation of returns equals +1, then the quarterly SR equals:

$$\frac{[E(R_p)-R_f]/4}{\sigma_p/4}=\frac{E(R_p)-R_f}{\sigma_p}.$$

Treynor Ratio

The **Treynor ratio** (TR) equals the expected excess return (defined as the difference between the mean return for the portfolio and the risk-free rate) earned per unit of *systematic risk*:

$$TR=\frac{E(R_p)-R_f}{\beta_p}$$

Note that as the return computation interval decreases (e.g., from annual to monthly), the numerator of the TR will become smaller, but the denominator (beta) is relatively unchanged. Therefore, the TR falls proportionally relative to decreased length of the return computation interval (e.g., a fund's monthly Treynor ratio will be 1/12 the size of the fund's annual Treynor ratio).

The Treynor ratio has four key properties:

1. Intuitively appealing measure of performance.
2. Based on systematic risk, rather than on total risk.
3. Loses usefulness when comparing portfolios with different skew and kurtosis.
4. Proportional to return computation interval.

Sharpe Ratio vs. Treynor Ratio

For well-diversified portfolios, the rankings of portfolios based on TR will be identical to the rankings of portfolios based on SR. However, for undiversified portfolios, the rankings are likely to differ. The TR should not be used on a standalone basis. On a standalone basis, the investment under consideration is the only asset held by the investor, in which case total risk is the appropriate measure of risk. The TR is appropriate when comparing components of a well-diversified portfolio.

Sortino Ratio

The **Sortino ratio** equals the portfolio excess return (defined as the difference between the mean return for the portfolio and the *target return*) divided by the *target semistandard deviation* (a downside risk measure):

$$\text{Sortino ratio} = \frac{E(R_p) - R_T}{\text{TSSD}}$$

where:
$E(R_p)$ = expected return for portfolio p
R_T = target return
TSSD = target semistandard deviation

Example: Sortino ratio calculation

Assuming the risk-free rate equals 5%, **compare** Funds A and B below using the Sharpe ratio and Sortino ratio. Assume the target returns for both funds equal 8%.

	Expected Return	*Standard Deviation*	*TSSD*
Fund A	0.10	0.20	0.10
Fund B	0.10	0.20	0.05

Answer:

The Sharpe ratio for both funds equals: $\frac{0.10 - 0.05}{0.20} = 0.25$

The Sortino ratios are:

$$\text{Sortino ratio}_{\text{Fund A}} = \frac{0.10 - 0.08}{0.10} = 0.20$$

$$\text{Sortino ratio}_{\text{Fund B}} = \frac{0.10 - 0.08}{0.05} = 0.40$$

Therefore, according to the Sharpe ratio, both funds performed equally. However, according to the Sortino ratio, Fund B outperformed Fund A because Fund B had lower downside risk.

Information Ratio

The **information ratio** equals the portfolio's excess return (defined as the difference between the mean returns for the portfolio and the benchmark) divided by the portfolio's *tracking error*.

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$$IR_p = \frac{E(R_p) - R_{benchmark}}{TE_p}$$

where:
$E(R_p)$ = expected return for the portfolio
$R_{benchmark}$ = benchmark expected return
TE_p = tracking error of the portfolio

Tracking error equals the standard deviation of the differences in returns between the portfolio and the benchmark (i.e., standard deviation of excess returns). Therefore, the information ratio (also known as the *appraisal ratio*) equals the active management return divided by active management risk.

Return on Value at Risk

The **return on value at risk**, or simply **return on VaR** (RoVaR), is the expected return on the portfolio divided by its value at risk, VaR:

$$RoVaR = \frac{E(R_p)}{VaR}$$

Risk-Adjusted Performance Measures

LO 5.4: Demonstrate knowledge of risk-adjusted performance measures used in alternative investment analysis.

For example:
- **Define the risk-adjusted performance measure type.**
- **Recognize and calculate Jensen's alpha, M^2 (M-squared), and average tracking error.**

We now turn our attention to risk-adjusted performance measures. *Risk-adjusted performance measures* provide a way to compare return performance adjusted for the risk level of a benchmark (e.g., the S&P 500 index). In this section, we examine the following risk-adjusted performance measures: Jensen's alpha, M^2, and average tracking error.

Jensen's Alpha

Jensen's alpha, also known simply as *alpha*, is the difference between the portfolio mean return and CAPM ex post mean return:

$$\alpha_p = R_p - [R_f + \beta_p(R_m - R_f)]$$

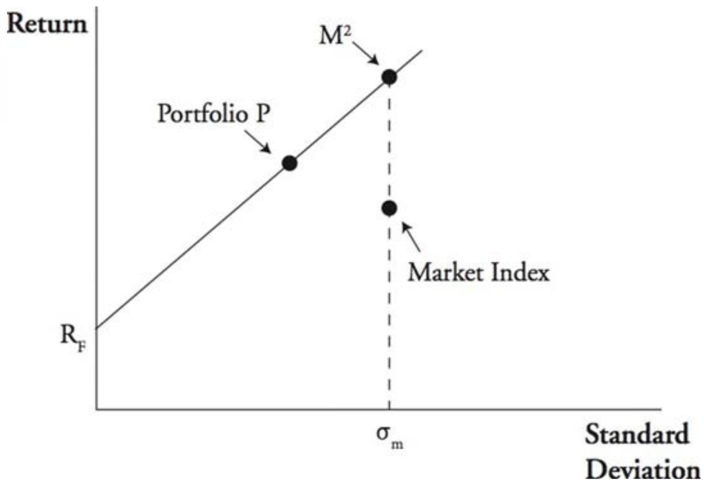
where:
R_p = return for portfolio *p*
R_m = return for the market portfolio
R_f = risk-free rate
β_p = sample estimate of the portfolio beta

Note that α_p equals the intercept estimate and β is the slope estimate of the regression of $R_p - R_f$ against $R_m - R_f$. Both the Treynor ratio and Jensen's alpha measure performance relative to systematic risk.

The M² Approach

The **M²** (or *M-squared*) is a risk-adjusted measure of the portfolio return. Using leverage, the portfolio standard deviation is adjusted to the point where it equals the standard deviation of the market index. The M^2 equals the expected return on the leveraged portfolio that has the same standard deviation as the market index. The following figure illustrates the M^2 approach.

Figure 1: The M² Approach



The M^2 measure is computed as follows:

$$M^2 = R_f + \frac{\sigma_m}{\sigma_p}\left[E(R_p) - R_f\right]$$

where:

R_f = risk-free rate
σ_m = standard deviation of returns for market *m*
σ_p = standard deviation of returns for portfolio *p*
$E(R_p)$ = expected return for portfolio *p*

Professor's Note: There are no squared terms in the M-squared calculation. The term "M-squared" merely refers to the last names of its originators (Leah and Franco Modigliani). The M² also has been defined as the difference in returns between the leveraged portfolio and the market index. Portfolio rankings based on the return of the leveraged portfolio, as discussed previously, will be identical to rankings based on difference in returns. Therefore, both definitions provide identical portfolio performance rankings.

The Average Tracking Error

The **average tracking error** is the difference in mean returns between the portfolio and the portfolio's benchmark. It is the numerator of the information ratio.

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Example: Performance measurement

The data below have been collected to evaluate the performance of two funds.

Figure 2: Performance Appraisal Data

	Fund 1	*Fund 2*	*Market Index*
Return	6.45%	8.96%	7.60%
Beta	0.88	1.02	1.00
Standard deviation	2.74%	4.54%	2.80%
Standard deviation of excess returns	5.60%	6.10%	N/A

The risk-free rate of return for the relevant period was 3% and the market index is used as the benchmark for the funds. For both funds, **calculate** Jensen's alpha, the Treynor ratio, the Sharpe ratio, the information ratio, and the M^2 measure.

Answer:

Jensen's Alpha

$$\alpha = R_p - [R_f + \beta_p (R_m - R_f)]$$

$$\alpha_{\text{Fund 1}} = 6.45\% - [3.00\% + 0.88(7.60\% - 3.00\%)] = -0.60\%$$

$$\alpha_{\text{Fund 2}} = 8.96\% - [3.00\% + 1.02(7.60\% - 3.00\%)] = 1.27\%$$

Treynor Ratio

$$TR = \frac{E(R_p) - R_f}{\beta_p}$$

$$TR_{\text{Fund 1}} = \frac{6.45\% - 3.00\%}{0.88} = 3.92\%$$

$$TR_{\text{Fund 2}} = \frac{8.96\% - 3.00\%}{1.02} = 5.84\%$$

Sharpe Ratio

$$SR = \frac{E(R_p) - R_f}{\sigma_p}$$

$$SR_{\text{Fund 1}} = \frac{6.45\% - 3.00\%}{2.74\%} = 1.26$$

$$SR_{\text{Fund 2}} = \frac{8.96\% - 3.00\%}{4.54\%} = 1.31$$

Information Ratio

$$IR = \frac{E(R_p) - R_{\text{benchmark}}}{TE_p}$$

$$IR_{\text{Fund 1}} = \frac{6.45\% - 7.60\%}{5.60\%} = -0.21$$

$$IR_{\text{Fund 2}} = \frac{8.96\% - 7.60\%}{6.10\%} = 0.22$$

M^2 Measure

$$M^2 = R_f + \frac{\sigma_m}{\sigma_p}\left(E(R_p) - R_f\right)$$

$$M^2_{\text{Fund 1}} = 3.00\% + \frac{2.80\%}{2.74\%}(6.45\% - 3.00\%) = 6.53\%$$

$$M^2_{\text{Fund 2}} = 3.00\% + \frac{2.80\%}{4.54\%}(8.96\% - 3.00\%) = 6.68\%$$

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Key Concepts

LO 5.1

Key risk measures that are used in addition to standard deviation include the following:

- Semistandard deviation equals the volatility of returns falling below the mean.
- Target semistandard deviation measures the volatility of returns falling below a prespecified target.
- Shortfall risk is the probability that the investment return will fall below the target.
- Tracking error measures the extent to which investment returns deviate from the benchmark returns over time.
- Drawdown equals the percentage decline in asset value from its previous high.
- Value at risk (VaR) is a measure of potential loss relative to a prespecified confidence level.
- Conditional VaR is the expected loss given that the portfolio return already lies below the pre-specified "worst case" quantile return (i.e., below the 5^{th} percentile return).

LO 5.2

Parametric VaR refers to a VaR calculation derived from the normal distribution. When calculating VaR, volatility can be estimated based on historical data or implied option volatility. Leptokurtic distributions require that VaR is modified to either utilize a distribution that can account for larger tails or a higher standard deviation value for a given confidence level.

Historical VaR uses past return data and ranks the returns to determine which fall below a given confidence level.

Monte Carlo analysis for VaR simulates values for risk factors and estimates how changes in risk factors might affect the fund's returns. A model is used to randomly generate possible future outcomes for the fund, and those simulated outcomes indicate what types of losses are possible for the fund.

Monte Carlo VaR is similar to historical VaR in that both determine the potential losses from a set of returns. The difference is that historical VaR uses realized returns from the fund's past, while Monte Carlo VaR uses hypothetical returns generated from the simulation.

The VaR of a two-asset portfolio where VaRs are the same equals the sum of the individual asset VaRs if the returns for the individual assets are perfectly positively correlated. The portfolio VaR equals zero if the individual asset returns are perfectly negatively correlated. If the assets are uncorrelated, the portfolio VaR is calculated as the square root of the sum of the squared VaRs.

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LO 5.3

Ratio-based performance measures include the Sharpe ratio, Treynor ratio, Sortino ratio, information ratio, and return on VaR.

- The Sharpe ratio equals the portfolio's expected return in excess of the risk-free rate, divided by the portfolio's total risk. The Sharpe ratio is appropriate if the portfolio is the investor's total "standalone" portfolio.
- The Treynor ratio equals the portfolio's expected return in excess of the risk-free rate, divided by the portfolio's systematic risk. The Treynor ratio is appropriate when comparing components of a well-diversified portfolio.
- The Sortino ratio equals the portfolio's expected return in excess of the target return, divided by the portfolio's target semistandard deviation.
- The information ratio equals the portfolio's expected return in excess of the benchmark return, divided by the portfolio's tracking error.
- The return on VaR is the expected return on the portfolio divided by its VaR.

LO 5.4

Risk-adjusted performance measures include Jensen's alpha, M^2, and average tracking error.

- Jensen's alpha equals the difference between the portfolio mean return and CAPM ex-post mean return.
- The M^2 equals the expected return on a leveraged portfolio that has the same standard deviation as the market index.
- The average tracking error equals the average return difference between the portfolio and the portfolio's benchmark.

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Concept Checkers

1. Dimitar Kostov manages a fund for investors who want low downside risk around the fund's historical average return. What is the *most appropriate* risk statistic for Kostov?
   A. Volatility.
   B. Target semistandard deviation.
   C. Shortfall risk.
   D. Semistandard deviation.

2. The value at risk (VaR) for a portfolio equals the sum of the individual asset VaRs if the returns for the individual assets:
   A. are perfectly negatively correlated.
   B. are perfectly positively correlated.
   C. follow a GARCH process.
   D. follow an ARCH process.

3. The Sortino ratio is *best* defined as the portfolio excess return earned per unit of:
   A. total risk.
   B. systematic risk.
   C. downside risk.
   D. tracking error.

4. An analyst has compiled the following data on Stock P:
   $\text{Covariance}_{\text{P, market:}}$ 0.0315
   $\sigma_{\text{Stock P}}$: 16.50%
   σ_{market}: 15.00%
   $\text{Beta}_{\text{Stock P}}$: 1.40
   Expected market return: 11.80%
   Risk-free rate: 4.50%
   Stock P actual return: 13.25%

   Calculate and interpret Jensen's alpha for Stock P.
   A. +1.47%; overperformed the market.
   B. –1.47%; underperformed the market.
   C. +1.45%; overperformed the market.
   D. –1.45%; underperformed the market.

Concept Checker Answers

1. **D** Semistandard deviation measures variation of returns lying below the fund mean return. (LO 5.1)

2. **B** The portfolio VaR equals the sum of the individual asset VaRs only if the returns for the individual assets are perfectly positively correlated. (LO 5.2)

3. **C** The Sortino ratio equals the portfolio excess return divided by the target semistandard deviation (a downside risk measure):

$$\text{Sortino ratio} = \frac{E(R_p) - R_T}{\text{TSSD}}$$

where:
$E(R_p)$ = expected return for portfolio *p*
R_T = target return
TSSD = target semistandard deviation

(LO 5.3)

4. **B** Jensen's alpha = actual return – CAPM expected return

$$\alpha_{\text{Fund P}} = 13.25\% - [4.50\% + 1.40(11.80\% - 4.50\%)] = -1.47\%$$

Stock P has underperformed the market by 1.47% when taking into account its level of risk as measured by beta. (LO 5.4)

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The following is a review of the Alternative Investment principles designed to address the learning objectives set forth by the CAIA Association®.

Foundations of Financial Economics

Topic 2.6

Exam Focus

This topic review addresses some of the key concepts in financial economics. First, you will be introduced to the three forms of market efficiency, which describe how securities prices adjust to new information sets in the market. The next section deals with asset pricing models. For the exam, be able to define and apply the Capital Asset Pricing Model, and know how to use the model to measure systematic and idiosyncratic components of risk and return. Recognize the key components of multiple-factor models such as the Fama-French three-factor model and the Fama-French-Carhart four-factor model. Be able to describe unique complications, such as non-normality of returns and illiquidity, which invalidate the use of conventional methods for alternative investments. Also, be able to discuss and apply binomial tree models as a simple option pricing tool. Next, we introduce the term structure of forward contracts and the cost-of-carry model scenarios under different assumptions. Be able to value forward contracts under these scenarios. The last three learning objectives address options. For the exam, be able to identify the different option strategies and be able to justify investor motivations for using each of the strategies. The four main option pricing models can value options on individual securities or on entire portfolios of long and short positions. "Option Greeks" are widely used terms to describe various option sensitivities to some underlying factor.

Informational Market Efficiency

LO 6.1: Demonstrate knowledge of the concept of informational market efficiency.

For example:

- **Define informational market efficiency.**
- **Recognize various forms of informational market efficiency.**
- **Identify factors driving informational market efficiency.**
- **Discuss the differences between informational market efficiency in traditional and alternative asset markets.**

When markets are described as efficient, it is most often in the context of informational efficiency. **Informational market efficiency** refers to the speed and extent to which security prices adjust to new market information. An informationally efficient market contains securities whose prices fully reflect all available information about that security. In such a market, investors are unable to consistently earn superior risk-adjusted returns.

Forms of Informational Market Efficiency

There are three forms of informational market efficiency, each based on a different information set.

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Weak form efficiency states that security prices fully reflect all available security data on past prices and volumes. In a weak form efficient market, investors cannot earn superior returns using technical analysis.

Semistrong form efficiency states that security prices fully reflect all publicly available information. Public information includes both past price and volume information and also financial statements and other economic data. In a semistrong form efficient market, investors cannot earn superior returns using either technical or fundamental analysis.

Strong form efficiency states that security prices fully reflect all publicly and privately available information. This includes both public and nonpublic (i.e., insider) information. In a strong form efficient market, no investor can earn superior risk-adjusted returns.

The information set in the three forms of efficiency is cumulative. That is, the semistrong form includes weak form efficiency, and strong form includes both weak form and semistrong form efficiency. Therefore, if weak form efficiency is violated, all three forms are violated. However, if strong form efficiency is violated, the markets may still be semistrong and weak form efficient.

Factors Affecting Market Efficiency

The six factors that affect informational market efficiency include:

1. **Asset size.** Assets with larger monetary values drive more competition for profits. A $5,000,000 trade mispriced by 0.5% draws more participants than a $500 trade mispriced by 0.5%, and requires better analysis and more information.

2. **Trade frequency.** Higher frequency of trades increases competition, reduces bid-ask spreads, and reduces inefficiencies by drawing in more participants.

3. **Trading frictions.** Little or no trading frictions encourage competition. Trading frictions include taxes, transaction costs, taxes, and various fees.

4. **Regulations.** Low levels of regulatory constraints lead to higher informational efficiency. Regulatory constraints include trade prohibitions and short selling and leverage restrictions.

5. **Information access.** Easier access to quality information makes analysis easier, which improves information efficiency.

6. **Valuation accuracy.** Lower levels of uncertainty about asset valuation ensure that asset prices trade closer to their efficient prices. This has been greatly facilitated by the development and improvement of pricing models.

Additional Factors Affecting Market Efficiency for Alternative Assets

Both traditional and alternative asset markets contain large, liquid, efficient markets, and smaller, illiquid, less efficient markets. However, alternative asset markets are often less informationally efficient, especially with regard to the fifth and sixth factors above (i.e., information access and valuation accuracy). Investors inherently better understand traditional markets and their information sets (e.g., equity prices and interest rates).

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Alternative asset markets often contain more complexity, significant nonpublic information, and less precise valuation methods. For example, hedge funds often use significant leverage and short positions, which require specialized managerial skills. Investment in private equity and real estate also requires specialized managerial skills as managers tend to invest in illiquid assets, and investments are restricted to sophisticated and well-capitalized traders.

Single-Factor Asset Pricing Models And The Capital Asset Pricing Model

LO 6.2: Demonstrate knowledge of single-factor asset pricing models and ex ante pricing.

For example:
- **Describe the key characteristics of single-factor asset pricing models.**
- **Recognize the capital asset pricing model (CAPM).**
- **Describe the key characteristics of ex ante and ex post asset pricing models.**
- **Recognize the distinctions between ex ante asset pricing and ex post asset pricing.**
- **Apply ex ante and ex post pricing in a single-factor framework.**
- **Define systematic and idiosyncratic risk and return.**

An **asset pricing model** is a model for determining an asset's expected (required) return or price based on its risk. A **single-factor asset pricing model** focuses on a single risk factor when looking at returns and systematic risk.

Capital Asset Pricing Model

The **capital asset pricing model (CAPM)** is the best-known example of a single-factor asset pricing model and one of the most fundamental concepts in investment theory. In fact, the CAPM is a special case of the single-factor asset pricing model where the single risk factor is the market risk factor. The CAPM is a general equilibrium model that derives the expected return on a stock, given the expected market return, the stock's beta coefficient, and the risk-free rate. The expected market return is based on a **market portfolio** that contains all marketable assets according to their **market weights** (i.e., the asset's value relative to other portfolio assets). Note that the actual market portfolio is unobservable and a market proxy must be used instead. The CAPM formula is as follows:

$$E(R_i) = R_f + \beta_i[E(R_m) - R_f]$$

where:

$E(R_i)$ = *expected* return on asset *i*

R_f = risk-free rate of return

$[E(R_m) - R_f]$ = *expected* market risk premium

β_i = stock's beta coefficient (i.e., sensitivity of the return of asset *i* to the market risk premium)

Therefore, the CAPM consists of three components: (1) the risk-free rate, R_f, (2) the stock's beta coefficient, β_i, and (3) the expected market risk premium, $[E(R_m) - R_f]$, which is the expected compensation associated with the asset's risk.

The CAPM formula above (known as the *ex ante CAPM*) is an example of an ex ante asset pricing model. Note that the CAPM has its own simplifying assumptions, including that all assets are publicly traded, there are no restrictions on short selling, all investors can borrow or lend indefinitely at the risk-free rate, there are no taxes or transaction costs, and that investors only consider an asset's mean returns and variance of returns.

Ex Ante Pricing Models

Ex ante asset pricing models describe "before-the-fact" expected future returns, which is the reason the ex ante CAPM measures *expected* returns.

There are two major assertions of the CAPM. First, the CAPM asserts that the expected return on any asset is solely determined by its **systematic risk** (beta). Second, the CAPM asserts that no additional expected return will be earned by bearing non-systematic or **idiosyncratic risk.** Systematic risks are driven by non-diversifiable market factors (e.g., macroeconomic factors). Idiosyncratic risks are driven by diversifiable investment-specific factors (e.g., product recalls, CEO resignations).

The CAPM implies that all investors are perfectly diversified and should use a two-fund strategy of investing a portion in the risk-free fund and the remainder in a well-diversified risky fund (mimicking market portfolio *m*). Relative to a highly risk averse investor, a more risk-tolerant investor should allocate a larger percentage to the risky fund. For instance, a highly risk averse investor might allocate 80% to the risk-free fund and 20% to the risky fund, while the more risk tolerant investor might allocate 20% to the risk-free fund and 80% to the risky fund. The important point is that the two investors invest in the same risky fund, even though their risk-return preferences differ significantly. The only risk factor both investors are exposed to is the risk that the price of the market portfolio will change.

Therefore, alternative investments become attractive only if the CAPM fails to adequately describe investment behavior. Otherwise, all investors can maximize their performance by using the two-fund approach described above. The following example illustrates the application of the CAPM when prices do not equal their CAPM-determined values and where the analysis of alternative investments becomes important.

Example: Applying the ex ante CAPM

An analyst observes that the beta of Goldmine shares is 1.5. The expected return on the market is 10% and the risk-free rate is 4%. Suppose the analyst forecasts that the Goldmine stock return will equal 14% next year. **Calculate** the CAPM-based return for Goldmine's shares, and **determine** if Goldmine is undervalued or overvalued according to the analyst forecast.

Answer:

CAPM required return = 0.04 + 1.5(0.10 – 0.04) = 0.13 = 13%

According to the analyst, Goldmine's stock is currently undervalued because the forecasted return (14%) exceeds the required return (13%). Notice that the analyst does not believe that the CAPM is accurate. If the analyst believed that the CAPM was valid, then the forecasted return should always equal the CAPM required return.

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Ex Post Pricing Models

An **ex post asset pricing model** describes "after-the-fact" historical returns. Ex post asset pricing models focus on *realized* returns rather than the *expected* returns of ex ante models. The ex post form of the CAPM is:

$$R_{i,t} - R_f = \beta_i(R_{m,t} - R_f) + \varepsilon_{i,t}$$

where:

$R_{i,t} - R_f$ = realized **excess return** (i.e., returns in excess of the risk-free rate) for asset *i* at time *t*

$(R_{m,t} - R_f)$ = realized market risk premium

$\varepsilon_{i,t}$ = unexplained return due to idiosyncratic risk at time *t*

The slope of the ex post CAPM measures the sensitivity of the asset's returns to changes in the broad market's returns over time. The premise of the model is that there are just two sources of risk:

1. Broad market events (systematic risk, or the dispersion in economic outcomes due to the variability of systematic return).

2. Idiosyncratic events (unsystematic risk, or the dispersion in economic outcomes that is specific to the asset).

Alternatively, the ex post CAPM demonstrates there are two sources of realized excess returns:

1. **Systematic returns**, $\beta(R_{m,t} - R_f)$. Systematic returns are investment returns attributable to broad market effects.

2. **Idiosyncratic returns**, ε_t. Idiosyncratic returns are investment returns attributable to events unique to the investment and unrelated to the broad market. According to the CAPM, $E(\varepsilon_t)$ equals zero, implying that idiosyncratic returns even out over time, and ε_t is uncorrelated with the broad market factor.

Note that the expected value of the ex post CAPM equals the ex ante CAPM:

$$E[R_{i,t} - R_f] = \beta E[(R_{m,t} - R_f)] + E[\varepsilon_{i,t}]$$

$$E(R_i) - R_f = \beta[E(R_{m,t}) - R_f], \text{ or}$$

$$E(R_i) = R_f + \beta[E(R_{m,t}) - R_f]$$

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Example: Applying the ex post CAPM

An analyst observes that the beta of NextGen shares is 1.5. Last year, the broad market return was 10%. The risk-free rate is 4%. The return on NextGen shares last year equaled 15%. **Calculate** last year's idiosyncratic return for NextGen shares.

Answer:

Using the ex post CAPM, last year's CAPM-based return for NextGen shares was:

$$R_f + \beta(R_{m,t} - R_f) = 0.04 + 1.5(0.10 - 0.04) = 0.13 = 13\%$$

The idiosyncratic return equals:

$$\varepsilon_t = R_t - [R_f + \beta(R_{m,t} - R_f)] = 0.15 - 0.13 = 0.02 = 2\%$$

Multifactor And Empirical Asset Pricing Models

LO 6.3: Demonstrate knowledge of multifactor and empirical asset pricing models.

For example:

- **Apply and interpret equations representing ex ante and ex post forms of multifactor asset pricing models.**
- **Distinguish between theoretically derived and empirically identified return factors.**
- **Describe the steps typically involved in empirical modeling of returns.**
- **Recognize the key components of the Fama-French and Fama-French-Carhart models, and discuss the appropriate application of these models in alternative investing.**
- **Discuss three key issues analysts should consider when using empirical multifactor models.**

Multifactor Asset Pricing Models

Multifactor asset pricing models describe the relationship between expected returns of assets and the assets' exposures to multiple risk factors, and therefore better explain systematic risk than single factor models. The equation for a general K-factor *ex ante* model is:

$$E(R_i) - R_f = \beta_{i,1}[E(R_1) - R_f] + \beta_{i,2}[E(R_2) - R_f] + \ldots + \beta_{i,K}[E(R_K) - R_f]$$

where:
$E(R_1)$ through $E(R_K)$ = *expected* returns on the *K* risk factors
$\beta_{i,1}$ through $\beta_{i,K}$ = sensitivities of the asset return to changes in the risk factor

The *ex post* version of the multifactor model based on *realized* returns is:

$$R_{i,t} - R_f = \beta_{i,1}(R_{1,t} - R_f) + \beta_{i,2}(R_{2,t} - R_f) + \ldots + \beta_{i,K}(R_{K,t} - R_f) + \varepsilon_{i,t}$$

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Risk factors are derived based either on theory or on empirical observation. **Theoretical models** use assumptions and logic that presumably capture underlying investment behavior. For instance, a model might be developed assuming that investors maximize utility based on the mean and variance of investment outcomes in a world with no trading barriers. In contrast, **empirical models** are based on historically observed behavior.

For example, we might estimate the relationship between residential real estate prices and various determinants of real estate transaction prices using historical data. Empirical models are more appropriate for alternative investments, which are characterized by many frictions such as illiquidity, non-normality, and time-varying risks. The main weakness with empirically derived multifactor models is that the factors may have been identified from *spurious correlation* (i.e., correlation between two factors that is purely coincidental as there is no relationship between the two factors) or may have explained the past well with little ability to explain the future.

The steps to derive an empirical multifactor model are:

1. Derive excess returns for the security (the dependent variable of the ex post regression).
2. Identify a set of potential factors.
3. Perform tests of significance to identify the important "priced" factors.

Assuming the factors are **tradable assets** (e.g., common stock), where rates of return can be observed from which the risk premiums can be calculated), then the intercept of the ex post multifactor model reflects the abnormal performance of the security.

Fama-French Three-Factor Empirical Model

The **Fama-French model** is an empirical multifactor asset pricing model. It is based on three factors: market beta, market capitalization, and book-to-market ratio. The Fama-French model has gained widespread popularity over the past few decades for use in examining conventional equity investments and equity-oriented alternative investments.

$$E(R_i) - R_f = \beta_1(R_m - R_f) + \beta_2 E(SMB) + \beta_3 E(HML)$$

where:
SMB = "small minus big"; size factor equal to the difference in returns between portfolios of small (small-cap) and big (large-cap) firms ($R_s - R_b$)
HML = "high minus low"; book-to-market factor equal to the difference in returns between portfolios of high and low book-to-market firms ($R_h - R_l$)

Notice that SMB is a hedge strategy that is long small firms and short big firms. Likewise, HML is a hedge strategy that is long high book-to-market firms and short low book-to-market firms.

The Fama-French model is an example of an empirical multifactor asset pricing model because, historically, average stock returns for small firms have been higher than average stock returns for big firms, even after controlling for the betas of the firms. Similarly, historically, average stock returns for high book-to-market firms have exceeded those of low book-to-market firms (even after controlling for the betas and size of the firms).

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Fama-French-Carhart Four-Factor Empirical Model

Subsequent to the development of the Fama-French three-factor model, professor Mark Carhart introduced a fourth factor based on the difference in returns between the prior year's winning and losing stocks (e.g., each January form a portfolio that is long last year's winning stocks and short last year's losing stocks, rebalancing each January). With the addition of this factor, the **Fama-French-Carhart model** was introduced:

$$E(R_i) - R_f = \beta_1(R_m - R_f) + \beta_2 E(SMB) + \beta_3 E(HML) + \beta_4 E(UMD)$$

where:
UMD = "up minus down"; difference in returns between stocks that were up the most and those that were down the most during the prior year

The UMD factor often is called the ***momentum factor***, in the sense that, historically, stocks that performed well in year *y* tend to perform well in year y + 1, and stocks that performed poorly in year *y* tend to perform poorly in year y + 1.

Note that β_2 will be positive for a small firm and negative for a big firm. β_3 will be positive for a high book-to-market firm and negative for a low book-to-market firm. β_4 will be positive for prior year winners and negative for prior year losers.

Professor's Note: Notice that the risk-free rate is not subtracted from the SMB, HML, and UMD factors. For example, the SMB can be shown to equal $(R_s - R_f) - (R_b - R_f) = R_s - R_b = SMB$. Consequently, the SMB is unchanged if the risk-free rate is subtracted from each component of the factors. The risk-free rate would be double-counted if it was also subtracted from the SMB.

Analyst Considerations for Empirical Multifactor Models

The Fama-French and Fama-French-Carhart models have found wide application for traditional equity investments, but application to non-equity alternative investments has been limited. Numerous multifactor models have been developed specifically for alternative investments. The key is to identify common sources of risk that either theoretically should explain or empirically do explain differences across returns for different investments.

Factors should be selected based on solid theoretical rationale or on rigorous empirical statistical testing. Three caveats are in order when deriving factors empirically:

First, testing a multitude of factors will produce statistically meaningful relationships purely by chance. Many factors will appear significant merely by chance. For instance, if testing 100 factors and using a 10% level of significance, 10 factors will appear significant merely by chance, even though they are not. The problem with using these factors is that they have no predictive powers in our model.

Second, we should avoid identifying factors based on spurious correlation. Consider a spurious model in which we predict that returns depend on a firm's industry affiliation. In this model, the stock's expected return will change if the company's industry classification changes, even though its risk characteristics might not have changed (which is most likely for a firm straddling two industries). In reality, a stock's expected return should change only if its risk characteristics change.

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Third, the CAPM might work well for traditional investments in which it might be logical to think investors will invest in the market portfolio and are able to easily diversify away idiosyncratic risk. However, for alternative investments, many assets are not publicly traded or at least not traded regularly (think of private real estate, private equity, and many hedge funds). Therefore, for alternative investments, the CAPM idiosyncratic risk is not so easily diversified away, which violates an assumption of the CAPM. If positive returns are paid for CAPM idiosyncratic risks, then it makes sense to attempt to find factors that capture those risks, and multifactor models may be useful. As explained earlier, a key consideration is to identify factors that will properly explain future returns. Just because factors explain past returns is no guarantee that they will explain future returns.

Arbitrage-Free Financial Models

LO 6.4: Demonstrate knowledge of arbitrage-free financial models.

For example:

- **Describe arbitrage-free models.**
- **Discuss applications of arbitrage-free models.**
- **Describe arbitrage-free pricing in spot markets.**
- **Describe hedged and unhedged carry trades.**
- **Define forward contracts, and recognize their uses in hedging.**
- **Recognize and apply cost-of-carry models.**
- **Discuss and apply binomial tree models.**

Arbitrage is the process of earning risk-free profits by trading relatively mispriced assets. An **arbitrage-free model** is a pricing model that assumes arbitrage opportunities are short-lived or nonexistent. According to the simplest arbitrage-free models, forward price curves are only an expression of current variables (e.g., interest rates, dividend yields). Models that are more complex incorporate supply and demand shifts, storage costs, and other variables. Note that arbitrage-free models assume there are no taxes, transaction costs, or other trading restrictions.

Arbitrage-free models are **relative pricing models**, which describe price relative to the price of another asset (this could be expressed as the ratio of two prices). For example, we could say that the American call option of an asset is 3% more expensive than the European call option of the same asset with the same maturity and strike price. In contrast, **absolute pricing models** describe price based on an asset's underlying economic fundamentals. Absolute models are often less precise than relative models.

Arbitrage-free pricing can exist in both spot markets and forward markets.

Arbitrage-Free Pricing in the Spot Market

In the **spot market** (or **cash market**), where trades are for immediate delivery, the only two criteria for the arbitrage-free pricing model are that: (1) two economically identical assets exist, and (2) their prices and returns are equal. For example, if in the spot market 1 U.S. dollar is worth 1.25 Canadian dollars, and 1 Canadian dollar is worth 0.75 Swiss francs, then 1 U.S. dollar should be worth 0.94 Swiss francs (= 1.25 × 0.75).

Carry Trades

A basic **carry trade** involves borrowing in a currency with a low interest rate (e.g., Japanese yen) and lending in a currency with a high interest rate (e.g., Australian dollar) in order to profit from the interest rate differential between the two currencies. For example, if the interest rate on the Japanese yen was 1.0% and the interest rate on the Australian dollar was 6.0%, the currency manager would borrow JPY and invest in AUD in order to earn: 6.0% – 1.0% = 5.0%.

Note that the basic carry trade is done without any exchange rate risk hedging. The objective is to earn the interest rate differential, but this only works *if the exchange rate between the currencies stays the same.* The primary risk to a basic carry trade is *exchange rate risk*, or the risk that a currency may appreciate or depreciate relative to another currency. If the high interest rate currency were to depreciate relative to the low interest rate currency by more than the interest rate differential, the trader could experience a loss. Carrying through our buy AUD, sell JPY example above, if the AUD depreciated by more than 5.0%; the trader would have a total return loss from his trading position (i.e., the 5% interest rate differential would be totally offset by the 5% AUD depreciation). As a result, derivatives are often used to hedge exchange risk. If exchange risk is fully hedged with derivatives, the trade can be viewed as an arbitrage trade as the risk has been hedged away.

Arbitrage-Free Pricing of Financial Forwards

In contrast to spot markets, forward markets allow trading for future delivery. A **forward contract** is a bilateral contract that obligates one party to buy and one party to sell a specific quantity of an asset, at a set price, on a specific date in the future. If the expected future price of the asset increases over the life of the contract, the right to buy at the contract price will have positive value and the obligation to sell will have an equal negative value. If the future price of the asset falls below the contract price, the result is opposite and the right to sell (at an above-market price) will have positive value.

Arbitrage-free pricing in forward markets involves the same pricing model criteria discussed for spot markets (i.e., two identical assets with identical prices and returns), but also factors in the passage of time. Consider an investor looking for a 12-month investment in Canadian Treasury bills (T-bills). The investor should be indifferent between either (1) buying a 9-month T-bill and rolling the proceeds at maturity into a 3-month T-bill or (2) buying a 12-month T-bill and holding it to maturity. Economically, these transactions are identical. As a result, the price of the 12-month T-bill should also equal the sum of the prices of the 9-month and 3-month T-bills. If the two sides do not balance, it presents an arbitrage opportunity. Note that only two of the trades are spot trades—the 12-month and the 9-month instrument. The 3-month instrument for delivery in 9 months is a forward contract.

Let's illustrate with an example. Assume that the spot price of the 12-month T-bill is \$95, the spot price of the 9-month T-bill is \$97, and the maturity value of a T-bill is \$100. This implies we can calculate the forward price, *F*, of the 3-month instrument:

$$\$100 / \$95 = (\$100 / \$97) \times (\$100 / F)$$

Based on this relationship, the arbitrage-free forward price of the 3-month T-bill is \$97.94.

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Example: Calculating the no-arbitrage value of a forward contract

An 8-month T-bill is selling for $98,500 in the spot market. A forward contract on a 4-month T-bill with a delivery in 8 months is selling for $99,500. What is the spot price of a 12-month T-bill? Assume all securities have a face value of $100,000.

Answer:

To prevent arbitrage, the return on the 12-month T-bill must be the same as the return on the 8-month T-bill reinvested at maturity for 4 months using the forward contract. Denoting *S* as the spot price of the 12-month T-bill, we can set up the following equation:

$$\$100{,}000 / S = (\$100{,}000 / \$98{,}500) \times (\$100{,}000 / 99{,}500)$$

$$S \approx \$98{,}000$$

There can only be one arbitrage-free value of a forward contract. When a forward price deviates from its arbitrage price, investors can benefit by buying the undervalued assets and short selling the overvalued assets.

These relationships can also be modeled with interest rates, where the no-arbitrage rates of the forward contracts are functions of spot rates:

$$F_{T-t} = [(T \times R_T) - (t \times R_t)]/(T - t)$$

where:
T = time to maturity of the longer maturity T-bill
R_T = continuously compounded yield to maturity of the longer maturity T-bill
t = time to maturity of the shorter maturity T-bill
R_t = continuously compounded yield to maturity of the shorter maturity T-bill
F_{T-t} = continuously compounded yield to maturity on the forward contract between the maturity of the shorter dated and longer dated T-bill.

Cost-of-Carry Model

Carrying costs (or *cost of carry*) refer to the cost involved with holding an asset until expiration of the forward contract and includes both the cost of storing the asset and the opportunity costs associated with using capital to purchase the asset. **Cost-of-carry models** involve two strategies with identical economic results but different current prices (and therefore returns) that reflect the carrying costs for each strategy. Buying an asset now or in the future through a forward contract both result in ownership of the asset and equivalent exposure to price risk. Thus, any difference between the spot and forward price is due to the cost of carry, which causes the term structure of forward prices to have a slope or curve. For commodities, the cost-of-carry relationship is as follows.

$$F(T) = S + \text{carrying costs}$$

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If at any point in time the forward price does not equal spot price plus carrying costs, arbitrage will ensue to restore the relationship.

Note that forward contracts exist for real assets (e.g., commodities) and financial assets (e.g., stocks), each of which generate economic costs and benefits related to direct ownership.

The costs and benefits of direct ownership and derivatives ownership are used to establish arbitrage-free pricing relationships between underlying assets and their associated forward contracts. For example, benefits of forward contracts should cause forward prices to increase while costs should cause forward prices to decrease relative to the spot price. The forward prices of assets with both costs and benefits will depend on the relative sizes of these factors. In the following sections, we will demonstrate how these relationships are derived.

Financed positions allow an investor to obtain economic ownership of an asset without forfeiting the cash value of the position. Forward contracts only require posting a small amount of collateral which earns a market interest rate, meaning we can ignore the collateral and classify forwards as financed positions with zero investment. It is similar to buying the asset and selling short a bond (i.e., borrowing funds). Unlike direct ownership of an asset, however, forward contracts do not entitle the holder to dividends or coupons paid by the underlying asset. Arbitrage-free models account for the financed position and lack of dividends/coupons in pricing forward contracts.

Financial forwards include futures contracts on stock indices, U.S. Treasury bond futures, and Eurodollar CD futures. With financial assets, there may be a monetary benefit to holding the underlying asset, which will decrease the no-arbitrage futures price because the net cost of holding the asset is lower. Accounting for a known dividend or coupon yield results in the following forward pricing relationship:

$$F(T) = S \times e^{(r-d) \times T}$$

$$S = F(T) \times e^{-(r-d) \times T}$$

where:
F(T) = price of the forward contract
S = spot price of the underlying asset
r = risk-free interest rate
d = continuously compounded dividend or coupon rate
T = time to maturity of the forward contract

Note that forward prices are reduced when dividends or coupons are greater than the risk-free rate. We can explain why in multiple ways, including:

- Dividends and coupons cause the value of financial assets to decrease on the day of the distribution. Forward contracts with maturities after the distribution date must reflect the decline in value.
- Financial asset values comprise (1) the present value of dividends or coupons until time *T* and (2) the present value of the market price at time *T*. A forward contract only accounts for the second part and therefore its price must be lower than the spot price to reflect the lack of cash distributions.

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Example: Forward price when the underlying asset pays a dividend

The S&P 500 is currently trading at $1,555, and the risk-free interest rate is 4.5%. The current dividend yield on the S&P 500 is 2.2%. **Calculate** the forward price of a six-month forward contract on the S&P 500.

Answer:

$$F(0.5) = \$1{,}555e^{(0.045 - 0.022)0.5} = \$1{,}572.99$$

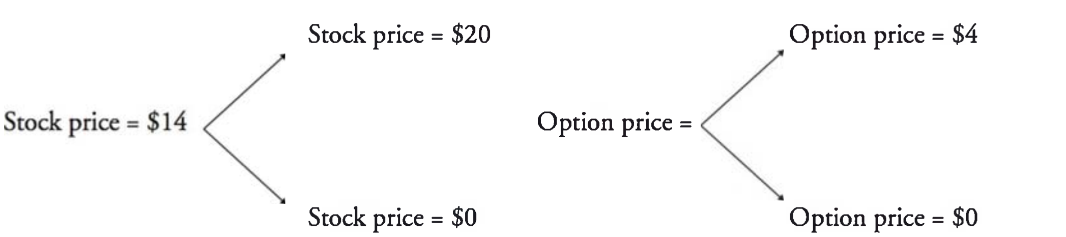
The pricing relationship for financial forwards indicates that the interest saved by utilizing a forward contract rather than purchasing the underlying asset is offset by the dividends or coupons that the investor forgoes.

Binomial Tree Models

A **binomial tree model** is often used for option pricing and shows the possible values an option can take at each given time period. It reflects the uncertainty in outcome by modeling an upward and downward movement at each state.

For example, consider a stock that sells for $14 today and does not pay dividends. Over the next six months, the stock is expected to either rise to $20 or fall to $0. A call option on the same stock expires in six months and has a strike price of $16. A binomial tree model should help us graph the option payoffs at each period, and help us determine the call option price today.

Figure 1: Binomial Tree Model



Looking at Figure 1, even without knowing the probabilities of an up and down move, we can calculate the value of the call option using arbitrage-free pricing. The option price today (C) is the option price's upper node (C_U) divided by the stock price's upper node value (S_U) multiplied by the stock price in time 0 (S). Therefore, the call option price at time 0 is calculated as:

$$\frac{C}{S} = \frac{C_U}{S_U}$$

$$\frac{C}{\$14} = \frac{\$4}{\$20}$$

$$C = \frac{\$4}{\$20}(\$14)$$

$$C = \$2.80$$

Term Structure And Pricing Of Forward Contracts

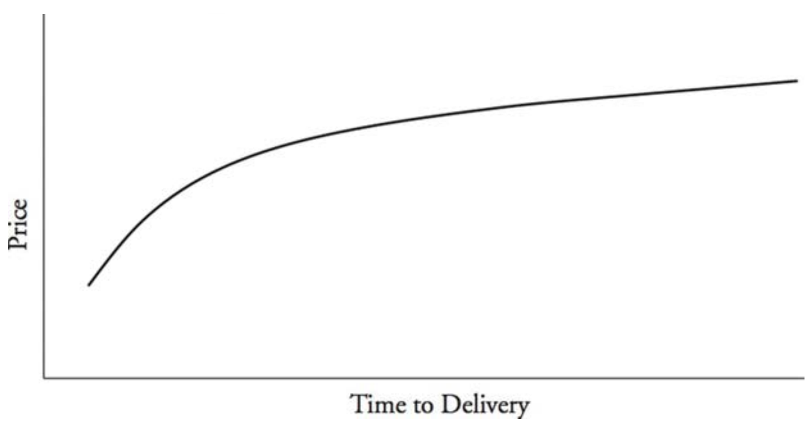
LO 6.5: Demonstrate knowledge of the term structure of forward contracts.

For example:

- **Identify the two determinants of forward prices on a risky financial security.**
- **Compare the pricing of forward contracts on financial securities and commodities.**
- **Apply the cost-of-carry model for pricing forward contracts on financial securities.**

The **term structure of forward contracts** refers to the relationship between forward prices (or forward rates in the case of interest rate contracts) and time to delivery. In determining the term structure at any point in time, we are concerned with an asset's spot price, *S*, and its forward price, *F(T)*, where *T* represents the time until contract maturity in years. Note that there will be a series of forward prices starting with shorter and extending to longer maturities. Once we compile these prices and graph them against time to maturity, we have the term structure. We illustrate this relationship in Figure 2.

Figure 2: Term Structure of Forwards



Forward contracts differ from spot transactions due to timing of payment and security exchange. Under a forward contract, payment is deferred until delivery of the security, and any dividend payments accrue to the security owner but not to the long position under the contract. Therefore, forward contracts are only dependent on the risk-free interest rate and the dividend or other distributions paid during deferral of delivery. The no-arbitrage forward price of the security must equal the cost of buying the security in the spot market with 100% financing, paying interest costs, and receiving any distributions.

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Example: Calculating the no-arbitrage forward price

A security is priced \$50 at the beginning of the year. At year-end, it is expected to pay a \$1 dividend. The security is fully financed at 4%. What is the one-year, no-arbitrage price of the forward contract?

Answer:

The one-year forward contract must be priced at \$51 for there to be no arbitrage opportunities. In the spot market, an investor could use 100% financing to buy the security for \$50. Financing cost for a year is \$2 (4% of \$50). This cost is then offset by the \$1 dividend, for a net cost of \$1. The forward contract must therefore be priced at \$50 + \$1 = \$51.

So far, we mentioned that the two factors that differentiate forward and spot trades are interest costs and dividend yields. This is true for most financial securities. However, commodities are driven by three additional factors: (1) forecasts for changes in supply and demand, (2) storage costs, and (3) convenience yield.

Four Cost-of-Carry Model Scenarios for Financial Securities

We previously introduced the basic cost-of-carry model that determined the forward price from spot prices, interest costs, and dividend yield:

$$F(T) = S \times e^{(r-d) \times T}$$

where:
F(T) = price of the forward contract
S = spot price of the underlying asset
r = risk-free interest rate
d = continuously compounded dividend or coupon rate
T = time to maturity of the forward contract

There are four cost-of-carry model scenarios for financial securities.

Scenario 1: No Interest And No Dividends

In a simple scenario with no interest costs and no dividends, $r = d = 0$, then $e^{(r-d) \times T} = 1$ and all forward prices with different maturities are the same, and all forward prices are the same as the spot price. The cost-of-carry model simplifies to F(T) = S. Under such a scenario, the term structure of forward prices is flat, and investors are indifferent between buying securities in the spot market and contracting to buy in the forward market for any maturity.

Scenario 2: Interest Rate Equals Dividend Rate

Under Scenario 2, the interest rate equals the dividend rate, $r - d = 0$, but both r and $d > 0$, then $e^{(r-d) \times T} = 1$. From a forward pricing perspective, Scenario 1 and Scenario 2 are the same. That is, the term structure of forward prices is flat and all forward prices with different maturities are the same, and all forward prices equal the spot price.

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Scenario 3: Interest Rate Exceeds Dividend Rate

When the interest rate exceeds the dividend rate, $r > d$, then $e^{(r-d) \times T} > 1$ and the no-arbitrage forward price must exceed the spot price. The term structure of forward prices under this scenario is upward sloping. Investors would be indifferent between (1) financing a spot transaction and receiving dividends on a security and (2) buying a security in the forward market, avoiding interest costs but also not receiving dividends.

Example: Calculating the no-arbitrage forward price when r > d

An equity index is selling for $1,200 in the spot market. The dividend yield is 3% and the risk-free interest rate is 6%. **Calculate** the four-month forward price of the index.

Answer:

The four-month no-arbitrage forward price equals:

$\$1{,}200\ e^{(0.06-0.03) \times 0.33} = \$1{,}212.06$

Scenario 4: Dividend Rate Exceeds Interest Rate

When the dividend rate exceeds the interest rate, $d > r$, then $e^{(r-d) \times T} < 1$ and the no-arbitrage forward price must be lower than the spot price. The term structure of forward prices under this scenario is downward sloping.

Why do dividends reduce the forward price? It is because dividends and other cash distributions typically lower the value of the security in the spot market. In other words, the security price typically falls by the amount of the dividend on the day the dividend is paid.

Option Characteristics, Spreads, And Combinations

LO 6.6: Demonstrate knowledge of option exposures.

For example:

- **Recognize the key characteristics of long and short positions in an underlying asset.**
- **Recognize the key characteristics of call and put exposures.**
- **Discuss characteristics of option spreads.**
- **Define bull and bear spreads.**
- **Discuss option combinations.**
- **Define and apply the concept of put-call parity.**

Options are contracts that give the option holder (the buyer or long position) the right, but not the obligation, to enter into a specific transaction in the future. The other side of a contract is the option seller (short position) who has an obligation to sell (call option) or buy (put option). A **call option** gives the option holder the right to buy a security or a particular asset in the future at a specified price. A **put option** gives the holder the right to sell a particular security or asset in the future at a specified price. The option holder pays a fee for the option (the premium) and risk is limited to the amount of the premium. As the security price changes over time, options can be in the money (immediate exercise would

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result in a positive payoff), at the money (zero payoff), and out of the money (immediate exercise would result in a negative payoff). These three money terms describe the option's **moneyness**. Note that an option price can never be negative, even for out-of-the-money options.

The **strike price** (or *exercise price*) refers to the price at which the option contract can be exercised. **Option maturity** is the time when the option expires. **European options** can only be exercised at maturity, while **American options** can be exercised at any time up to and including maturity.

Strategies with One Option Position

Options allow investors to make or change their decisions as new information about a security or asset arrives into the market. Alternative investment strategies often rely on the use of options, or securities with options.

This section examines risk exposures, also called option payoffs, using payoff diagrams, where in-the-money options are shown at maturity. Price is shown on the horizontal axis, and profits are shown on the vertical axis.

A long position in a security has unlimited upside profit potential but limited downside loss potential since the security value cannot fall below zero value. A short position is the mirror exposure and has unlimited loss potential, but limited profit potential. Short positions can be particularly important in alternative investment strategies.

Option positions behave differently than the underlying security given that the right (but not the obligation) to buy or sell the security limits the downside for the call and put option holder to the premium paid. A **long call** option has unlimited upside profit potential but limited downside, while a **short call** has unlimited downside potential but limited upside. A **long put** option has limited upside profit potential since the security price cannot fall below zero and has limited downside, while a **short put** has limited downside loss potential and limited upside. The following figures illustrate the payoff diagrams of a basic call and put option.

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Figure 3: Long and Short Call Payoff Diagram

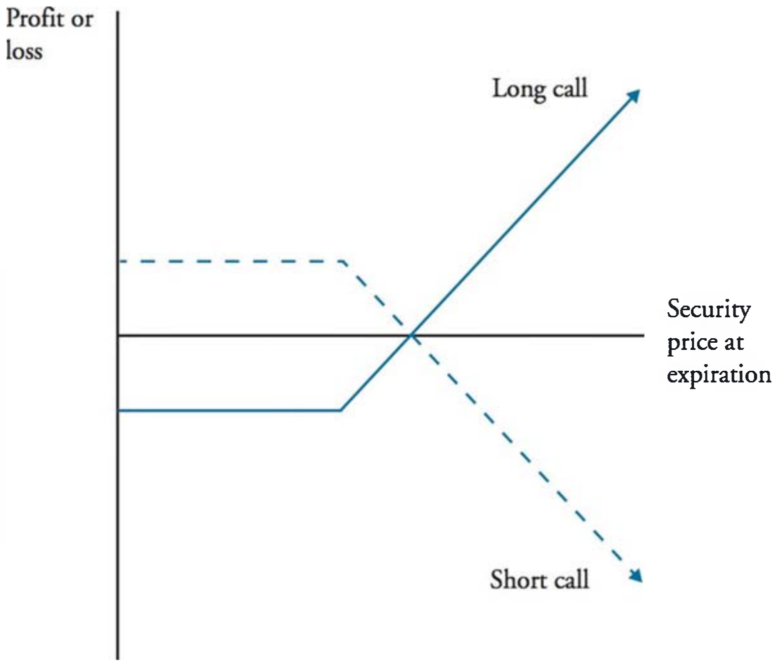
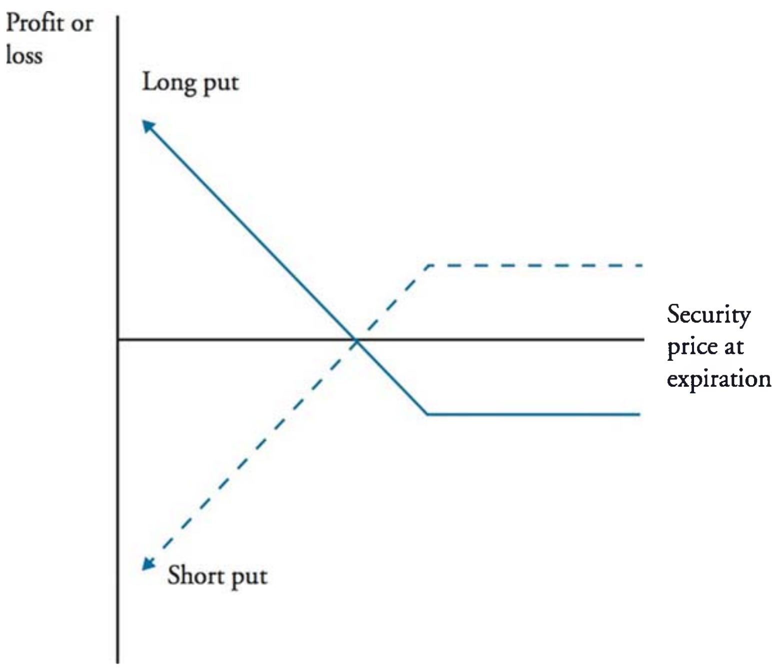


Figure 4: Long and Short Put Payoff Diagram



Naked options (or *uncovered options*) refer to short options in which the holder of the option does not also own a position in the underlying asset. A **covered call** strategy combines being long the underlying security and being short a call option on the security. The term "covered" means the long security position covers the investor's obligation to deliver the security. A covered call has limited upside, limited downside, and has the same payoff diagram as a short put. A **protective put** strategy combines being long the underlying security and being long a put option on the security. The term "protective" means the put option protects the investor against downside risk, while keeping unlimited upside

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potential. A protective put has the same payoff diagram as a long call. The figures below illustrate the payoff diagrams of a covered call and a protective put.

Figure 5: Covered Call Payoff Diagram

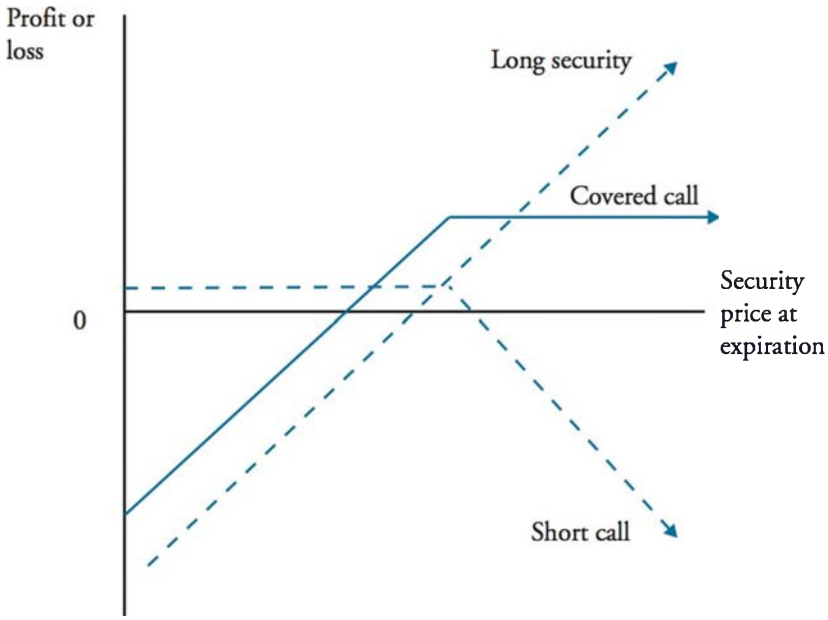
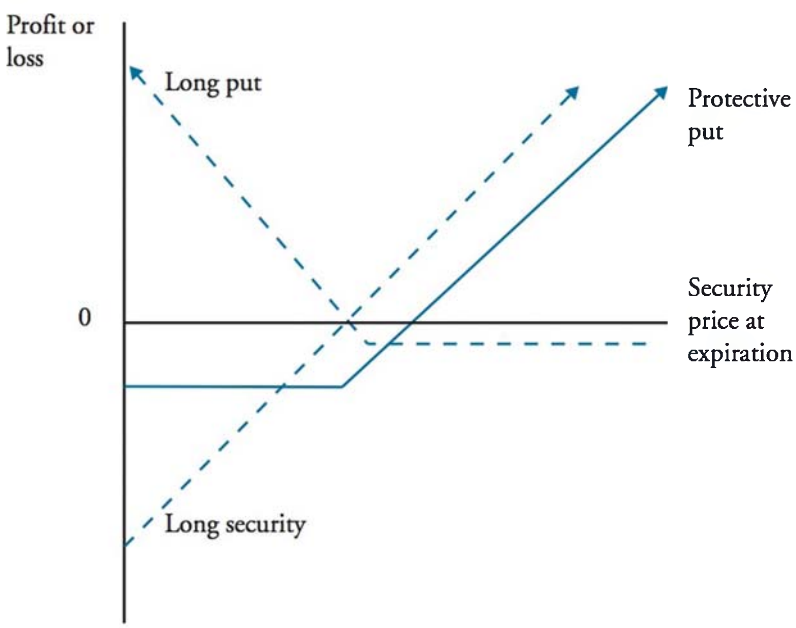


Figure 6: Protective Put Payoff Diagram



Strategies with Two Option Positions

An **option spread** involves (1) either calls or puts (but not both) and (2) both long and short positions on the underlying security. The options used in *horizontal spreads* (or *calendar spreads*) differ only by expiration date. The options used in *vertical spreads* differ only by strike price. Finally, the options used in *diagonal spreads* differ by both expiration date and strike price.

The figures below show the payoff diagrams of a bull spread and a bear spread. A **bull spread** is an option strategy that combines a long position in a lower strike price option with a short position in a higher strike price option. The strategy results in a bullish exposure that starts at the lower strike price and is bound by the higher strike price. A **bear spread** combines a long position in a higher strike price option with a short position in a lower strike price option. The strategy results in a bearish exposure that starts at the higher strike price and is bound by the lower strike price.

Figure 7: Bull Spread Payoff Diagram

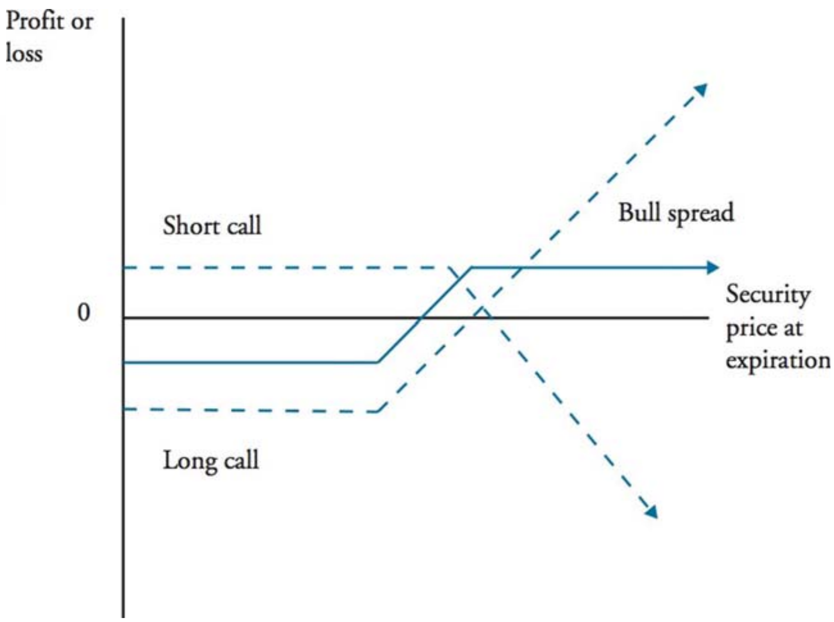
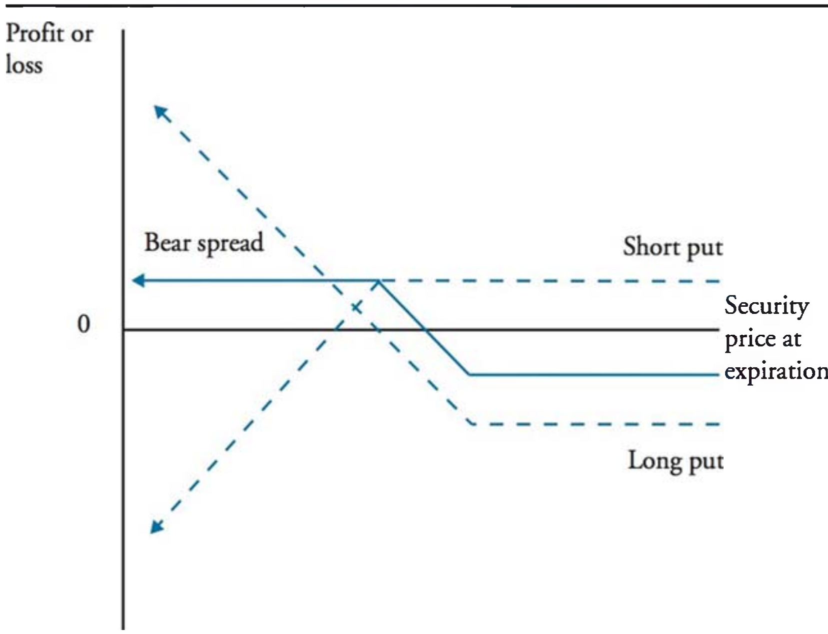


Figure 8: Bear Spread Payoff Diagram



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Option combinations involve a combination of both calls and puts on the underlying security. Two of the better-known volatility strategies are the option straddle and the option strangle. An **option straddle** is a position in a call and a put (either both long or both short) on the same underlying security, same expiration date, and same strike price. An **option strangle** is a position in a call and a put (either both long or both short) on the same underlying security and expiration date, but with *different strike prices*. The figures below illustrate the payoff diagrams of a long straddle and long strangle.

Figure 9: Straddle Payoff Diagram

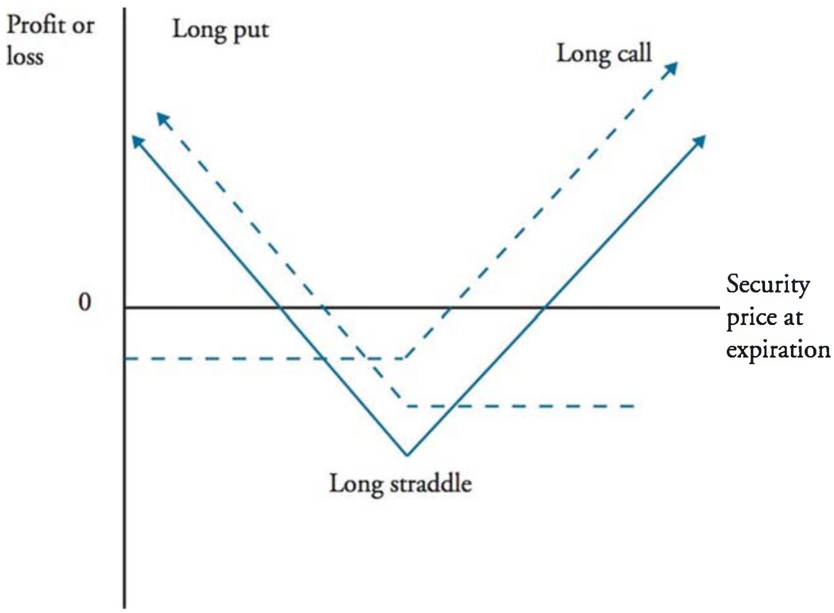
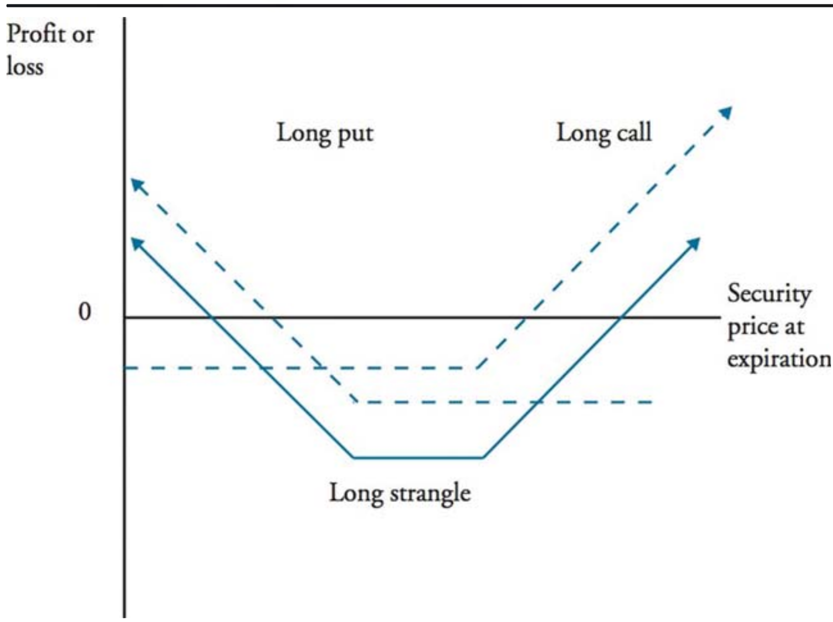


Figure 10: Strangle Payoff Diagram



Professor's Note: Option straddles and strangles are called volatility strategies because they are used when large swings are expected in the security price, but the direction of the swings is not known. They are often used ahead of earnings announcements. Given the two option premiums, these are expensive strategies for the long investor who is expecting sufficient swings in security price to recover both premiums.

If an option straddle consists of options with different signs (e.g., long call and short put), the result would be a synthetic position in the underlying security with a straight-line payoff diagram. A long call and short put would result in a synthetic long position in the security, while a long put short call would result in a synthetic short position in the security.

We can also extend the previous scenario to option strangles. For example, a long out-of-the-money call combined with a short out-of-the-money put on the same asset and with the same expiration is called a **risk reversal**. It is similar to a synthetic long position in the underlying security, but it has a break between the two option strike prices.

Another popular strategy is a collar. A **collar** includes a long position in the underlying security, which is combined with a long put option and a short call option. It is in some regard a hybrid of the protective put and covered call positions. The idea behind a collar is that the investor expects only modest volatility and is looking to protect against downside risk but is willing to forgo upside potential beyond a certain point. An **option collar** is a long position in an out-of-the-money put and a short position in an out-of-the-money call. The option collar is therefore the same as the short position in a risk reversal, and has the same payoff diagram as a bull spread.

Put-Call Parity

Using the option positions we previously described, we can construct the put-call parity, a particularly important relationship for analyzing options. The **put-call parity** is a no-arbitrage relationship between two sets of positions with identical payoffs: (1) a long position in an underlying asset and (2) a long call, short put, and long risk-free bond positions.

call + risk-free bond – put = underlying asset

The call and the put both have identical strike prices and expiration dates. Upside exposure is provided by the long call and downside exposure by the short put. The risk-free bond indicates the amount of cash that must be invested today. This equation can be rearranged many ways, including to calculate the value of the call or the put. However, no matter how it is rearranged, the intuition will always be that the two sides require the same investment and provide the same exposure, and therefore their values must always be equal.

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Option Pricing Models

LO 6.7: Demonstrate knowledge of option pricing models.

For example:
- **Recognize and apply the Black-Scholes call option formula.**
- **Recognize and apply the Black forward option pricing model.**
- **Recognize and apply the currency option pricing model.**

In this section, we look at four option pricing models. All models assume that the underlying asset does not pay dividends or other cash distributions.

General Option Pricing Model

This basic option pricing model values an option on a portfolio that contains both long and short positions. The purchaser of the option can either purchase the entire portfolio, including both long and short asset positions, or simply walk away and let the option expire.

$$P_o = P_1\, N(d) - P_s\, N(d - v)$$

Provided on Exam

where:
P_o = option value
P_l = long asset position value
P_s = short asset position value
N = cumulative normal distribution
d = $[\ln(P_l/P_s)/v\,] + (v/2)$
v = volatility of portfolio returns

The volatility variable, *v*, measures the volatility of the combined long and short positions, and therefore factors in their separate volatilities as well as the correlation between the two positions.

Two Black-Scholes Option Formulas

Two special cases of the model we just introduced are the Black-Scholes formulas for calculating call or put values, which also build on our intuition of the put-call parity relationship. The **Black-Scholes call option formula** shows the price of a call option as a

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function of the price of the underlying security, the option strike price, the volatility of security returns, the option's time to expiration, and the risk-free rate:

$$c = SN(d_1) - e^{-rT}KN(d_2)$$

Provided on Exam

where:
c = call option price
S = underlying security
$d_1 = [\ln(S/e^{-rT}K)/v] + (v/2)$
$v = \sigma_s\sqrt{T}$
σ_s = constant return volatility of S
r = risk-free rate
T = time to option expiration
K = face value of bond
$d_2 = d_1 - v$

A variation of this formula is the Black-Scholes put option formula, which is the well-known form of the Black-Scholes formulas and measures the value of a put option in relation to the same five factors we discussed for the call option formula. The difference is that the put option formula assumes a short position in the security and a long position in the bond.

Black Forward Option Pricing Model

When we replace the underlying security with the forward contract in the Black-Scholes call option formula, we derive the **Black forward option pricing model:**

$$c = e^{-rT}[FN(d_1) - KN(d_2)]$$

Provided on Exam

where:
F = present value of forward
$d_1 = [\ln(F/K)/v] + (v/2)$
$d_2 = d_1 - v$

You should recognize that the model replaced the underlying security *S* with the present value of the forward contract *F* and assumes no dividends. In the forward model, both *F* and *K* are present values.

Currency Option Pricing Model

Building on the previous models, we can also derive a **currency option pricing model**:

$$\text{option price} = e^{-r^*T}S^*N(d_1) - e^{-rT}SN(d_2)$$

Provided on Exam

In this model, there are two risk-free interest rates that correspond to the two currencies that are exchanged. In other words, the model prices an option that gives the right to exchange S^* units of one currency with its associated r^* risk-free interest rate, for S units of another currency at r risk-free interest rate.

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Option Sensitivities And The "Option Greeks"

LO 6.8: Demonstrate knowledge of option sensitivities.

For example:

- **Recognize and describe the five most popular option sensitivities (i.e., delta, vega, theta, rho, and gamma).**
- **Discuss option sensitivities.**
- **Discuss the uses of option sensitivities in risk management.**

Both call and put options exhibit sensitivities to underlying factors, and these sensitivities are assigned Greek names (hence they are often called "option Greeks"). The four most important factors are as follows: the underlying security (S), the return volatility of the asset (σ_s), time to expiration (T), and the risk-free interest rate (r). The corresponding sensitivities, which are first partial derivatives, are called delta, vega, theta, and rho, respectively.

- **Delta** measures the sensitivity of the option price to changes in the price of the underlying security. To illustrate with an example, a delta of 0.6 indicates that the price of the option will change by $0.6 dollars for every $1 change in the underlying asset price.
- **Vega** measures the sensitivity of the option price to changes in the price volatility of the underlying security.
- **Theta** measures the sensitivity of the option price to changes in time to expiration.
- **Rho** measures the sensitivity of the option price to changes in the risk-free interest rate.

Another popular sensitivity is **gamma**, which is a second derivative, and measures the rate of change in delta to changes in the price of the underlying security.

Professor's Note: A little trick helps remember some of these option terms. The first letter of the Greek name will help you recall the sensitivity concept. Think "v" for "vega" and "volatility," "t" for "theta" and "time," and "r" for "rho" and "risk-free interest rate."

In addition, recall that a long call (short put) option's delta is always positive between 0 and 1, and a long put (short call) option's delta is always negative between 0 and –1. Deltas change over time and are not constant.

There are many other option sensitivities, including **omicron,** which measures a position's price sensitivity to changes in the credit spread.

Rather than using partial derivatives, some option sensitivities use elasticity. **Elasticity** is a measure of responsiveness of one variable in response to a change in another variable. **Lambda** and **omega** measure the elasticity of the option price with respect to the underlying security's price. Other more esoteric sensitivity measures also exist.

Investors favor option sensitivities since they reveal information about underlying risks. For example, a convertible bond trader may use option sensitivities to (1) isolate the risk that the price of a security underlying a convertible bond will change and (2) establish a hedge ratio. Another use is to manage all potential portfolio risks by utilizing option sensitivities (i.e., a total derivative approach).

KEY CONCEPTS

LO 6.1

Informational market efficiency refers to the speed and extent to which security prices adjust to new market information.

The three forms of market efficiency include weak form (security prices fully reflect all available security data on past prices and volumes), semistrong form (security prices fully reflect all publicly available information) and strong form (security prices fully reflect all publicly and privately available information).

Six factors that result in improved informational market efficiency are: (1) larger asset values, (2) higher frequency of trades, (3) little or no trading frictions, (4) low levels of regulatory constraints, (5) easier access to quality information, and (6) lower levels of uncertainty about asset valuation.

LO 6.2

Ex ante asset pricing models describe "before-the-fact" expected future returns. Ex post asset pricing models describe "after-the-fact" historical returns.

The ex ante form of the capital asset pricing model (CAPM) is an equilibrium model that derives the expected return on a stock given the expected return on the market portfolio, the stock's beta coefficient, and the risk-free rate: $E(R_i) = R_f + \beta_i[E(R_m) - R_f]$.

The ex post CAPM focuses on realized returns: $R_{i,t} - R_f = \beta_i(R_{m,t} - R_f) + \varepsilon_{i,t}$.

The CAPM implies that the expected return on any asset is solely determined by its systematic risk (beta) and that no additional expected return will be earned by bearing non-systematic or idiosyncratic risk. The CAPM also implies that all investors should use a two-fund strategy of investing a portion in the risk-free fund and the remainder in a well-diversified risky fund.

Asset pricing models can be used to separate risks and returns into diversifiable (idiosyncratic) and non-diversifiable (systematic) components and to quantify the compensation expected to be received for risk.

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LO 6.3

Multifactor asset pricing models describe the relationship between expected returns for an asset and its exposures to multiple risk factors:

$$E(R_i) - R_f = \beta_{i,1}[E(R_1) - R_f] + \beta_{i,2}[E(R_2) - R_f] + \ldots + \beta_{i,K}[E(R_K) - R_f].$$

Theoretical models are based on assumptions and logic that presumably captures underlying behavior. In contrast, empirical models are based on historically observed behavior. The main weakness with empirically derived multifactor models is that the factors may have been identified from spurious correlations (correlations between factors that are purely coincidental).

The steps to derive an empirical multifactor model are:

1. Derive excess returns for the security (the dependent variable of the ex post regression).
2. Identify a set of potential factors.
3. Perform tests of significance to identify the important "priced" factors.

Assuming the factors are tradable assets (i.e., rates of return can be observed), the intercept of the ex post multifactor model reflects the abnormal performance of the security.

The Fama-French three-factor model is an empirical multifactor model which states that $E(R_i) - R_f = \beta_1(R_m - R_f) + \beta_2 E(SMB) + \beta_3 E(HML)$, where $R_m - R_f$ is the excess return, SMB is the size factor equal to the difference in returns between small and big firms ($R_s - R_b$), and HML is the book-to-market factor equal to the difference in returns between high and low book-to-market firms ($R_h - R_l$).

The Fama-French-Carhart four-factor model states that $E(R_i) - R_f = \beta_1(R_m - R_f) + \beta_2 E(SMB) + \beta_3 E(HML) + \beta_4 E(UMD)$, where UMD (or the momentum factor) equals the difference in returns between stocks that were up the most and those that were down the most during the prior year.

Factors should be selected based on solid theoretical rationale or based on rigorous statistical testing. Three caveats are in order when deriving factors. First, we should not indiscriminately test a multitude of factors. Second, we should avoid identifying factors based on spurious correlation. Third, the CAPM does not work well for alternative assets, which could have large idiosyncratic risks that are not easily diversified away.

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LO 6.4

Arbitrage-free models are pricing model that assumes arbitrage opportunities are short-lived or nonexistent. According to the simplest arbitrage-free models, futures price curves are only an expression of current variables.

In the simplest forward pricing model:

$$F(T) = S \text{ for all maturities, } T$$

Cost of carry is a measure of the financial difference between holding a position in the spot market and holding a position in the forward market. Any difference between the spot and forward price is due to the cost of carry, which causes the term structure of forward prices to have a slope or curve. The cost of carry relationship is as follows:

$$F(T) = S + \text{carrying costs}$$

Financial forwards include futures contracts on stock indices, U.S. Treasury bond futures, and Eurodollar CD futures. The pricing relationship for financial forwards is as follows:

$$F(T) = S \times e^{(r-d) \times T}$$

A binomial tree model shows the possible values an option can take at each given time period, and reflects the uncertainty in outcome by modeling an upward and downward movement at each state.

LO 6.5

Two factors that differentiate most forward and spot trades are interest costs and dividend yields. Commodities are driven by three additional factors: (1) forecasts for changes in supply and demand, (2) storage costs, and (3) convenience yield.

There are four cost-of-carry model scenarios for financial securities.

1. In a simple scenario with no interest costs and no dividends, there are no differences in forward prices and all forward prices equal the spot price. This results in a flat term structure of forwards.

2. The interest rate equals the dividends rate, but both are positive. This also results in a flat term structure of forwards.

3. The interest rate exceeds the dividend rate. When that happens, the no-arbitrage forward price must exceed the spot price and the term structure of forward prices is upward sloping.

4. The dividend rate exceeds the interest rate, and the no-arbitrage forward price is lower than the spot price. The term structure of forward prices is downward sloping.

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LO 6.6

Option payoff diagrams show option payoffs at maturity, with the price on the horizontal axis and profits on the vertical axis.

- A covered call strategy combines being long the underlying security and being short a call option on the security. It has limited upside and limited downside.
- A protective put strategy combines being long the underlying security and being long a put option on the security, and has unlimited upside and limited downside.

An option spread involves (1) either calls or puts and (2) both long and short positions on the underlying security.

- A bull spread combines a long position in a lower strike price option and a short position in a higher strike price option.
- A bear spread combines a long position in in a higher strike price option and a short position in a lower strike price option.

Option combinations involve both calls and puts on the underlying security.

- An option straddle is a position in a call and a put (either both long or both short) on the same underlying security, same expiration date, and same strike price.
- An option strangle is a position in a call and a put (either both long or both short) on the same underlying security and expiration date, but with different strike prices.
- A risk reversal consists of a long out-of-the-money call combined with a short out-of-the-money put on the same asset and with the same expiration.
- A collar includes a long position in the underlying security, which is combined with a long put option and a short call option.

Put-call parity is a no-arbitrage relationship between two sets of positions with identical payoffs: (1) a long underlying asset and (2) a long call, short put, and long risk-free bond.

call + risk-free bond – put = underlying asset

LO 6.7

The four option pricing models are as follows:

1. The basic option pricing model values an option on a portfolio that contains both long and short positions. The option gives the option holder the right to either purchase the entire portfolio or walk away and let the option expire.

   $$P_o = P_l N(d) - P_s N(d - v)$$

2. The Black-Scholes call option formula values a call option as a function of the price of the underlying security, the option strike price, the volatility of security returns, the option's time to expiration, and the risk-free rate:

   $$c = SN(d_1) - e^{-rT}KN(d_2)$$

   A variation of this formula is the well-known Black-Scholes put option formula.

3. The Black forward option pricing model replaces the underlying security in the Black-Scholes call option formula with the forward contract.

   $$c = e^{-rT}[FN(d_1) - KN(d_2)]$$

4. In the currency option pricing model, there are two risk-free interest rates that correspond to the two currencies that are exchanged. In other words, the model prices an option that gives the right to exchange S^* units of one currency with its associated r^* risk-free interest rate, for S units of another currency at r risk-free interest rate:

   $$\text{option price} = e^{-r^*T}S^*N(d_1) - e^{-rT}SN(d_2)$$

Topic 2.6

LO 6.8

"Option Greeks" measure option sensitivities to four underlying factors: the underlying security, the return volatility of the asset, time to expiration, and the risk-free interest rate.

The most widely used sensitivities are delta, vega, theta, rho, and gamma.

- Delta measures the sensitivity of the option price to changes in the price of the underlying security.
- Vega measures the sensitivity of the option price to changes in the price volatility of the underlying security.
- Theta measures the sensitivity of the option price to changes in time to expiration.
- Rho measures the sensitivity of the option price to changes in the risk-free rate.
- Gamma measures the rate of change in delta relative to changes in the price of the underlying security.

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Concept Checkers

1. An analyst determines that investors cannot earn superior returns in a particular commodities market using fundamental analysis. The analyst's *best* conclusion about the market is that it may be:
   A. weak form efficient.
   B. weak form and semistrong form efficient.
   C. weak form, semistrong form, and strong form efficient.
   D. strong form efficient, but not weak form or semistrong form efficient.

2. A common theme shared by different asset pricing models is that investors should:
   A. find risk by itself to be desirable.
   B. expect to be paid for taking on idiosyncratic risk.
   C. expect to be paid for taking on diversifiable risk.
   D. expect to be paid for taking on systematic risk.

3. In the Fama-French three-factor asset pricing model, the book-to-market (B/M) factor equals the:
   A. B/M ratio for big firms minus the B/M ratio for small firms.
   B. stock return on low B/M firms minus the stock return on high B/M firms.
   C. B/M ratio for small firms minus the B/M ratio for big firms.
   D. stock return on high B/M firms minus the stock return on low B/M firms.

4. A stock index is at 978, the continuous dividend yield is 1.5%, and the continuous risk-free rate is 3.5%. The fair value for a 3-month futures contract on the index is *closest* to:
   A. $983.
   B. $987.
   C. $990.
   D. $997.

5. An option strategy that combines a long put option with a higher strike price and short put option with a lower strike price is a:
   A. bull spread.
   B. straddle.
   C. bear spread.
   D. covered put.

6. An options trader determines that for each $1 move in the price of a security, a call option on the security moves by $0.40. The sensitivity measure that *best* describes this relationship is:
   A. gamma.
   B. theta.
   C. delta.
   D. vega.

CONCEPT CHECKER ANSWERS

1. **B** Since the information set in the three forms of efficiency is cumulative, if fundamental analysis is not useful, the market is both weak form and semistrong form efficient as the semistrong form includes weak form. However, there is not enough information to determine if the market is strong form efficient. (LO 6.1)

2. **D** A basic tenet of asset pricing models is that investors should expect compensation for non-diversifiable (systematic) risk but not for diversifiable (idiosyncratic) risk. (LO 6.2)

3. **D** The Fama-French three-factor model is an empirical multifactor model: $E(R_i) - R_f = \beta_1(R_m - R_f) + \beta_2 E(SMB) + \beta_3 E(HML)$, where SMB is the size factor equal to the difference in returns between small and big firms ($R_s - R_b$), and HML is the book-to-market factor equal to the difference in returns between high and low book-to-market firms ($R_h - R_l$). (LO 6.3)

4. **A** Futures price = $\$978e^{(0.035 - 0.015) \times (0.25)} = \$982.90$ (LO 6.4)

5. **C** An option strategy that combines a long put option with a higher strike price and a short put option with a lower strike price is a *bear spread*. The investor can benefit from the price decline of the underlying security starting at the higher strike price put, but bound by the lower strike price put.

   A *bull spread* is a long position in a lower strike price option and a short position in a higher strike price option. A *straddle* is a long (or short) position in both a call and a put on the same underlying security, same expiration date and same strike prices. A *covered call* combines a long position in the underlying security with a short call option on the same security (typically at a strike price above the market price). (LO 6.6)

6. **C** The price sensitivity is *delta*, which measures the sensitivity of the option price to changes in the price of the underlying security. *Gamma* measures the rate of change in delta to changes in the price of the underlying security. *Vega* measures the sensitivity of the option price to changes in the price volatility of the underlying security. *Theta* measures the sensitivity of the option price to changes in time to expiration. (LO 6.8)

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The following is a review of the Alternative Investment principles designed to address the learning objectives set forth by the CAIA Association®.

Benchmarking and Performance Attribution

Topic 2.7

Exam Focus

Investments are routinely evaluated against benchmarks such as peer benchmarks or passive index benchmarks, or by using single-factor or multifactor asset pricing models. For the exam, be knowledgeable of benchmarking and its role in the analysis of the risk and return of investments. You will want to be able to recognize and understand various types of asset pricing models. Finally, become familiar with the limitations of the CAPM approach for analysis of alternative investments.

Benchmarking

LO 7.1: Demonstrate knowledge of benchmarking and its role in the analysis of risk and return of investments.

For example:

- **Define benchmarking in the context of investing.**
- **Recognize various types of benchmarks (i.e., peer returns and index returns).**
- **Apply the concept of benchmarking.**
- **Discuss considerations in benchmarking (appropriateness of the benchmark selected, statistical significance of performance differences relative to a benchmark, reasons behind performance differences relative to a benchmark).**

Benchmarking is the process of identifying the appropriate comparison against which a portfolio's performance is evaluated. For any fund, the appropriate benchmark is one that matches the fund's objectives and constraints and is often selected by an external investor or analyst.

The incremental performance of the fund manager equals the difference between the fund return and the benchmark return. Tracking error measures the departure of the fund performance from the benchmark over time and equals the standard deviation of the differences in returns between the fund and the benchmark. For instance, a fund manager might be expected to earn a return in excess of the benchmark, while minimizing tracking error.

Benchmarks might be formed based on peer groups or on indices. A **peer group** typically is a group of comparison funds with objectives and constraints that are similar to the fund under examination. The incremental performance of the fund manager equals the difference between the fund return and the average (or median) peer group return. A **peer group benchmark** is an active benchmark because the peer group consists of active money managers.

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Many indices exist, but most are value-weighted averages of the index components. The MSCI World Index and Russell 2000 are popular equity benchmarks. In contrast to peer group benchmarks, indices are passive benchmarks.

Example: An application of benchmarking

The New Millennium Fund earned an average monthly return of 1% over the past five years with a monthly standard deviation equal to 5%. The Russell 2000 earned a monthly average return of 0.8% with a standard deviation of 6% over the same period. Did the New Millennium Fund outperform its benchmark (i.e., the Russell 2000)?

Answer:

Yes, because the fund's monthly return was better than the benchmark's return, and its risk was less than the benchmark's risk.

Unfortunately, performance analysis using benchmark comparisons can be complicated. We must be careful to ensure that the drivers of the benchmark returns match those of the fund. Also, we must determine if the differences in return between the investment and its benchmark are statistically and economically significant, and whether that incremental performance was attributable to skill or luck.

Asset Pricing Models

LO 7.2: Demonstrate knowledge of various types of asset pricing models.

For example:

- **Define normative and positive models, and compare their key characteristics.**
- **Define theoretical and empirical models, and compare their key characteristics.**
- **Define applied and abstract models, and compare their key characteristics.**
- **Describe the advantages and disadvantages of various types of models in the context of alternative investments.**
- **Define cross-sectional and time-series approaches, and compare their key characteristics.**

As discussed in the previous topic, asset pricing models describe relationships between risk and expected return. These models can be distinguished based on three criteria: normative versus positive, theoretical versus empirical, and applied versus abstract.

A **normative model** is one that attempts to explain how investors *should* behave. An example of normative model is Markowitz's modern portfolio theory, which predicts how rational utility maximizing investors should behave. In contrast, a **positive model** is one that attempts to explain how investors *do* behave. An example of a positive model is a behavioral model that explains how investors' actions are affected by psychological biases that often lead to suboptimal behavior.

Theoretical models use assumptions and logic that presumably capture underlying investment behavior. For instance, a model might be developed assuming that investors maximize utility based on the mean and variance of investment outcomes in a world with no trading barriers. In contrast, **empirical models** are based on historically observed

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behavior. For example, we might estimate the relationship between residential real estate prices and various determinants of real estate transaction prices using historical data. Empirical models are more appropriate for alternative investments, which are characterized by many frictions such as illiquidity, non-normality, and time-varying risks.

Applied models are pragmatic in nature and are designed to address real-world problems, such as how to achieve efficient diversification. Most asset pricing models are applied models. In contrast, **abstract models** (or *basic models*) are theoretical models designed to describe behavior under hypothetical, unrealistic conditions (e.g., a simplified economy in which there is just one consumer or producer who acts to maximize utility while also maximizing profits). Alternative investments are best addressed using applied models.

Cross-sectional models describe differences across subjects for a single point in time. For example, a cross-sectional model would be used to explain why profits differed across 50 oil drilling projects last year. In contrast, **time-series models** describe differences across time for a single subject. For example, a time-series model would be used to explain why the profits of one oil drilling project changed over the past five years. A third type of model, a **panel data set**, makes use of data that spans both cross-sectional and time-series data. For example, a panel data set might comprise annual profits for 50 oil drilling projects over the most recent five years—a total of 250 observations.

When applied to asset returns, time-series asset pricing models are used to identify the sources of return differentials over time for an individual asset and aid in the identification of risk-adjusted benchmarks. In contrast, cross-sectional asset pricing models are used to identify the sources of return differentials across assets for a single point in time and aid in the identification of peer groups.

In the following sections, more detail is provided on the how to interpret time-series and cross-sectional returns based on single-factor and multifactor asset pricing models.

Performance Attribution

LO 7.3: Demonstrate knowledge of various approaches to performance attribution.

For example:

- **Describe the characteristics of single-factor models.**
- **Apply single-factor models to benchmarking.**
- **Interpret the results of single-factor benchmarking analysis.**
- **Discuss multifactor benchmarking.**

Return attribution (or **performance attribution**) is the process of ascribing returns to the various contributors to an asset's performance. For example, consider an actively managed fund with a 12% return last year that is benchmarked against an index that earned 10% over the same period. The **active return** equals the difference between the fund's return and its benchmark, which in this example equals 12% – 10% = 2%. The fund's return can be attributed to two components: the systematic return and the idiosyncratic return. In this example, 10% of the fund's 12% return is attributable to the systematic component and 2% is attributable to the idiosyncratic component of the fund. The idiosyncratic component return is the active return.

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Benchmarking Analysis Using Single-factor Models

The CAPM is an example of a single-factor asset pricing model. Other single-factor asset pricing models exist that are empirically derived. The derivation of the ex ante CAPM is based on formal theory (i.e., based on assumptions of normally distributed returns and of rational investor behavior). In contrast, empirically derived single-factor models rely on observed correlations across assets: a single factor is derived that explains the cross-correlations. When an empirically observed market index (e.g., S&P 500 or MSCI World) is used as a proxy for the market (i.e., factor *m*), the ex post CAPM equation is often referred to as the single-factor market model, or simply the "market model." The key distinction is that the CAPM is derived based on formal theory, while other single-factor models are derived based on empirical observation. Compared to the CAPM, other single-factor models offer the advantage of allowing for an intercept that can account for non-normal returns.

Because the active return equals the deviation of the realized return from the ex post CAPM expected return, the ex post CAPM equation is useful as a performance attribution tool.

Example: Performance attribution using the ex post CAPM

The Albey Rhodes Fund (ARF) earned a 15% return last year, while the market portfolio earned 10%. The risk-free rate is 3% and the long-term expected annual return on the market portfolio is 8%. The beta for ARF equals 2. **Conduct** a performance attribution for ARF.

Answer:

The expected return for ARF using the *ex ante* CAPM is:

$$R_f + \beta[E(R_{m,t}) - R_f] = 0.03 + 2(0.08 - 0.03) = 0.13 = 13\%$$

Therefore, ARF beat its *ex ante* expectation by 2 percentage points (15% versus 13%). However, we cannot conclude only from this that ARF produced a positive active return. The market portfolio return last year was better than expected, and this better-than-expected market portfolio return should have aided ARF greatly because the ARF fund's beta is high.

To calculate the active return, we must use the *ex post* CAPM, which produces the appropriate ex post benchmark return:

$$\varepsilon_{Albey,t} = R_{Albey,t} - R_f - \beta(R_{m,t} - R_f)$$

$$\varepsilon_{Albey,t} = 0.15 - 0.03 - 2(0.10 - 0.03) = -0.03 = -2\%$$

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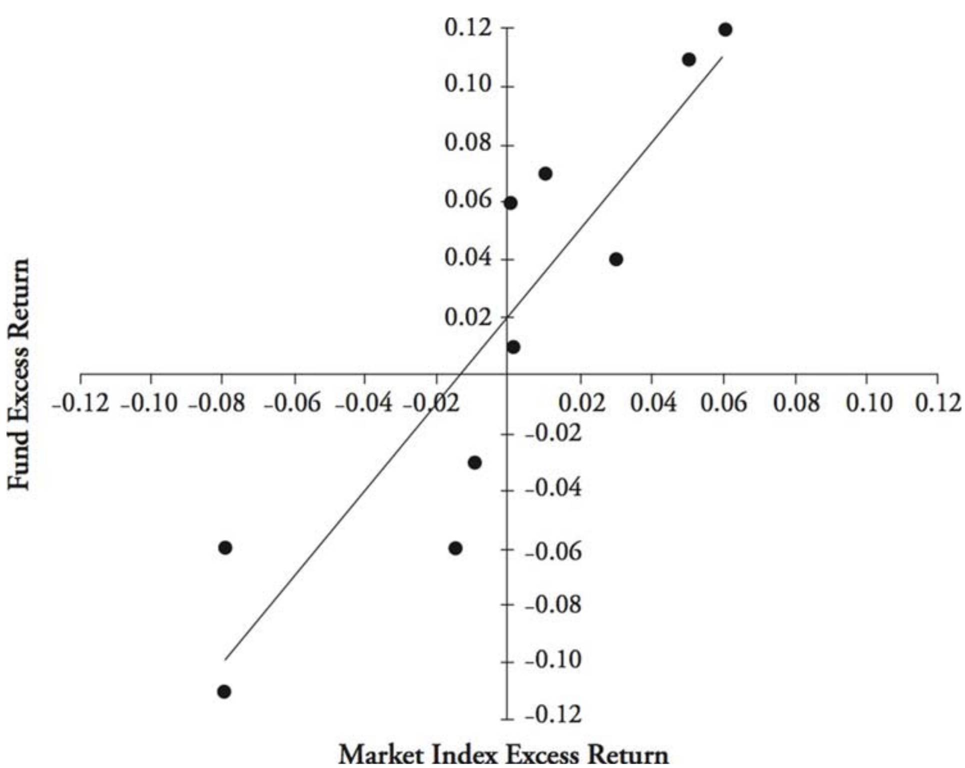
Therefore, the initial impression based on ARF outperforming its ex ante expected return was misleading, because the fund's return last year was presumably aided by the better-than-expected market portfolio performance. ARF's excess return equaled 12% (equal to last year's fund return minus the risk-free rate). The attribution for the ARF's excess return is as follows:

- Systematic component = 14%
- Idiosyncratic component = –2%

To summarize, once we adjust for last year's realized performance for the market portfolio, the idiosyncratic return for ARF is –2%.

The following figure illustrates a time-series ex post CAPM regression, $R_{i,t} - R_f = a + B(R_{m,t} - R_f) + e_{i,t}$, where *a*, *B*, and *e* are the regression estimates of the true intercept, slope, and error. If *m* is proxied by an observable index, such as the MSCI World, then the regression is known as a ***market model regression.***

Figure 1: Benchmarking with an Ex Post Time-Series CAPM Regression



In Figure 1, the beta estimate equals 1.5, and the alpha estimate equals 0.02. The beta indicates that, on average, the fund excess return changes by 1.5 units for every 1-unit change in the market index excess return.

Furthermore, the 2% alpha estimate indicates that, on average, the fund's excess return exceeded the ex post CAPM expected excess return by 200 basis points. This is an example of how to benchmark with the ex post CAPM using the market model style approach.

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Professor's Note: In any linear regression, $Y = \alpha + \beta X + \varepsilon$, the estimate of the intercept equals: $a = \bar{Y} - b\bar{X}$, where a is the α estimate and b is the β estimate. Therefore, in the time-series regression for the ex post CAPM, the intercept equals the asset's average excess return minus the beta multiplied by the market's average excess return. According to the CAPM, the asset's excess return should equal beta multiplied by the market's excess return. Therefore, the alpha estimate should be zero, or, at least, statistically close to zero.

If the assumptions underlying the CAPM are valid, then empirical tests of the time-series CAPM-based regression should indicate that:

- The intercept estimate is not significantly different from zero, indicating that the excess return for the asset equals the expected return described by the CAPM.
- The beta estimate equals the true beta of the asset.
- The estimates of ε (called "residuals") reflect the effects of non-market (idiosyncratic) risks.

Performance Attribution Using Multifactor Benchmarking

In the previous topic, we examined how multifactor return models describe the relationship between expected returns of assets and those assets' exposures to various risk factors. As a reminder, the equation for a general K-factor ex ante return model is:

$$E(R_i) - R_f = \beta_{i,1}\,[E(R_1) - R_f] + \beta_{i,2}\,[E(R_2) - R_f] + \beta_{i,K}\,[E(R_K) - R_f]$$

where:
$E(R_1)$ through $E(R_K)$ = expected returns on the K risk factors
$\beta_{i,1}$ through $\beta_{i,K}$ = sensitivities of the asset return to changes in the risk factor

The ex post version of the multifactor model is:

$$R_{i,t} - R_f = \beta_{i,1}\,(R_{1,t} - R_f) + \beta_{i,2}\,(R_{2,t} - R_f) + \ldots + \beta_{i,K}\,(R_{K,t} - R_f) + \varepsilon_{i,t}$$

The Fama-French and Fama-French-Carhart multifactor models can be used to benchmark fund performance. For instance, a time-series regression can be run using the ex post four-factor asset pricing model:

$$R_t - R_f = \alpha + \beta_1(R_{m,t} - R_f) + \beta_2\,SMB_t + \beta_3\,HML_t + \beta_4\,UMD_t + \varepsilon_t$$

where:
SMB = "small minus big"; size factor equal to the difference in returns between portfolios of small (small-cap) and big (large-cap) firms ($R_s - R_b$)
HML = "high minus low"; book-to-market factor equal to the difference in returns between portfolios of high and low book-to-market firms ($R_h - R_l$)
UMD = "up minus down"; difference in returns between stocks that were up the most and those that were down the most during the prior year

The intercept reflects the abnormal performance of the security after controlling for the fund's exposures to the market, firm size, value (book-to-market), and momentum factors.

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Example: Benchmarking with the Fama-French-Carhart model

The following table reports factor sensitivities for King Investments using the Fama-French-Carhart four-factor asset pricing model. Historical factor premiums also are provided. The historical average annual excess return for King Investments, $R_{King} - R_f$, was 10%.

	Factor Sensitivities	*Factor Premiums*
$R_m - R_f$	1.25	0.05
SMB	0.20	0.01
HML	0.50	0.04
UMD	0.25	0.04

Therefore, the expected excess return for King Investments was:

$$1.25(0.05) + 0.20(0.01) + 0.50(0.04) + 0.25(0.04) = 0.0945 = 9.45\%$$

The above result implies that King Investments outperformed its four-factor benchmark by 55 basis points (e.g., 0.10 – 0.0945 = 0.0055), which, equivalently implies that the historical alpha was 0.55%.

Alternative Asset Benchmarking

LO 7.4: Demonstrate knowledge of the limitations of the CAPM approach for analysis of alternative investments.

For example:

- **Recognize and describe multiperiod issues in CAPM analysis.**
- **Recognize and describe the limitations of CAPM analysis when applied to non-normal return distributions in alternative investments.**
- **Describe the potential effect of illiquidity on returns of alternative investments.**

While the CAPM is a useful tool, its application to alternative investments is limited due to three primary reasons: multiperiod non-stationarity, non-normality of returns distributions, and investment illiquidity.

The CAPM is a single-period equilibrium model. In order for the CAPM to be applicable to multiple time periods, the distribution of returns must be stationary. Alternative investment returns are non-stationary, implying that means, variances, and/or correlations are not constant over time. Therefore, the single-factor CAPM may need to be modified in a multiperiod framework.

The shape of return distributions is another concern. The CAPM assumes that returns are *normally* distributed and so implies that investors are only concerned about two parameters of a distribution: mean and variance. However, the returns for many alternative investments are non-normal, and the non-normal elements of an investment's return, such as skewness and kurtosis, are likely to impact investors' decisions. Therefore, models that account for exposures of investments to higher moments of the return distribution should be used.

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The CAPM also assumes that all assets are liquid, implying that they trade with no restrictions. However, in actual practice, asset illiquidity can restrict a manager's ability to manage the portfolio effectively. Many alternative investments suffer from high illiquidity. It is reasonable for investors to demand compensation for such illiquidity. In such cases, asset pricing models should be used that include a liquidity risk premium, such that the expected return is higher for investments with low liquidity.

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Key Concepts

LO 7.1

Benchmarking is the process of identifying the appropriate index against which a portfolio's performance is evaluated. For any fund, the appropriate benchmark is one that matches the fund's objectives and constraints. A benchmark is often selected by an external investor or analyst.

Benchmarks might be formed based on peer groups or on indices. A peer group is a group of funds with objectives and constraints that are similar to the fund under examination. Many indices exist, but most are value-weighted averages of the index components. The MSCI World Index and Russell 2000 are two popular equity benchmarks.

LO 7.2

Asset pricing models describe relationships between risk and expected return, produce expected returns that are used to determine asset intrinsic values, describe the variability of returns, and separate risks into diversifiable and non-diversifiable sources.

A normative model is one that attempts to explain how investors should behave. In contrast, a positive model is one that attempts to explain how investors actually do behave.

Theoretical models are based on assumptions and logic that presumably captures underlying behavior. In contrast, empirical models are based on historically observed behavior.

Applied models are pragmatic in nature and are designed to address real-world problems, such as how to achieve efficient diversification. In contrast, abstract models are theoretical models designed to describe behavior under hypothetical, often unrealistic, circumstances. Alternative investments are best addressed with applied models, because they are designed to address real-world problems.

Cross-sectional asset pricing models are used to identify key sources of return differentials across assets and aid in the identification of peer groups. In contrast, time-series asset pricing models are used to identify key sources of return differentials over time for an individual asset or portfolio and aid in the measurement of performance relative to risk-adjusted benchmarks. Panel data sets refer to data spanning multiple time periods and multiple assets (a combination of cross-sectional and time-series data).

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LO 7.3

Return attribution is the process of ascribing returns to different components of the asset's performance. The active return equals the difference between the managed fund's return and its benchmark.

Using the ex post CAPM equation (a single-factor model), the active return equals the deviation of the realized return from the ex post CAPM expected return, which equals the intercept of the regression of excess returns for the investment against the excess returns for the market.

The Fama-French and Fama-French-Carhart multifactor models can be used to benchmark fund performance. The fund's incremental performance equals the difference between the historical excess return earned by the fund versus the return generated by the ex post model.

LO 7.4

The CAPM fails to account for common alternative investment characteristics such as multiperiod non-stationarity, non-normality of returns distributions, and investment illiquidity.

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Concept Checkers

1. A commodity trader advisor, Burk Williams, is being evaluated. Which of the following peer group benchmarks is *most appropriate* to use to evaluate the performance of Williams?
   A. The average return earned by the universe of commodity traders.
   B. The return earned on a mechanical commodity trading strategy.
   C. The return earned on a value-weighted index of commodities.
   D. The return on gold futures.

2. A behavioral model that predicts how investors' actions are affected by psychological biases that often lead to suboptimal behavior is *best* described as a(n):
   A. normative model.
   B. positive model.
   C. negative model.
   D. ex post model.

3. An analyst wanting to evaluate the historical risk-adjusted performance of a hedge fund manager should use a:
   A. time-series, ex post asset pricing model.
   B. time-series, ex ante asset pricing model.
   C. cross-sectional, ex post asset pricing model.
   D. cross-sectional, ex ante asset pricing model.

4. An asset earned 10% last year. Its beta equals 1.25. The risk-free rate was 2% and the market return was 8%. Using the ex post CAPM, the asset's idiosyncratic return for the last year was *closest* to:
   A. 0.0%.
   B. 0.5%.
   C. 2.0%.
   D. 4.0%.

5. Alternative investments with high levels of illiquidity should earn:
   A. lower returns than the return predicted by the CAPM.
   B. returns equal to the return predicted by the CAPM.
   C. returns equal to the return predicted by the Fama-French-Carhart model.
   D. higher returns than the return predicted by the CAPM.

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Concept Checkers Answers

1. **A** The universe of commodity traders constitutes a peer group for a commodity trader because the universe of commodity traders is a comparison group with similar risk and return objectives as the commodity trader. (LO 7.1)

2. **B** A positive model is one that attempts to explain how investors *do* behave. In contrast, a normative model explains how investors *should* behave. Positive models allow for irrationalities. (LO 7.2)

3. **A** A time-series model should be used to evaluate the performance of any investment. To evaluate historical performance, an ex post model should be used. (LO 7.2)

4. **B** Using the ex post CAPM, the required return for the asset last year was:

   $R_f + \beta(R_m - R_f) = 0.02 + 1.25(0.08 - 0.02) = 0.095 = 9.5\%$

   The idiosyncratic return equals:

   $\varepsilon_t = R_t - [R_f + \beta\,(R_m - R_f)] = 0.10 - 0.095 = 0.005 = 0.5\%$

   (LO 7.3)

5. **D** The CAPM assumes that all investments are liquid. Therefore, the expected return in the CAPM may be appropriate for investments with no liquidity risk, but it is not appropriate for investments with high liquidity risk. It is reasonable to assume that investors will demand compensation for illiquidity. Therefore, investments with high liquidity risk should earn higher returns than the return predicted by the CAPM. (LO 7.4)

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The following is a review of the Alternative Investment principles designed to address the learning objectives set forth by the CAIA Association®.

Alpha, Beta, and Hypothesis Testing

Topic 2.8

Exam Focus

Performance evaluation is a key component of the portfolio management process. Traditional performance measures are strongly influenced by the single-factor capital asset pricing model or multifactor asset pricing models. For the exam, be able to explain the drivers of beta and alpha for alternative investments and how to infer ex ante alphas from ex post alphas. Understand why and how return attribution is accomplished. Know how return model misspecifications such as omitted factors, misestimated betas, nonlinear risk-return relationships, and nonstationary betas affect the results. Also, understand how alphas and betas can become commingled. Be able to distinguish systematic versus idiosyncratic components and skill versus luck when analyzing investment returns. Understand the basics and terminology of hypothesis testing, including the steps of hypothesis testing, demonstrate knowledge of sampling and testing problems, and know the fallacies of alpha and beta estimation.

Alpha and Beta

LO 8.1: Demonstrate knowledge of beta and alpha.

For example:

- **Recognize the role of beta in the analysis of traditional and alternative investments.**
- **Recognize the role of alpha in the analysis of traditional and alternative investments.**

Beta is a measure of an asset's systematic risk. Although total risk is classified into idiosyncratic (firm-specific) and systematic (market) components, a well-diversified portfolio's risk will consist of only the systematic risks of the individual assets in the portfolio.

The capital asset pricing model (CAPM) beta for an asset equals the covariance of returns between the asset and the market portfolio, divided by the variance of market portfolio returns. The beta can be estimated from a regression of the asset's excess returns (i.e., $R_i - R_f$) against the market portfolio's excess returns (i.e., $R_m - R_f$). The slope coefficient of the regression is the estimate of the asset's beta. An asset with a beta above one has higher-than-average systematic risk. For example, if Fund A has a beta of 0.75 and Fund B has a beta of 1.75, then Fund B faces greater systematic risk and will have a greater risk premium.

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Beta is useful in traditional and alternative investment analysis in the following ways:

- Beta measures systematic risk. An asset's or portfolio's expected return must be commensurate with its systematic risk. An investor seeking a higher expected return will seek portfolios with higher betas. Thus, beta is an important factor in asset valuation.
- In multifactor models, the betas measure exposures to separate sources of systematic risk (e.g., such as illiquidity of the asset). Thus, the knowledge of multiple betas helps investors understand the asset's exposures to different sources of systematic risk.

Alpha is the incremental return earned by an asset relative to a risk-adjusted benchmark. It is the extra return after compensating for the time value of money and systematic risk.

Alpha is useful in the following ways:

- Alpha can be used to determine if assets are underpriced or overpriced. The presence of a positive alpha suggests that a security is underpriced and cheap. Thus, alpha is useful in security selection.
- Alpha can be used to measure the skill of the investor. The presence of a positive alpha may indicate superior performance of the fund relative to the risk-adjusted benchmark.

Ex Ante vs. Ex Post Alpha

LO 8.2: Demonstrate knowledge of the concepts of ex ante and ex post alpha.

For example:

- **Define and apply the concept of ex ante alpha, and identify its key characteristics.**
- **Define and apply the concept of ex post alpha, and identify its key characteristics.**
- **Distinguish between ex ante and ex post alpha.**

The **ex ante alpha** is the anticipated incremental return on an investment after adjusting for time value of money and systematic risk effects. The ex ante alpha often is indicative of the managerial skill of a manager, not a mere result of luck. We can rearrange the single-factor market model to solve for ex ante alpha as seen below:

$$E(R_i) - R_f = \alpha_i + \beta_i[E(R_m) - R_f]$$

$$\alpha_i = E(R_i) - \{R_f + \beta_i[E(R_m) - R_f]\}$$

where:
α_i = ex ante alpha
$E(R_i)$ = expected return on asset *i*
$E(R_m)$ = expected return on the market portfolio
R_f = risk-free rate
β_i = beta for asset *i*

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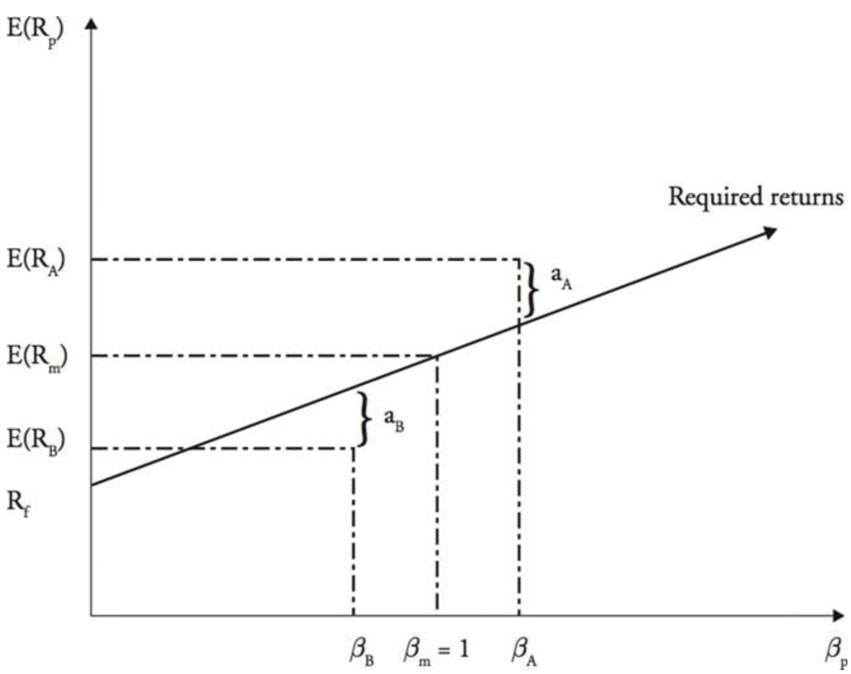
Professor's Note: The single-factor market model looks identical to the ex ante CAPM. The difference is that the CAPM makes some unrealistic assumptions leading to the conclusion that all investors should hold the market portfolio, and all asset returns equal their required returns. In other words, according to the CAPM assumptions, all alphas equal zero. The single-factor market model can be viewed as a version of the CAPM that relaxes some of its unrealistic assumptions so that nonzero alphas are possible. Using the single-factor market model, $R_f + \beta_i[E(R_m) - R_f]$ is referred to as the asset's "required return." Therefore, alpha is the difference between the asset's expected return and its required return.

For example, a skilled fund manager might seek to match the systematic risk of the S&P 500 but does so by purchasing undervalued securities. The beta for the fund will equal 1, and the ex ante alpha will be positive. Alternatively, consider another fund manager who simply attempts to index the fund (i.e., matches the systematic risk of the S&P 500) but does so at a high cost. The beta for the fund will equal 1, and the ex ante alpha will be negative.

The following figure illustrates ex ante alphas for two portfolios, A and B, relative to the graph of the single-factor market model. The expected return for Portfolio A exceeds its required return, and the expected return for Portfolio B is less than its required return. Therefore, the alpha is positive for Portfolio A and is negative for Portfolio B.

Figure 1: Ex Ante Alpha and Beta



In contrast, the **ex post alpha**, also called *idiosyncratic return*, is a measure of realized incremental returns, after adjusting for the time value of money and systematic risk effects. The ex post alpha measures how well a portfolio performed in comparison to its risk-adjusted benchmark over a specific period. While ex post alpha can be estimated accurately, further examination is necessary to determine if the alpha is due to skill or to luck.

For example, consider a fund that mimics the S&P 500 by randomly selecting 20 securities in the S&P 500, while constraining the fund to have a beta (relative to the S&P 500) equal to 1. Assume there was unexpectedly good news about two stocks held in the fund, so that last year's return on the fund was 11%, while the return on the S&P 500 was 10%. The fund generated a 100 basis point ex post alpha even though the ex ante alpha was zero. In this example, the ex post alpha was attributable to luck because the fund manager merely randomly selected 20 stocks to replicate the systematic risk of the S&P 500.

Therefore, there are two steps to performance evaluation:

Step 1: Calculate the ex post alpha after appropriately controlling for systematic risks.
Step 2: Determine the extent to which the ex post alpha was attributable to skill or luck.

In general, the ex post alpha, for period t, is the residual, ε_t, of the ex post single-factor market model (also known as the ex post CAPM):

$$R_i - R_f = \beta_i(R_m - R_f) + \varepsilon_i$$

Therefore, the ex post alpha can be stated as follows:

$$\text{ex post alpha} = \varepsilon_i = R_i - [R_f + \beta_i(R_m - R_f)]$$

Example: Calculating the ex post alpha

The beta of a fund equals 2. Last year, the broad market return was 10%. The risk-free rate is 4%. Last year, the return on the fund equaled 18%. **Calculate** the ex post alpha for the fund and **determine** if this is indicative of the fund manager's skill.

Answer:

$$\text{ex post alpha} = R_i - [R_f + \beta_i(R_m - R_f)]$$
$$\text{ex post alpha} = 0.18 - [0.04 + 2(0.10 - 0.04)] = 0.02 = 2\%$$

The 2% ex post alpha might be attributable to manager skill or to luck. If the manager truly has identified a superior strategy, then both the ex ante alpha and ex post alpha will be positive. If the manager merely produced the 2% incremental return by luck, then the ex ante alpha equals zero, even though the ex post alpha is positive.

The ex ante and ex post alpha can be distinguished as follows:

- Ex post alpha is observable, whereas ex ante alpha is not. The ex post alpha is based on observable realized returns, whereas the ex ante alpha is based on unobservable expected returns.
- Ex ante alpha reflects the skill of the manager, whereas ex post alpha can be attributable to luck, skill, or a mixture of the two.

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Determining Ex Ante Alpha

LO 8.3: Demonstrate knowledge of empirical approaches to inferring ex ante alpha from ex post alpha.

For example:
- **Identify the steps involved in estimating ex ante alpha from historical performance.**
- **Discuss challenges to empirical analysis of manager skill.**

The calculation of the ex ante alpha is a key focus of investing. A positive alpha investment is desirable and will be weighted more heavily in the portfolio. Unfortunately, the calculation of the ex ante alpha is difficult because expected returns are not observable, nor are they consistent across investors. Ex ante alpha differs across investors with different expected returns. Identifying ex ante alpha involves empirical analysis of a manager's investment procedures and style as well as historical data on past returns.

There are two steps when using empirical analysis to analyze the ex post alpha to estimate ex ante alpha:

Step 1: Identify the appropriate ex post asset pricing model or benchmark.
Step 2: Test the statistical properties of the ex post alpha to determine the extent to which the alpha is attributable to luck, skill, or a mixture of the two.

Step 1: Identifying the Appropriate Ex Post Model

In the first step, the identification of the correct asset pricing model or benchmark may be challenging, especially if the asset's systematic risks cannot be easily measured relative to benchmarks. If the wrong benchmark is used, then the wrong ex post alpha will be calculated.

A challenge encountered in the first step centers on the choice of asset pricing model. **Model misspecification** refers to the use of models that do not properly capture systematic and idiosyncratic risks. Model misspecification errors are associated with misidentification of variables in the model or in the functional form used to represent the relationships in the model. For example, our model might provide a benchmark return of 10%, when, in fact, the true required return for the fund is 12%. A fund with an 11% historical return will erroneously produce a 1% ex post alpha, when, in fact, the true ex post alpha was –1%. Different types of model misspecification are discussed later in this topic review.

Step 2: Tests of Skill vs. Luck

In this step, statistical tests are run to determine if the ex post alphas are significantly different from zero (e.g., *t*-tests of the hypothesis that the true ex post alpha equals zero versus the alternative that the true ex post alpha does not equal zero). Also, tests of consistency can be performed. If the ex post alpha is consistently positive, then the analyst can be more confident in the predictive ability of the ex post alpha.

A potentially confounding challenge to the empirical method for determining ex ante alphas is that we might incorrectly attribute high returns to skill. For example, a researcher might choose to examine the performance of the best-performing strategy out of 100 possible strategies and then calculate the probability that the winning strategy was attributable to skill. The inference drawn from this test is erroneous because the analyst focuses on just one of the 100 trading strategies. The good performance of the examined strategy may simply have been a random chance event.

Return Attribution

LO 8.4: Demonstrate knowledge of return attribution.

For example:

- **Calculate beta, ex ante, and ex post alpha.**
- **Recognize the three primary types of model misspecification (i.e., omitted systematic return factors, misestimated betas, and nonlinear risk-return relationships) and their effects on return attribution.**
- **Describe various types of beta nonstationarity (i.e., beta creep, beta expansion, and market timing) and their effects on return attribution.**
- **Discuss how alpha and beta can become commingled.**

The primary goal of return attribution analysis is to properly attribute returns to:

- Systematic risk (i.e., beta).
- Ex ante alpha (i.e., skill).
- Idiosyncratic risk (i.e., luck).

Return attribution analysis must calculate the fund's ex ante and ex post alphas, as well as determine the portion of the ex post alpha attributable to skill versus luck.

Example: Return attribution

The NewGen Fund has a beta of 0.80 and an expected return of 12%. The expected return on the market is 12%, and the risk-free rate of return is 3%. During the following year, the market earns 20% while the NewGen Fund earns 19%.

Calculate the ex ante alpha and ex post alpha for NewGen and **determine** the portions of the ex post alpha attributable to skill versus luck.

Answer:

To derive the ex ante alpha, we use the single-factor market model as follows:

$$E(R_{NG}) - R_f = \alpha_{NG} + \beta_{NG}[E(R_m) - R_f]$$

$$\alpha_{NG} = E(R_{NG}) - R_f - \beta_{NG}[E(R_m) - R_f]$$
$$\alpha_{NG} = 0.12 - 0.03 - 0.80(0.12 - 0.03) = 1.80\%$$

Therefore, similar risk investments require a 10.2% return, but the NewGen Fund is expected to produce a 12% return. The ex ante alpha is the difference between the expected return of 12% and the required return of 10.2%. The NewGen Fund is expected to produce a return 180 basis points higher than what is required based on its systematic risk.

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Next, we estimate the ex post alpha by applying the ex post version of the single-factor market model (also called the ex post CAPM):

$$R_{NG,t} - R_f = \beta_{NG}(R_{mt} - R_f) + \varepsilon_{NG,t}$$

$$\text{ex post alpha} = \varepsilon_{NG,t} = R_{NG,t} - R_f - \beta_{NG}(R_{mt} - R_f)$$
$$\text{ex post alpha} = 0.19 - 0.03 - 0.80(0.20 - 0.03) = 2.40\%$$

Therefore, the ex post alpha of the NewGen Fund is 2.40%, indicating that although NewGen underperformed the market (19% versus 20%), it performed 240 basis points better than its ex post required return.

Our final step is to attribute the ex post alpha to skill and luck as follows:

$$\text{ex post alpha } 2.40\% \begin{cases} \rightarrow \text{skill (ex ante alpha) } 1.80\% \\ \rightarrow \text{luck } 0.60\% = (2.40\% - 1.80\%) \end{cases}$$

Different Types of Model Misspecification

Errors in empirical return attribution analyses may arise from three different types of model misspecification: misestimated betas, nonlinear relationships, and omitted or misidentified factors.

Misestimated betas. If systematic risk (beta) of the return series is misestimated, then the return attribution also will be misestimated. For example, if we overestimate the beta, then we will underestimate the ex post alpha, and if we underestimate the beta, we will overestimate the ex post alpha.

Nonlinear relationships. If the asset pricing model assumes a linear relationship between risk and return whereas the true relationship is quadratic or exponential, then the estimate of systematic and idiosyncratic components of the asset's return will be biased. Alternative investments often have nonlinear risk-return relationships.

Omitted or misidentified factors. If any part of the investment return is attributed to omitted or misidentified factors, then it might be incorrectly attributed to either skill or luck. Using a misspecified model, the ex post alpha we estimate equals the true ex post alpha plus the effects of the omitted factors.

Beta Nonstationarity

Beta nonstationarity refers to the tendency for beta to shift over time. For instance, if the leverage of the asset changes over time, then the systematic risk of the asset also will change over time. Types of beta nonstationarity include the following:

- **Beta creep** refers to gradual increase in beta over time. Beta creep might occur as more funds compete for expected returns.

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- **Beta expansion** refers to increases in beta as market conditions change. Betas increase as the correlation of the fund's returns with the market's returns increase.
- **Market timing** refers to attempts of the fund manager to alter beta in anticipation of changes in market conditions. A skilled market timer will take a positive risk exposure in anticipation of upward movements in the broad market and will take a negative risk exposure in anticipation of downward market movements.

Nonstationarity of beta raises a key question regarding whether a fund's superior return is attributable to alpha or beta. If a constant beta model is used to calculate alphas, the superior return of a good market timer will appear to be alpha-driven, when, in reality, it is beta-driven. If a model is used that accounts for the shifting betas of a good market timer, the calculated alpha will move toward zero.

Model misspecification and estimation errors can be mitigated by evaluating portfolio performance over a **full market cycle**, which is a time period spanning multiple market conditions (bull and bear markets).

The Commingling of Alpha and Beta

Alpha and beta effects are difficult to disentangle. For instance, a private equity manager may correctly identify superior returns from specialized investments and may only be able to exploit the opportunities by bearing systematic risk. If hedging or derivatives are unavailable in the specialized market, the performance of the manager is likely to be associated with systematic risk relative to the sector. Arguments can be made that the superior returns constitute ex ante alpha attributable to the manager's skill at identifying the investment opportunities. Arguments also can be made that the superior returns are due to beta attributable to the fund's systematic risk exposure to the outperforming sector.

We might also extend the example to common stocks. Research indicates that returns on high book-to-market stocks exceed those of low book-to-market firms. Suppose an astute portfolio manager heavily exposes the portfolio to high book-to-market firms, earning a superior return for the portfolio. Is the return attributable to alpha or beta? The manager increased the book-to-market factor beta for the portfolio, which led to high returns. Therefore, an argument can be made that the superior return is attributable to beta. On the other hand, the manager was astute enough to identify a profitable investment strategy, consistent with a positive ex ante alpha.

In summary, attribution of performance to alpha and beta is imprecise. In most cases, performance is attributable to a commingling of alpha and beta.

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Performance Persistence

LO 8.5: Demonstrate knowledge of ex ante alpha estimation and return persistence.

For example:

- **Recognize the characteristics of return persistence.**
- **Define abnormal return persistence.**
- **Discuss attribution of idiosyncratic returns to luck or skill.**

The efficient market hypothesis implies that past performance cannot predict future performance. However, in reality, inefficiencies exist and abnormal security performance might be predictable based on historical data. The concept of abnormal return persistence is used to minimize potential errors when discerning ex ante alpha from ex post alpha.

Abnormal return persistence refers to the tendency for idiosyncratic performance to be positively correlated over time. As mentioned earlier, a major issue in estimating ex post alpha and inferring ex ante alpha is the separation of the estimated idiosyncratic return into skill and luck components. Return persistence analysis can help dislodge the skill and luck attributes.

Professor's Note: Correlation of returns in successive periods is called serial correlation. A high serial correlation implies highly predictable asset returns over time.

Assuming that an appropriate asset pricing model or benchmark has been used to attribute returns to systematic risks and idiosyncratic risks, we can attribute idiosyncratic returns to skill or luck using return persistence as follows:

Step 1: Calculate the ex post alpha for time period t.
Step 2: Calculate the ex post alpha for time period $t+1$.
Step 3: Test whether the ex post alphas are correlated.

The hypothesis of performance persistence is supported if the correlation is significantly positive. To the extent that the model used to derive alphas is properly specified, we can attribute most of the superior returns to skill if the correlation is significantly positive. Alternatively, if the correlation is low, then we can conclude that the investment results are attributable mostly to luck.

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Drivers of Alpha and Beta

LO 8.6: Demonstrate knowledge of return drivers.

For example:
- Discuss the classification of assets into beta drivers and alpha drivers.
- Discuss the characteristics of beta drivers and their behavior over time.
- Discuss passive beta drivers as pure plays on beta.
- Discuss the characteristics of alpha drivers.
- Discuss product innovators and process drivers.

Return drivers of a portfolio are investments, products, and strategies that generate the portfolio's risk and return. Usually, return drivers are divided into two classes: beta drivers and alpha drivers.

Beta Drivers

Beta drivers are exposures to market risk factors that compensate investors for bearing nondiversifiable market risk. In a CAPM model, beta drivers provide exposure to a single risk factor: the market risk factor. In a multifactor framework, beta drivers may provide exposure to more than one factor.

With regard to beta drivers, the excess return that the market provides above the risk-free rate is referred to as the **equity risk premium** (ERP). The tendency of the ERP to exceed its expected value based solely on risk aversion is known as the **equity risk premium puzzle**. Economists are puzzled that so many investors significantly underweight equities in their portfolios and overweight risk-free assets. Conceptually, while systematic risks (relative to single- or multiple-risk factors) should be rewarded with higher returns, the estimation of precise future risk premiums is difficult, and the high ERP of the past may not persist in the future.

Passive beta drivers are return drivers from a pure play on beta. A **pure play** on beta refers to passive investing such as a buy-and-hold strategy to replicate a benchmark index. Returns from a passive beta strategy follow a one-to-one risk and return relationship with the benchmark. Passive investments such as pure beta drivers that have a constant level of risk relative to the market are said to **have linear risk exposure**.

A pure play on beta is illustrated in Figure 2, in which historical monthly returns of the Vanguard Index 500 mutual fund are plotted against the actual S&P 500 returns. The correlation between the two data series is 0.9998, the graph is linear, and the beta equals 1, indicating a one-to-one relationship of returns for the Vanguard fund and the market index.

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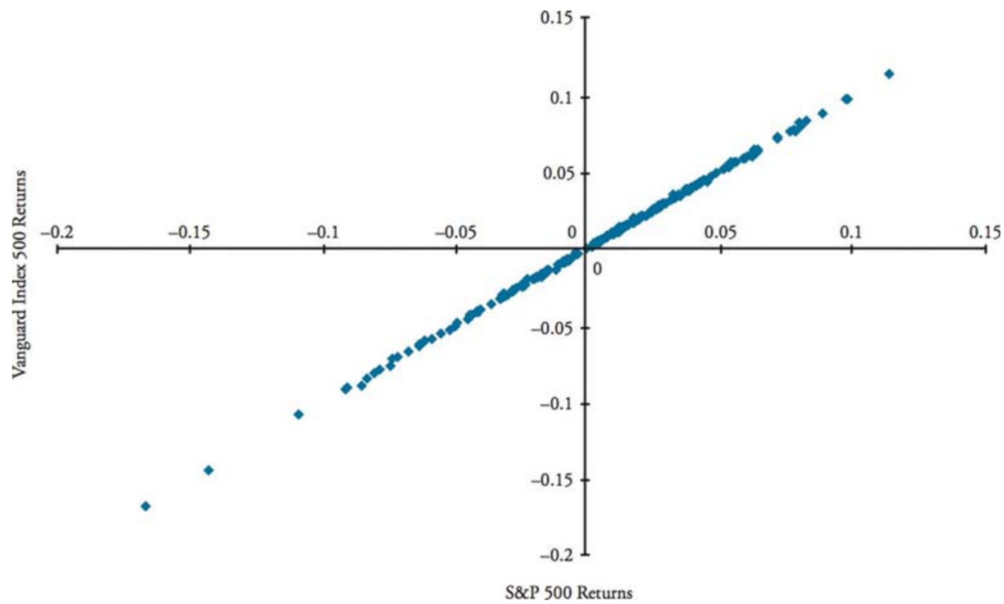
Figure 2: Passively Managed Index vs. S&P 500 Index



Alpha Drivers

While beta drivers are exposures to market risk factors, **alpha drivers** are exposures to active return factors. Investment strategy, as opposed to asset class or geographic location, determines if an investment is an alpha driver. Alpha drivers seek to add returns that are unrelated to benchmark exposures. Most alternative assets are classified as alpha drivers due to their reliance on complex, active investment strategies that have low correlations with traditional asset classes.

Product Innovators and Process Drivers

Interest in alpha drivers and beta drivers has been on the rise, and terminology has been developed to distinguish the two performance drivers. **Product innovators** are alpha drivers that create new investment opportunities. In contrast, **process drivers** are beta drivers that deliver beta as cheaply and efficiently as possible. Process drivers are asset gatherers in that they are index trackers that pursue passive investments linked to popular benchmarks. Recently, process drivers have become more fine-tuned, tracking sectors of the market rather than the broad market as a whole. In this way, process drivers segment the market into separate sources of systematic risk and return.

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Hypothesis Testing Steps

LO 8.7: Demonstrate knowledge of statistical methods for locating alpha.

For example:

- **Identify the four steps of hypothesis testing (i.e., state the hypothesis, formulate an analysis plan, analyze sample data, and interpret results).**
- **Recognize the components of hypothesis statements (i.e., null hypothesis and alternative hypothesis).**
- **Describe the process of designing hypothesis tests.**
- **Describe the process of creating test statistics for use in analyzing sample data.**
- **Explain the decision-making process for rejecting or failing to reject the null hypothesis.**
- **Recognize the four common problems with using inferential statistics (i.e., misinterpretation of high p-values, failure to distinguish between statistical significance and economic significance, violation of distributional assumptions, and misinterpretation of level of confidence).**
- **Define and discuss type I and type II errors in hypothesis testing.**

Hypotheses are propositions that underlie an analysis. Hypothesis testing procedures, based on sample statistics and probability theory, are used to determine whether a hypothesis is a reasonable statement and should not be rejected or if it is an unreasonable statement and should be rejected.

The four steps in hypothesis testing are:

Step 1: State the hypothesis.
Step 2: Form an analysis plan (design the statistical test).
Step 3: Analyze the sample data (calculate the test statistic).
Step 4: Interpret the results (reject or fail to reject the null hypothesis).

Step 1: State the Hypothesis

The most important step in hypothesis testing is stating the components of a hypothesis statement. The first component is the **null hypothesis**, which usually is the statement that the analyst attempts to reject. The second component is the **alternative hypothesis**, which is the opposite claim of the null hypothesis and represents the behavior that exists if the null hypothesis is false.

The null and the alternative hypotheses are usually mutually exclusive and are complements to each other. Therefore, rejecting the null hypothesis is interpreted as supporting the alternative hypothesis.

Step 2: Form an Analysis Plan

After the null hypothesis is established, the next step is to design a method to test the hypothesis. The null hypothesis is examined using a **test statistic**, which is a function of the observed values of the random variables of interest, based on distributional assumptions for the data. Large values of the test statistic indicate the sampled data are far from expected, providing evidence against the null hypothesis and in favor of the alternative hypothesis.

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To conduct the test, a **significance level** must be established. The significance level denotes the probability that a significant result may be due to random chance. Often significance levels are set at 1%, 5%, or 10%. The **confidence level** equals 100% minus the significance level. A **confidence interval** is a range of values around the expected outcome within which we expect the actual outcome to be some specified percentage of the time. For example, a 99% confidence level for an investment's beta may have a confidence interval of 0.5 to 1.3.

Step 3: Analyze the Sample Data

The next step is to derive the value of the test statistic, which is used to test the null hypothesis. The test statistic is calculated from the data and is compared against the predetermined critical value to make a reject or fail to reject decision regarding the null hypothesis.

The test statistic is often standardized, such as:

$$\text{test statistic} = \frac{\text{estimated value} - \text{hypothesized value}}{\text{standard error of statistic}}$$

The numerator is the difference between the calculated sample statistic and the value stated in the null hypothesis. The denominator is the standard error of the statistic, defined as the standard deviation of the sample statistic and is a measure of the precision of the statistic.

The test statistic quantifies how far the estimated value is from the hypothesized value, in standard deviation units. The standardization process of the test statistic allows the test statistic to have a zero mean and unit standard deviation under the null hypothesis.

Based on the distributional assumptions of the test statistic, the ***p*-value** can be determined, which also can be used to test the null hypothesis. For example, a *p*-value of 0.022 implies that, assuming the null hypothesis is true, there is a 2.2% chance of finding a value as extreme as the one derived from the sample.

Step 4: Interpret the Results

The decision rule is to reject the null hypothesis if the calculated test statistic exceeds its critical value or if the *p*-value is less than the significance level. Identical decisions will be reached using the test statistic or the *p*-value decision rule. As the test statistic rises, the *p*-value falls. If the test statistic exceeds its critical value, then the *p*-value will be less than the significance level.

Failing to Reject the Null Hypothesis vs. Accepting the Null Hypothesis

It is important to understand the difference between *failing to reject* and *accepting* the null hypothesis. Consider a person charged with a crime.

H_0: The accused person is innocent of the crime.

H_1: The accused person is guilty of the crime.

The test of the hypotheses is the trial of the accused, and the data is the evidence presented by both sides. After the evidence is presented, the jury evaluates the data and delivers the decision. If the evidence is substantial to show that the accused committed the crime, the jury rejects the null hypothesis that the accused is innocent in favor of the alternative hypothesis that the accused is guilty.

However, if the evidence is not substantial, the jury's verdict is *not guilty*, which is the equivalent of failing to reject the null hypothesis. The proper conclusion is that the evidence is insufficient to show that the null hypothesis is false (i.e., evidence was insufficient to reject the hypothesis of innocence).

Lack of sufficient evidence does not imply that the null hypothesis is true. Therefore, we cannot claim that we accept the null hypothesis. Instead, we state that we fail to reject the null hypothesis. Note that the jury's verdict is not *innocent*, which is the equivalent of accepting the null hypothesis, but instead is *not guilty*, which is the equivalent of not rejecting the null hypothesis.

In summary, statistical tests are designed to disprove rather than to prove the null hypothesis statement.

Four Common Problems Using Inferential Statistics

A result is statistically significant if it is unlikely to have occurred merely by chance. Common errors in the interpretation of statistical significance relate to:

- Strength of relationships.
- Economic significance.
- Distribution assumptions.
- Level of confidence.

Strength of Relationships

Outcomes with lower p-values (or higher test statistics) often are mistaken to indicate stronger relationships. For instance, an outcome with a p-value less than 0.01 is misinterpreted to have a stronger relationship than the outcome with a p-value less than 0.05. Both p-values are less than 0.05, which supports the proposition that relationships exist (using a 5% level of significance), but the p-values should not be used to indicate the strength of relationship.

For example, consider a hypothesis test performed on a portfolio beta. Assume two tests are run on the same portfolio but with different sample sizes. In the first test, the portfolio beta equals 0.50 with a p-value of 0.04. In the second test, a larger sample for the same portfolio is examined, in which the beta equals 0.50, with a p-value of 0.01. Using a 95% confidence level, the beta is significantly different from zero in both tests, indicating that a relationship exists between the returns of the portfolio and the market. The p-value is smaller for the second test because the number of observations is greater, not because the relationship is stronger.

Professor's Note: The standard error usually becomes smaller as the sample size becomes larger, causing t*-statistics to rise and* p*-values to fall.*

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Economic Significance

A common error is to mistake statistical significance for **economic significance**. The test statistic might exceed its critical value because the standard error (denominator of the test statistic) is small, not because the estimate (numerator of the test statistic) is large. Economic significance describes the extent to which a variable has a meaningful impact.

Similarly, sometimes variables that establish no statistical significance could have a substantial economic significance. After considering the absolute size of the parameter and the dispersion in the related explanatory variable, the analyst might determine that the relationship, if true, would have a material impact on the model.

Distribution Assumptions

A *p*-value is calculated assuming the data follow a particular kind of distribution (e.g., a normal distribution). When interpreting a *p*-value, an analyst should confirm whether the data are indeed distributed in the assumed way. The *p*-value is not meaningful if the data violate the distributional assumption.

Level of Confidence

Another common error is to confuse the confidence level for the probability that a relationship exists. For example, assume we reject the null hypothesis that a venture capital (VC) firm's profits, π, equal zero, using a 99% confidence level. The null hypothesis and alternative hypothesis are:

$$H_0: \pi = 0$$

$$H_1: \pi \neq 0$$

What is the probability that the VC's profits do not equal zero, given that the null hypothesis (of zero profits) is rejected for the firm? The common mistake is to assume the answer equals the confidence level (99%), but that is a wrong interpretation of the confidence level. For instance, consider a market in which the probability that VC profits equal zero is 0.9999, and the probability that VC profits do not equal zero equals 0.0001. Assume the test is performed using a 99% confidence level (or a 1% significance level). Therefore, there is a 1% chance that the null is rejected for VC firms that truly earn zero profits. That is, there is approximately a 1% probability that the VC's profits are nonzero, given that the null hypothesis is rejected. Stated differently, there is a 1% probability that the alternative hypothesis is correct, given that the null hypothesis is rejected. The main point is that the confidence level does not equal the probability that a relationship exists (i.e., that the alternative hypothesis is true), and the difference can be substantial.

Type I and Type II Errors

The two major types of errors made in hypothesis testing are type I and type II errors.

A **type I error** occurs when rejecting a true null hypothesis. For example, consider a null hypothesis that an independent variable has no effect on the dependent variable. A type I error is made when the analyst attributes the results to the effect of an independent variable, when, in fact, the independent variable has no effect. The probability of a type I error is usually denoted by α and should not be confused with the investment alpha. The term α is the significance level, and it is selected by the analyst. The $1 - \alpha$ is called the confidence level, or specificity of the test.

A **type II error** occurs when failing to reject an untrue null hypothesis. For example, a type II error is made when the analyst concludes that an independent variable has no effect when in fact it does have an effect. The probability of a type II error is usually denoted by β and should not be confused with the symbol used to denote systematic risk. The statistical power of the test is denoted by $1 - \beta$.

The probabilities of both type I and type II errors can be reduced by increasing the sample size.

Figure 3: Type I and Type II Errors in Hypothesis Testing

	True State	
Decision	*Null hypothesis is true*	*Null hypothesis is false*
Reject the null	Type I error	Correct decision
Fail to reject the null	Correct decision	Type II error

According to these definitions, a type I error can only occur if the null hypothesis is true. If the 95% confidence level is chosen, and if the null hypothesis is true, then there is a 95% chance that the null will not be rejected and a 5% probability that the null will be rejected. Unfortunately, we can never know for sure if the null hypothesis is true.

Sampling and Testing Issues

LO 8.8: Demonstrate knowledge of sampling and testing problems.

For example:

- **Recognize the characteristics of unrepresentative data sets (e.g., selection bias, self-selection bias, survivorship bias) and their effects on test results.**
- **Discuss data mining and data dredging, and recognize their effects on test results.**
- **Discuss backtesting and backfilling, and recognize their effects on test results.**
- **Discuss cherry-picking and chumming, and recognize their effects on test results.**

In the previous section, we discussed common misinterpretations of hypothesis tests. In this section, we define and recognize the effects of erroneous sampling.

Unrepresentative Data Sets

The validity of a statistical analysis relies not only on the robustness of the statistical test, but also on the extent to which the sample represents the entire population that the analyst is testing. Statistical tests are unreliable when samples are biased. For example, **selection bias** refers to the exclusion of certain observations from the sample, causing distortions in the relevant characteristics of the population.

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A particular type of selection bias, known as **survivorship bias**, occurs when funds or companies that are no longer in existence are excluded from the sample. Only the funds or companies that have survived are included in the database.

Another related bias is called **self-selection bias**, in which fund managers voluntarily decide to report or not report performance. Poor-performing funds may tend not to report performance. As a result of survivorship bias and self-selection bias, most hedge fund and private equity databases underrepresent poorer-performing funds. Tests of performance using these databases tend to exhibit an upward performance bias.

Data Mining and Data Dredging

Data mining refers to the practice of vigorously testing data until valid relationships are found. The premise is that vigorous testing is justified to identify previously uncovered relationships. **Data dredging**, also known as *data snooping*, refers to the practice of overusing statistical tests (e.g., running hundreds of tests) to identify significant relationships with little regard for underlying economic rationale. The main problem with data dredging relates to the failure to take the number of tests into account when examining the results (i.e., placing too much confidence in the results).

Backtesting and Backfilling

Backtesting is the process of applying models on historical data to determine how well the models would have explained the actual results. Backtesting offers a way to assess the models before putting them to use going forward, and it is generally a good practice. However, backtesting, when combined with data dredging, implies that too many hypothetical strategies are tested, which can lead to false predictions. Backtesting is dangerous when performed with overfitted models. **Overfitting** occurs when many parameters are used to fit a model to historical data. Models with fewer parameters tend to fit future data better than models that are overfitted.

Backfilling refers to updating databases by inserting returns that pre-date the date of entry in the database. For example, consider the addition of a private equity fund's performance to a database in 2015. Backfilling occurs if the fund's performance prior to 2015 also is added to the database. The danger with backfilling is **backfill bias**, also known as ***instant history bias***, which occurs when funds and strategies added to the database are not representative of the population. In this case, backfilling creates an upward performance bias because it is more likely that successful funds will backfill. Backfill bias is similar to selection bias, which was discussed earlier.

Cherry-Picking and Chumming

Cherry-picking is the process of selectively reporting results, biasing the reporting toward results that support a particular view. For example, a fund manager who oversees 10 funds will likely experience prolonged success in at least one of the 10 funds, merely by chance. The fund manager is cherry-picking by advertising and promoting the one fund that experienced prolonged success while ignoring the performance of the other funds.

Chumming originally was used to describe the process of luring big fish by scattering pieces of inexpensive fish as bait. In the world of finance, an unscrupulous advisor chums when scattering investment advice, luring unsuspecting investors. For instance, consider the unscrupulous advisor who mails various newsletters with different predictions to millions of readers. If enough predictions are made, some will be correct and might be used to lure investors. To correctly determine if the successful prediction was merely a random event, we must evaluate the correct prediction relative to the number of predictions being made.

Alpha and Beta: Issues With Attribution

LO 8.9: Demonstrate knowledge of statistical issues in analyzing alpha and beta.

For example:

- **Recognize the effect of non-normality on the cross-sectional search for alpha.**
- **Identify the potential effects of outliers on reported results.**
- **Recognize issues involving biased testing in the search for alpha.**
- **Discuss the challenges of spurious correlation in beta estimation.**
- **Compare causality of values with true correlation of values.**
- **Recognize three major fallacies of alpha estimation and the lessons that arise from them.**
- **Recognize two major fallacies of beta estimation and the lessons that arise from them.**

Non-Normality and Cross-Sectional Search for Alpha

If non-normality of returns is not properly modeled, then analysts might reach erroneous conclusions regarding manager skill. For example, assume a study shows that 10 out of 40 managers earned alphas that were more than 1.96 standard deviations above zero. If data are normally distributed, and if managers do not possess skill on average, then only one of the managers (2.5% of the managers) is expected to earn an alpha that is at least 1.96 standard deviations above zero. The finding of 10 successful managers would lead an analyst to conclude that the number of managers exhibiting skill exceeds the number expected from random chance.

This example and conclusion rely on the assumption that fund returns are normally distributed. In fact, most alternative investment funds are non-normal. If returns are normally distributed, then the percentage of abnormal performers should equal the significance level (assuming the null hypothesis of no abnormal performance is valid). However, if returns are non-normal, then the percentage of funds with abnormally high alphas may be higher or lower than the percentage predicted by the normal distribution.

Outliers and Biased Testing

Outliers are unusual observations that are far from the mean of a distribution. Outliers within a sample, especially a small sample, can distort estimates of a distribution's mean and variance. Whether an analyst should include or exclude outliers in a statistical test depends on whether they represent observations that are reasonably likely to recur in the future.

Two ways an analyst may introduce bias into a test for alpha are:

1. Selecting well-performing funds and testing whether their additional return is statistically significant, rather than selecting funds at random to analyze.

2. Establishing test procedures, such as the significance level or the sample period, based on the data that have been collected rather than prior to analyzing the data. Choosing these parameters to fit the observations is a form of data dredging.

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Spurious Correlation, Causality, and the Estimation of Beta

Beta is used to measure the systematic risk of an asset, which also is interpreted as the sensitivity of the asset's returns to changes in market-wide risk factors. Beta estimation is affected by all of the issues that affect alpha, which were discussed previously. Two additional challenges are considered here:

- *Differentiating between true correlation and spurious correlation.* In contrast to true correlation, **spurious correlation** is a false indication of a true relationship, is coincidental or idiosyncratic, and is limited to the set of observations being examined. Therefore, spurious correlations vary over time. Betas for assets also vary over time, but the time variation does not, by itself, imply a lack of relationship (i.e., lack of true correlation). A time-varying beta may be driven by both true correlation and spurious correlation.
- *Differentiating between true correlation and causality.* The difference between true correlation and **causality** is that causality indicates when a reliable and direct cause-and-effect relationship exists among variables. Causality exists when one variable at least partly determines the value of another variable. A high correlation does not necessarily imply causality. The prices of two variables might be highly correlated, but not because one variable causes the other. The high correlation may simply be the consequence of an underlying common factor, such as inflation, on the two price variables. Also, correlation can change over time if short-term and long-term causes differ.

Models that do not properly account for nonlinearities are misspecified and can lead to erroneous conclusions regarding correlation and causality. Correlation is a measure of the strength of linear relationship between variables. If a nonlinear relationship exists, the correlation between the untransformed variables will be low. The low correlation, however, is misleading. A potentially powerful relationship indeed exists, and it is misdiagnosed by the misspecified model.

Alpha Estimation Fallacies

When considering a variety of tests and samples, three of the major fallacies regarding alpha estimation come to light. First, consider a sample of funds with identical systematic risks. Assume the analyst finds several funds with significantly better-than-average performance. It is wrong to conclude that some of the superior performance is attributable to skill. The findings are likely explained by the non-normally distributed idiosyncratic returns. The managers may be skilled or not skilled at all. Also, even if the data are normally distributed, and if *all* of the managers are skilled, only a small percentage (the upper tail of the normal distribution) of the managers would be expected to generate performance significantly above the sample mean.

Lesson 1: Returns should be compared against a proper risk-adjusted benchmark rather than compared against each other. Results should be visually inspected.

Second, consider a sample with dissimilar systematic risks. Assume the analyst uses a multifactor model and concludes that statistically significant alphas imply a higher-than-average risk-adjusted return. The conclusion is wrong because the analyst actually is testing a joint null hypothesis that (1) the multifactor model is properly specified and (2) true alpha equals zero. A rejection of the null hypothesis could merely indicate that part 1 is rejected, while part 2 is not rejected. This problem exists for any test in which a model is used to measure performance.

Lesson 2: Test results are only as reliable as the asset pricing model used to estimate performance.

Third, consider a test in which a properly specified asset pricing model is used, and a statistically significant positive alpha is found for a fund at the 95% confidence level. It is wrong to conclude that there is a 95% chance that the fund earned a positive ex ante alpha. This issue was discussed earlier in relation to the Bayesian formula that should be used to derive the correct probability, assuming sufficient information is available to apply the formula.

Lesson 3: Using a 95% confidence level, the proper conclusion regarding confidence levels and significant results is that a fund with a zero ex ante alpha (the null hypothesis statement) has only 5% chance of being estimated as having a nonzero ex ante alpha (i.e., there is only a 5% chance of rejecting the null hypothesis when it is a true). There is insufficient information to make claims regarding the probability that the alternative hypothesis is true; it is incorrect to say this probability is 95%.

Beta Estimation Fallacies

Fallacies regarding beta estimation include the last fallacy discussed in the previous alpha estimation section, along with two additional fallacies.

Lesson 1 (from alpha estimation): Using a 95% confidence level, the proper conclusion regarding confidence levels and significant results would appear to be that a fund with zero beta has only 5% chance of being estimated as having a nonzero beta. In practice, there is insufficient information to make this claim.

Next, consider a test run using linear regression. If the test indicates that the beta is not significantly different from zero, it is wrong to conclude that the investment returns and the risk factor returns are unrelated. Many alternative and market-timed investments possess nonlinear relationships to risk factors.

Lesson 2: A zero beta from a linear regression does not imply a lack of relationship. It only implies a lack of linear relationship.

Lastly, it is wrong to conclude that a statistically significant beta implies causality. As discussed earlier, the prices of two variables might be significantly related, but that alone does not imply causality. The prices of the two variables might be linked through inflation or some other common factor, while no causality exists in the relationship between the two price variables.

Lesson 3: A statistically significant beta does not imply causality because a common factor may be responsible for the perceived correlation.

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Key Concepts

LO 8.1

Beta is a measure of systematic risk, and alpha is a measure of investment return in excess of the risk-adjusted benchmark.

LO 8.2

Alpha can be categorized into two types:

- Ex ante alpha is a forecast of incremental return after adjusting for time value of money and systematic risk effects. Ex ante alpha is the return attributable to the skill of the manager.
- Ex post alpha measures the realized incremental return after adjusting for the time value of money and systematic risk effects. Ex post alpha may be attributable to skill, luck, or a combination of the two.

LO 8.3

There are two steps when analyzing the ex post alpha to estimate ex ante alpha:

1. Identify the appropriate ex post asset pricing model or benchmark.

2. Statistically examine the ex post alpha to determine the extent to which the alpha is attributable to luck or skill.

Potentially confounding challenges to the empirical method for determining ex ante alphas are invalid inferences, non-normality of returns, and sample selection biases.

LO 8.4

The primary goal of return attribution analysis is to attribute returns to systematic risk (beta), skill (ex ante alpha), and idiosyncratic risk (luck).

Model misspecification refers to the use of models that do not properly capture systematic and idiosyncratic risks. Alphas will be misdiagnosed in the presence of model misspecification. Types of model misspecification include misestimated betas, nonlinear relationships, and omitted or misidentified factors.

Beta nonstationarity refers to the tendency for beta to shift over time. Nonstationarity of beta raises a key question regarding whether a fund's superior return is attributable to alpha or beta. Examples of beta nonstationarity include the following:

- Beta creep refers to gradual increase in beta over time.
- Beta expansion refers to increases in beta as market conditions change.
- Market timing refers to attempts of the fund manager to alter the fund beta in anticipation of changes in market conditions.

Alpha and beta effects are difficult to disentangle. In most cases, performance is attributable to a commingling of alpha and beta.

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LO 8.5

Abnormal return persistence refers to the tendency of idiosyncratic performance to be positively correlated over time. A positive correlation suggests that most superior returns are attributable to skill, rather than to luck.

LO 8.6

Return drivers of an investment are investments, products, and strategies that generate the investment's risk and return. Return drivers are divided into two classes: beta drivers and alpha drivers.

- Beta drivers are exposures to market risk factors that compensate investors for bearing nondiversifiable market risk. The excess return that a stock provides above the risk-free rate is referred to as the equity risk premium (ERP). The tendency of the ERP to exceed its expected value based solely on risk aversion is known as the equity premium puzzle. Passive beta drivers are return drivers from a pure play on beta, which refers to passive investing such as a buy-and-hold strategy to replicate a benchmark index.
- Alpha drivers are exposures to active return factors and determined by investment strategy. Most alternative assets are alpha drivers.

Product innovators are alpha drivers that create new investment opportunities, while process drivers are beta drivers that deliver beta as cheaply and efficiently as possible.

LO 8.7

The four steps in hypothesis testing are:

1. State the hypothesis.
2. Form an analysis plan.
3. Analyze sampled data.
4. Interpret the results.

The null hypothesis is the statement that the analyst attempts to reject. The alternative hypothesis is the opposite claim of the null hypothesis, and it represents the behavior that exists if the null hypothesis is false.

The null hypothesis is examined using a test statistic, which is a function of the observed values of the random variables of interest. Large test statistics indicate sampled data are far from expected, in which case the null hypothesis is rejected. If the test statistic is not large, then we fail to reject the null hypothesis.

The *p*-value equals the probability of observing a sample estimate as extreme as the one observed, assuming the null hypothesis is true.

The significance level denotes the probability that a significant result may be due to random chance. The confidence level equals 100% minus the significance level.

Statistical tests do not offer evidence to prove a null hypothesis. Statistical tests are designed to disprove rather than to prove the null hypothesis statement.

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Outcomes with lower *p*-values often are mistakenly interpreted as having a stronger relationship.

Statistical significance is often mistaken for economic significance. The test statistic might exceed its critical value because the standard error is small, not because the estimate is large. Economic significance describes the extent to which a variable in an economic model has a meaningful impact.

The confidence level is misinterpreted to equal the probability that a relationship exists. In reality, the probability that a true relationship exists, even if the statistical test indicates one exists, generally is unknown.

A type I error occurs when wrongly rejecting a true null hypothesis. A type II error occurs when failing to reject an untrue null hypothesis.

LO 8.8

Selection bias refers to the exclusion of certain observations from the sample, causing distortions in the relevant characteristics of the population. Survivorship bias, a type of selection bias, occurs when funds or companies no longer in existence are excluded from the sample. Another related bias is self-selection bias, in which fund managers make the decision to report or not report performance. As a result of selection bias, most hedge fund and private equity databases underrepresent poorer-performing funds. Affected databases will likely exhibit an upward bias.

Data mining refers to the practice of vigorously testing data until valid relationships are found. Data dredging refers to the practice of overusing statistical tests (e.g., running hundreds of tests) to identify significant relationships with little regard for underlying economic rationale. The main problem with data dredging relates to the failure to take the number of tests into account when examining the results (i.e., placing too much confidence on the results).

Backtesting is the process of applying models on historical data to determine how well the models would have explained the actual results. Backtesting, when combined with data dredging, implies that too many hypothetical strategies are tested, which can lead to false predictions. Overfitting occurs when many parameters are used to fit a model to historical data. Backfilling refers to updating the database by inserting returns that pre-date the date of entry in the database. The danger with backfilling is backfill bias, also known as instant history bias, which occurs when funds and strategies added to the database are not representative of the population. In this case, backfilling creates an upward return bias because it is more likely that successful funds will backfill.

Cherry-picking is the process of selectively reporting results, biasing the reporting toward results that support a particular view. Chumming refers to scattering disparate investment predictions in the hopes that some of the predictions are correct and then luring unsuspecting investors with marketing material focusing on the winning predictions while concealing the losing predictions.

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LO 8.9

If returns are normally distributed and the null hypothesis of zero alphas is correct, then the percentage of abnormal performers should equal the significance level. However, if returns are non-normal, then the percentage of funds with abnormally high alphas may be higher or lower than the percentage predicted by the normal distribution.

Spurious correlation is correlation that does not result from a true or direct relationship. A spurious correlation is coincidental or idiosyncratic and is limited to the set of observations being examined, causing the correlation to vary over time. Causality refers to a reliable and direct cause-and-effect relationship among variables. Causality exists when one variable at least partly determines the value of another variable.

Models that do not properly account for nonlinearities are misspecified and can lead to erroneous conclusions regarding correlation and causality. Correlation is a measure of the strength of linear relationship between variables. If a nonlinear relationship exists, the correlation between the untransformed variables will be low. A potentially powerful relationship indeed exists, which is misdiagnosed by the misspecified model.

Beta estimation is affected by the choice of factors used in the model. If thousands of tests are performed, hundreds of factors might seem statistically significant merely by chance. Therefore, significant factors might be found where no true relationship exists.

Lessons regarding alpha estimation include the following:

- Returns should be compared against a proper risk-adjusted benchmark rather than compared against each other.
- Alpha calculations are only as reliable as the asset pricing model used to estimate performance.
- The probability that a fund alpha is nonzero, given that the test indicated a statistically significant alpha, is generally unknown.

Lessons regarding beta estimation include the following:

- The probability that a fund beta is nonzero, given that the test indicated a statistically significant beta, is generally unknown.
- Using a linear regression model, a zero beta does not necessarily imply a lack of relationship; a zero beta only implies a lack of linear relationship.
- A statistically significant beta does not necessarily imply causality; the prices of two variables might be linked through inflation or some other common factor, while no causality exists in the relationship between the two price variables.

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Concept Checkers

1. Consider a fund that invests only in automobile stocks. Recently, it hired a skilled manager who selected a portfolio that was 2% underpriced but eventually underperformed by 2% with comparable portfolios due to an unexpected increase in federal tax in the automobile industry. What was the ex ante alpha and ex post alpha for the manager?
   A. 2% and 2%.
   B. 2% and 0%.
   C. 2% and –2%.
   D. 2% and 4%.

2. Consider a fund with a 2.5% ex ante alpha. Last year, the fund outperformed the market by 3% and outperformed funds with similar risk by 4%. What portion of the ex post alpha was generated purely by luck?
   A. 0.5%.
   B. 1.5%.
   C. 2.5%.
   D. 3.0%.

3. Which of the following refers to the overrepresentation of successful managers in a database?
   A. Survivorship bias.
   B. Nonlinearity bias.
   C. Non-normality bias.
   D. Overrepresentation bias.

4. Which of the following is *least likely* associated with beta nonstationarity?
   A. Beta expansion.
   B. Beta creep.
   C. Market timing.
   D. Beta driver.

5. The correlation between successive ex post alphas for a hedge fund equals zero. Which of the following statements *most accurately* describes the performance of the hedge fund?
   A. The fund's investment results are attributed solely to managerial skill.
   B. The fund is a good diversifier.
   C. The fund's investment results are attributed solely to luck.
   D. The fund's investment results are attributed neither to skill nor to luck.

6. Product innovators are *best* described as investment managers who attempt to:
   A. refine investment processes in order to decrease costs.
   B. create new investment products with high alpha content.
   C. create products with high capacity for assets under management.
   D. extract alpha from beta within their offering of investment products.

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7. An analyst conducts a test of the null hypothesis that a fund's monthly average alpha equals zero. The analyst runs the test over a large sample of months and finds that the test statistic is less than its critical value. Which of the following summarizes the conclusion that the analyst should reach?
A. Accept the null hypothesis.
B. Reject the null hypothesis.
C. Fail to reject the alternative hypothesis.
D. Fail to reject the null hypothesis.

8. A test that always correctly identifies a false null hypothesis *most likely* has:
A. zero type I error.
B. zero type II error.
C. 100% type I error.
D. 100% type II error.

9. An advisor examines hundreds of trading strategies until finding a significant relationship and then writes a newsletter promoting one successful strategy. The advisor is *most likely* guilty of:
A. survivorship bias.
B. cherry-picking.
C. backfilling.
D. backtesting.

10. Which of the following is a *least accurate* description of spurious correlation? Spurious correlation:
A. tends to be idiosyncratic in nature.
B. tends to vary over time.
C. tends to be coincidental.
D. tends to stabilize betas.

11. Analyst Edwin Douglas studies a group of funds attempting to identify funds that perform well. The funds examined by Douglas have identical systematic risks. Douglas finds that 20 managers out of 100 produced significantly better-than-average performances. From his results, Douglas concludes that some of the superior performance is attributable to skill. Analyst Sharon Smith examines a group of funds with dissimilar systematic risks and estimates ex post alphas using a multifactor asset pricing model. She concludes that a statistically positive alpha indicates that the fund earned an above-average risk-adjusted return. Which of the analysts have drawn a correct conclusion?
A. The conclusions of both Douglas and Smith are correct.
B. The conclusion of Douglas is incorrect, while the conclusion of Smith is correct.
C. The conclusion of Douglas is correct, while the conclusion of Smith is incorrect.
D. The conclusions of both Douglas and Smith are incorrect.

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Concept Checker Answers

1. **C** In this scenario, the manager had an ex ante alpha of 2% (skill) and an ex post alpha of –2% (i.e., 2% skill and –4% luck). Although the manager had skill, he eventually ended up with negative excess return due to unexpected bad news. (LO 8.1)

2. **B** Luck is the difference between ex post alpha and ex ante alpha (i.e., skill). We are given an ex ante alpha of 2.5% and can infer that the ex post alpha is 4.0%. Therefore, the portion attributable to luck is calculated as 0.04 – 0.025 = 0.015 or 1.5%. (LO 8.2)

3. **A** The overrepresentation of successful managers in a database is known as a survivorship bias. (LO 8.8)

4. **D** Examples of beta nonstationarity include beta creep, beta expansion, and market timing. Beta drivers refer to a process of delivering beta cheaply and efficiently. (LO 8.4)

5. **C** Abnormal return persistence refers to the tendency of idiosyncratic performance in one period to be correlated with the idiosyncratic performance in the subsequent period. A zero correlation suggests that performance is random from one period to the next, which is indicative of luck. (LO 8.5)

6. **B** Product innovators attempt to create high alpha content products. (LO 8.6)

7. **D** If the test statistic is less than the critical value, then the test statistic is not large enough to reject the null hypothesis. Therefore, the analyst should fail to reject the null hypothesis. (LO 8.7)

8. **B** If the test always identifies an untrue null hypothesis, then it never fails to reject an untrue hypothesis. A type II error equals the probability of failing to reject an untrue null hypothesis. Therefore, if the test always correctly identifies a false null hypothesis, then there is no type II error. (LO 8.7)

9. **B** Cherry-picking is the process of selectively reporting results, thus biasing the reporting toward results that support a particular viewpoint. (LO 8.8)

10. **D** Spurious correlation is limited to the set of observations being examined. Therefore, spurious correlations change over time. Beta is affected by the estimated correlation, which is driven by both true correlation and spurious correlation. (LO 8.9)

11. **D** Neither conclusion is correct. Douglas should have examined returns using a risk-adjusted benchmark, rather than comparing funds to each other. It is possible that none of the sampled fund managers possess skill. Smith's conclusion also is incorrect. The test conducted by Smith is a test of the joint hypothesis that her multifactor model is properly specified and the alpha is zero. A rejection of the null hypothesis could merely indicate that her model has been rejected. (LO 8.9)

The following is a review of the Alternative Investment principles designed to address the learning objectives set forth by the CAIA Association®.

Regression, Multivariate, and Nonlinear Methods

Topic 2.9

Exam Focus

This topic review describes and applies regression techniques with key focus on issues unique to alternative investments, such as nonlinearity, dynamic risk exposures, and nonstationarity. The basics of regression are discussed first, including interpretation of intercept, slopes, R-squared, and of problems that might affect a regression such as outliers, autocorrelation, and heteroskedasticity. The discussion is then extended to an examination of multifactor models and related topics such as multicollinearity, stepwise regression, and important multifactor model applications. For the exam, be able to interpret a regression and identify when the data violate key assumptions. Know how to apply multifactor models relative to asset classes held by the fund, funds with similar strategies, marketwide factors, and specialized market factors, and to apply methods to examine hedge fund performance persistence.

Single-Factor Regression Models

LO 9.1: Demonstrate knowledge of single-factor regression models.

For example:

- **Explain the use of ordinary least squares to estimate regression parameters.**
- **Describe the problem outliers pose to regression analysis.**
- **Describe the problem autocorrelation poses to regression analysis.**
- **Describe the problem heteroskedasticity poses to regression analysis.**
- **Interpret a regression's goodness of fit.**
- **Evaluate the statistical significance of regression parameter estimates.**
- **Calculate the t-statistic.**

A **regression** is a statistical method that describes the relationship between a **dependent variable** and one or more **independent variables**. A **linear regression** describes a linear relationship for the dependent variable. Independent variables also are known as *explanatory variables*.

A **simple linear regression** is a statistical method that models a linear relationship between a dependent variable and a single independent variable. Therefore, a simple linear regression

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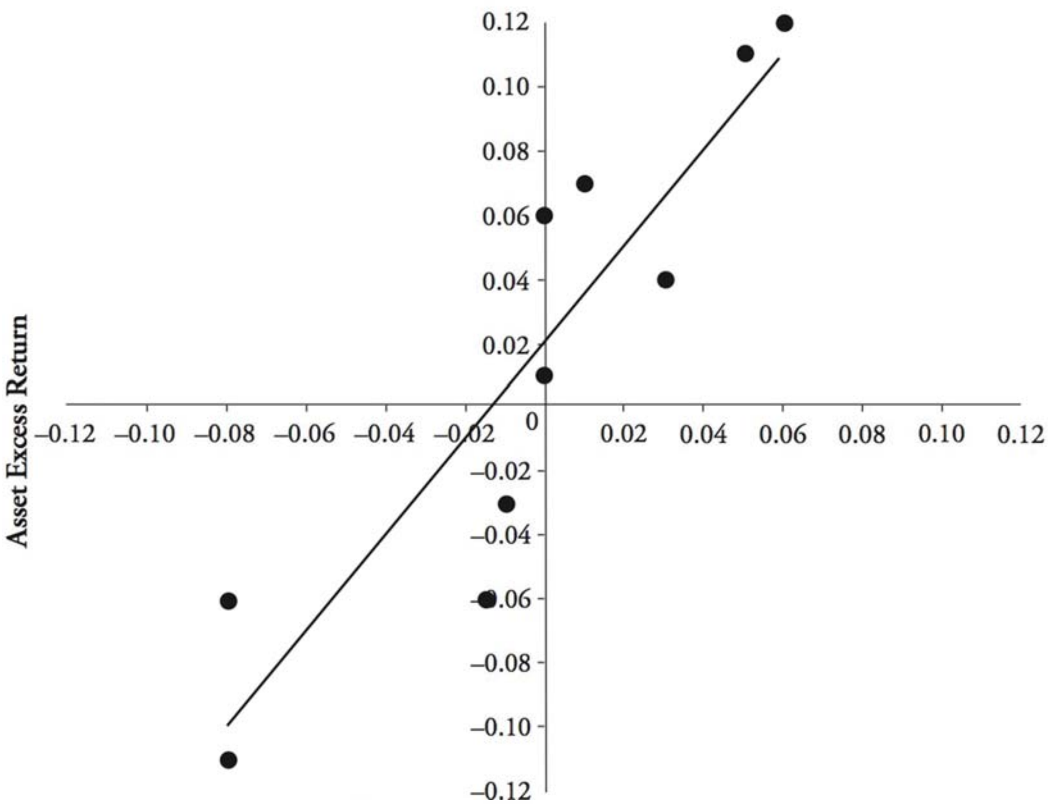
fits a line to a scatter of paired observations for the dependent and independent variable. The equation for a simple linear CAPM-based regression is:

$$R_{it} - R_f = a_i + B_i(R_{mt} - R_f) + e_{it}$$

where:
R_i = stock return for asset *i* in period *t*
R_f = risk-free rate
R_{mt} = market portfolio return for period *t*
a_i = regression intercept estimate for asset *i*
B_i = regression slope estimate for asset *i*
e_{it} = regression residuals for asset *i* in period *t*

The following figure illustrates a CAPM-based regression.

Figure 1: CAPM-Based Regression



The regression equation for the figure above is:

regression estimate of asset excess return = $0.02 + 1.50(R_{mt} - R_f)$

The estimated **slope coefficient** of the simple linear regression equals the expected change in the dependent variable for every 1-unit change in the independent variable. In a CAPM-based regression, the slope coefficient equals the asset's **beta,** which is the sensitivity of the asset's returns to changes in the market portfolio returns.

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In the previous figure, the slope coefficient equals 1.5, indicating that, on average, the asset's excess return changes by 1.5 percentage points for every 1 percentage point change in the market portfolio excess return.

The **intercept** of the CAPM-based regression equals the incremental performance of the asset relative to the CAPM benchmark return, and is called the asset's **alpha**. In Figure 1, the 2% alpha estimate indicates that, on average, the fund's return exceeded the ex post CAPM expected or "required" return by 200 basis points. When applied to portfolios, the alpha measures the return attributable to skill or luck of the portfolio manager.

The **residuals** in the regression formula reflect the deviation of idiosyncratic realized returns from the mean idiosyncratic return (i.e., the estimate of the error term).

Professor's Note: Application of the CAPM-based regression for benchmarking was discussed in Topic 2.7.

Ordinary Least Squares Method

Ordinary least squares (**OLS**) is a statistical method that derives estimates that minimize the sum of squared residuals. The residuals are the differences between the dependent variable and the regression estimate of the dependent variable (e.g., the vertical distances between the scatter points and the regression line). Therefore, in the simple linear regression, the regression line best fits the scatter of points. The OLS method is most likely to generate accurate, unbiased estimates if the regression residuals are normally distributed, uncorrelated, and homoskedastic. Each assumption and violations of the assumption are discussed below.

Normal distribution. The normality assumption often is violated when data contain **outliers**, which are data points with extreme values. Alternative investment returns often are leptokurtic, implying a greater number of outliers relative to the normal distribution. Outliers have disproportionate effects during the residual squaring process of the OLS method. To identify outliers in a dataset, we can plot the residuals versus the independent variable, or plot the residuals versus time. An outlier can be removed from the regression if the analyst determines that the event underlying an outlier is unlikely to repeat.

Uncorrelated. The OLS method assumes that regression residuals are uncorrelated with their lagged values. The consequence of serial correlation (also known as autocorrelation) is that the standard errors and *t*-statistics estimated by the regression will be invalid. Tests of first order autocorrelation can be performed with the Durbin-Watson test statistic (discussed at length in Topic 2.4).

Homoskedasticity. The OLS method assumes that the variance of the residuals is constant (i.e., the residuals are assumed to be homoskedastic). **Heteroskedasticity** refers to a violation of the constant error variance assumption. *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 residuals changes as the value of the independent variable changes, as shown in Figure 2. 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*. The consequence of conditional heteroskedasticity is that the standard errors and *t*-statistics estimated by the regression will be invalid.

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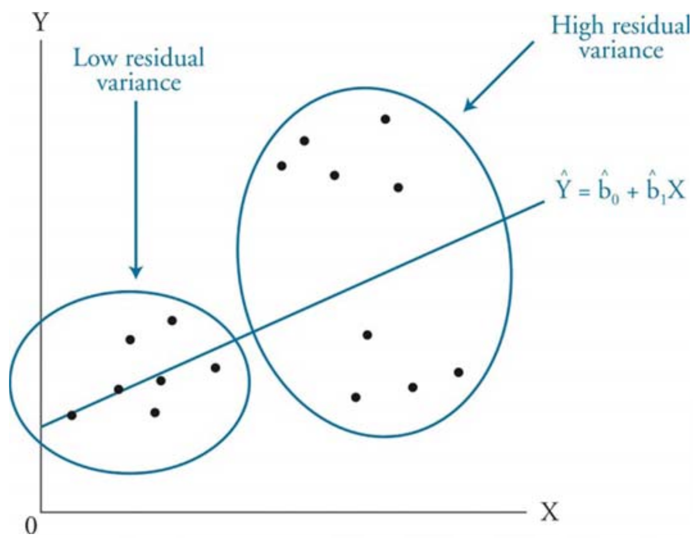
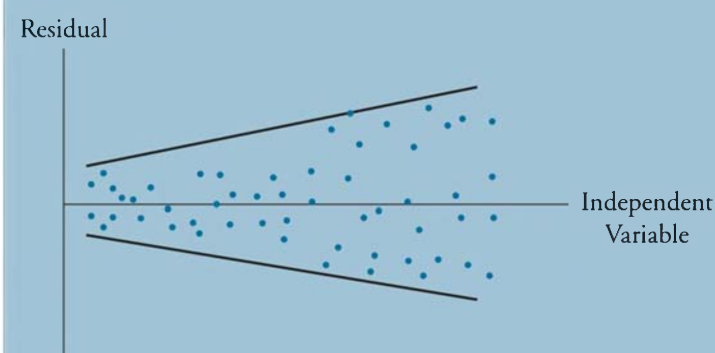
Figure 2: Conditional Heteroskedasticity



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 do not seem to fit the firm's stated risk profile. For your analysis, you have prepared a scatter plot of the residuals (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.

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Interpreting Goodness of Fit

The **goodness of fit statistic**, or ***R*-squared** value of the regression, is a measure of its overall explanatory power. It is equal to the percent of the variation in the dependent variable explained by the independent variables. The *R*-squared ranges from 0 to + 1. For instance, when applied to a CAPM-based regression, an *R*-squared of 0.80 indicates that 80% of the variation in the asset's excess returns is explained by the market's excess returns. In a simple linear regression, the *R*-squared equals the square of the correlation between the dependent and independent variable. The percent of the asset's variation attributable to idiosyncratic risk equals 1 minus the *R*-squared.

T-tests and Statistical Significance

Estimates of the individual parameters derived from a regression can also be tested for statistical significance using a *t*-test. The ***t*-test** is a widely used hypothesis test that employs a test statistic that is distributed according to a *t*-distribution. To conduct a *t*-test, the **t-statistic** (which equals the parameter estimate divided by its standard error) is compared to a critical *t*-value at the desired level of significance with the appropriate degrees of freedom. The result indicates if the estimate is significantly different from zero. In large samples, using a 5% level of significance, we can conclude that the intercept or slope estimate is statistically significant if its *t*-statistic exceeds 1.96 in absolute value, implying that the estimate is more than 1.96 standard errors removed from zero.

Example: Interpreting regression results

Consider a large sample CAPM-based regression with the following results:

	Estimate	*Standard Error*
Intercept	*0.02*	*0.10*
Slope	*1.25*	*0.50*

Determine the statistical significance of the intercept and the slope, using a 5% level of significance.

Answer:

The *t*-statistic for the intercept equals 0.02/0.10 = 0.20, and the *t*-statistic for the slope equals 1.25/0.50 = 2.50. The slope estimate is statistically significant because its *t*-statistic exceeds the critical value of 1.96. The intercept estimate is not statistically significant.

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Multifactor Regression Models

LO 9.2: Demonstrate knowledge of multifactor regression models.

For example:

- Describe the ex post version of the Fama-French model.
- Describe the problem that multicollinearity poses to multifactor regression analysis.
- Discuss the selection process of independent variables for multifactor regression analysis and the potential shortcomings to the stepwise regression technique.

Multifactor regression models (also known as **multiple regression models**) describe relationships between asset returns and the returns on multiple risk factors. The equation for a general *k*-factor regression model is:

$$R_{it} - R_f = a_i + B_{i1}F_{1t} + B_{i2}F_{2t} + \ldots + B_{ik}F_{kt} + e_{it}$$

where:
R_{it} = return on asset *i* in time for period *t*
R_f = risk-free rate
B_{ij} = beta of asset *i* relative to factor *j*
F_{jt} = return on risk factor *j* for period *t*

The Fama-French three-factor model (discussed in Topic 2.6) is an example of a multifactor asset pricing model:

$$R_{it} - R_f = a_i + B_m(R_{mt} - R_f) + B_1(R_{st} - R_{bt}) + B_2(R_{ht} - R_{lt})$$

where:
R_{mt} = return on the market index for period *t*
R_{st} = return on a portfolio of small firms for period *t*
R_{bt} = return on a portfolio of big firms for period *t*
R_{ht} = return on a portfolio of high book-to-market firms for period *t*
R_{lt} = return on a portfolio of low book-to-market firms for period *t*

Fama and French contend that small firms are riskier than big firms, and high book-to-market firms are riskier than low book-to-market firms. Therefore, on average, both $R_s - R_b$ and $R_h - R_l$ will be positive. $R_s - R_b$ and $R_h - R_l$ are the factor premiums for the small firm and high book-to-market risk factors. The Fama-French three-factor model predicts that stock returns will be high for firms with high market beta, small market capitalization, and high book-to-market ratio. B_1 will be positive for small firms and B_2 will be positive for high book-to-market firms.

The multifactor alpha equals the incremental return earned by the asset relative to the multifactor benchmark return. As true risk factors are added to a multifactor asset pricing model, the *R*-squared will increase and the alpha will decline. The alpha will decline because returns that previously were attributable to abnormal performance were, in fact, driven by risk.

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Example: Effect of additional risk factors on the alpha calculation

The data provided below summarize the factor betas for the AI Fund and premiums for the risk factors of the Fama-French three-factor model. The average return for the AI Fund is 14.1%. The risk-free rate is 4%.

Factor	*Factor Betas*	*Factor Premiums*
$R_{mt} - R_f$	1.25	0.06
$R_s - R_b$	0.50	0.02
$R_h - R_l$	0.40	0.04

Calculate the alpha (1) based on the single-factor CAPM and (2) based on the Fama-French three-factor model.

Answer:

CAPM alpha = 0.141 – 0.04 – 1.25(0.06) = 0.026 = 2.6%

Fama-French alpha = 0.141 – 0.04 – [1.25(0.06) + 0.50(0.02) + 0.40(0.04)] = 0

Therefore, the alpha fell from 2.6% when calculated based on the single-factor CAPM to zero when calculated based on the three-factor model.

Multicollinearity Issues

Multicollinearity refers to the condition in which two or more of the independent variables are highly correlated with each other. When independent variables are correlated, the intercept and slope standard errors are biased upward, which, in turn, biases the *t*-statistics downward. Therefore, as a result of multicollinearity, there is a greater probability that we will incorrectly conclude that a variable is not statistically significant (i.e., a Type II error).

Multicollinearity has no effect on either the *R*-squared or *F*-statistic of a regression, but has a downward biased effect on the *t*-statistics of the intercept and slopes. Therefore, we can identify that multicollinearity is a significant problem if the *R*-squared is high and the *t*-statistics are small.

A common solution to the multicollinearity problem is to transform the independent variables. For instance, consider a two-variable regression in which independent variables X_1 and X_2 are highly correlated. We can run a regression in which the first independent variable is X_1 and the second independent variable is $D = X_2 - X_1$. While the correlation between X_1 and X_2 might be high, the correlation between X_1 and D is likely to be much lower.

Stepwise Regression

A major challenge of multifactor regressions relates to the selection of the appropriate factors. The **stepwise regression** method chooses independent variables based on each variable's explanatory power. The first independent variable chosen is the one with the highest *t*-statistic for its slope. Then, additional variables are added sequentially depending

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on the magnitude of their *t*-statistics. The researcher sets a minimum cut-off for the *t*-statistic, at which point no additional variables are brought into the regression.

Stepwise regression is a pure statistical approach to the selection of the independent variables. Therefore, very little economic theory is applied when using stepwise regression, which can lead to overfitting. Overfitted models explain the past well, but do not necessarily predict the future well. The analyst must resist the temptation of overfitting by limiting the choice of variables to those with sound economic rationale.

Nonlinear Return Models

LO 9.3: Demonstrate knowledge of dynamic risk exposure models.

For example:

- **Define nonlinear exposure.**
- **Discuss and apply the dummy variable approach to analyzing market-timing strategies.**
- **Discuss the separate regression approach to analyzing market-timing strategies.**
- **Discuss and apply the quadratic approach to analyzing market-timing strategies.**

The models discussed above examine linear relationships between dependent and independent variables. However, alternative investment returns often have **nonlinear exposures** to market factors. Nonlinear exposure occurs when the sensitivity of a position's value changes depending on the size of the change in the market factor. **Nonlinear models** examine nonlinear relationships between dependent and independent variables.

Nonlinear relationships among asset returns and factor returns might arise from market forecasting attempts by fund managers. For instance, consider a market timer that is able to forecast market movements with 100% accuracy. The market timer would take long or short positions based on the market's direction. The payoffs for the market timer would mirror that of an option straddle where the option premiums are $0. That is, the profit/loss diagram relative to market returns would form a V-shaped pattern, bottoming out at a payoff equal to zero. In this case, a linear regression would erroneously indicate a lack of relation. A clear relation exists, albeit a nonlinear one.

Dynamic risk exposure models examine nonlinear relationships caused by factor risk exposures that change over time. For example, fund managers might attempt to time the market by targeting higher betas as the market index improves.

We will examine three dynamic risk exposure methods. In the first method (known as the **dummy variable regression model**), the fund beta takes one of two values: an up-market beta and a down-market beta. The **up-market beta** is based on periods when the market's return exceeds the risk-free rate and the **down-market beta** is based on periods when the market's return falls below the risk-free rate.

The dummy variable regression model is:

$$R_{it} - R_f = a_i + \{[b_{i,d} + (D_1 \times b_{i,diff})] \times (R_{mt} - R_f)\} + e_{it}$$

Provided on Exam

where:
$b_{i,d}$ = down-market beta
D_1 = dummy variable; equals 1 when $R_{mt} - R_f$ is positive, and equals 0 when $R_{mt} - R_f$ is zero or negative
$B_{i,diff}$ = difference between up-market beta and down-market beta

For example, in a down-market period, $D_1 = 0$, and the formula can be simplified to:

$$R_{it} - R_f = a_i + B_{i,d}(R_{mt} - R_f) + e_{it}$$

In an up-market period, $D_1 = 1$, and the formula can be simplified to:

$$R_{it} - R_f = a_i + (B_{i,d} + B_{i,diff})(R_{mt} - R_f) + e_{it}$$

which also indicates that the up-market beta equals $B_{i,u} + B_{i,diff}$. If $B_{i,diff}$ is significantly positive, then we can conclude that the down-market beta is significantly less than the up-market beta, indicative of good market-timing.

Example: Up-market and down-market betas

A dynamic risk exposure model is estimated for Portfolio P:

$$R_{pt} - R_f = 0.02 + [1.2 + D_1(-0.40)]\ (R_{mt} - R_f)$$

where:
D_1 equals 1 when $R_{mt} - R_f$ is positive and equals 0 when $R_{mt} - R_f$ is zero or negative

Determine the up-market beta and the down-market beta and **determine** if the portfolio manager exhibited market-timing skill.

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Answer:

During up-markets, the regression equation is:

$$R_{pt} - R_f = 0.02 + (1.20 - 0.40)(R_{mt} - R_f), \text{ or}$$

$$R_{pt} - R_f = 0.02 + 0.80(R_{mt} - R_f).$$

Therefore, the up-market beta equals 0.80.

During down-markets, the regression equation is:

$$R_{pt} - R_f = 0.02 + 1.20(R_{mt} - R_f).$$

Therefore, the down-market beta equals 1.20.

Alternatively, we can answer the question more directly, by knowing that $B_{i,u}$ is the up-market beta, and $B_{i,diff}$ equals the difference between the up-market beta and the down-market beta (e.g., the down-market beta equals 1.20 and the up-market beta equals: 1.20 + (–0.40 = 0.80). These findings suggest that the fund manager timed the market poorly as portfolio exposure to markets increased in poor markets and decreased in good markets.

In the second dynamic risk exposure approach (known as the **separate regressions model**), the analyst runs separate non-overlapping regressions to estimate betas for each regression period. Several different time periods are examined, and several periodic betas are derived for the asset.

In the third dynamic risk exposure model (known as the **quadratic curve regression model**), excess returns for the asset are regressed against the square of the market excess returns, resulting in a quadratic curve regression:

$$R_{it} - R_f = a_i + B_{im}(R_{mt} - R_f)^2 + e_{it}$$

A positive value for B_{im} indicates that the fund manager continually adjusted the beta higher as the market return increased, and adjusted the beta lower as the market return fell. A negative value for B_{im} is indicative of a bad market-timer. The intercept of the regression measures the skill of the manager after controlling for market-timing ability. Note that B_{im} is not the CAPM beta. B_{im} measures the sensitivity of the asset's excess returns to the *square* of the market's excess returns.

The following data and graph illustrate the return pattern for a fund manager (i) with B_{im} = 0.50, and a_i = 1%, for a nonlinear regression with a perfect fit. All following numbers are in percent.

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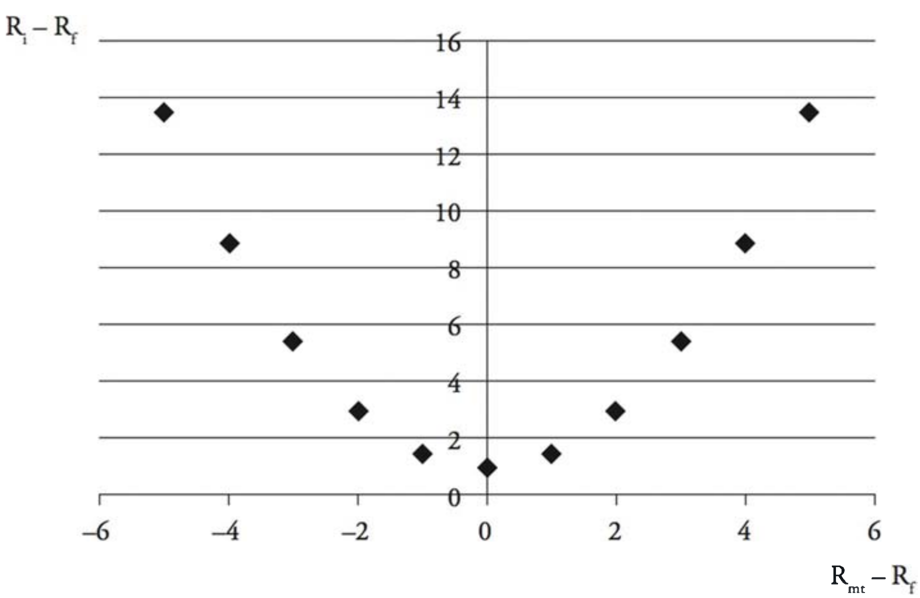
Figure 3: Manager Returns

$R_{mt} - R_f$	$(R_{mt} - R_f)^2$	$R_i - R_f$
–5%	25%	12.51%
–4%	16%	8.01%
–3%	9%	4.51%
–2%	4%	2.01%
–1%	1%	0.51%
0%	0%	0.01%
1%	1%	0.51%
2%	4%	2.01%
3%	9%	4.51%
4%	16%	8.01%
5%	25%	12.51%

Figure 4: Quadratic Curve Regression



Notice that the asset's excess returns improve as the market excess returns becomes either more positive or more negative. If B_{im} had equaled zero, the relation would have been a flat line at a value equal to the alpha. If the B_{im} had been negative, the relation would have been hump-shaped (peaking at a value equal to the alpha).

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Modeling Changing Correlation

LO 9.4: Demonstrate knowledge of methods for modeling changing correlation.

For example:
- Recognize and describe the concept of conditional correlation.
- Describe the rolling window approach to modeling changing correlation.

In many cases, alternative investment returns are **nonstationary**, implying that key parameters such as means, variances, and/or correlations are not constant over time. **Conditional correlation** is the correlation between two variables conditional on a specified set of circumstances (e.g., the correlation between the returns of two assets during up-markets only). Conditional correlations help explain the nature of nonlinear relationships, and are analogous to the dummy variable method used in dynamic risk exposure models discussed previously.

With regard to funds and markets, a **positive conditional correlation** refers to situations where the correlation between a fund's returns and the market's returns are more positive during up-markets than during down-markets. A **negative conditional correlation** refers to situations where the correlation is lower during up-markets than during down-markets. A positive conditional correlation is indicative of market timing skill. A negative conditional correlation shows that the fund is more exposed to down-markets than to up-markets, which also shows that the fund is poorly diversified.

Example: Nonstationarity and conditional correlation

The following table provides summary statistics for quarterly returns on the S&P 500 market index and three hedge funds, A, B, and C. **Explain** how the data demonstrates conditional correlations.

Periods When the Excess Return on the S&P 500 is Positive			
Asset	*Mean*	*Variance*	*Correlation with Market Index*
S&P 500	0.03	0.01	1.00
Fund A	0.06	0.05	0.90
Fund B	0.01	0.02	0.40
Fund C	0.04	0.04	0.40

Periods When the Excess Return on the S&P 500 is Negative			
Asset	*Mean*	*Variance*	*Correlation with Market Index*
S&P 500	–0.02	0.01	1.00
Fund A	–0.03	0.10	0.45
Fund B	–0.01	0.02	0.40
Fund C	–0.04	0.06	0.80

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Answer:

The data show that the correlation for Fund A changes over time. The conditional correlations for Fund A and the S&P 500 equal 0.90 and 0.45 during up-markets and down-markets, respectively. In contrast, the correlations are not conditional on the market circumstances for Fund B. The conditional correlations between the returns for Fund B and the S&P 500 equal 0.40, regardless of market condition.

Fund A is an example of positive conditional correlation—its correlation with the S&P 500 is higher during up-markets than during down-markets. Fund C is an example of negative conditional correlation—its correlation with the S&P 500 is higher during down-markets than during up-markets.

Time-varying correlations can be derived based on a **rolling window analysis**, in which a moving window of time is used to derive periodic correlations. For example, correlation sample A is calculated over January 2010 through December 2014, correlation sample B is calculated over February 2010 through January 2015, correlation sample C is calculated over March 2010 through February 2015, etc.

Time-varying regression estimates also can be derived using a rolling window approach. For instance, using a 120-month dataset, and 30-month rolling window regressions, a total of 91 regressions can be conducted (regression 1 spans months 1–30, regression 2 spans months 2–31, and so forth, until the last regression is run which spans months 91–120). The 91 regressions produce 91 estimates of the intercept and 91 estimates of each slope. These 91 regressions are not, however, independent statistical tests as they use overlapping data. Only four statistically independent 30 month regressions could be performed with 120 months of data (months 1–30, 31–60, 61–90, 91–120).

The dynamic nature of the risk factor exposures of the fund can be assessed by examining the slope estimates over time. Of particular interest is the examination of style drift, which is evidenced by drifts in the slope estimates over time.

Multifactor Applications

LO 9.5: Demonstrate knowledge of approaches to analyzing hedge fund returns using multifactor models.

For example:
- **Describe how style analysis and asset class groupings can be used to analyze fund performance.**
- **Describe how performance of a fund can be analyzed using returns of funds with similar strategies.**
- **Describe how marketwide factors can be used to analyze performance of a fund.**
- **Describe how specialized market factors can be used in hedge fund replication.**

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Multifactor models are applied to explain fund returns relative to:

- Returns of asset classes held by the fund (style analysis).
- Returns of funds with similar strategies.
- Market factors that drive asset returns.
- Fund replication using specialized market factors.

Each application is addressed below.

Style Analysis

Regression-based **style analysis** was developed by Nobel Prize winner, professor William Sharpe. In regression-based style analysis, a multiple linear regression is estimated in which portfolio returns are regressed against asset class index returns. Each slope coefficient measures the extent to which the portfolio is exposed to each asset class included in the regression. Examples of the asset class indices used in style analysis include various domestic and international stock and bond indices, as well as real estate and commodity indices. The *R*-squared indicates the degree to which the asset class indices explain the fund's returns, and 1 minus the *R*-squared indicates the degree to which the returns are attributable to manager skill or to luck. For instance, if the manager specifies and maintains a particular style and the style indices perfectly mimic the portfolio style, the regression would have an *R*-squared equal to one. An *R*-squared of one also would indicate that the fund manager added no incremental value beyond the asset class selections. Although style analysis has shown that up to 90% of mutual fund returns can be explained by underlying asset class returns, it has been much less successful when applied to alternative investments.

Similar Strategies

Returns of a portfolio can be compared against portfolios that follow similar strategies (long-only equity, long/short, market neutral, global macro, etc.). The approach works best when the portfolio holdings are observed, so that the investment style is easily determined. Difficulties with this approach when applied to hedge funds include:

- Holdings often lack transparency.
- Portfolios and risk exposures often change over time.
- Investment style often is not clearly verbalized.
- Within style, strategies and returns can differ greatly.
- Investment style of the fund may drift over time.

Principal components analysis is a multivariate statistical method that helps identify funds with similar strategies, without the need to observe fund holdings. The factors, called principal components, are derived statistically by grouping funds that have high return correlations. Therefore, each principal component comprises a subgroup of funds that behave similarly. Often, names of trading styles are assigned to the principal components according to the commonality characterizing the principal components. Research based on principal component analysis indicates that hedge funds can be classified into one of five trading style groups: distressed, global macro, value, opportunistic, and trend-following. Studies show that the principal component analysis is better than methods that compare fund returns against mixtures of observable traditional asset classes. For example, it is better to compare an opportunistic fund against a group of funds similarly grouped as opportunistic, than to compare an opportunistic fund against a benchmark comprising a mixture of various traditional asset classes (style analysis).

Marketwide Factors

The Fama-French three-factor model discussed previously can be used to examine the relationship between the returns of a fund and the returns on marketwide factors. The key to the Fama-French model is that the factors are tradable empirically derived, and factor exposure is empirically estimated. For example, two of the factors equal rate of return spreads between twin stock styles (small vs. big, high book-to-market vs. low book-to-market), and the factors are identified based on historical observation, not on theoretical derivation. The Fama-French model provides estimates of the portfolio exposure to each factor. The exposures are estimated from the regression, rather than derived from examining the holdings of the portfolio.

Similar models have been developed for hedge funds. The objective of the analysis is to develop an arbitrage-free model in which the model accurately explains the cross-sectional differences in fund returns. In other words, the model is helpful if no set of funds performs differently from the prediction of the model. Factors are developed based on four steps:

1. Identify variables (e.g., size) that conceptually differentiate fund returns.

2. Segment the sample in two groups based on each variable (e.g., small vs. big).

3. Derive the return spread between the two groups for each factor.

4. Test the data to see if the factor return spreads adequately explain the entire sample of asset returns.

Seven marketwide factors that have been identified for hedge funds include:

- Excess return on the S&P 500 (index return minus the risk-free return).
- Small cap minus big cap stock return.
- 10-year Treasury bond return minus the risk-free return.
- Baa-rated bond return minus 10-year Treasury bond return.
- Return on a portfolio of bond call and put options.
- Return on a portfolio of currency call and put options.
- Return on a portfolio of commodity call and put options.

The three option portfolios identified (i.e., the last three bullets of the list above) are constructed to match the payoffs for a series of **look-back options**. The payoff on a look-back option is based on the value of the underlying asset over a specific reference period, rather than just at the expiration date.

Fund Replication

Hedge fund replication is a process of identifying an investment strategy that mimics a particular fund's returns. In fund replication, a model is derived that uniquely identifies *specialized* factors for each fund and the exposure to each factor. A key goal is to have a beta that is approximately equal to the fund beta The key difference here versus the multifactor modeling discussed previously is that, for fund replication, the model identified factors for a specific fund, rather than marketwide factors for a broad cross-section of funds. In the fund replication method, a fund's return is explained by a specialized set of market-based (as opposed to marketwide) factors.

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Multifactor Return Summary

Some caveats are in order for applications of multifactor models for hedge funds.

- *Returns explained by returns of asset classes held by the fund.* This method does not apply well to hedge funds. Tests show that hedge fund returns are not explained well by passive asset class returns. For example, while a fund might hold commodity positions (e.g., a managed futures fund), the correlation of the fund with a commodities index might be low because the fund might hold long and short positions, and it might follow strategies more closely tied to trends (changes) in commodity prices rather than to the level of commodity prices.
- *Returns explained by returns on funds with similar strategies*. This method does not apply well to hedge funds. For instance, hedge funds often are unique, driven primarily by idiosyncratic risks, and, therefore, may not correlate highly with other funds that employ similar strategies.
- *Returns explained by marketwide factors.* This method does not apply well to hedge funds. For example, a merger arbitrage fund correlates more highly with probabilities of the merger's success than with marketwide factors. While marketwide factors fail to accurately explain individual hedge fund returns, the seven factors above explain 90% of the return variation for a diversified portfolio of hedge funds.
- *Returns explained by specialized market factors.* This method may work for hedge funds. Market-based factors might be identified uniquely for each fund. For example, a merger arbitrage fund's returns might correlate highly with a specialized factor representing hedged positions in all mergers.

Performance Persistence

LO 9.6: Demonstrate knowledge of estimating hedge fund performance persistence.

For example:
- **Discuss approaches to estimating hedge fund performance persistence.**

The persistence of fund performance is a key focus of performance evaluation. Can the fund manager consistently deliver superior returns? Both regression tests and skill-based measures are used to test performance persistence.

Regression tests. If the slope coefficient is positive for a regression of current hedge fund returns on past hedge fund returns, then good performance in the past is indicative of good performance in the future. Results of regression tests of the predictability of hedge fund returns are mixed. An issue with this form of analysis is that results may be driven by serial correlation. **Serial correlation** (or *autocorrelation*) is the correlation of the period t return with the period $t-1$ return. If the serial correlation of hedge fund returns is positive, then good performance in one period likely will be followed by good performance in the subsequent period. Unfortunately, serial correlation for hedge fund returns often is artificially induced because hedge fund returns may be based on smoothed appraisals, which artificially induces positive serial correlation into reported hedge fund returns. In addition, return comparisons typically fail to adjust returns in different periods according to their risk level. This failure to incorporate risk causes the finding that a given manager exhibits return persistence to have limited value.

Measures of skill tests. Persistence of performance exists if measures of skill are positively correlated over time. An example of a measure of skill is the fund's incremental return (i.e., risk-adjusted return) as measured by the CAPM, divided by the fund's standard deviation. Funds are ranked based on the skill measure, and the correlation of the rankings is calculated (i.e., the Spearman rank correlation discussed in Topic 2.4). If the correlation of the skill rankings is high, then we can conclude that performance persistence exists. Tests using this metric have supported the proposition of performance persistence among hedge funds. While this method adjusts for risk, it may fail to fully incorporate the true risk exposures of alternative assets.

Hopefully, improved measures of performance persistence that fully reflect a manager's skill will be developed in the near future as current measures make it nearly impossible to determine with certainty that a given fund or manager has exhibited performance persistence.

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Key Concepts

LO 9.1

A simple linear regression is a statistical method that estimates a linear relationship between a dependent variable and a single independent variable. In a simple linear CAPM-based regression, the asset's excess returns are regressed against the market's excess returns. The slope coefficient measures the asset's beta, which is the sensitivity of the asset's returns to changes in the market portfolio returns. The intercept of the CAPM-based regression equals the incremental performance of the asset relative to the CAPM benchmark return and is called the asset's alpha.

Ordinary least squares (OLS) is an estimation method that minimizes the sum of squared regression residuals.

- Outliers have disproportionately large effects on regressions due to the residual squaring process of OLS regressions.
- The OLS method assumes that regression residuals are not correlated with their lagged values. Violation of the assumption is called serial correlation, which causes standard errors and *t*-statistics to be incorrectly calculated.
- The OLS method assumes that the variance of the residuals is constant. Heteroskedasticity refers to a violation of the constant error variance assumption. Conditional heteroskedasticity is related to the level of the independent variables, and causes standard errors and *t*-statistics to be incorrectly calculated.

LO 9.2

Multifactor regression models describe relationships between asset returns and the returns on multiple risk factors. The Fama-French model is a multifactor model that regresses an asset's excess returns against the market's excess returns, firm size factor returns, and book-to-market factor returns.

Multicollinearity refers to the condition in which two or more of the independent variables are highly correlated. When independent variables are correlated, the intercept and slope standard errors are biased upward, which, in turn, biases the *t*-statistics downward.

The stepwise regression method chooses independent variables based on each variable's explanatory power. The first independent variable chosen is the one with the highest *t*-statistic for its slope. Then, additional variables are added sequentially depending on the magnitude of their *t*-statistics. Limited economic theory is applied when using stepwise regression, which can lead to overfitting.

LO 9.3

Nonlinear models examine nonlinear relationships between dependent and independent variables. Dynamic risk exposure models examine nonlinear relationships caused by factor risk exposures that change over time. Three dynamic risk exposure models are: dummy variable regression model, separate regressions model, and the quadratic curve regression model.

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LO 9.4

Alternative investment returns are nonstationary, implying that means, variances, and/or correlations are not constant over time. Conditional correlation is the correlation between two variables relative to a specific set of circumstances. A positive conditional correlation exists when the correlation between a fund's returns and the market index returns is higher in up-markets versus down-markets. A negative conditional correlation exists when the correlation is lower during up-markets than during down-markets. A positive conditional correlation is indicative of a good market timer.

Time-varying correlation and regression estimates can be derived using a rolling window analysis, in which a moving window of time is used to derive periodic correlation and regression slope estimates.

LO 9.5

Multifactor models explain fund returns relative to: returns of asset classes held by the fund, returns of funds with similar strategies, market factors that drive asset returns, and specialized market factors.

In regression-based style analysis, a multiple linear regression is estimated in which portfolio returns are regressed against asset class index returns. Each slope coefficient measures the extent to which the portfolio is exposed to each asset class included in the regression.

Principal components analysis is a multivariate statistical method that groups funds that correlate highly with each other. Studies show that funds can be classified into one of five trading style groups: distressed, global macro, value, opportunistic, and trend-following.

Hedge fund replication identifies investment strategies mimicking a particular fund's returns. In the fund replication method, a fund's return is explained by a specialized set of market-based (as opposed to marketwide) factors.

LO 9.6

Performance persistence can be examined with regression tests and measures of skill tests. Results of empirical testing regarding the performance persistence of hedge funds are mixed largely due to inadequate measures.

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Concept Checkers

1. Consider a large sample CAPM-based regression with the following results:

	Estimate	Standard Error
Intercept	0.01	0.05
Slope	1.50	0.50

Which of the following statements *best* describes the regression results, using a 5% level of significance?

A. For every 1-unit change in the market excess return, the asset's excess return changes by 0.01 units.
B. The alpha is significantly different from zero, but the beta is not significantly different from zero.
C. Both the alpha and the beta are significantly different from zero.
D. The beta is significantly different from zero.

2. A statistical method that sequentially adds factors to a multifactor model based on highest *t*-statistics is known as:

A. style analysis regression.
B. dynamic risk exposure regression.
C. stepwise regression.
D. rolling window regression.

3. A dynamic risk exposure model is estimated for portfolio *p*:

$$R_{pt} - R_f = 0.01 + [0.80 + D_1\ (0.30)]\ (R_{mt} - R_f)$$

where:
D_1 equals 1 when $R_{mt} - R_f$ is positive and equals 0 when $R_{mt} - R_f$ is zero or negative

Within this model, what are the correct values for the up-market beta and the down-market beta?

	Up-market beta	Down-market beta
A.	0.80	0.30
B.	0.80	0.50
C.	1.10	0.80
D.	0.80	1.10

4. During periods in which the market excess return is positive, the correlation between the ARB Fund returns and the market index returns is 0.80. During periods in which the market excess return is negative, the correlation between the ARB Fund returns and the market index returns is –0.20. The conditional correlation between the returns for the ARB Fund and the market index is:

A. nonstationary and negative.
B. stationary and negative.
C. nonstationary and positive.
D. stationary and positive.

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5. Which of the following methods derives factors by grouping funds that correlate highly with each other?
   A. Fama-French method.
   B. Principal components method.
   C. Regression-based style method.
   D. Specialized factor method.

6. The most likely problems when estimating performance persistence by examining the correlation between earlier and later returns are that:
   A. returns are not risk-adjusted and smoothed pricing can lead to negative serial correlation.
   B. returns are risk-adjusted and smoothed pricing can lead to negative serial correlation.
   C. returns are risk-adjusted and smoothed pricing can lead to positive serial correlation.
   D. returns are not risk-adjusted and smoothed pricing can lead to positive serial correlation.

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Concept Checker Answers

1. **D** The *t*-statistic for the beta equals the beta divided by its standard error = 1.50/0.50 = 3.0, which exceeds the critical value (1.96), based on a 5% level of significance. (LO 9.1)

2. **C** The stepwise regression method chooses independent variables based on each variable's explanatory power. The first independent variable chosen is the one with the highest *t*-statistic for its slope. Then, additional variables are added sequentially depending on the magnitude of their *t*-statistics. (LO 9.2)

3. **C** During down-markets, $D_1 = 0$, so the regression equation is:

   $R_{pt} - R_f = 0.01 + 0.80(R_{mt} - R_f)$.

   Therefore, the down-market beta equals 0.80.

   During up-markets, $D_1 = 1$, the regression equation is:

   $R_{pt} - R_f = 0.01 + (0.80 + 0.30)(R_{mt} - R_f)$, or

   $R_{pt} - R_f = 0.01 + 1.10(R_{mt} - R_f)$.

   Therefore, the up-market beta equals 1.10. (LO 9.3)

4. **C** Correlations that are not constant across all market conditions are nonstationary. A positive conditional correlation exists when the correlation between a fund's returns and the market index returns is higher in up-markets versus down-markets. (LO 9.4)

5. **B** Principal components analysis is a multivariate statistical method that groups funds according to the correlations of their returns with other funds. (LO 9.5)

6. **D** Alternative investments often are valued with a lag, based on smoothed appraisals. This induces positive serial correlation into reported hedge fund returns. Returns used for regressions are typically not risk-adjusted. To account for differences in risk, risk-adjusted skill-based measures can be used. However, these measures may fail to fully account for the risk inherent in alternative investments. (LO 9.6)

The following is a review of the Real Assets principles designed to address the learning objectives set forth by the CAIA Association®.

Natural Resources and Land

Topic 3.1

Exam Focus

This topic review examines real assets, including natural resources, land purchased for development, timberland, and farmland. You should understand the characteristics, risks, and returns of each of these alternative assets. Also, know the investment vehicles and methods of obtaining exposure to these alternative asset classes. Furthermore, it is important to understand that the market for real assets is thin (i.e., low transaction volume). As a result, real assets are often valued using the appraisal method. Be able to explain how data smoothing is a key area of concern for real assets because it reduces the variability of returns, making the asset class look less risky than it is. Finally, know the historical performance of timber and farmland, including their performance relative to world equities, global bonds, high-yield bonds, and commodities.

Warm-up: Real Assets and Natural Resources

Real assets are associated with investments that directly control nonfinancial assets and represent actual rights to consumption rather than indirect financial claims (i.e., **financial assets** such as stocks and bonds) to cash flows generated by the tangible and intangible assets of a firm.

Natural resources are a form of real assets that are still in their raw form and original location. Examples of natural resources include mining locations, water, and wind. Commodities are often created by removing or transforming natural resources (e.g., oil fields are a natural resource and extracted oil is a commodity).

Natural Resources

LO 10.1: Demonstrate knowledge of natural resources other than land.

For example:

- **Discuss natural resources as an exchange option.**
- **Discuss the concept of moneyness as it pertains to the development of natural resources.**
- **Discuss why some in-the-money options should not be immediately exercised.**
- **Describe the relationship between the moneyness of natural resource options and short-term financial risks.**

Many natural resources are subterranean (i.e., located below the surface of the earth). In the United States, private land ownership often includes both surface and underground rights. In addition, some states allow split estates. **Split estate** refers to estates where the surface rights to a property are owned by a different party than the rights to the minerals underneath the surface. However, many countries limit private land ownership to the

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surface, while governments retain possession of the mineral and energy natural resources located below the surface. Owners of the subterranean rights to a land parcel typically lease these rights (rather than sell the property) to developers to extract the natural resources.

Institutional investors interested in a portfolio allocation to natural resources can purchase pure play investments, purchase subterranean mineral rights, purchase surface land that includes subterranean mineral rights, or lease mineral rights.

A **pure play** investment refers to a direct investment that only contains the risks and earns the returns of the underlying asset. For institutional investors, it can be difficult to locate a pure play investment in the natural resources sector due to the ownership issues mentioned above (i.e., government ownership and private ownership that includes surface rights). However, a few pure play natural resource investments exist, such as *Natural Resource Partners* (NRP). NRP is a publicly traded master limited partnership that primarily owns U.S. mineral rights. However, even this investment is not completely a pure play as it earns approximately 10% of its revenues from equity and unconsolidated investment income.

Exchange Options

An **exchange option** is an option to exchange one risky asset for another risky asset. The capacity to convert natural resources to commodities can be considered an exchange option. Similar to a call option, an investor in an exchange option must pay the strike price. However, the strike price for exchange options is often uncertain for natural resources. This is because the money and resources required to convert the natural resource to a commodity are not known with certainty prior to the conversion. In option terminology, the inputs to the strike price would be considered the *deliverables* and the resulting output (i.e., commodities) would be the *receivables*.

Figure 1: Natural Resources Exchange Option Example

Deliverables (Costs incurred by Option Buyer)	*Receivables (Received by Option Buyer)*
• Mineral rights costs • Equipment costs • Labor costs • Material costs	• Commodities

Because both the extraction cost and the value of commodities are stochastic (i.e., randomly distributed and unable to be accurately estimated), the value of the option varies over time based on three factors: (1) the correlation between the deliverables and receivables prices, (2) the volatility of the deliverables' prices, and (3) the volatility of the receivable's price. These factors are the same as those identified by Markowitz in his work regarding an equally weighted two-asset portfolio.

Figure 2: Influence on Price of Exchange Option

Factor	*Impact on Option Price*
Correlation	Higher correlation decreases option value
Volatility of Inputs	Higher volatility increases option value
Volatility of Outputs	Higher volatility increases option value

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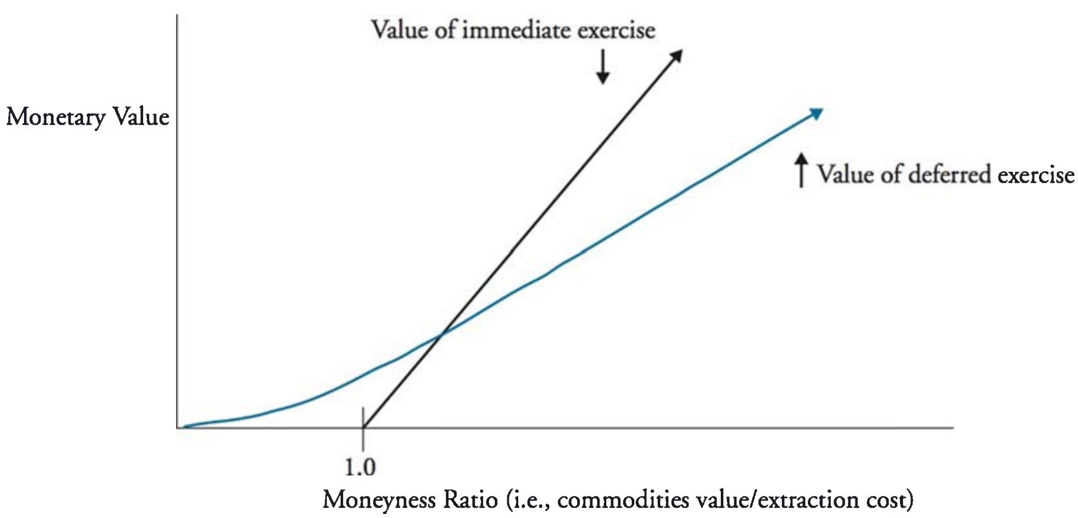
Natural resource development options can be either American or European style. American options can be exercised throughout the life of the option, while European options can only be exercised on the expiration date of the option. Some development options have a specific date of expiration, while the majority of natural resource development options never expire (i.e., **perpetual options**). Perpetual options must by definition be American options.

Moneyness refers to whether an option is *in the money or out of the money*. If immediate exercise of the option would generate a positive payoff, it is in the money. If immediate exercise would result in a loss (negative payoff), it is out of the money. When the current asset price equals the exercise price, exercise will generate neither a gain nor loss, and the option is *at the money*.

The lack of expiration date for a perpetual option increases the complexity of the decision of when to exercise. While the option must be in the money for exercise, the amount by which it must be in the money to make exercise worthwhile is more complicated to determine and relies on the three factors mentioned previously (correlation, input price volatility, and output price volatility). In the figure below, moneyness is based on the ratio of the receivables price relative to the deliverables cost. As the price of the receivables increases relative to the cost of the deliverables, the option's moneyness increases and exercise becomes more likely.

Figure 3: Moneyness of a Natural Resource Option



Delaying Option Exercise

We define the **intrinsic option value** (or *exercise value of an option*) as the maximum of zero and the amount that the option is in the money. That is, the intrinsic value is the amount an option is in the money (if it is in the money) or zero (if the option is at or out of the money). The intrinsic value is also the exercise value, the value of the option if exercised immediately.

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Prior to expiration, an option has time value in addition to any intrinsic value. The **time value of an option** is the amount by which the **option price** (premium) exceeds the intrinsic value and is sometimes called the speculative value of the option. This relationship can be written as:

option price = intrinsic value + time value

Returning to Figure 3, we can see that the options that are deep in the money (high intrinsic option value) possess a negative time value of money. That is, the holder of the option is likely to experience the greatest benefit by immediately exercising the option. In terms of exercise timing, a natural resource exchange option is similar to an American put option. Conversely, a deep out of the money option has zero intrinsic value but a positive time value of money.

Moneyness and Financial Risks

When a developer has multiple options that could be exercised, it is crucial to first exercise the one with the highest benefit to cost ratio (i.e., option that is most in the money). This is known as the **low-hanging fruit principle** and can be summarized as first developing the options that have the lowest opportunity cost relative to their benefits. In natural resource development, the low-hanging fruit principle is applied by analyzing all estimated costs of development for each option (e.g., legal costs, environmental remediation costs, extraction costs, transportation costs). Note that technological innovation can result in a shift in the cost of deliverables, so opportunity costs can vary greatly over different time periods and change the order in which a given set of options should be exercised. As a result, options that are unlikely to be exercised for a long period are most exposed to risks related to the cost of deliverables.

Land as an Alternative Asset

LO 10.2: Demonstrate knowledge of land as an alternative asset.

For example:
- **Define land banking.**
- **Describe the three types of land lots (i.e., paper lots, blue top lots, and finished lots).**
- **Discuss investment in undeveloped land as a call option.**
- **Apply the binomial option pricing model approach for valuing land as a call option.**
- **Describe the risks and returns of investing in land.**
- **Calculate the expected return of land investments.**

Undeveloped land (a.k.a. *raw land* or *unimproved land*) is a real asset that is not currently being used to generate a scarce resource, such as recreation, crops, or shelter. The value of undeveloped land lies in the future consumption that will arise as a result of its development. As mentioned previously, undeveloped land is sold with both the rights to improve as well as the rights to the natural resources beneath the surface of the land (e.g., mineral rights) in some jurisdictions. In other jurisdictions, the two potential sources of value are titled separately.

Land Banking

Some investors purchase undeveloped land for the purpose of developing the land in the future. This is called **land banking**. These investors buy land for the sole purpose of selling it to homebuilders in the future. The value increases if the location is in the path of future development, residential growth, or both. Thus, undeveloped land near metropolitan areas is more valuable and expensive than undeveloped land that is far from existing development. Improved lots that are held by third parties but are optioned by homebuilders for future use are also classified as land banking.

Land is categorized based on the level of existing improvements that have been made. Lots which may be purchased for investment are classified as:

- **Paper lots.** These lots are vacant but have zoning approval for development.
- **Blue top lots.** The process of development has begun for these lots, including rough grading of the property and interim drainage and erosion controls. Some development fees as well as building permit fees have not been paid.
- **Finished lots.** These lots are ready for construction with all development fees paid. What remains is the payment for the building permit and property inspection.

Historically, builders purchased and inventoried lots for future use. However, as building companies have grown in size and sophistication, they have increasingly relied on third parties to bank land on their behalf. Institutional investors now provide lots to homebuilders in the full spectrum from unfinished to ready for construction.

Land investing is a long-term strategy. Investors seek properties that can be purchased at an attractive price relative to the property's value as a finished project. The time from investment in the land to the finished project can be years.

Key risks that investors face in undeveloped residential land are:

- **Type.** The more potential uses for a piece of land, the more valuable it is. Therefore, single-use properties are typically more risky.
- **Location.** For example, lots in the path of future development and those closer to cities and suburbs are more valuable than those in rural areas. Therefore, rural properties typically have a higher level of risk.

Land as a Call Option

Investors in undeveloped land are in essence buying a call option on development. The components of the call option are:

- **Strike or exercise price.** The strike price consists of construction and other costs required for developing the land (e.g., consider the cost of developing the land and constructing a duplex).
- **Time to expiration.** The option typically does not have an expiration date. The time to develop the land is generally unlimited.
- **Underlying asset.** The underlying asset is a combination of the land and the improvements that are made to develop the land (e.g., a duplex and the land on which the duplex sits).
- **Option payoff.** The payoff of the option is the difference between the value of the completed project (i.e., the value of the underlying asset) and the cost of developing and constructing the project (i.e., the strike price).

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- **Exercising the option.** The option will be exercised (i.e., the property will be developed) when the expected income from the developed property exceeds the value of retaining the option to develop the property.
- **Moneyness.** If the value of the underlying asset is greater than the strike price, the option is in the money and if the value of the underlying asset is less than the strike price, the option is out of the money. The volatility of the spread between the asset value and the strike price, the income yield of the completed project, the risk-free rate, and the costs of holding the property such as taxes and insurance, all affect the value of the option.

With traditional call options on stocks, the strike price is fixed. However, with land, the strike price can increase or decrease. This is because the cost of construction is positively correlated with the price of the improved property. Increasing real estate prices draw new builders into the market. This, in turn, pushes the price of construction materials and services up as demand increases.

If land has mineral rights associated with it, the opportunities are similar. The cost of mining and refining the minerals is the strike price. The refined minerals are the underlying asset. The value of land with mineral rights is likely higher than land purchased solely for development because the volatility of metal and energy prices increases option values.

An investor can analyze the value of developing land using single or multiperiod binomial option pricing models. In a **binomial option pricing model**, there are only two possible outcomes, an upward movement or a downward movement with a risk-neutral probability of each outcome occurring. **Risk-neutral probabilities** assume that investors are risk neutral (i.e., indifferent to varying levels of risk given a level of return) and therefore are not necessarily real world probabilities. Using risk-neutral probabilities allows risky assets to be discounted using a risk-free rate of return. Assuming a 0% risk-free rate and a one-period model simplifies the analysis. An important difference from the binomial tree option models covered previously is that the downward node for land options can have non-zero values.

Example: Land as a binomial option

Arch Faley, a real estate developer, is considering an investment in a piece of undeveloped land. Faley would like to estimate the value of the option to develop the land using a binomial option pricing model approach. He assumes a 0% risk-free rate of interest and will use a single-period model. Faley determines that if the economy weakens, the cost of construction will be $200,000, but the value of the finished project will be $175,000. If the economy strengthens, the cost of construction will increase to $250,000, but the value of the completed project will be $340,000. Faley conducts an analysis of comparable finished projects in the region and finds they are selling for $208,000. **Calculate** the value of the option to develop the property.

Answer:

Step 1:

Use the value of comparable projects and the up movement and down movement values to determine the risk-neutral probability that the economy will strengthen. If the risk-free rate is zero, there is no need to discount cash flows back to the present. Also, with a zero rate, the ending value of the property based on risk-neutral probabilities will be equal to the current value (i.e., the value of comparable improved properties in the market).

current value of improved properties = (UpVal × UpProb) + [DownVal × (1 – UpProb)]

where:
UpVal = value in an improved or up state of the economy
DownVal = value in a worsened or down state of the economy
UpProb = risk neutral probability of the up state
(1 – UpProb) = risk neutral probability of the down state

Inserting the comparable property value and the value given an up or down state, we solve for the up probability as follows:

$208,000 = ($340,000 × UpProb) + [$175,000 × (1 – UpProb)]
$208,000 = $340,000 × UpProb + $175,000 – 175,000U
$208,000 – 175,000 = $340,000 × UpProb – 175,000U
33,000 = 165,000 × UpProb
33,000 / 165,000 = UpProb
0.2 = UpProb

Therefore, the UpProb is 20% (or 1/5) and the down probability (1 – 0.20) is 80% (or 4/5).

Step 2:

Insert the probabilities calculated above the equation introduced in Step 1 to find the value of the option. You must first find the value of the project in either state of the economy (i.e., up or down). The value of the option is then the weighted-average value based on the probabilities of the up and down states.

$$\text{option value}_{\text{up state}} = \$340{,}000 - \$250{,}000 = \$90{,}000$$

$$\text{option value}_{\text{down state}} = \$175{,}000 - \$200{,}000 = -\$25{,}000$$

In the case of the loss, the investor would allow the option to expire unexercised (i.e., would not undergo construction) so it would be worth zero.

Using this information, the value of the option is calculated as:

option value = ($90,000 × 0.2) + ($0 × 0.8) = $18,000

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Additional Scenarios

Once the probabilities are calculated, the investor can perform scenario analysis. For example, assume construction costs are not positively correlated with improved property values, but are instead fixed. If construction costs are fixed at \$210,000 (the original expected value), then the value of the option rises to:

$$(\$340{,}000 - \$210{,}000) \times 0.20 = \$26{,}000$$

Volatility of the value of the underlying asset also increases the value of an option. This is because the upside potential is increased, but the limited downside (i.e., allowing the option to expire unexercised) prevents an increase in the potential loss. For example, returning to the original values, if the property is worth \$400,000 in an up economy and only \$150,000 in a down state, the option value increases to:

$$(\$400{,}000 - \$250{,}000) \times 0.20 = \$30{,}000$$

This is a simplified, 1-period, 0% risk-free rate example. The analyst could increase the complexity of the model by making alternative interest rate assumptions (which would require discounting future cash flows) or choosing a multiperiod model.

Risk and Return of Land

Raw land is a risky investment because it does not provide the investor with an annual cash flow and generally requires a longer holding period. However, it does not require constant maintenance, as developed properties do, and it typically does not lose value over time the way some developed properties do.

The expected return of land is a probability-weighted average of the expected returns if the land is developed or not developed. For example, assume there is a 15% chance that a parcel of land will be developed and an 85% chance that it will not be developed. If developed, the return is expected to be 30%. If not developed, the return is expected to be 4%. The probability that a property will be developed affects the expected return on the investment. The expected return on the land is:

$$E(R) = [P_d \times E(R_d)] + [(1 - P_d) \times E(R_{nd})]$$

where:
P_d = probability of developing land
$E(R_d)$ = expected return of developed land
$E(R_{nd})$ = expected return of undeveloped land

Thus, the expected return of the undeveloped land is:

$$E(R) = (0.15 \times 0.30) + (0.85 \times 0.04) = 7.9\%$$

Some analysts argue that undeveloped land is a poor investment because prices do not increase substantially over time. However, the returns to developed land are higher. Land that has not been developed was likely a bad investment (i.e., investors let the call options expire unexercised). Thus, if analysts only consider the returns to properties that were never developed, they are understating the expected returns to all undeveloped land investments by virtue of ignoring the returns on the properties that were developed (the winners). This is an example of **negative survivorship bias**, which we illustrate below.

Example: Negative survivorship bias

Assume that an equally-weighted undeveloped land index exists. Last year, 10% of the properties used as components in the index were developed and removed from the index. During this period, developed properties increased in value by 10%, while undeveloped properties increased in value by 3%. Calculate the negative survivorship bias for this index.

Answer:

The return on the index is 3%. However, the actual return of all the properties originally contained in the index is calculated as follows:

$$(0.90 \times 0.03) + (0.10 \times 0.10) = 3.7\%$$

Therefore, the return on the index has a negative survivorship bias of 0.7% (= 3.7% – 3%)

Professor's Note: Beware of the unique nature of survivorship bias for undeveloped land. We often see positive survivorship bias in investment indices due to the removal of underperforming or defunct investments. For undeveloped land indices, the reason for removal is due to the investment's increased value, so negative survivorship bias occurs.

Timber and Timberland as Alternative Assets

LO 10.3: Demonstrate knowledge of timber and timberland as alternative assets.

For example:

- Discuss the characteristics of timber and timberland.
- Discuss the role of timberland investment management organizations (TIMOs).
- Describe the risks and returns of timberland investments.
- Identify methods of timberland ownership.

Timberland is an alternative investment that has garnered attention in recent years. Investors make long-term investments in wood via existing forestland. There is private (i.e., companies and individual investors) and public (i.e., government) ownership of forestland. Much of the forests worldwide are publicly owned, ranging from 98% in Africa to approximately 43% in the United States. The United States is unique among nations in having a majority of forests privately owned.

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Historically, firms dealing in wood products were highly integrated. However, in the late 1970s and 1980s, leveraged buyouts (LBOs) resulted in the sell-off of various divisions of companies, including timberland. For example, Sir James Goldsmith bought Crown Zellerbach in the 1980s and then sold the firm's forests and other assets at large margins. Firms such as Boise Cascade and International Paper sold off their own timberland assets in an attempt to stave off takeover attempts. They generally sold their timberland with long-term agreements to purchase timber from the new owners.

There has also been a significant increase in **timberland investment management organizations** (TIMOs) in recent years. TIMOs manage timberland owned by investors for a fee. They also share in profits when timber is harvested. This has changed the ownership structure of timberland. Ownership is now dominated by institutional investors such as pension funds, insurance companies, and endowments.

Timberland Risk and Return

Timberland returns exhibit low correlation with stock and bond returns. This is generally cited as the key advantage to investing in timberland. However, it is difficult to measure the returns to illiquid assets such as timberland, so the low correlation may be more a function of poor measurement of returns than of truly uncorrelated or negatively correlated returns.

Advantages of investing in timberland include:

- Low correlation with stock and bond returns.
- May act as a hedge against inflation.
- Investors are making an investment in land, a real asset.
- Timber is a renewable resource although it has a long growth cycle.
- There is some flexibility with respect to harvesting. If an investor postpones harvest to wait for higher prices, the trees continue to grow, gaining value.
- Timber can be used for a variety of products, which may add significant value if alternative uses are not perfectly correlated.

Disadvantages of investing in timberland include:

- Trees can be destroyed by fire, disease, drought, and other natural disasters.
- The value of timber is closely related to cyclical industries such as home construction.
- Timber supplies are renewable, rather than fixed like commodities such as gold and oil.
- Technology and recycling may diminish the demand for timber.
- The investment horizon is quite long. Pine takes 25 to 60 years to grow from seed to harvest (called **rotation**) and hardwoods require 60 to 80 years to produce high quality saw-timber products.

Owning Timberland

While most timberland is owned and traded by institutional investors, there are two ways that individuals can invest in timberland:

1. **Exchange-traded funds** (**ETFs**) developed to track the S&P Timber and Forestry Index. There are two ETFs that track timberland and both have underperformed the index with more volatility.

2. **Real estate investment trusts** (**REITs**). There are four REITs that invest in timberland.

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Farmland as an Alternative Asset

LO 10.4: Demonstrate knowledge of farmland as an alternative asset.

For example:

- **Discuss the characteristics of farmland investments.**
- **Calculate the value of farmland based on annual operating income and the cap rate.**
- **Discuss financial analysis of farmland investments.**
- **Discuss factors that affect farmland prices and returns.**
- **Describe farmland as a multiple use option.**
- **Identify methods of obtaining exposure to farmland.**

Like timberland and land purchased for development, **farmland** is an investment in a real asset. However, unlike timberland and land intended for development, farmland generates annual crop income. The crop cash flow generated from farming is more closely linked to commodity prices than to rents. As a result, the price of farmland itself is highly correlated with commodity prices.

Owners lease farmland to local farmers, cooperatives, or sometimes to agricultural corporations. Leasing the farmland introduces an agency relationship. The property owner (the principal) entrusts decision-making power to the local farmer (the agent) to act in the best economic interest of the owner. However, the decisions the farmer makes may not maximize the economic benefits to the owner (e.g., damage long-term soil quality in order to maximize short-term crop income). This is an example of **agency risk**.

Farmland Prices and Returns

Benefits that accrue to farmland investors include:

- A *renewable annual cash flow stream* from crop income.
- A potential *steady cash flow stream*, received on a calendar basis, if the land is leased.
- A *short growth cycle*. This allows for planting and harvesting the crop within one year (contrasted to timber, which takes up to 80 years to harvest).
- The shorter growth cycle allows for a *valuable, multi-purpose option* on the land, allowing the owner to *repurpose the land*. For example, if the farm is planted in soybeans and the price of corn increases, there is a short period before the land can be repurposed to take advantage of higher corn prices. In contrast, timberland typically does not have a multi-purpose option.
- An expected *increase in the world's population* (forecasted to increase by 33% in the next 40 years) will increase the need for food and thus land, increasing land values.
    - *Increasing use of crops to produce bio-fuels* increases commodity prices and land values.
    - *Favorable government policies.* Government policies are usually favorable to farmers. Crops are often subsidized and improvements to farmland, such as drainage systems, may be rapidly depreciated for tax reporting.
    - *Revenues, and thus farmland prices, are less dependent on local economies.* Commodities such as soybeans, wheat, and corn trade on international markets and prices are quoted on international futures exchanges.
    - *Farmland does not deteriorate and require repairs over time.* Unlike buildings, farmland does not usually deteriorate.
    - *Farming is scalable.* It takes a relatively small marginal increase in labor and machinery to farm additional land. This means there is strong competition to lease farmland.

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Disadvantages incurred by farmland investors include:

- *Agency risks* that result from leasing the property to farmers and cooperatives.
- *Political risks* that result from government decision-making. **Political risks** refer to the potential for governments to make decisions that decrease the value of farmland (e.g., reducing or eliminating government agricultural subsidies). Also, in some countries such as Zimbabwe, the government has expropriated lands from private owners.
- *Less flexibility in harvesting schedules.* Timberland investors have flexibility in determining the best time to harvest wood. Farmers must harvest annually, and often in a short time window.
- *Natural forces may destroy a crop.* Droughts, floods, storms, or other natural factors may destroy an entire crop.
- *Farm-specific inefficiencies.* In some cases, a farm may earn lower returns than its competitors due to inefficiencies of operation.
- *Revenues are driven by market factors.* Macro factors, such as commodity prices, affect revenues.

Financial Analysis of Farmland

Return on equity (= net income/owner's equity) and operating return on assets (= operating income/total assets) are both used as financial metrics in farmland transactions. Note that the return on assets is often called the **cap rate** (capitalization rate) in real estate. The financial aspects of a farmland investment are explained in the following example.

Example: Calculating returns to farmland

Assume a piece of farmland costs $11,000 per acre and an investor purchases 100 acres. The investor finances 75% and puts 25% equity in the deal. The bank loan rate is 5%. The investor leases the farm to a local farmer for $1,200 per acre per year for annual revenue of $120,000. Property taxes are $30,000 and insurance is $10,000. **Calculate** the return on equity and cap rate for the investor.

Answer:

Purchase Price	$1,100,000
Bank Financing	825,000
Equity Investment	275,000
Annual Revenue	120,000
Less Property Taxes	–30,000
Less Insurance	–10,000
Operating Income	80,000
Less Interest (0.05 × 825,000)	–41,250
Net Income	$38,750

return on equity = 38,750 / 275,000 = 0.1409 = 14.09%
cap rate = 80,000 / 1,100,000 = 0.0727 = 7.27%

The cap rate (or yield) is 7.27% in this deal. One way an investor might value real estate is to divide the annual operating income from the deal by the cap rate. In other words, you just reverse the previous equation and solve for price instead of yield as seen in the following equation.

value of real estate = annual operating income / cap rate

value of real estate = 80,000 / 0.0727 = $1,100,000

Multiple Use Options

The key factors that affect the value of farmland are potential revenues (i.e., commodity prices) and farming expenses. In turn, revenues and expenses are affected by macroeconomic factors and government policies. However, farmland has multiple uses, creating a higher option value than if the property only had one potential use. For example, a farmer could switch a farm from soybeans to corn with little cost if government subsidies for corn increased due to a push for increased ethanol production.

Three factors drive the value of the option to produce alternative crops:

- The **correlation** (or lack of) between the profitability of each alternative crop.
- The **volatility** of the profitability of each alternative crop.
- The **current closeness of the profitability** of each alternative crop.

If the profitability of each crop is very different, there is no incentive (i.e., reduced option value) to switch from the more profitable crop to the less profitable crop. Also, if there is little variability in the price of either crop, there is no incentive to switch. Finally, if the commodity prices are highly correlated, there is no incentive to switch.

The value of an agricultural option may increase based on other alternatives for the land, such as residential or commercial development or mineral extraction. The potential for agricultural or nonagricultural uses can dramatically increase the value of the multi-use option. The correlation between the profitability of nonagricultural and agricultural uses is likely lower than the profitability of different crops for agricultural-use only land.

Farmland Exposure

Private ownership of farmland is the key way to gain exposure to farmland in a portfolio. There are two indices that track the farmland and agribusiness industry: DAX Global Agribusiness Index and the Thomson-Reuters-in-the-Ground Global Equity Index. Both indices track publicly traded companies engaged in agricultural products, packaged foods, seeds and fertilizers, and farm machinery. There is also an ETF (ticker symbol MOO) that invests in stocks represented in the DXAG Index. The performance of the MOO is similar to that of the index.

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Smoothing and Volatility

LO 10.5: Demonstrate knowledge of valuation and volatility of real assets.

For example:
- **Discuss the smoothing of prices and returns.**
- **Determine the effect of smoothing on observed volatility.**
- **Describe how values and returns are managed.**
- **Discuss how appraisals contribute to smoothing of real asset prices.**
- **Compare smoothed returns with market returns.**

Many of the assets discussed in this section are illiquid and most are not traded on an exchange. As a result, real assets are often valued based on appraisals. The result is that prices are smoothed. **Smoothing** results in lower volatility of prices and returns, which makes an asset look less risky than it might actually be.

For example, consider a bank certificate of deposit (CD) that has a large penalty for withdrawal. It appears "safer" than a Treasury bill (T-bill) because the bank statement ignores the impact of rate changes and reports a stable value for the CD. Conversely, a T-bill is less risky than the CD because it is more liquid (i.e., no penalty for early withdrawal) but looks riskier due to the sensitivity of the T-bill to interest rate changes. The value and returns of the CD in this example are subject to smoothing, while the value and returns of the T-bill are not.

Volatility Impact of Smoothing

Managers may have an incentive to smooth perceived "outliers." For example, if returns were 10%, 20%, 30%, –10%, –20%, and –30% across six years (not necessarily in that order) the average return is 0% and the standard deviation of returns is 23.66%. However, if the returns are smoothed and the highest and lowest returns (i.e., 30% and –30%) are changed to 20% and –20%, the mean return is still zero, but the standard deviation of returns falls to 19%. Smoothing also reduces the correlation of an asset's returns with unsmoothed returns on other assets, which implies that the benefits from diversification are greater than they actually are.

Volatility Impact of Managed Returns

Managed returns occur if managers have discretion with respect to reporting asset values. Asset values and returns may be managed in the following four ways:

1. **Market manipulation.** The prices of thinly traded assets may be manipulated through trading activity. For example, placing an order to buy near the close of trading may result in a higher closing price for a stock that has low trading volume. This may be used to report more favorable results or to smooth prices.

2. **Model manipulation.** Assumptions in valuation models may be altered to get the desired price and return results. This method may be used when valuing unlisted assets, such as some derivatives. Increasing the estimated volatility of an underlying asset's returns will increase an option's value, for example.

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3. **Selective appraisals.** Because appraisals are expensive, managers often order them infrequently. A manager can manipulate the timing of appraisals and the assets to be appraised in order to manage returns.

4. **Favorable mark.** A manager may request a valuation of an asset from a source that has an incentive to bias the value in favor of the manager (e.g., seek high property appraisal in order to qualify for larger mortgage).

Appraisals and Smoothing

Real assets are generally unique and are not traded in active secondary markets. As such, values are often based on appraisals. Problems with appraised values include:

- Appraisers may unintentionally underprice assets that have experienced a large increase in value and overprice assets that have experienced a large decrease in value. This results in smoothing of prices and returns, implying lower risk than is actually present.
- Real assets are often illiquid. Months may go by between the agreement on a price and the actual transaction. Thus, appraised values often lag true market values. The lag results in lower reported correlations compared to actual correlations. This increases the perceived diversification benefit of adding these assets to a portfolio.

Market Returns vs. Smoothed Returns

One issue that is relevant to real asset valuation is whether market prices or appraised values are better. For example, market prices for publicly traded assets seem unduly influenced by the market's mood and emotions. For example, **contagion may occur**, where a crisis in one market sector spills over to seemingly unrelated markets (e.g., a large price drop in the financial sector may cause a decrease in the price of healthcare REITs). Conversely, appraised values may not reflect true values in a timely fashion. Whether one method is better than the other is unclear as both may fail to reflect the true asset volatility. However, it does seem clear that appraised values result in the false perception that appraised assets are less risky than they are and have a lower correlation with other asset classes than they actually do. Both may lead investors to assign a higher portfolio weight to real assets than is optimal.

Historical Performance of Timber and Farmland

LO 10.6: Demonstrate knowledge of historical performance of timber and farmland.

For example:

- **Recognize inferences that can be drawn from comparing definable characteristics of timber and farmland investing with their historical stand-alone and portfolio performance.**

In general, timberland and farmland performed well during the period January 2000 to December 2014. Returns were generally positive and volatility (i.e., standard deviation of returns) was low. The Sharpe index indicates strong risk-adjusted performance for both asset classes. Figure 4 uses quarterly return data for the NCREIF Timberland and Farmland indices as well as equity, bond, and commodity benchmarks.

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It is important to remember that timberland and farmland returns are based on appraised values. This has a tendency to smooth returns, reducing the volatility of returns. Also, since appraisals are expensive, they are not conducted daily or monthly, but generally quarterly or less frequently. As such, the timberland and farmland data is based on quarterly, not monthly, returns. To ensure consistency, quarterly return data is used here for the other indices as well. Elsewhere, monthly data is used.

Figure 4: Returns of Timberland and Farmland compared to benchmarks, January 2000–December 2014[1]

Asset Class (Index)	*Average Return*	*Standard Deviation*	*Sharpe Ratio*	*Maximum and Minimum Returns*	*Skewness*	*Maximum Drawdown*
Timberland (NCREIF Timberland)	6.5%*	5.4%	0.79	12.0% and –6.5%	1.0*	–6.5%
Farmland (NCREIF Farmland)	13.3%*	7.7%	1.45	22.8% and 0.0%	3.0*	0.0%
World Equities (MSCI World)	4.7%*	17.9%	0.14	20.7% and –21.8%	–0.4	–49.0%
Global Bonds (Barclays Capital Global Aggregate Bond)	5.7%*	6.0%	0.58	9.0% and –3.4%	0.5	–6.3%
U.S. High-Yield Bonds (Barclays Capital U.S. Corporate High Yield)	7.9%*	11.0%	0.52	23.1% and –17.9%	0.1	–27.1%
Commodities (S&P GSCI Total Return)	4.8%*	26.0%	0.10	28.7% and –47.0%	–0.9*	–66.2%

* Significance at 95% confidence level

The returns in Figure 4 represent average returns of assets within the asset class. Because it is an average across business lines, actual investors could experience returns quite different from those reported in the table. For example, someone investing in a paper manufacturing company might have experienced negative returns, while an investor in actual forestland simultaneously earned positive returns.

Notice that returns and Sharpe ratios for both timberland and farmland are strong. The Sharpe ratio of 1.45 for NCREIF Farmland is the highest of the reported indices.

Maximum drawdown, the percentage difference between the peak and the trough of an index or investment, was also lowest for farmland at 0%, with timberland coming in third lowest at –6.5%.

Another way to consider returns to investors is to examine the accumulated wealth over the period. For example, $1,000 invested in farmland in January 2000 would have grown to approximately $6,800 by the end of 2014. The same $1,000 invested in timberland would have grown to approximately $2,500 by the end of 2014. For comparison, if the $1,000 had been invested in global equities, the investor would have ended with approximately $1,600 at the end of the 15-year period. An investment in global bonds would have grown to $2,300.

1 Chambers, Donald R. et al., *Alternative Investments: CAIA Level I, 3rd Edition* (Wiley Finance, 2015)

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Finally, beta and correlation analysis indicate little or no relationship between timberland and farmland indices and other major market indices. The correlation coefficient between timberland and world equities is 0.00. The correlation between farmland and world equities is 0.19. This implies that there would be risk reduction benefits from adding farmland and timberland to a portfolio of traditional assets. An ad hoc analysis of returns at different economic periods and events (e.g., the post internet bubble, the financial crisis, the 9/11 terrorist attacks) indicate that both farmland and timberland returns appear unrelated to equity returns during major events.

In addition, timberland and farmland have favorable correlations with commodities (–0.06 and –0.15, respectively). This indicates that timberland and farmland provide investment portfolios unique diversification benefits relative to the diversification benefits offered by commodities.

Professor's Note: One of the themes that runs throughout this topic review is the issue of return measurement. The fact that real asset prices are generally determined by an appraisal, rather than determined by the market, results in smoother returns. This smoothness makes some individuals suspicious of the reported returns. In other words, maybe the returns look good because the appraisal is timed to maximize value, et cetera. However, the message in this topic review is that even if returns are smoother than market returns, and volatility is lower than volatility derived from market prices, timberland and farmland still appear to be strong performers with robust average returns and Sharpe ratios. Also, their returns do not appear to be highly correlated with other traditional asset class returns, implying that there is a potential risk reduction benefit to adding farmland and timberland to traditional portfolios, despite issues with data smoothing.

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Key Concepts

LO 10.1

An exchange option is an option to exchange one risky asset for another risky asset. The option to convert natural resources to commodities can be considered an exchange option. In option terminology, the inputs to the strike price would be considered the deliverables (i.e., mineral rights, equipment, labor, and materials) and the resulting output (i.e., commodities) would be the receivables.

Moneyness refers to whether an option is in the money or out of the money. The lack of expiration date for a natural resource perpetual option increases the complexity of the decision of when to exercise the option. While the option must be in the money for exercise, the amount it must be in the money in order to exercise is more complicated to determine and relies on correlation, input price volatility, and output price volatility.

A change in the price of the resulting commodity is the primary short-term risk factor of in-the-money natural resource options. Long-term out-of-the-money options have a greater sensitivity to changes in the costs of the option's deliverables.

LO 10.2

Land banking involves the purchase undeveloped land for the purpose of developing the land in the future.

Investment land can be classified into the following three types:

- Paper lots. These lots are vacant but have zoning approval for development.
- Blue top lots. The process of development has begun for these lots including rough grading of the property and interim drainage and erosion controls and some fees have been paid.
- Finished lots. These lots are ready for construction with all development fees paid.

Raw land is a risky investment because it requires a long holding period and does not provide the investor with an annual cash flow. Raw land does not require constant maintenance, as developed properties do, and it does not lose value over time the way some developed properties do.

Investors in undeveloped land are in essence buying a call option on development. A binomial option pricing model can be used to value land as a call option. The components of the option are:

- Strike price. The strike price consists of construction and other costs required for developing the land.
- Time to expiration. Typically unlimited.
- Underlying asset. The underlying asset is a combination of the land and the improvements that are made to develop the land.
- Option payoff. The payoff of the option is the difference between the value of the completed project (the value of the underlying asset) and the cost of developing and constructing the project (the strike price).

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- Exercising the option. The option will be exercised (i.e., the property developed) when the expected income from the developed property exceeds the value of retaining the option to develop the property.
- Moneyness. If the value of the developed property (the underlying receivable asset) is greater than the strike price, the option is in the money.

LO 10.3

Investors make long-term investments in wood (timberland) via existing forestland. There is private (i.e., companies and individual investors) and public (i.e., government) ownership of forestland.

Advantages of investing in timberland include: low correlation with stock and bond returns, the investment serves as an inflation hedge, real asset investment, a flexible harvesting schedule, and multiple uses for timber products.

Disadvantages of investing in timberland include: natural disasters can destroy the investment, investment values are tied to cyclical industries, timber supplies are not fixed, technology and recycling may diminish the demand for timber, and the investment horizon is long.

Public investment in timberland occurs via exchange-traded funds (ETFs) and real estate investment trusts (REITs).

LO 10.4

Farmland is an investment in a real asset. Farmland generates crop income. The cash flow generated from farming is more closely linked to commodity prices than to rental prices.

A capitalization rate (cap rate) may be used to value farmland. The value of farmland using a cap rate model where the capitalization rate equals the operating cash flow of the farm divided by the total assets of the farm is:

$$\text{value of real estate} = \frac{\text{annual operating income}}{\text{cap rate}}$$

Farmland provides a renewable annual cash flow stream from crop income, enjoys a potential steady cash flow stream if the land is leased, and has a short growth cycle, which increases its value because it allows for multi-use options. Farm revenues are driven by market factors.

Private ownership of farmland is the key way to gain exposure to farmland in a portfolio. There are two indices that track the farmland and agribusiness industry. There is also an ETF that invests in stocks represented in the DXAG Index.

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LO 10.5

Many real assets are illiquid, not traded on an exchange, and valued based on appraisals. The result is that prices are smoothed. **Smoothing** results in lower price and return volatility. This makes the asset look less risky than it might actually be.

Appraisals contribute to smoothing of real asset prices because:

- Appraisers may unintentionally underprice assets that have experienced a large increase in value and overprice assets that have experienced a large decrease in value. This results in smoothing of prices and returns, implying lower risk than is actually present.
- Appraised values often lag true market values. The lag results in lower reported correlations compared to actual correlations.

Real asset returns are managed by:

1. Market manipulation. The prices of thinly traded assets may be manipulated through trading activity.

2. Model manipulation. Assumptions in valuation models may be altered to get the desired price and return results.

3. Selective appraisals. Because appraisals are expensive, managers often order them infrequently. A manager can manipulate the timing of the appraisal and also the assets to be appraised in order to manage returns.

4. Favorable mark. A manager may request a valuation of an asset from a source that has an incentive to bias the value in favor of the client.

There is a debate about whether market prices are better than appraised values. Market prices for stocks seem unduly influenced by the market's mood and emotions (e.g., contagion). Conversely, appraised values may not reflect true values in a timely fashion and result in smoothed price and return data.

LO 10.6

Average returns and Sharpe ratios for both timberland and farmland were strong during the period January 2000 to December 2014. The Sharpe ratio of 1.45 for NCREIF Farmland is the highest of the reported indices. In addition, both asset classes have low correlation with other asset classes. This indicates that farmland and timberland offer diversification potential to an investment portfolio.

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Concept Checkers

1. Which of the following statements regarding a perpetual, natural resource option that is deep in the money is *most accurate*?
   A. This option is an American option.
   B. This option is best viewed as a covered call rather than an exchange option.
   C. The value of the deliverables will be higher than the value of the receivables.
   D. A decrease in the volatility of the associated commodity will increase the value of the option.

2. When viewing land development as a call option, the strike price (exercise price) is the:
   A. forecasted selling price of the developed property.
   B. construction and other costs required to develop the land.
   C. price of the land.
   D. price of comparable properties.

3. Which of the following is a disadvantage of timberland investments?
   A. Recycling efforts may dampen the demand for timber products.
   B. There is only one or two products derived from timber.
   C. Timber supplies are fixed.
   D. Harvesting schedules are strict with little flexibility.

4. Which of the following will **NOT** increase the value of farmland as an investment?
   A. The property has many potential uses, including possible development options.
   B. The crop that is best suited to the property must be harvested in a short time window.
   C. The cash flow stream generated by a farm is renewable.
   D. Government policies are generally favorable to farming.

5. Smoothed return data for an asset class such as real estate *most likely* increases:
   A. correlation of returns with other asset class returns.
   B. volatility of returns.
   C. volatility of prices.
   D. risk-adjusted return measures.

6. Which of the following statements regarding the performance of farmland during the period January 2000 to December 2014 is **FALSE**?
   A. Farmland outperformed world equities.
   B. Farmland had a higher Sharpe ratio than other reported asset classes.
   C. Farmland had a larger drawdown than other reported asset classes.
   D. Farmland did not have a negative minimum return while other reported asset classes had a negative minimum return.

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Concept Checker Answers

1. **A** Perpetual options can be exercised at any time, which meets the definition of an American option. Natural resource options are best viewed as exchange options. To be in the money, the value of the receivables must exceed the value of the deliverables. A decrease in the volatility of the associated commodity will *decrease* the value of the option. (LO 10.1)

2. **B** When viewing land development as a call option, the strike price consists of construction and other costs required for developing the land. For the land to be in the money, the value of the option to develop the property must be greater than the cost to develop the property. (LO 10.2)

3. **A** Disadvantages of timberland investments include: natural disasters can destroy the investment, investment values are tied to cyclical industries, timber supplies are not fixed, technology and recycling may diminish the demand for timber, and the investment horizon is long. Harvesting schedules are very flexible, an advantage of timberland investments. There are several uses of timber products. (LO 10.3)

4. **B** It is a disadvantage of farming that the harvest time for a crop is usually short and occurs at a very specific time of the year. (LO 10.4)

5. **D** Smoothed returns result in lower volatility of returns, lower correlation with other asset returns and, as a result, higher risk-adjusted return measures, such as the Sharpe ratio. (LO 10.5)

6. **C** Farmland had the smallest drawdown (0%) of all the reported asset classes. However, the remarkable results of farmland as an alternative asset class may be partially attributable to data smoothing resulting from appraised values. (LO 10.6)

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The following is a review of the Real Assets principles designed to address the learning objectives set forth by the CAIA Association®.

Commodity Forward Pricing

Topic 3.2

Exam Focus

Commodities have become an increasingly important investment in recent years for both traditional and alternative investors. This topic review focuses on primary methods of investing in commodities (i.e., forwards and futures contracts) and the mechanics of these investment vehicles. Know the basic attributes of forwards and futures as well as the process of using them to gain and maintain exposure to commodities. Understand the term structure of forward prices, including contangoed and backwardated markets and their implications for investors. Know the forward pricing models used to price forwards on different types of underlying assets. Finally, understand futures returns, including different methods used to generate returns in the futures market.

Forward and Futures Contracts

LO 11.1: Demonstrate knowledge of forward and futures contracts.

For example:

- **Describe the trading differences between forward and futures contracts.**
- **Describe and apply the marking-to-market process for futures positions.**
- **Discuss the effect of marking-to-market on counterparty risk.**
- **Recognize the effect of marking-to-market and the time value of money on risk and prices.**
- **Define and calculate initial margin for futures positions.**
- **Define and calculate maintenance margin for futures positions.**

Economic exposure to commodities can be gained simply by purchasing some quantity of a physical commodity for cash. These purchases take place in the **spot market** for immediate delivery. The issue is that once the commodity is purchased, the investor must store it. As an alternative, investors may gain exposure to commodities through forward or futures contracts.

A **forward contract** is a bilateral contract that obligates one party to buy and one party to sell a specific quantity of an asset, at a set price, on a specific date in the future. If the expected future price of the asset increases over the life of the contract, the right to buy at the contract price will have positive value and the obligation to sell will have an equivalent negative value. If the future price of the asset falls below the contract price, the result is opposite and the right to sell (at an above-market price) will have positive value.

A futures contract is a forward contract that is standardized and exchange-traded. The main differences between futures and forwards are that futures are regulated, traded in an active secondary market, backed by a clearinghouse, and require daily settlement of gains and losses. All trading in financial, currency, and commodity futures is regulated by the Commodity Futures Trading Commission (CFTC).

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Differences Between Forwards and Futures

Futures contracts are *similar* to forward contracts in the following ways:

- *Settlement*: Futures and forwards can be either deliverable (i.e., the underlying asset must be delivered) or cash settlement contracts.
- *Initial pricing*: Futures and forwards are priced to have zero value at the time an investor enters into the contract.

Futures contracts *differ* from forward contracts in the following ways:

- *Exchange trading*: Futures contracts trade on organized exchanges and provide daily liquidity and transparent pricing. Forwards are private over-the-counter (OTC) contracts, generally do not trade, and do not have observable prices.
- *Standardization*: Futures contracts have standardized contract sizes and terms. Forward terms (e.g., collateral size, contract size, delivery terms, etc.) are customized to the needs of the parties involved, which is a significant advantage to using forwards.
- *Clearinghouse*: A single clearinghouse is the counterparty to all futures contracts. The clearinghouse comprises exchange members who pool capital and guarantee contract performance even if a single member were to default. Forwards are contracts with the originating counterparty and contain significant counterparty risk.
- *Mark-to-market*: Futures contracts are marked-to-market. Forward contracts are generally not marked-to-market. This process will be detailed in the next section.
- *Regulation*: The government regulates futures markets. Forward contracts are usually not regulated.

The party to the futures contract that agrees to buy or receive the financial or physical asset has a *long futures position* and is called the *long*. The party to the futures contract that agrees to sell or deliver the asset has a *short futures position* and is called the *short*. A trader may make a reverse (i.e., offsetting or opposite) trade in the futures market to close out the position of the initial futures contract. Forward contracts are more difficult to "close out," as they require agreement by the counterparty to exit the contract. One party can always take an opposite position in another contract to eliminate market exposure, but counterparty risk will still exist. *Counterparty risk* is the risk that a party to a contract fails to perform the duties associated with that contract.

Open interest in the futures market is the number of outstanding contracts. A long position and a short position on the same futures contract are counted as one contract toward open interest. Only about 1% of all futures contract positions involve the delivery of the underlying commodity.

Economic exposure to commodities can also be managed through **commodity swaps**, which are custom, privately negotiated packages of forward contracts that have pre-specified prices (which may vary) and different expiration dates. Swaps are OTC instruments (i.e., not exchange traded) with limited liquidity. A company that regularly purchases a commodity may use a commodity swap to lock in prices over time.

Marking-to-Market

In the futures markets, margin is a performance guarantee. It is money deposited with a broker by both the long and the short. To safeguard the clearinghouse, the exchange requires traders to post margin and settle their accounts on a daily basis.

Over the course of each daily trading session, futures contracts change in value, representing a loss to one counterparty and a gain to the other. At the end of the day, futures contracts are **marked-to-market**, a process in which the change in contract value is transferred in cash from the margin account of the counterparty with a loss in value to the margin account of the counterparty with a gain in value. This adjusts the futures contract price to the **spot price** (i.e., current price of the underlying asset), resulting in a contract value of zero. For example, consider a long futures contract at a price of $10. If the underlying asset experiences a $1 decrease in value, the long position experiences a $1 per contract loss and will lose this amount from the margin account. Because of the $1 cash transfer out of the margin account, the new long contract price is effectively $9 per contract (i.e., $10 minus $1).

As a result of the mark-to-market process, large gains or losses are not allowed to accumulate over the life of the contract and because the clearinghouse is the counterparty to all contracts, counterparty risk is minimal. Any counterparty that is unable to meet the financial obligation required in the mark-to-market process forfeits its position and a new counterparty takes over. In the absence of daily marking-to-market, a **crisis at maturity** will exist. This form of counterparty risk occurs when a party fails to deliver either the payment required or the asset itself at the end of the contract. Note that some firms prefer to use forward contracts to avoid the daily cash flow volatility that can occur from the mark-to-market process in futures markets. Forward contracts are not typically marked to market and as such will be exposed to higher counterparty risk.

Because the marking-to-market concept requires that parties to futures contracts pay or receive cash on a daily basis, cash flows are accelerated versus identical forward contracts, which only require payment at maturity or settlement. As a result of the earlier payment and receipt of cash, futures contracts have higher price volatility (risk) and higher present values than forward contracts which are otherwise identical.

Marking-to-market and the concept of time value of money also impacts prices on futures contracts. In a hypothetical situation where an identical forward and futures contract has an underlying asset with no systematic risk, the present value of the expected cash flows from marking-to-market is zero if interest rates are *uncorrelated* with the spot price.

The present value of the expected cash flows from marking-to-market will be positive to the long side of the futures contract when the spot price increases and interest rates are *positively correlated* to the spot price. In other words, when the spot price on the asset increases, interest rates are also increasing and the long party to the futures contract will receive cash in a higher rate environment. This will drive the price of the futures contract above the forward contract.

When interest rates are *negatively correlated* to the spot price, the long party will deliver cash flows when rates are higher and receive cash flows when rates are lower; this will drive the price of the futures contract below an identical forward contract.

Margin Terminology

Initial margin is the collateral (i.e., cash) that must be deposited in a futures account before any trading takes place. Initial margin requirements are unique to each type of underlying asset. Initial margin, which is expressed in currency per contract (e.g., $1,000 per contract),

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is relatively low and equals about one day's maximum price fluctuation on the total value of the contract's underlying asset. Generally, this is less than 10% of the full contract price.

The **maintenance margin requirement** is the amount of margin, expressed as currency per contract that must be maintained in a futures account for open positions. If the margin balance in the account falls below the maintenance margin due to a change in the contract price for the underlying asset, additional funds must be deposited to bring the margin balance back up to the initial margin requirement. Maintenance margin is the amount of margin that must be maintained in a futures account and is usually set at 75% to 80% of the initial margin.

As the price of the futures contract fluctuates, the value of a trader's margin account is adjusted to account for any gains and losses that have occurred as of the end of the trading day. These increases or decreases in the trader's margin account are called the ***variation margin***. Positive variation margin adds to the equity in the margin account and can be withdrawn at any time. Negative variation margin reduces the equity in the margin account.

If negative variation margins reduce the trader's margin below the maintenance margin, the trader will receive a margin call. A **margin call** is a notification by the exchange to the trader that additional funds must be deposited to bring the equity in the account back to the *initial margin* level. The futures commission merchant may liquidate the position if the trader cannot post additional margin. Note that margin requirements may change with significant volatility or price changes.

Example: Margin balance

Consider a long position of five July wheat contracts, each of which covers 5,000 bushels. Assume that the contract price is $2.00 and that each contract requires an initial margin deposit of $150 and a maintenance margin of $100. The total initial margin required for the five-contract trade is $750. The maintenance margin for the account is $500. **Compute** the margin balance for this position after a 2-cent decrease in price on Day 1, a 1-cent increase in price on Day 2, and a 1-cent decrease in price on Day 3.

Answer:

Each contract is for 5,000 bushels so that a price change of $0.01 per bushel changes the contract value by $50, or $250 for the five contracts: (0.01)(5)(5,000) = $250.00.

The following figure illustrates the change in the margin balance as the price of this contract changes each day. Note that the initial balance is the initial margin requirement of $750 and that the required deposit is based on the previous day's price change.

Margin Balances (Long Position)

Day	*Required Deposit*	*Price/Bushel*	*Daily Change*	*Gain/Loss*	*Balance*
0 (initiation)	$750	$2.00	0	0	$750
1	0	$1.98	–$0.02	–$500	$250
2	$500	$1.99	+$0.01	+$250	$1,000
3	0	$1.98	–$0.01	–$250	$750

At the close on Day 1, the margin balance has gone below the maintenance margin level of $500. Therefore, the long position experiences a margin call and a deposit of $500 is required to bring the margin back to the initial margin level of $750. We can interpret the margin balance at any point as the amount the investor would realize if the position were closed out by a reversing trade at the most recent settlement price.

Now let's consider the short side of the contract.

Margin Balances (Short Position)

Day	*Required Deposit*	*Price/Bushel*	*Daily Change*	*Gain/Loss*	*Balance*
0 (initiation)	$750	$2.00	0	0	$750
1	0	$1.98	–$0.02	+$500	$1,250
2	0	$1.99	+$0.01	–$250	$1,000
3	0	$1.98	–$0.01	+$250	$1,250

Note that for the short position, the gains and losses are the same magnitude, but opposite sign as the long position. In this case, the margin balance for the short position does not fall below the maintenance margin requirement despite the occurrence of both gains and losses (i.e., positive and negative variation margin) in the margin account. Therefore, no margin calls are necessary.

Rolling Contracts

LO 11.2: Demonstrate knowledge of the rolling futures contracts.

For example:
- **Explain the process of maintaining long-term futures exposures through short-term futures positions.**
- **Discuss the effects of rollover decisions on the returns of long-term futures exposures.**

Using futures contracts presents a challenge for an investor who wants to maintain long-term exposure to a commodity without taking delivery of the underlying commodity. Most futures contracts have an expiration date of only a few months. In order to maintain commodity exposure, the investor will have to repeatedly close out the existing futures position and establish a new position in a new futures contract with a longer maturity.

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This process is called **rolling contracts** and can be costly depending on the structure of the market for the particular commodity.

Different Settlement Dates

Since commodity derivative contracts expire, a speculator or hedger who wants to maintain a position over time must close out the expiring derivative position and re-establish a new position with a settlement date further in the future. The contract with the shortest time to expiration is referred to as the **front month contract** (also known as the nearby, front, or spot contract). The longer maturity contracts are referred to as **distant contracts** (also known as the deferred or back contracts), with the first deferred being the next nearest contract, the second deferred being the second nearest contract, and so on. From the moment a futures position is established until it is time to roll the contract, the investor is said to be *riding* the contract. For a three-month futures contract, a long-term investor would ride the contract for up to three months, roll to the next contract, ride again for up to three months, roll to the next contract, et cetera.

Professor's Note: Riding and rolling as described above are terms used to describe the maintenance of long-term exposure to an asset through futures. However, for commodity forwards, the term roll may also refer to holding a position through time.

Rollover Decisions

Futures investors that roll contracts have two key choices to make when rolling:

1. When will the roll be initiated (e.g., contract expiration or sometime before)?

2. Which deferred contract will be used in the roll (e.g., the next nearest contract or a longer maturity contract)?

These decisions have a significant impact on the returns earned by the investor, causing different investors in the same futures contract (but with different roll patterns) to have different returns. Thus, return estimates can only be calculated by assuming some roll pattern based on when rolls are initiated and which contract is used.

Term Structure of Forward Prices

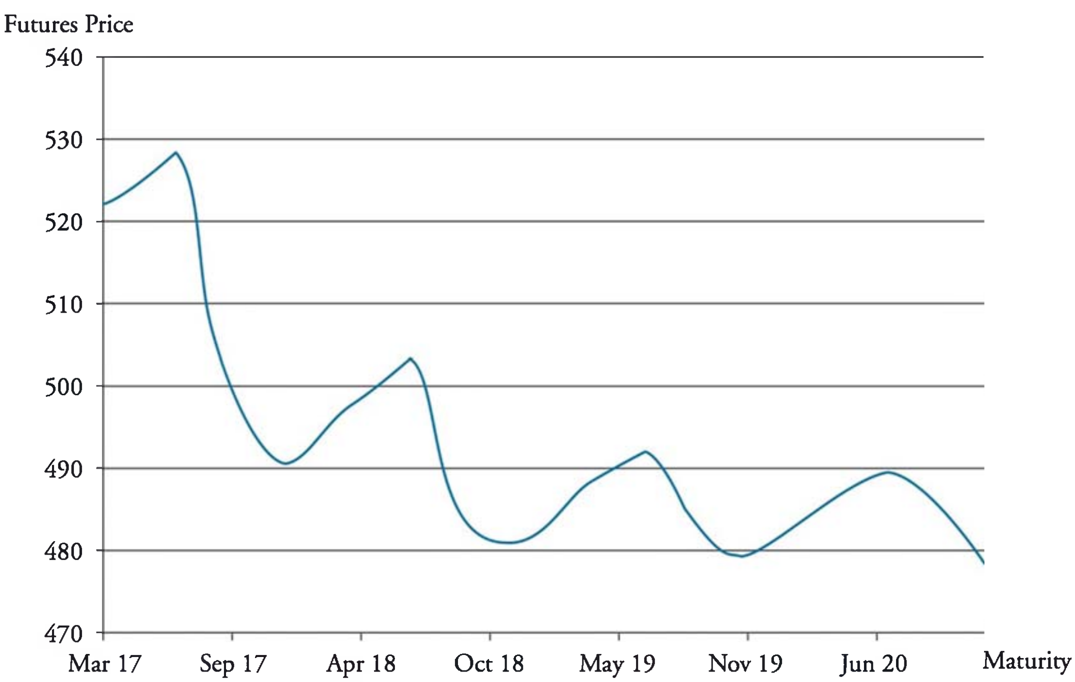
LO 11.3: Demonstrate knowledge of the term structure of forward prices on commodities.

For example:
- **Recognize the cost-of-carry model for commodity futures contracts.**
- **Calculate cost of carry for commodity futures contracts.**
- **Recognize arbitrage-free forward pricing for physical assets.**
- **Calculate arbitrage-free forward prices for physical assets.**
- **Recognize limitations to arbitrage-free forward pricing for physical assets.**
- **Discuss the effect of harvests, supply elasticity, and shifts in supply and demand on the term structure of forward prices.**

Professor's Note: In this section, we discuss commodity forward prices over time. In Topic 2.6, we discussed financial forwards and there is a considerable amount of overlapping material. The forward relationships discussed here apply to commodity futures as well, but the mark-to-market process unnecessarily complicates the discussion. Thus, we will focus on the term structure of commodity forward prices.

The **term structure of forward prices** refers to the relationship between forward prices (or forward rates in the case of interest rate contracts) and time. In determining the term structure at any point in time, we are concerned with an asset's spot price, *S*, and its forward price, *F(T)*, where *T* represents the time until contract maturity in years. Note that there will be a series of forward prices with longer and longer maturities. Once we compile these prices and graph them against time to maturity, we have the term structure. Figure 1 demonstrates a hypothetical term structure for corn futures contracts.

Figure 1: Term Structure of Corn Futures Prices



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In Figure 1, the futures prices of corn are displayed on the vertical axis for each maturity shown on the horizontal axis.

Simple Forward Pricing

The simplest forward pricing model states that the forward prices of an asset are equal to the spot price of the asset, expressed as follows.

$F(T) = S$ for all maturities, T

where:
$F(T)$ = current forward price of a contract expiring at time T
S = spot price

In order for the simple model above to hold, we must make the following assumptions:

- Transaction costs, taxes, or market imperfections do not exist.
- Risk-free interest rate is zero.
- Underlying asset can be borrowed at no cost.
- Underlying asset has no dividend yield, convenience yield, or storage cost.
- Underlying asset can be easily obtained.

The simple model also assumes no arbitrage opportunities exist. To see why, assume that $F(T) > S$. In this situation, an arbitrageur would purchase the asset at the spot price, fund the purchase with a 0% interest loan, sell the asset at the forward price, and earn $F(T) – S$ for zero risk. If $F(T) < S$, the arbitrageur would borrow the asset at no cost, sell it in the spot market, purchase the asset for the forward price, return the asset in the future and earn $S – F(T)$ for no risk. The arbitrage process would thus align the spot and forward prices according to the pricing model. In this case, the term structure of forward prices would be a horizontal line in which the spot and forward prices are equal across time. Traders in this type of market have no preference for immediate or deferred transactions. This does not mean that spot and forward prices will remain constant, simply that current forward prices and the spot price are equal. Spot prices may increase or decrease which will shift the horizontal line up or down. Thus, the current term structure may not reveal expectations of future spot prices.

In contrast to the flat term structure of forward prices (or simply, the “forward curve”) in the simple model, other forward curves may have positive or negative slope. **Contango** refers to a price pattern where forward prices are above the spot price and converge to the spot price from above over time. Contango markets have an upward sloping forward curve. **Backwardation** refers to instances in which forward prices are less than the current spot price. In these cases, the forward curve will be downward sloping, indicating that the forward price is lower for longer-term contracts. These price patterns are illustrated in Figure 2. We will discuss reasons that term structures may exhibit contango or backwardation in subsequent sections.

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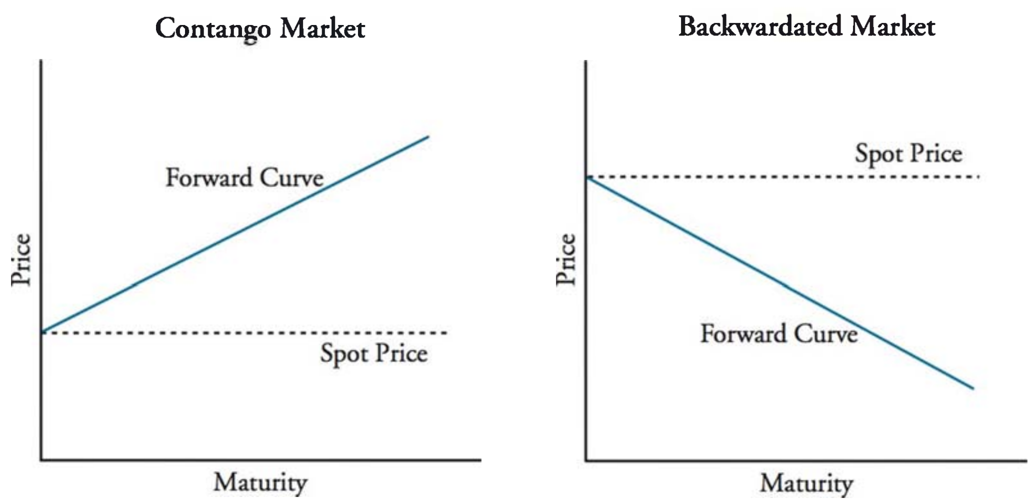
Figure 2: Contangoed and Backwardated Forward Curves



Cost of Carry Model

Cost of carry is a measure of the financial difference between holding a position in the spot market and holding a position in the forward market. For commodities, the cost-of-carry relationship is as follows.

$$F(T) = S + \text{carrying costs}$$

If at any point in time the forward commodity price does not equal the spot commodity price plus carrying costs, arbitrage will ensue to restore the relationship. The costs and benefits of direct ownership for real assets (e.g., commodities) and financial assets (e.g., stocks) are summarized in Figure 3. Note that the costs and benefits in Figure 3 are generally expressed in continuous terms, but that non-continuous rates are also valid as long as the time units for all rates are consistent.

Figure 3: Costs and Benefits of Direct Ownership of Assets

	Costs	*Benefits*
Real Assets	Interest (r) + Storage (c)	Convenience (y)
Financial Assets	Interest (r) + Custody (zero)	Dividends & Coupons (d)

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Example: Calculating the cost of carry given the spot and futures price

The current price of platinum is $1,419 per troy ounce. The three-month forward contract price on platinum is $1,436.85. **Calculate** the implicit cost of carry.

Answer:

F(T) = S + carrying costs

$1,436.85 = $1,419 + carrying costs

carrying costs = $17.85

Forward Prices and Arbitrage

As previously noted, forward prices are a function of the spot price and the carrying costs involved with holding the asset until expiration of the forward contract. For an underlying asset that does not pay any income, the forward price may be written as follows:

$$F(T) = S \times e^{r \times T}$$

where:
F(T) = price of the forward contract
S = spot price of the underlying asset
e = transcendental number used to calculate continuous compounding ≈ 2.718
r = risk-free interest rate
T = time to maturity of the forward contract

Example: Calculating the forward price for an asset that pays no income

The spot price of gold is currently $700/oz. The current continuously compounded interest rate is 4%. **Compute** the price of a six-month forward contract on gold.

Answer:

$$F(0.5) = \$700e^{0.04 \times 0.5} = \$714.14$$

When forward contract prices conform to this relationship, arbitrage, or risk-free profit opportunities, will not exist and the value of the futures contract for both the buyer and seller at contract initiation is zero.

Arbitrage-Free Pricing of Physical Asset Forwards

When pricing financial forwards, we account for the fact that owning the underlying asset has a benefit (e.g., interest and dividends) that reduces the effective cost of holding the underlying asset relative to buying a forward contract.

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Buying and holding a physical commodity (e.g., energy products, metals, food products, etc.) involves **storage costs**, which are the costs of maintaining a physical location in which to keep the commodity (e.g., warehouse fees, insurance, spoilage, and shipping). Storage costs increase the effective cost of commodity ownership. If an investor owns 5,000 bushels of wheat, the investor's income will be reduced by the cost of storing that wheat in a silo. Later in this topic review, we will incorporate continuously compounded storage costs, *c*, into the forward pricing relationship.

In some cases, consumers may believe there is a benefit to holding a physical commodity. Consider the situation where a lack of rainfall causes a shortage in wheat. Kellogg's, a cereal maker, may believe it will have difficulty obtaining wheat in the future and that there is a benefit in buying wheat now and storing it until it is needed. The certainty of being able to use the asset by holding some physical quantity may be of value relative to the uncertainty related to a forward contract position.

The **convenience yield** reflects a return from holding the physical asset. The convenience yield reduces the cost of ownership for a physical asset the same way receiving a dividend reduces the cost of ownership for a financial asset. We will express the continuously compounded convenience yield as *y* in the forward pricing relationship. By incorporating storage costs and convenience yield, the forward pricing relationship becomes:

$$F(T) = S \times e^{(r+c-y) \times T}$$

where:
F(T) = price of the forward contract
S = spot price of the underlying asset
r = risk-free interest rate
c = storage costs
y = convenience yield
T = time to maturity of the forward contract

The equation above represents the relationship between the forward and spot price primarily to the spread between storage costs and the convenience yield for what is called **the marginal market participant** (an entity with individual benefits and costs that make the entity indifferent between synthetic and physical positions).

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Example: Commodity forward pricing accounting for storage costs and a convenience yield

The current price of platinum is $1,425 per troy ounce. The risk-free interest rate is 5%, and the cost to store platinum in a warehouse is 3.5% of the purchase price. Platinum can be leased to jewelry dealers with a promise to repay the platinum at a later date. The lease rate is 2.5%. **Calculate** the price of a six-month forward contract on platinum.

Answer:

$$F(0.5) = \$1{,}425e^{(0.05 + 0.035 - 0.025) \times 0.5} = \$1{,}468.40$$

Note that the convenience yield (i.e., the platinum lease rate) effectively decreases the forward price.

It is important to note that storage costs and convenience yield are not singular values in the market. Both may vary according to supply and demand, physical location, and market participants. Storage costs for certain commodities vary by season due to the relative change in demand from one season to the next. The seasonality also causes forward prices to vary by maturity date, depending on the season in which contracts expire and the expected supply and demand balance in each season. Convenience yield also may vary according to supply and demand relationships in addition to location. Furthermore, each market participant may have a unique convenience yield since the relative benefit of holding physical assets to each participant will vary. During commodity shortages, convenience yields to consumers and producers are likely to be higher.

Due to the potential variation in storage costs and convenience yields, the term structure of forward prices is unlikely to be monotonically increasing or decreasing, but instead may exhibit wave forms with increasing and decreasing slopes as in Figure 1. Variation in storage costs, convenience yields, and supply and demand expectations allow investors with superior forecasting ability (with respect to supply, demand, and the shape of the term structure) to generate alpha. Financial forwards do not encounter the additional complexity found in commodity forwards.

Arbitrage is more complicated for commodity forwards than for financial forwards for two reasons.

1. *Difficulty creating short positions.* Commodity lenders may be difficult to find.

2. *Differing convenience yields and storage costs.* Not all participants have the same cost or yield expectations.

Because of the above complications, the commodity forward pricing relationship may be more accurately expressed as an inequality as follows:

$$F(T) \leq S \times e^{(r+c-y) \times T}$$

This inequality demonstrates that arbitrage is possible when the long spot position is priced too high, but that arbitrage may not be possible when the forward price is too low due to the inability to short the spot price (e.g., the underlying is not available or is too costly to short).

Harvests, Supply Elasticity, and Demand/Supply Shifts

Supply and demand for a physical asset can have a significant impact on not only current prices, but also the convenience yield, and consequently, the shape of the term structure of forward prices.

With respect to supply, it is important to establish the supply elasticity for an asset. **Perfectly elastic supply** means that any level of market demand for an asset (e.g., currencies) can instantly be supplied without limit or price impact. **Inelastic supply** means that a change in supply to meet market demand requires large price changes or that supply quantities react slowly to price changes. Commodities generally have inelastic supply, especially those subject to seasonal harvests, which limit available supply until the next harvest. Inelastic supply tends to increase convenience yields since there is greater likelihood of a shortage.

With respect to demand, economic factors may cause fast or slow demand shifts. For commodities such as natural gas, fast demand shifts due to weather or other volatile factors tend to increase convenience yields since there is greater likelihood of a shortage.

Backwardation and Contango

LO 11.4: Demonstrate knowledge of the concepts of backwardation, normal backwardation, contango, and normal contango.

For example:

- **Define and compare backwardated markets and markets in contango.**
- **Discuss backwardation and contango in informationally efficient markets.**
- **Define and compare normal backwardation and normal contango.**
- **Discuss normal backwardation and normal contango in informationally efficient and inefficient markets.**

Backwardation and Contango in Efficient Markets

As we noted previously, futures or forward markets are in backwardation when contract prices are lower than the spot price and the term structure is downward sloping. Futures or forward markets are in contango when contract prices are greater than the spot price and the term structure is upward sloping. There are two key points regarding the term structure of forward prices that you must understand.

1. The slope and shape of the term structure are driven by differences in the cost of carry.

2. The slope and shape of the term structure are not related to returns earned on forward contracts.

We will demonstrate these points using the prices of forward contracts on two different financial assets in the following example.

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Example: Relationship between term structure of forward prices, cost of carry, and returns on forwards

Dividend Fund maintains a portfolio of 30 equity assets. All dividend payments are distributed to shareholders. The continuously compounded dividend yield, *d*, for the fund is 8%. The current price of Dividend Fund is $200.

Capital Fund maintains the same portfolio of 30 equity assets as Dividend Fund. All dividend payments are reinvested in the fund such that the weight of each equity is the same as in the Dividend Fund. The continuously compounded dividend yield, *d*, for the fund is 0%. The current price of Capital Fund is $200.

Assume that the risk-free rate, *r*, is 4%. **Determine** the relationship between forward prices, the term structure, and expected returns.

Answer:

Note that because financial forwards are used in this example, dividends are used in the calculations rather than storage costs and convenience yield. The forward pricing relationships for Dividend Fund and Capital Fund are as follows:

$$F(T)_{\text{Dividend Fund}} = 200e^{(0.04-0.08)T} = 200e^{(-0.04)T}$$

$$F(T)_{\text{Capital Fund}} = 200e^{(0.04-0.00)T} = 200e^{(0.04)T}$$

By inserting time periods of 6 months (T = 0.5), 12 months (T = 1), and 18 months (T= 1.5), we can observe the shape of the term structure.

	Spot Price		*Forward Prices*	
	T = 0	T = 0.5	T = 1.0	T = 1.5
Dividend Fund	200	196.04	192.16	188.35
Capital Fund	200	204.04	208.16	212.37

In the table above, the downward sloping term structure for the Dividend Fund indicates backwardation whereas the upward sloping term structure for the Capital Fund indicates contango. The expected return on forward contracts on either fund is the same despite the different term structure. A one-year forward contract on the Capital Fund is 8% more expensive than the Dividend Fund, reflecting the internal growth expectation of 8% (i.e., the reinvested dividend). The one-year forward contract on the Dividend Fund appears cheaper, but since the fund pays out all dividends, the expected return is 8% (i.e., the same as the Capital Fund).

From the previous example we see that the term structure is downward sloping when $r < d$, is upward sloping when $r > d$, and would be flat if $r = d$. The key point is that the term structure of forward prices is driven by the cost of carry. In efficient markets, therefore, one term structure is not preferable to another. This analysis is simplified by using financial assets, where cost of carry variables are observable. For physical assets with differing or unobservable convenience yields and storage costs, the analysis is more complicated. These markets may be inefficient, in which case the term structure may reveal mispriced forward contracts, which can be exploited to earn above average returns.

Normal Backwardation and Normal Contango

Professor's Note: Our discussion here involves the relationship between forward prices and expected future spot prices, not the relationship between futures and the current spot price. The expected spot price is unobservable and can only be estimated.

Normal backwardation refers to a price pattern where the forward price is *below* the expected future spot price and converges to that price from below over time (i.e., the forward price rises toward the expected future spot price). Thus, a long forward contract is expected to earn positive return with no investment (except for posting margin). However, normal backwardation theory does not specify whether this positive return is attributable to a systematic risk premium or to ex ante alpha resulting from market inefficiency. Under normal backwardation, a short forward contract is expected to incur a loss.

Normal contango refers to a price pattern where the forward price is *above* the expected future spot price and converges to that price from above over time (i.e., the forward price falls toward the expected future spot price). Thus, a short forward contract is expected to earn positive return with no investment (except for posting margin). A long forward contract is expected to incur a loss. An inefficient market may allow for normal contango due to forward mispricing. However, in efficient markets normal contango only exists for commodity forwards with negative betas and would therefore be rare.

We can summarize the possible forward market term structures according to the relationship between the expected future spot price and the current forward price or by the relationship between the current spot price and the current forward price.

- *Backwardation*—the current forward price is less than the current spot price.
- *Normal backwardation*—the current forward price is less than the expected future spot price.
- *Contango*—the current forward price is greater than the current spot price.
- *Normal contango*—the current forward price is greater than the expected future spot price.

Note that normal backwardation and normal contango are mutually exclusive situations. However, a market can be in normal backwardation and also be in backwardation or contango. Likewise, a market can be in normal contango and also be in backwardation or contango.

Whether a particular commodity is in a normal backwardation or normal contango price pattern depends on the relationship between hedgers and speculators in the forward market.

Normal backwardation. Hedgers will tend to hold more short contracts than long contracts. Because hedgers are risk averse, they will accept a lower forward price. The discount (i.e., return) required to get speculators to accept the systematic risk of the corresponding long forward position will place downward pressure on forward prices. Because the futures price must converge to the spot price as the contract gets closer to maturity, a stable spot price will result in an increasing forward price over the life of the contract.

Normal contango. Hedgers are net long forward contracts rather than net short. A contango market suggests that when hedgers are net long forward contracts, they must pay a premium (i.e., return) above the expected future spot price in order to coax speculators to accept the

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systematic risk of the corresponding short positions. Thus, the forward price is greater than the expected future spot price. Because the forward price must converge to the spot price as the contract gets closer to maturity, a stable spot price will result in a decreasing forward price over the life of the contract.

Informationally *Efficient* Markets

Whenever a forward position involves systematic risk, an efficient market requires that expected spot prices and forward prices differ. When the underlying asset has positive systematic risk, the expected spot price exceeds the forward price with the excess representing compensation for bearing the risk of a long forward position. For the short side, the expected loss represents the cost of hedging systematic risk using a forward contract. If the asset has no systematic risk, the expected spot price equals the forward price.

Informationally *Inefficient* Markets

Because of the fact that arbitrage opportunities are more likely to exist with futures/forward contracts on real assets than they are with financial assets, investors may be able to earn higher returns on the former without bearing higher systematic risk.

When a firm with a natural long/short position in a commodity wants to hedge its exposure to that commodity, it may be willing to pay a premium to purchase protection (a futures/forward contract) against an unfavorable price movement in that commodity. For example, a firm hedging against a long position in a commodity will look to establish a short futures position in the same commodity; taking the long side of the futures contract will be speculators, with lower prices needed in order to induce speculator demand. Futures prices below expected spot prices result in normal backwardation, with speculators expecting a profit from long positions in futures. The opposite situation occurs when speculators take short positions in futures contracts, as normal contango may result because futures prices will exceed expected spot prices.

Because of the need for speculators in the marketplace, and limited competition within the speculator arena, the term structure of forward prices may reflect premiums paid to speculators in order to induce them to bear risk.

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Returns on Forwards

LO 11.5: Demonstrate knowledge of the characteristics of returns on forward and futures contracts.

For example:
- **Discuss futures and forward contracts as alpha and beta drivers.**
- **Define the law of one price.**
- **Describe the relationship between ex ante alpha and the shape of the term structure of forward prices.**
- **Discuss informationally inefficient term structures of forward curves.**
- **Define and determine the basis of forward contracts.**
- **Describe calendar spreads, and discuss their risks and returns.**
- **Calculate returns to calendar spread positions.**

Investors have different motivations for taking positions in futures or forward contracts. In this section, we discuss these motivations, the implication of the term structure on certain trades, and basic spread trading strategies.

Futures Returns, Beta, Alpha, and the Law of One Price

An investor may utilize forward or futures contracts as beta drivers or alpha drivers.

- *Futures and forwards as beta drivers.* Investors who use futures as beta drivers attempt to gain the risk and return exposure of the underlying asset while minimizing costs. The investor will determine the appropriate investment time horizon (e.g., one year) and analyze the trading costs of holding a single position (e.g., one contract with a settlement date in one year) or rolling over multiple positions (e.g., using four three-month settlement contracts) over the time horizon. The relative cost of using futures to obtain the desired exposure must also be weighed against other investment vehicles, such as exchange-traded funds (ETFs), which provide the same exposure. Based on this analysis, the investor will choose the lowest cost option to obtain the beta exposure.
- *Futures and forwards as alpha drivers.* The **law of one price** states that two assets with identical payoffs must have the same price. Investors who use futures as alpha drivers look for violations of the law of one price in the futures market and engage in the appropriate arbitrage transactions. The arbitrageur will purchase the undervalued asset and sell the overvalued asset to earn a riskless return. Arbitrage opportunities may occur due to mispricing between a futures contract and the underlying spot price or between the futures contract and other investment vehicles with the same exposure to the underlying asset. Mispricing between the futures contract and the underlying occur infrequently. Thus, investors generally look for relative mispricing among different futures contracts.

Alpha and the Term Structure

Alpha-based strategies frequently involve speculation on changes in the shape of the forward term structure. These changes may occur quickly due to new information or large trades or may occur slowly due to the passage of time. Ex ante alpha strategies attempt to profit from these changes based on the belief that the shape of the term structure is informationally inefficient (i.e., pricing relationships incorrectly incorporate current information). Due to the disequilibrium inherent in an **informationally inefficient term structure**, market

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participants will take excessive long or short positions, creating a supply and demand imbalance.

The ex ante alpha strategy is to purchase underpriced forward contracts and sell overpriced forward contracts. As more arbitrageurs follow this strategy, the market will be pushed to equilibrium and the shape of the term structure will move toward efficiency. Successful implementation of the ex ante alpha strategy requires knowledge of models for equilibrium pricing, arbitrage-free pricing, and efficient pricing in order to identify inefficient term structures and forecast the direction in which the term structure will change. The term structure may never reach equilibrium, but knowing the equilibrium relationships allows an investor to predict the most likely direction of change.

Basis and Calendar Spreads

Basis in terms of a forward contract is the difference between the spot price and the price of the forward contract. In equation form, basis is written as follows.

$$\text{basis} = S - F(T)$$

where:
S = spot price of the underlying asset
F(T) = price of the forward contract

One type of alpha-focused strategy attempts to hedge the forward price against the spot price, by analyzing the basis and predicting future changes. If the assets are efficiently priced, this strategy will be riskless and only earn the cost of carry, which is to be expected since the difference between the spot price and forward price according to the forward pricing relationships we defined previously is the cost of carry. If assets are not efficiently priced, the strategy may generate alpha as the basis changes.

A **calendar spread** strategy is an ex ante alpha strategy that combines a long forward position and a short forward position on the same underlying asset but with different expiration dates. The strategy is an implicit bet on the shape and the slope of the forward term structure and an attempt to earn profits from the relative mispricing between related forward or futures contracts. Thus, to generate alpha the strategy relies on mispricing in informationally inefficient markets. Investors must be able to recognize such markets and predict movements toward efficiency using equilibrium pricing relationships.

A well-known example of a calendar spread strategy was implemented by Amaranth Advisors LLC. Amaranth took long positions in natural gas futures in winter months and short positions in summer months with the expectation that natural gas demand in winter months would exceed expectations and result in substantial profits from the calendar spread.

We can generalize a calendar spread as the numerical difference between forward contracts with different maturities using the following formula.

$$\text{calendar spread} = F(T + t) - F(T)$$

where:
F(T) = price of a forward contract that expires at time T
F(T + t) = price of a forward contract that expires at time $T + t$
t = amount of time between expiration of contracts

Slope changes in the forward price term structure and carrying cost changes drive returns on calendar spreads. If a calendar spread has equivalent notional values on its long and short positions, it is hedged against changes in the spot price. A spot price change causes additive or parallel term structure shifts, while cost of carry changes causes slope changes in the term structure.

From a risk perspective, a calendar spread is sensitive to carrying costs. The longer (shorter) the spread between the settlement times of the contracts within the spread, the more (less) risk overall. When costs of carry rise (fall), a calendar spread which is long the contract with the longer term benefits (suffers).

Example: Calculating calendar spread returns

An investor is long a three-year forward and short a two-year forward on a commodity with a spot price of $50. The investor has an equivalent number of contracts on the long and short side. Assume interest rates are 1.5%, storage costs are 2.75%, and the convenience yield is 4.25%. The investor is betting on storage costs rising.

1. **Calculate** the profit/loss if the spot price falls $1.

2. **Calculate** the profit/loss if storage costs fall to 1.75%.

Answer:

If the spot falls $1, because $r + c - y = 0$, the forward price will match the spot price and the basis will remain at zero. In turn, there is no profit or loss when the spot changes.

If storage costs fall, forward prices will drop relative to spot prices. The three-year forward (long position) will fall more than the two-year forward (short position), which means the investor will lose money because storage costs fell.

The three-year forward price will fall from $50 to $48.52 as shown below:

$$F = 50e^{(0.015 + 0.0175 - 0.0425) \times 3} = \$48.52$$

The two-year forward price will fall from $50 to $49.01 as shown below:

$$F = 50e^{(0.015 + 0.0175 - 0.0425) \times 2} = \$49.01$$

The loss is equal to: $48.52 - $49.01= –$0.49.

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Example: Calculating calendar spread returns

An investor is long a three-year forward and short a two-year forward on a commodity with a spot price of $50. The investor hedges $500,000 in notional on the long and short side. Assume interest rates are 4.0%, storage costs are 2.5%, and the convenience yield is 1.0%. The investor is betting on storage costs rising.

1. **Calculate** the approximate number of short two-year forward contracts required in order to hedge $500,000 notional in the three-year forward contract.

2. **Calculate** the profit/loss if storage costs rise from 2.5% to 3.0%.

Answer:

A $500,000 notional position in the three-year forward, priced at $58.97, would consist of 8,479 contracts.

$$F = 50e^{(0.04 + 0.025 - 0.01) \times 3} = \$58.97$$

contracts needed = $500,000/$58.97 ≈ 8,479 contracts

To hedge this position, we need 8,959 two-year forward contracts priced at $55.81.

$$F = 50e^{(0.04 + 0.025 - 0.01) \times 2} = \$55.81$$

contracts needed = $500,000/$55.81 ≈ 8,959 contracts

If storage costs rise to 3.0%, the price of the three-year forward will rise to $59.86 while the price of the two-year forward will rise to $56.37.

$$F = 50e^{(0.04 + 0.03 - 0.01) \times 3} = \$59.86$$

$$F = 50e^{(0.04 + 0.03 - 0.01) \times 2} = \$56.37$$

The contracts will now be worth approximately $507,553 (= 8,479 × $59.86) for the three-year long position and $505,018 (= 8,959 × $56.37) for the two-year short position. The gain is equal to $507,553 – $505,018 or $2,535.

Key Concepts

LO 11.1

Futures contracts are similar to forward contracts in terms of settlement and initial pricing. Futures contracts differ from forward contracts in terms of exchange trading, standardization, clearinghouse, marking-to-market, and regulation.

Marking-to-market requires that the change in futures contracts value is transferred daily in cash from the margin account of the counterparty with a loss in value to the margin account of the counterparty with a gain in value, preventing an accumulation of large gains or losses and thereby reducing counterparty risk and avoiding a crisis at maturity. Futures contracts have higher price volatility and present values relative to comparable forward contracts due to the daily exchange of cash flows from the marking-to-market process.

When interest rates are positively (negatively) correlated to the spot price for an asset underlying a futures contract, the price of the futures contract will be above (below) the comparable forward contract price.

Initial margin is the collateral that must be deposited in a futures account before any trading takes place. Maintenance margin is the amount of margin that must be maintained in a futures account for open positions. A margin call is a notification by the exchange to the trader that the margin balance is below the maintenance margin level, requiring that additional funds must be deposited to bring the equity in the account back to the initial margin level.

LO 11.2

Rolling futures contracts is the process of closing out the existing futures position and establishing a new position in a longer maturity contract.

The contract with the shortest time to expiration is the front month (nearby, front, or spot) contract. The contract with the longest time to expiration is the distant (deferred or back) contract.

From the moment a futures position is established until it is time to roll the contract, the investor is said to be riding the contract.

Key decisions with a significant impact on the returns when rolling contracts:

1. When will the roll be initiated?

2. Which deferred contract will be used in the roll?

LO 11.3

The term structure of forward prices refers to the relationship between forward prices (or forward rates in the case of interest rate contracts) and time.

Cost of carry is a measure of the financial difference between holding a position in the spot market and holding a position in the forward market. Any difference between the spot and

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forward price is due to the cost of carry, which causes the term structure of forward prices to have a slope or curve. The cost of carry relationship is as follows:

$$F(T) = S + \text{carrying costs}$$

The forward pricing relationship for physical assets is as follows:

$$F(T) = S \times e^{(r + c - y) \times T}$$

Arbitrage is more complicated for commodity forwards for two reasons.

1. Difficulty creating short positions.

2. Differing convenience yields and storage costs.

Thus, the commodity forward pricing relationship may be more accurately expressed as the following inequality:

$$F(T) \leq S \times e^{(r + c - y) \times T}$$

Commodities generally have inelastic supply, which tends to increase convenience yields since there is greater likelihood of a shortage. Fast demand shifts tend to increase convenience yields since there is greater likelihood of a shortage.

LO 11.4

Key points regarding the term structure of forward prices.

1. The slope and shape of the term structure are driven by differences in the cost of carry.

2. The slope and shape of the term structure are not related to returns earned on forward contracts.

In efficient markets, one term structure is not preferable to another. For physical assets with differing or unobservable convenience yields and storage costs, the market may be inefficient, creating opportunities to earn above average returns.

Possible forward market term structures include:

- Backwardation—the current forward price is less than the current spot price.
- Normal backwardation—the current forward price is less than the expected future spot price.
- Contango—the current forward price is greater than the current spot price.
- Normal contango—the current forward price is greater than the expected future spot price.

In a market in normal backwardation, hedgers are net short forward contracts and will accept a forward price lower than the expected spot price, thereby placing downward pressure on forward prices. A stable spot price will result in an increasing forward price over the life of the contract.

In a market in normal contango, hedgers are net long forward contracts and will accept a forward price above the expected spot price, thereby placing upward pressure on forward prices. A stable spot price will result in a decreasing forward price over the life of the contract.

Whenever a forward position involves systematic risk, an efficient market requires that expected spot prices and forward prices differ. When the underlying asset has positive systematic risk, the expected spot price exceeds the forward price. If the asset has no systematic risk, the expected spot price equals the forward price.

Futures prices below expected spot prices result in normal backwardation, with speculators expecting a profit from long positions in futures. The opposite situation occurs when speculators take short positions in futures contracts, as normal contango may result because futures prices will exceed expected spot prices. The term structure of forward prices may reflect premiums paid to speculators in order to induce them to bear risk.

LO 11.5

An investor may utilize forward or futures contracts as a beta driver or as an alpha driver.

- Beta drivers. Investors attempt to gain the risk and return exposure of the underlying asset while minimizing costs.
- Alpha drivers. Investors look for violations of the law of one price and engage in arbitrage transactions. The arbitrageur will purchase the undervalued asset and sell the overvalued asset to earn a riskless return. Investors generally look for relative mispricing among different futures contracts.

Alpha-based strategies frequently involve speculation on changes in the shape of the forward term structure based on the belief that the shape of the term structure is informationally inefficient. The ex ante alpha strategy is to purchase underpriced forward contracts and sell overpriced forward contracts.

Basis in terms of a forward contract is the difference between the spot price the price of the forward contract.

$$\text{basis} = S - F(T)$$

A calendar spread strategy combines a long forward position and a short forward position on the same underlying asset but with different expiration dates. The strategy is an implicit bet on the shape of the forward term structure. We can generalize a calendar spread using the following formula.

$$\text{calendar spread} = F(T + t) - F(T)$$

Calendar spread returns are determined based on changes in forward prices due to changes in individual carrying costs.

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Concept Checkers

1. Which of the following statements regarding economic exposure in commodities is *most likely* correct?
   A. Storage costs reduce the costs of carrying physical commodities.
   B. Futures contracts provide economic exposures not available with forward contracts.
   C. Commodity swaps are a series of forward contracts with uniform contract prices but different expiration dates.
   D. If commodity prices rise, the holder of a short position in a commodity futures contract has a greater likelihood of receiving a margin call.

2. Which of the following is **NOT** a benefit of marking-to-market?
   A. Avoiding a potential crisis at maturity.
   B. Daily settlement of accounts for both sides of a futures contract.
   C. Daily recognition of a gain to one party and a loss to the opposite party.
   D. Reducing cash flow volatility that exists in comparable forward contracts.

3. An investor has a long position in a cotton futures contract. The contract price is \$0.94 per pound and the contract size is 50,000 pounds. Initial margin is \$4,700 and maintenance margin is \$3,525. If the price on the cotton futures contract is \$0.91 at the end of day one and \$0.90 at the end of day two, what will the amount of the margin call be at the end of day two?
   A. \$0.
   B. \$325.
   C. \$500.
   D. \$825.

4. To initiate arbitrage if the futures contract is overpriced, the trader should:
   A. borrow at the risk-free rate, short the asset, and sell the future.
   B. short the asset, invest at the risk-free rate, and buy the future.
   C. short the asset, invest at the risk-free rate, and sell the future.
   D. borrow at the risk-free rate, buy the asset, and sell the future.

5. The spot price of silver is \$13.72 per troy ounce. Assume the storage cost for silver is 1.8% of the purchase price, and the risk-free rate is 4.5%. The silver has a convenience yield of 1.2%. Which of the following is *closest* to the price of a six-month futures contract on silver?
   A. \$13.12.
   B. \$13.86.
   C. \$13.92.
   D. \$14.07.

6. Which term *best* describes the relationship between the spot price, *S*, and the price of a commodity futures contract, *F(T)*, in the equation $S < F(T)$?
   A. Arbitrage.
   B. Contango.
   C. Convenience yield.
   D. Backwardation.

7. In a futures market where hedgers are taking more short positions than long positions:
   A. normal contango would result where the futures price is less than the expected future spot price.
   B. normal contango would result where the futures price is greater than the expected future spot price.
   C. normal backwardation would result where the futures price is greater than the expected future spot price.
   D. normal backwardation would result where the futures price is less than the expected future spot price.

8. An investor in futures contracts has taken a long position in a contract she believes is undervalued and a short position in a contract she believes is overvalued. Both positions were established after analyzing the cost to execute several different strategies. Which of the following *best* describes how the investor is utilizing futures contracts?
   A. Beta driver.
   B. Alpha driver.
   C. Calendar spread.
   D. Cash and carry arbitrage.

9. An investor has an equivalent number of contracts for a long 12-month forward and a short six-month forward on a commodity. If the spot price stays the same, but the convenience yield increases, which of the following statements is CORRECT?
   A. The investor will incur a loss.
   B. The basis will stay the same.
   C. Forward prices will rise relative to spot prices.
   D. The short forward price will fall more than the long forward price.

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Concept Checker Answers

1. **D** A short position in a futures contract has a negative relationship with changes in commodity prices. If a commodity's price increases, the value of the short position will fall. A decrease in the value of a futures position will create a negative variation margin, which makes it more likely that the trader will receive a margin call. The other answer choices are false. Storage costs increase the cost of carrying a physical commodity. Futures contracts are standardized exchange-traded forward contracts. Any economic exposure available through a futures contract could be replicated with a forward contract. Commodity swaps are custom, privately negotiated packages of forward contracts that have pre-specified prices (which may vary) and different expiration dates. (LO 11.1)

2. **D** Marking-to-market requires the daily transfer of cash from the margin account of the counterparty with the loss to the margin account of the counterparty with the gain; this represents an increase in cash flow volatility relative to a comparable forward contract that does not require daily settlement. Benefits of marking-to-market include the reduction of counterparty risk via the avoidance of a crisis at maturity, the daily settlement of accounts for both sides, and the daily recognition of a gain for one party and loss for the other party. (LO 11.1)

3. **A** At the end of day one, the loss in the margin account is equal to $1,500 = (0.94 – 0.91) × 50,000. The margin account balance is reduced to $3,200 = (4,700 – 1,500). The investor will receive a margin call of $1,500 to bring the margin balance back to the initial margin level. At the end of day two, the loss in the margin account is equal to $500 = (0.91 – 0.90) × 50,000. The margin is reduced to $4,200 = (4,700 – 500). The investor will not receive a margin call at the end of day two because the account balance of $4,200 is above the maintenance margin level of $3,525. (LO 11.2)

4. **D** If the actual futures price is too high relative to the no-arbitrage price, sell futures, borrow at the risk-free rate, and buy the asset that can be delivered against your futures sale. At futures maturity, deliver the asset, receive the futures price, repay debt, and keep the profit. (LO 11.3)

5. **D** Futures price = $\$13.72e^{(0.045 + 0.018 - 0.012)0.5} = \$14.07$/troy oz. (LO 11.3)

6. **B** Contango refers to a price pattern where the futures price is above the spot price and converges to that pattern over time. (LO 11.3)

7. **D** Normal backwardation suggests that when hedgers are net short futures contracts, they must be willing to go short contracts at a discount relative to the expected future spot price in order to coax speculators to take the long positions in the contracts. When this occurs, the futures price will be less than the expected future spot price, and the difference is the premium required to get speculators to take the corresponding long futures position. (LO 11.4)

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8. **B** Investors who use futures as alpha drivers look for violations of the law of one price in the futures market and engage in the appropriate arbitrage transactions. The arbitrageur will purchase the undervalued asset and sell the overvalued asset to earn a riskless return. Investors generally look for relative mispricing among different futures contracts. (LO 11.5)

9. **A** If the convenience yield increases, the forward price on the long position will fall more than the forward price on the short position and the investor will incur a loss as a result. The basis will change because the forward price will decrease with no change in the spot. (LO 11.5)

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The following is a review of the Real Assets principles designed to address the learning objectives set forth by the CAIA Association®.

Commodities: Applications and Evidence

Topic 3.3

Exam Focus

Commodities play an important role in portfolio diversification and return enhancement. In this topic review, we focus on the motivation for including commodities in portfolios, methods of obtaining commodity exposure, and empirical evidence regarding commodity returns and risks. For the exam, understand the role of commodities in providing portfolio diversification and return enhancement in different market environments. Know the various investment vehicles used to obtain commodity exposure. Understand key considerations of using futures to obtain commodity exposure and be able to explain issues related to roll returns. Know the key characteristics of commonly used commodity futures indices. Finally, understand the historical risk and return attributes of commodities.

Diversification Through Commodity Investing

LO 12.1: Demonstrate knowledge of the diversification benefits of commodities.

For example:

- **Explain the sources of potential diversification benefits offered by commodities.**
- **Discuss commodities in the context of equilibrium diversification.**
- **Discuss how market imperfections relate to determining allocations to commodities.**
- **Discuss commodities as a diversifier of inflation risk.**

Investors who utilize commodity investments for diversification generally seek to reduce risk while maintaining return expectations. We will examine several scenarios in which different risks are mitigated using commodities.

Traditional Asset Diversification

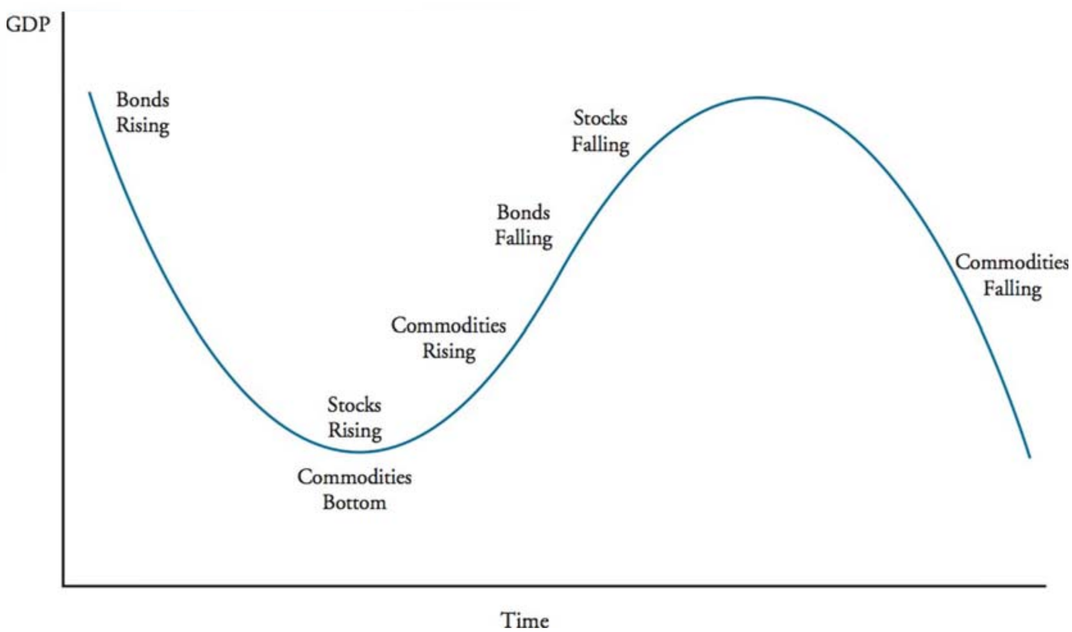
Commodity prices should be lowly correlated or negatively correlated to the prices of stocks and bonds for the following four reasons:

1. *Supply and demand.* The values of stocks and bonds are driven by the present value of expected cash flows. Commodity prices, however, do not have cash flows to discount but are instead driven by supply and demand interactions. Therefore, the correlation between commodities and traditional assets should be low or negative.

2. *Correlation with inflation.* **Inflation** occurs when the value of a currency decreases in relation to a representative basket of goods (e.g., commodities) and services. Thus, increasing commodity prices are a source of inflation. Both inflation and changes in the inflation rate are negatively correlated to the nominal prices of stocks and bonds but are positively correlated to the nominal prices of commodities. Therefore, commodity nominal prices are negatively correlated with stock and bond prices. **Nominal prices** reflect the impact of inflation, while **real prices** are adjusted (typically downward) to remove inflation effects. Real prices allow for direct comparisons across different periods by using a base year (e.g., 2000) and removing any inflationary effects from non-base year prices.

3. *Short-term versus long-term expectations.* Commodity futures prices are affected by short-term supply and demand expectations (e.g., high demand for wheat to fulfill current demand for bread), while the prices of stocks and bonds reflect long-term cash flow expectations (e.g., lower profitability as a result of higher inflation expectations). As shown in Figure 1, stock and bond prices lead or anticipate changes in the economy, while commodities reflect current economic conditions.

Figure 1: Commodities, Financial Assets, and the Business Cycle



4. *Capital costs versus raw material costs.* The price of the production process comprises the costs of labor, capital, and raw materials (e.g., commodities). A significant increase in raw materials costs will decrease corporate profits and the price of stocks and bonds in the short term. Thus, commodities prices and stock and bond prices should exhibit negative correlation.

Diversification Under Equilibrium

In equilibrium markets (i.e., where supply equals demand), participants are well diversified, which allows systematic and idiosyncratic risks to be measured accurately. Models such as the capital asset pricing model (CAPM) assume market equilibrium and perfectly diversified

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portfolios that hold all assets according to their relative **market weights** (i.e., the asset value relative to the value of all assets). Any deviation from market weights involves accepting additional idiosyncratic risk without additional expected return. Thus, equilibrium models assume all investors diversify their portfolios, which includes holding commodities according to their market weights. However, determining the appropriate market weight can be difficult. For example, is the total value of gold the amount already extracted or does it include gold reserves that are years away from extraction? In addition, it is not always clear how to separate the impact of commodity prices on the stocks and bonds of commodity producers.

Diversification Under Disequilibrium

Commodity market imperfections (e.g., transportation costs and taxes) may cause persistent disequilibrium through shortages or excess supply that is not corrected through price adjustments. In this type of market, some participants will hold more than the market weight of commodities, causing other participants to hold less than the market weight. Consequently, the optimal weight for commodities is unknown for imperfect markets in disequilibrium. Commodities could be a good or poor investment in this case. To overcome this ambiguity, empirical models such as the Markowitz model use empirical return data (e.g., mean, variance, and covariance) to estimate the set of asset weights that maximize the investor's return and risk objectives.

Inflation Diversification

Inflation risk is the uncertainty of economic results caused by potential changes in the value of a currency. Asset prices generally reflect expected inflation rates. Therefore, investors utilize commodities to diversify their portfolios against unexpected inflation and the accompanying decrease in cash flow values. The protection provided by commodities can be explained in two ways:

1. Commodity prices are a factor in inflation measures and are, therefore, positively correlated with inflation.

2. Commodity prices represent the value of consumption. The real value of consumption is independent of inflation rates (e.g., a bushel of wheat represents the same food consumption in a country with high inflation and in a country with no inflation).

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Commodity Investing for Return Enhancement

LO 12.2: Demonstrate knowledge of commodities as potential return enhancers.

For example:
- **Discuss potential return enhancement from idiosyncratic returns.**
- **Discuss potential return enhancement from systematic returns in efficient markets.**
- **Discuss potential return enhancement from systematic returns in inefficient markets.**
- **Discuss potential return enhancement from providing insurance through commodity futures.**

Commodity investors are frequently interested in enhancing returns through alpha and beta strategies. However, there is significant debate over whether commodities can provide beta return enhancement.

Alpha Return Enhancement

Commodity investors pursue alpha primarily through speculation on the idiosyncratic movement of commodity prices. Speculators using this strategy believe commodities are mispriced (i.e., the commodity itself is mispriced on an absolute basis, not relative to other securities) based on forecasted prices derived through fundamental and technical analysis. Traders use forecasted commodity prices to select long and short trades with the best risk-adjusted returns. The goal of the strategy is to gain commodity exposure and hold the position long enough to profit from the anticipated price correction. Traders may use futures, forwards, or other vehicles to obtain commodity exposure.

Spread strategies may also be used to generate alpha from commodities. However, these strategies capitalize on relative mispricings between futures contracts and the underlying asset and between different futures contracts, respectively. These strategies were introduced in the previous topic review.

Equilibrium Beta Return Enhancement

In equilibrium (i.e., where supply of and demand for an investment are in balance), beta returns are generated entirely from the systematic risk of an investment. Therefore, return enhancement (i.e., increased returns) is only achievable through greater systematic risk exposure. Commodities have low systematic risk due to their ability to reduce downside risk and hedge inflation. As a result of the low systematic risk, the expected returns of commodities should also be low. Therefore, commodities do not enhance returns in equilibrium markets. Investors in this type of market should hold commodities according to their market weights and expect a reduction in risk and return.

Disequilibrium Beta Return Enhancement

Investors often do not hold commodities according to their market weights (e.g., they may over- or underweight commodities or take short positions), which may cause commodity markets to be in disequilibrium. Disequilibrium should cause prices to adjust to encourage other investors to counterbalance the over- or underweighting that exists in the market. These price adjustments create superior risk-adjusted return opportunities. In other words,

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commodities in disequilibrium provide greater return per unit of beta risk than other beta exposures.

In disequilibrium, systematic risk exposure in commodities may represent beta returns (i.e., the higher returns require additional systematic risk exposure) or alpha returns (i.e., superior returns are earned due to inefficient pricing of risk).

Insurance Return Enhancement

Commodity futures can also be used to enhance returns by functioning as insurance products. Speculators may recognize an inherent imbalance between supply and demand and enter commodity markets in order to earn the risk premiums resulting from selling contracts that are in demand (and therefore overpriced) and purchasing contracts that have an excess supply (and therefore underpriced). This type of risk premium earned by speculators is similar to the insurance risk premium earned by insurance companies.

Commodity Investing Without Futures

LO 12.3: Demonstrate knowledge of investing in commodities without futures.

For example:
- **Recognize characteristics of physical ownership of commodities.**
- **Recognize investments in commodities through related equity instruments.**
- **Recognize investments in commodities through exchange-traded funds (ETFs).**
- **Recognize investments in commodities through commodity-linked notes.**
- **Apply option valuation methods to price commodity-linked notes.**

Futures contracts are commonly used to obtain exposure to commodities. Investors may also obtain commodity exposure through physical commodity ownership, commodity-related equity investments, exchange-traded funds and notes, and commodity-linked notes.

Physical Commodities

Physical commodity ownership requires financing, purchasing, transporting, and storing the commodity. Most investors are unfamiliar with this process or are unwilling to bear the costs of direct ownership. However, some market participants have a high convenience yield for certain commodities or may be able to store them at lower-than-average cost. Recall that convenience yield is the marginal economic benefit from having direct access to a physical commodity. Commodity prices (i.e., spot and futures prices) reflect a market consensus convenience yield that balances demand for physical ownership with supply of a commodity. A cereal manufacturer may have a high convenience yield for grain commodities to prevent cereal supply disruptions in the event of a grain shortage. In contrast, a natural gas supplier purchases and stores natural gas in order to resell the commodity to consumers rather than consume the commodity itself. The natural gas supplier earns profits through a competitive advantage in transporting and storing the commodity. Institutional investors who hold physical commodities are likely to have a lower than average convenience yield and above average storage costs which will lead to lower returns. For investors, the key point is that physical commodity ownership is an inefficient method of obtaining commodity exposure unless the investor has a high convenience yield or a competitive storage advantage.

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Commodity-Related Equity Investments

Many natural resource companies derive the majority of their revenues from buying and selling physical commodities. Because the returns of these companies rise and fall with commodity prices (i.e., company returns and commodity returns are nearly perfectly correlated), investing in the equity securities of these companies is often considered a way to gain commodity exposure. However, commodity firms are complex investments in that they have two types of beta: (1) commodity beta and (2) equity market beta. For example, if an investor wants to gain economic exposure to copper, she could buy shares of Freeport-McMoRan, a large publicly traded copper producer. When copper prices are high, Freeport-McMoRan will earn larger profit margins, all else equal, which should result in a higher stock price. However, if copper prices fall, Freeport-McMoRan's margins will contract, and its stock price is likely to decline.

Commodity firm investments do not always work in practice because investing in natural resource companies involves exposure to systematic (i.e., market) and unsystematic (i.e., firm-specific) risks that are not associated with owning commodities. An investor may find that the stock price of a natural resource company moves more in line with the overall stock market than with commodity prices (i.e., the market beta dominates the commodity beta). Since the stock price of a company comprises its earnings per share (EPS) and price to earnings (P/E) ratio, changes in the stock market that tend to negatively affect P/E ratios will impact the stock price of the commodity firm even though commodity prices may be increasing. This would cause underperformance of the firm relative to the commodity performance. Additionally, the operating and financing decisions that company management makes have nothing to do with commodity prices but could have a significant effect on the value of the investment. Furthermore, a natural resource company may employ a hedging strategy to reduce its exposure to future commodity price volatility. An aggressive hedging strategy would minimize the correlation of the company's earnings with commodity prices. Finally, most diversified investors already have exposure to commodity-related equities through other investments. Consequently, a commodity firm investment is unlikely to achieve its intended purpose of pure commodity exposure and portfolio diversification.

Commodity Exchange-Traded Funds and Notes

Commodity exchange-traded funds (ETFs) are investment funds that seek to replicate the returns on a commodity, a basket of commodities, or an index and provide intraday liquidity by listing shares on major stock exchanges. An example of an ETF that follows a single commodity is UNG, which replicates the returns on U.S. natural gas.

Commodity ETFs gain exposure to commodities using commodity firm equities, commodity futures, and physical ownership. Some commodity ETFs specialize in leveraged or short exposure to commodities. Commodity ETFs provide low-cost opportunities for retail investors to gain commodity exposure, but institutional investors generally do not obtain the same cost effectiveness.

Commodity ETFs that invest in physical commodities typically invest in a single commodity (often a metal), which incurs storage costs. Investors hold a share of the physical stock but are not directly exposed to equity market or futures market risks.

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Commodity ETFs that invest in futures are exposed to basis risk. Changes in the basis may cause futures returns to deviate from the commodity spot returns sought by investors. If the ETF uses futures traded on exchanges with clearing corporations, the investor will be protected from counterparty risk.

Commodity ETFs that invest in equities of commodity producers are subject to equity market risk and commodity market risk. Rising spot and futures prices for commodities may be muted by a troubled equity market.

Commodity exchange-traded notes (ETNs) are similar to commodity ETFs, but commodity ETNs represent a claim to a debt security with cash flows (i.e., interest and principal payments) linked to commodity prices. Commodity ETNs are exposed to the credit risk of the issuing investment bank or commercial bank. If the issuer fails, ETN investors become general creditors of the firm. If the ETN utilizes forward contracts or swaps, investors will be subject to counterparty risk in addition to the issuer's credit risk. Commodity ETNs may provide exposure to the returns on a commodity, a basket of commodities, or an index.

Commodity-Linked Notes

Commodity-linked notes (CLNs) are fixed-income securities of intermediate term that combine a standard interest-paying debt instrument with either a commodity futures contract or an option on commodity prices. CLN cash flows include interest over the life of the instrument and a payment at maturity, each of which may be tied to the value of a commodity or basket of commodities. In some cases, the principal value of the CLN is protected, which puts a floor on the downside exposure of the commodity-linked final payment. This is effectively a call option that allows for upside participation with limited downside risk. CLN investors accept lower coupon payments on the debt instrument in exchange for receiving the upside potential from commodity prices. Some CLNs have full exposure to commodity prices, allowing the final payment to increase or decrease with the underlying commodity exposure. In this arrangement, the CLN incorporates the structure of a futures contract. CLN issuers include banks looking to design securities to meet customer demands and commodity producers looking to more closely match the risks of their assets and liabilities. CLNs contain both commodity risk and default risk of the issuer.

Compared to other methods of gaining economic exposure to commodities, investing in CLNs has several advantages:

- The investor does not have to worry about rolling futures contracts to maintain long-term exposure.
- Because a CLN is effectively a bond, it can be a means to avoid violating any restrictions an investor may have against investing in commodities.
- Any tracking error issues with a specific commodity are the responsibility of the note issuer, not the investor.

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Example: CLN transaction

A large pension fund purchases a one-year, $1,000,000 par value Commodore Industries bond that is tied to the value of the Bloomberg Commodity (BCOM) Index. The BCOM is currently at 160. At maturity, the pension fund will receive at least the par value of the bond and the coupon payment, but if the BCOM exceeds a level of 180, the pension will share in the percentage appreciation of the index. The following information applies to the transaction:

- The stated interest rate of the CLN is 4%.
- Ordinary bonds issued by Commodore Industries have an interest rate of 6%.
- At maturity, the value of the BCOM is 195.

Calculate the effective cost of the commodity exposure and the appreciation resulting from the commodity exposure at maturity.

Answer:

The effective cost of the commodity exposure is the interest given up by investing in the CLN as opposed to a standard bond. This cost represents the embedded call option on the price appreciation of the BCOM.

$$(4\% - 6\%)(\$1{,}000{,}000) = -\$20{,}000$$

The pension fund is effectively paying $20,000 per year for the commodity exposure.

The appreciation gained as a result of the commodity exposure is a function of the ending value of the BCOM and the predetermined level set by Commodore Industries.

$$[(195 - 180) / 180] \times \$1{,}000{,}000 = \$83{,}333$$

Therefore, the sum of the cash flows in this transaction will be as follows:

$$\begin{aligned}\text{transaction value} &= \text{bond value at maturity} + \text{appreciation} + \text{coupon payment} \\ &\quad - \text{initial bond value} \\ &= \$1{,}000{,}000 + \$83{,}333 + \$40{,}000 - \$1{,}000{,}000 = \$123{,}333\end{aligned}$$

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Commodity Exposure through Futures

LO 12.4: Demonstrate knowledge of commodity investment through futures contracts.

For example:

- **Recognize the basis risk and investments in commodities through futures contracts.**
- **Recognize the components of returns to futures positions (i.e., spot return, roll yield, collateral yield, and excess return).**
- **Describe roll yield for financial and physical commodity futures.**
- **Describe the two interpretations of rolling contracts.**
- **Relate roll yield to the slope of the forward curve.**
- **Discuss convergence and the relationship between futures and spot prices through time.**
- **Calculate the aggregated profit or loss for a futures position.**
- **Recognize rollover strategies and their effect on returns from futures investments.**
- **Recognize the three propositions regarding roll return.**

Basis Risk

The *basis* is the difference between the spot price and the futures price. As the maturity date nears, the basis approaches zero, as the futures price and spot price converge. At expiration, the spot price must equal the futures price because the futures price has become the price today for delivery today, which is the same as the spot. **Convergence** is the term often used to describe the basis shrinking over time until it reaches zero at maturity.

Not all futures contracts are held until maturity, but changes in the basis can impact the returns to the futures contract. This is the nature of **basis risk,** which is defined as the uncertainty in economic outcomes resulting from changes in the spot price/futures price relationship.

Investors utilizing futures contracts to gain commodity exposure must be aware that the returns to a commodity futures contract can differ from spot returns for three reasons:

1. The cost of carry implied by the basis differs from the cost of carry for spot positions.
2. The basis changes.
3. The convenience yield differs from storage costs.

Returns to futures contracts with different maturities will also differ for two reasons:

1. The calendar spread changes.
2. The cost to roll over the long-term exposure changes over time.

Thus, the returns to different futures contracts are determined by basis and spreads, which also drive changes in the term structure of forward prices.

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Example: Why the futures price must equal the spot price at expiration

Suppose the current spot price of silver is $10.65. **Demonstrate** by arbitrage that the futures price of a silver contract that expires in one minute must equal the spot price.

Answer:

Suppose the futures price was $10.70. We could buy the silver at the spot price of $10.65, sell the futures contract, and deliver the silver under the contract at $10.70. Our profit would be $10.70 – $10.65 = $0.05. Because the contract matures in one minute, there is virtually no risk to this arbitrage trade.

Suppose instead that the futures price was $10.61. Now we would buy the silver contract, take delivery of the silver by paying $10.61, and then sell the silver at the spot price of $10.65. Our profit is $10.65 – $10.61 = $0.04. Once again, this is a riskless arbitrage trade.

Therefore, in order to prevent arbitrage, the futures price at the maturity of the contract must be $10.65.

Futures Return Components

A **fully collateralized position** in futures is composed of a futures contract and an amount of cash (i.e., short-term risk-free bonds, such as T-bills) equal to the notional value of the futures contract. We can express the returns to a fully collateralized future position (R_{fcoll}) using the following two equivalent formulas:

$$R_{fcoll} = \text{collateral yield} + \text{excess return}$$

$$R_{fcoll} = \text{collateral yield} + \text{spot return} + \text{roll yield}$$

The variables for these formulas are defined as follows:

1. *Spot return.* **Spot returns** reflect changes in the spot price of a commodity. Commodity price changes occur as the underlying supply of and demand for commodities changes. These changes are a result of weather patterns, seasonal factors, and real demand increases. Increasing (decreasing) commodity prices result in positive (negative) spot returns for commodity index investors. Spot returns are a primary driver of unhedged futures returns.

2. *Collateral yield.* The **collateral yield** (also called the collateral return) is the interest earned on the risk-free assets (e.g., T-bills) purchased to collateralize the face amount of the commodity futures held for investment. Futures do not require full collateralization (just a margin deposit), in which case the investment is a leveraged position with leveraged returns. A fully collateralized unleveraged position can generate substantial collateral returns.

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3. *Excess return.* The **excess return of a futures contact** is generated from changes in futures prices. Excess returns on futures contracts with different maturities will vary as their relative prices change with the term structure of forward prices. Excess returns are a function of spot returns and changes in the basis.

4. *Roll yield.* The **roll yield** (or **roll return**) is the return that results from changes in the basis of a futures contract. The basis changes for two reasons.
   - **Passage of time.** As the time to maturity shortens, the futures price and basis converges (i.e., rolls up or down) to the spot price, generating a return.
   - **Changes in cost of carry.** The basis is determined by the cost of carry (i.e., interest rates, dividends, storage costs, and convenience yield). Therefore, changes in the cost of carry directly impact the basis.

Rolling Contracts

In futures literature, *rolling a contract* is often mentioned. However, this can refer to two very different concepts and different interpretations of roll yield:

- *Rolling between contracts* (i.e., closing out the existing futures position and buying a new futures contract with a longer maturity). As an investor rolls between contracts, unrealized gains and losses are realized. However, this is not a true roll yield. Roll yield is generated over time as the basis changes rather than at the moment one futures contract is exchanged for another.
- *Describing how the price of a futures contract changes over time as it approaches maturity.* Assuming spot prices, the cost of carry, and the term structure of forward prices are constant, a positive roll yield is earned in a backwardated market as the futures price rolls up the term structure of forward prices. Similarly, a negative roll yield is earned in a contango market as the futures price rolls down the term structure of forward prices.

Roll Yield and the Forward Curve

For forward prices, recall the definitions of contango and backwardation. **Contango** refers to a price pattern where forward prices are above the spot price and converge to the spot price from above over time. Contango markets have an upward sloping forward curve. **Backwardation** refers to instances in which forward prices are less than the current spot price. In these cases, the forward curve will be downward sloping, indicating that the forward price is lower for longer-term contracts.

If the cost of carry is constant, an efficient market with a backwardated (i.e., downward sloping) forward curve will generate positive roll return, and an efficient market with a contangoed (i.e., upward sloping) forward curve will generate negative roll return to the extent that the total returns are equal for the cash and futures markets. Note that commodity markets are often not completely efficient and costs of carry often vary over time.

Spot Prices, Futures Prices, and Convergence

Convergence at settlement refers to the tendency of futures prices to move toward the spot price as the contract maturity date approaches. At maturity, the futures price and spot price must be equal. The convergence property indicates that the basis will move toward zero over time and at contract maturity will equal zero. Convergence is driven by the law of one price and the actions of arbitrageurs.

For example, consider a riskless position consisting of a debt-financed long spot position in a financial asset combined with a short futures position on the same asset that expires in one year. If the futures contract is efficiently priced at contract expiration, the futures price will equal the spot price for a net value of zero and the investor's carrying costs (e.g., convenience yield and storage costs) will determine the profit or loss.

$$\text{profit} = F(T) - S_0 - \text{carrying costs}$$

Therefore, a futures position carries the same risk and return as a spot position after adjusting for differences in the cost of carry. If the market is inefficient, there may be alpha generation opportunities.

Roll Yield and Financial Assets

For futures contracts on financial assets, a high dividend yield results in a backwardated term structure and a low dividend yield results in a contangoed term structure. Assuming constant spot prices and term structures, the roll yield on a futures contract for a financial asset with a high dividend yield will be positive while the roll yield on a futures contract for a financial asset with a low dividend yield will be negative. This result holds even if the financial assets are identical except for their respective dividend yields. Note that the higher roll yield for high dividend paying financial assets is not a source of alpha since the total return on futures on these financial assets should be the same. Therefore, the high dividend/high roll return financial asset will be offset by a low spot return and the low dividend/low roll return financial asset will be offset by a high spot return, ensuring the total returns are equal and arbitrage is not possible. Recall the futures pricing relationship on financial forwards.

$$F(T) = S \times e^{(r - d) \times T}$$

where:
$F(T)$ = price of the futures contract
S = spot price of the underlying asset
r = risk-free interest rate
d = continuously compounded dividend or coupon rate
T = time to maturity of the futures contract

Using the equation above, we examine two key scenarios:

$r < d$: The term structure is backwardated and the high dividend rate results in a greater proportion of total return concentrated in roll returns and a lower proportion concentrated in spot returns.

$r > d$: The term structure is in contango and the low dividend rate results in a smaller proportion of total return concentrated in roll returns and a higher proportion concentrated in spot returns.

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Roll Yield and Real Assets

Roll yield generated by futures contracts on real assets, such as commodities, can be a source of alpha due to **heterogeneous** costs of carry among market participants (i.e., each investor has a unique cost and benefit structure). Specifically, storage costs (c) and convenience yield (y) vary among market participants and are unobservable. Investors with high convenience yields or a competitive advantage for storage are able to generate alpha through roll returns on futures contracts. Note that alpha may also be generated through mispriced futures contracts that deviate from no-arbitrage pricing models. Investors may compare futures prices with those implied by the cost of carry model to predict the direction of futures price changes, thereby earning superior risk-adjusted returns (i.e., alpha).

Professor's Note: With futures, it is easy to get hung up on the terminology. To make things simpler, recognize that basis, carrying costs, and roll yield are terms that refer to the same issue. For example, the roll yield will equal the basis if a contract is held to maturity. In addition, if the carrying costs and basis are both expressed in currency terms, then their absolute value will be equal.

Spot Prices, Futures Prices, and Contract Rolling

Long-term futures exposure is maintained by closing a futures position as the maturity date draws near and simultaneously opening another position in a longer maturity contract that is otherwise identical to the position just closed. This process is often referred to as *rolling between futures contracts*. The process raises two key issues.

1. *What benchmark is appropriate for rolled positions*? Rollover patterns (i.e., the timing of the roll and selection of new contract maturity) and returns to the pattern are unique to each investor. Therefore, benchmarks must also be unique to each pattern. Benchmark returns for fully collateralized strategies may deviate from the strategy returns due to different assumptions regarding collateral yield. The key point is that an index or benchmark must assume a particular roll strategy and collateral yield.

2. *How do expected returns relate to particular roll strategies*? Investors are interested in whether certain rollover strategies generate higher risk-adjusted returns. The difference in rollover returns for different strategies can be expressed as a calendar spread return. Consider the following rollover strategies on the same futures contracts.
   - Investor X: Rolls over contracts one month prior to expiration into the first deferred contract.
   - Investor Y: Rolls over contracts at expiration into the nearby contract.

   Assume both investors entered the same contract three months ago. One month prior to contract expiration, Investor X will rollover to the first deferred contract (i.e., longer maturity) and Investor Y will be holding the same contract, which is now the nearby contract (i.e., shorter maturity). The difference in strategies is equal to a calendar spread. Any change to an investor's rollover strategy is therefore a speculation on calendar spreads. Investors must also consider the cost-effectiveness of various rollover strategies.

Roll Return Propositions

Investors are frequently confused about the concept of roll return. The source of confusion is generally related to investors mistakenly viewing roll return as something that is earned from switching contracts (i.e., the accounting view of roll returns) rather than something that is generated over time (i.e., the investment view of roll returns). Investors should ensure they understand the three propositions regarding investing and roll returns.

Proposition 1: *Roll return is NOT directly attributable to closing and opening positions to maintain exposure.* Roll return is not the difference in the price of different futures contracts used in a rollover process. Roll return occurs over the contract holding period and is the difference between the futures price when the contract is opened and the futures price when it is closed less the change in the spot price over the holding period.

$$\text{roll yield} = F_0 - F_{-1} - (S_0 - S_{-1})$$

where:
F_0 = current price of the futures contract
F_{-1} = last period's price of the futures contract
S_0 = current spot price of the underlying asset
S_{-1} = last period's spot price of the underlying asset

Proposition 2: *Backwardated markets do NOT always generate positive roll returns.* If the cost of carry, and therefore the term structure, of forward prices does not change, backwardated markets will generate positive roll returns. However, the cost of carry and term structure are not always static. In the short run, the term structure can shift such that roll returns in a backwardated market are negative.

Proposition 3: *Positive roll returns do NOT always generate alpha.* For futures contracts on financial assets, alpha generation is not related to whether roll returns are positive or negative. Roll return on financial futures serve as a counterbalance in the total return to make the spot position and futures position equally attractive. A futures contract on a financial asset with a dividend yield greater than the risk-free rate (i.e., $r < d$) will have a positive roll yield to offset the relatively high dividend. A futures contract on a financial asset where $r > d$ will have a negative roll yield to offset the relatively low dividend. For futures contracts on real assets, differences in storage costs and convenience yield may allow investors to earn alpha through roll returns.

In perfectly efficient markets, alpha is not generated through buying, holding, rolling, or riding futures contracts. In addition, positive roll return is not linked to backwardation or contango, either of which may exist depending on the components of the cost of carry. In inefficient markets, alpha may be generated through futures on real assets.

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Commodity Futures Indices

LO 12.5: Demonstrate knowledge of commodity indices.

For example:
- **Discuss the process of construction of commodity futures indices.**
- **Discuss the characteristics of commodity indices given by S&P GSCI, BCOM, and CRB.**

Overview of Commodity Futures Indices

Indices are valuable tools for analyzing portfolio performance and constructing portfolios. A desirable characteristic of indices is that they are investable. An **investable index** is one where the underlying security returns of the index reflect actual returns that an investor can obtain in the market.

Investors look to indices to provide representative performance data for asset classes. For the commodity futures market, a representative investable index should reflect the total return from unleveraged long-only futures contracts on commodities. An unleveraged index is fully collateralized by assuming risk-free assets are held in an amount equal to the notional value of the futures. Financial futures should be excluded from the commodity futures index. Spot prices are not used to represent commodity index returns since commodities trade in different locations at different prices, which cannot be arbitraged due to transportation costs. Futures prices provide a more uniform method of measuring commodity performance and ensure that each dollar invested in the index represents one dollar of commodity price exposure.

Investment managers use commodity futures indices in three primary ways:

1. As a benchmark for return attribution and performance analysis.

2. As a tool to execute active tactical investment strategies on the performance of commodities.

3. As a tool to execute passive investment strategies designed to diversify portfolio risk.

Popular Commodity Futures Indices

There are three commodity futures indices commonly used by academics and investment practitioners.

1. **The Standard & Poor's Goldman Sachs Commodity Index (S&P GSCI):** The S&P GSCI is a long-only, tradable index of nearby physical commodity futures contracts. Futures contracts based on the S&P GSCI can be purchased. The index comprises the shortest maturity contract for each of the 24 physical commodities contracts included in the index. A unique attribute of the index is that futures contracts trade on the S&P GSCI itself. The S&P GSCI is **production-weighted index** (i.e., uses the relative output quantities of each index component to determine its index weight), using five-year averages of economic data to reflect the importance of each component to the global economy. The five groups of real assets in the S&P GSCI are precious metals, industrial metals, livestock, agriculture, and energy. Energy makes up over 70% of the index.

2. **The Bloomberg Commodity Index (BCOM):** Formerly known as the Dow Jones-UBS Commodity Index (DJ-UBSCI), the BCOM is a long-only, diversified index of 22 physical commodities. The BCOM is weighted primarily by the trading volume (i.e., liquidity) of the future's contracts and secondarily on production. The index also requires that no commodity group comprise more than 33% of the index. The physical commodities in the BCOM are from the following groups: energy, precious metals, industrial metals, grains, livestock, and soft commodities (which include coffee, cotton, and sugar).

3. **The Reuters/Jeffries Commodity Research Bureau (CRB) Index:** The CRB Index is the oldest commodity index and includes 19 physical commodities. The index consists of four weighted tiers: tier 1 includes petroleum products; tier 2 consists of liquid contracts (natural gas, corn, soybeans, live cattle, gold, aluminum, and copper); tier 3 represents broad diversifiers (sugar, cotton, cocoa, and coffee); and tier 4 includes additional diversifiers (nickel, wheat, lean hogs, orange juice, and silver). Tier and component weights are subjective, but the weights are intended to reflect the global economic importance of each tier or component.

Comparison of Commodity Futures Indices

Figure 2 provides a comparison of key attributes related to the weighting schemes of the three commodity futures indices.

Figure 2: Commodity Futures Indices Attributes

	S&P GSCI	*BCOM*	*CRB*
Weighting Scheme	Based on commodity production levels	Primarily based on trading activity (i.e., liquidity)	Tiered weighting
Weighting Rationale	The most economically important commodities (as measured by production data) should have greatest influence	The most actively traded commodities are the most important	Subjective, fixed weights that reflect economic importance

Commodity Risks and Returns

LO 12.6: Demonstrate knowledge of risks associated with commodity investments.

For example:
- **Discuss the effect of event risk on returns from investments in commodities.**
- **Discuss the role of commodities as defensive investments.**
- **Discuss acceptance of commodity investments by institutional investors.**

Commodity investments are subject to different risk and return characteristics than other investments. In particular, commodities are exposed to event risk and can serve as defensive investments. Both of these characteristics as well as the growing acceptance of commodities by institutional investors are discussed in the following sections.

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Event Risk

Event risk is the exposure to significant events that have potential to cause large negative returns. Most investments have negative exposure to unexpected events, but commodities generally have positive exposure to events due to the following four reasons.

1. Events (e.g., droughts, floods, crop destruction, wars, political instability, sudden cold weather, strikes, or labor unrest) that affect commodities tend to reduce supply and increase prices, thereby benefiting investors.

2. Events that decrease commodity prices (i.e., those that increase supply or reduce demand for commodities) occur infrequently and tend to be less severe than events that increase commodity prices. Therefore, the return distribution for commodities should be positively skewed.

3. Negative events that occur usually are specific to a given commodity or commodity group rather than to the entire commodity market. Therefore, the returns of individual commodities tend to be uncorrelated with each other.

4. Events that benefit commodities tend to hurt stocks and bonds through reductions in raw materials. As a result, commodity returns tend to be uncorrelated or negatively correlated with financial assets.

Commodity Futures as a Defensive Investment

During periods of market stress, global equity markets tend to be more highly correlated and begin to decline together. Thus, when diversification is most needed, it is no longer available. Almost all traditional assets tend to react negatively to unfavorable macroeconomic events (e.g., an oil price spike). To counter high downside correlations, investors have increasingly sought skill-based investments (e.g., hedge funds with neutral market exposure) as well as passive assets (e.g., commodity futures) that can provide diversification and downside risk protection (i.e., portfolio value protection in declining markets).

Institutional Acceptance of Commodity Investments

Commodity futures indices are well developed and transparent and are able to provide performance tracking for commodity investments. However, commodities tend to be underrepresented in institutional portfolios (especially relative to hedge funds, which lack proper benchmarks). Many institutions avoid commodities because they believe commodities are extremely risky or do not fully understand commodity investment characteristics. As more institutions attempt to find portfolio diversifiers, demand for real assets such as commodity investments will continue to grow.

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Historical Risks and Returns

LO 12.7: Demonstrate knowledge of the return characteristics of commodity investments.

For example:

- **Recognize inferences that can be drawn from comparing definable characteristics of commodities with their historical investment performance.**

In this section, we describe the key performance statistics and resulting inferences for commodity investments as represented by S&P GSCI monthly returns over the period January 2000 through December 2014.

During this period, commodity returns averaged a return of 3.8% and the highest volatility of the listed asset classes. The minimum return was –28.2% and the maximum drawdown was –69.4%. The data also indicates negative skewness and leptokurtosis.

If an institution had invested $1,000 in commodities in January 2000, it would have peaked around $3,800 in 2008 and then quickly dropped to below $1,500 within a year. By the end of 2014, the investment would have been valued at approximately $1,400. In comparison, the same $1,000 would have had an ending value of $2,200 for global bonds and $1,600 for world equities. A large portion of the return variability in the S&P GSCI during this period can be attributed to price swings in crude oil. This highlights a weakness of this index when used to benchmark commodities.

Correlation results indicate positive correlation with global equity and bond markets (0.38 and 0.21, respectively). In addition, commodity returns are negatively correlated with the VIX and credit spreads (–0.27 and 0.29, respectively). This indicates that greater uncertainty in equity markets is negatively related to commodity returns. Commodities experienced the largest negative and positive returns during the same two months that equities experienced similar extreme returns. If these outliers are removed, the correlation becomes very weak. Thus, the tendency for assets to move together during market stress is an important consideration as this is when diversification is most important.

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Figure 3: Returns of Commodities, January 2000 to December 2014

Asset Class (Index)	*Average Return*	*Standard Deviation*	*Sharpe Ratio*	*Maximum and Minimum Returns*	*Skewness*	*Maximum Drawdown*
Commodities (S&P GSCI)	3.8%*	23.3%	0.1	19.7% and –28.2%	–0.5*	–69.4%
World Equities (MSCI World)	4.4%*	15.8%	0.1	11.2% and –19.0%	–0.7*	–54.0%
Global Bonds (Barclays Capital Global Aggregate Bond)	5.7%	5.9%	0.6	6.6% and –3.9%	0.1	–9.4%
U.S. High-Yield Bonds (Barclays Capital U.S. Corporate High Yield)	7.7%*	10.0%	0.6	12.1% and –15.9%	–1.0*	–33.3%

* Significance at 95% confidence

Professor's Note: While commodities tend to have positive skewness, the S&P GSCI displays negative skewness as shown in Figure 3. This unexpected result may be due to the time period used or the fact that the S&P GSCI and its attributes (e.g., futures contracts and weighting scheme) are not equivalent to a truly passive commodity portfolio. This is also why the S&P GSCI has a higher correlation with other assets, relative to what we would expect for commodities as an asset class.

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Key Concepts

LO 12.1

Commodity prices should be lowly correlated or negatively correlated to the prices of stocks and bonds for four reasons:

1. Commodity prices are driven by supply and demand rather than discounted cash flows.
2. Commodities are positively correlated with inflation.
3. Commodity prices are affected by short-term expectations, while stocks and bonds reflect long-term expectations.
4. A significant increase in commodity costs will decrease corporate profits and the price of stocks and bonds.

In equilibrium markets, participants hold commodities according to their market weights. Any deviation from market weights involves additional idiosyncratic risk without additional expected return.

In disequilibrium markets, some participants will hold more and others will hold less than the market weight of commodities. Empirical models are used to find optimal asset weights that maximize return and risk objectives.

Investors utilize commodities to diversify their portfolios against unexpected inflation. The protection can be explained in two ways: (1) commodity prices are a factor in inflation, and (2) commodity prices represent the value of consumption.

LO 12.2

Commodity investors pursue alpha primarily through speculation on the idiosyncratic movement of commodity prices. Investors hold the position long enough to profit from the price correction.

Basis trades and spread strategies may generate alpha. However, these strategies capitalize on relative mispricings between futures contracts and the underlying asset and between different futures contracts.

In equilibrium, beta returns are generated from systematic risk. Commodities have low systematic risk and therefore do not enhance returns in equilibrium. Investors should therefore hold commodities according to market weights.

In disequilibrium, investors do not hold commodities according to market weights, causing prices to adjust to counterbalance the over- or underweighting. These price adjustments create opportunities to earn returns from systematic risk exposure. Systematic risk exposure represents both beta returns and alpha returns. Idiosyncratic risk exposure represents alpha returns.

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Speculators can use commodity futures to earn returns similar to insurance risk premiums by selling overpriced contracts that are in demand and purchasing underpriced contracts that have an excess supply.

LO 12.3

Investors may obtain commodity exposure through the following investments:

- Physical commodities: Physical ownership requires financing, purchasing, transporting, and storing the commodity. For most investors, physical ownership is an inefficient method of obtaining commodity exposure unless the investor has a high convenience yield or a competitive storage advantage.
- Commodity-related equity investments: These investments involve exposure to systematic and unsystematic risks that are not associated with commodities. Changes in the stock market that negatively affect P/E ratios, operating and financing decisions, and hedging exposure to commodity price volatility will affect the stock performance of commodity firms but will not affect commodity prices.
- Commodity ETFs and ETNs. Commodity ETFs replicate the returns on a commodity, a basket of commodities, or an index and provide intraday liquidity. Commodity ETFs use commodity firm equities, commodity futures, and physical ownership. Commodity ETFs that invest in physical commodities typically invest in a single commodity and shield investors from equity and futures market risks. Commodity ETFs that invest in futures are exposed to basis risk. Commodity ETFs that invest in equities are subject to equity market risk and commodity market risk. Commodity ETNs represent a claim to a debt security with cash flows linked to commodity prices. If the ETN utilizes forward contracts or swaps, investors will be subject to counterparty risk in addition to the issuer's credit risk. Commodity ETNs may provide exposure to the returns on a commodity, a basket of commodities, or an index.
- Commodity-linked notes (CLNs) combine a standard interest-paying debt instrument with either a futures or option contract. Cash flows include interest and principal, each of which may be tied to commodities. The principal value may be protected, which effectively creates a call option on upside participation with limited downside risk. Other CLNs allow the final payment to increase or decrease with the commodity exposure, which effectively incorporates a futures contract. CLNs contain both commodity risk and default risk of the issuer.

LO 12.4

Returns to a commodity futures contract can differ from spot returns for three reasons:

1. The cost of carry implied by the basis differs from the cost of carry for spot positions.
2. The basis changes.
3. The convenience yield differs from storage costs.

Returns to futures contracts with different maturities can differ for two reasons:

1. The calendar spread changes.
2. The cost to roll over the long-term exposure changes over time.

The returns to a fully collateralized futures position can be attributed to the following four components:

1. Spot returns reflect changes in the spot price of a commodity resulting from changes in supply of and demand. Spot returns are a primary driver of unhedged futures returns.

2. Collateral yield is the interest earned on the risk-free assets purchased to collateralize commodity futures. A fully collateralized unleveraged position can generate substantial collateral returns.

3. Excess return on a futures contact is generated from changes in futures prices and is a function of spot returns and changes in the basis.

4. Roll yield is the return that results from changes in the basis due to the passage of time, changes in the cost of carry, or both. Assuming spot prices, carrying costs, and the term structure of forward prices are constant, a positive (negative) roll yield is earned in a backwardated (contango) market.

For futures contracts on financial assets, roll return is not a source of alpha. A high dividend/high roll return financial asset will be offset by a low spot return and the low dividend/low roll return financial asset will be offset by a high spot return, ensuring the total returns are equal. Roll yield generated by futures contracts on real assets can be a source of alpha. Investors with high convenience yields or a competitive storage advantage may generate alpha through roll returns.

Rolling a contract can refer to two different concepts:

1. Rolling between contracts (i.e., closing out the existing futures position and buying a new futures contract with a longer maturity).

2. Describing how the price of a futures contract changes over time as it approaches maturity.

If the cost of carry is constant, an efficient market with a backwardated (contangoed) forward curve will generate positive (negative) roll return to the extent that the total returns are equal for the cash and futures markets.

Convergence at settlement refers to the tendency of futures prices to move toward the spot price as the contract maturity date approaches. The convergence property indicates that the basis will move toward zero over time.

When rolling between futures contracts, two key issues must be addressed including: choosing an appropriate benchmark for rolled positions and determining how expected returns relate to particular roll strategies.

The three propositions regarding roll returns for investors are as follows:

1. Roll return is NOT directly attributable to closing and opening positions to maintain exposure.

2. Backwardated markets do NOT always generate positive roll returns.

3. Positive roll returns do NOT always generate alpha.

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In perfectly efficient markets, alpha is not generated through buying, holding, rolling, or riding futures contracts. In addition, positive roll return is not linked to backwardation or contango, either of which may exist depending on the components of the cost of carry.

LO 12.5

There are three commodity futures indices commonly used by academics and investment practitioners.

1. The Standard & Poor's Goldman Sachs Commodity Index (S&P GSCI): long-only, tradable index of 24 nearby physical commodity futures; production-value weighted, using five-year averages data to reflect economic importance of each component; includes precious metals, industrial metals, livestock, agriculture, and energy.

2. The Bloomberg Commodity (BCOM) Index: long-only, diversified index of 22 physical commodities from the following groups: energy, precious metals, industrial metals, grains, livestock, and soft commodities; weighted primarily by trading volume and secondarily by production; maximum commodity group weight of 33%.

3. The Reuters/Jeffries Commodity Research Bureau (CRB) Index: maintains weights through time for each of the 19 physical commodities that comprise the index; consists of four weighted tiers.

LO 12.6

Commodities tend to benefit from unexpected events that reduce supply and increase prices. Therefore, commodity returns tend to be positively skewed and returns of individual commodities tend to be uncorrelated with each other. Events that benefit commodities tend to hurt stocks and bonds.

During periods of market stress, global equity markets tend to be more highly correlated and begin to decline together. To counter high downside correlations, investors have increasingly sought passive assets (e.g., commodity futures) that can provide diversification and downside risk protection.

As more institutions attempt to find diversifiers and realize that commodities may offer another form of beta to smooth risk exposures, demand for commodity investments will continue to grow.

LO 12.7

S&P GSCI monthly returns over the period January 2000 through December 2014 demonstrated:

- Relatively low mean returns with high volatility.
- Maximum drawdown of –69.4% and a worst single-month performance of –28.2%.
- Significant impact from both the large price increases before the recent financial crisis and the very large market crash during the crisis.
- Negative price reactions to market stress.
- Modest diversification benefits with global equities or global bonds.
- Negatively skewed and leptokurtic returns.
- Moderate positive correlation with global bonds and global equities.
- Moderate negative correlation with credit spreads and equity volatility.

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Concept Checkers

1. Which of the following is **NOT** a reason to expect commodities and traditional asset to be lowly correlated, uncorrelated, or negatively correlated?
   A. Stocks and bonds are valued on long-term rather than short-term expectations.
   B. Increasing commodity prices have a positive impact on corporate profitability.
   C. Commodities are driven by supply and demand rather than cash flow expectations.
   D. Inflation has a negative impact on traditional assets but a positive impact on commodities.

2. When commodity markets are in equilibrium, which of the following is *most likely* correct regarding beta return enhancement through commodity investment? Beta return enhancement is:
   A. not possible and investors should hold market-weighted commodities.
   B. possible by taking on idiosyncratic risk related to mispriced commodities.
   C. not possible and investors should hold greater than the market weight of commodities.
   D. possible by taking advantage of superior risk-adjusted return opportunities resulting from investors that overweight commodity exposure.

3. An investor would like to obtain diversified exposure to commodities with limited downside risk. Which of the following commodity investments would be *most appropriate* for the investor?
   A. Physical commodities.
   B. Commodity-linked note.
   C. Commodity exchange-traded note.
   D. Commodity-related equity investments.

4. Which of the following *best* describes the component of futures returns that is earned as a result of changes in futures prices?
   A. Roll return.
   B. Spot return.
   C. Excess return.
   D. Collateral return.

5. Which of the following statements is **FALSE** regarding the propositions of roll returns?
   A. Roll return is earned by closing and opening positions to maintain exposure.
   B. An investor who is able to generate positive roll returns may generate alpha.
   C. Roll returns in a backwardated market may be negative.
   D. Roll return is not the difference in the price of different futures contracts used in a rollover process.

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6. Which of the following is a characteristic of the Standard & Poor's Goldman Sachs Commodity Index (S&P GSCI)?
   A. The index uses the first deferred contract on 24 physical commodities.
   B. Energy dominates the other four groups of real assets included in the index.
   C. Index weights are determined by trading data using five-year averages.
   D. Tier and component weights are subjective, but intended to reflect their global economic importance.

7. Which of the following *best* describes commodity exposure to event risk?
   A. Commodity prices tend to increase as a result of exposure to economic events that increase supply.
   B. Commodity prices tend to decrease initially after an economic event but then increase over the long term.
   C. Commodity prices are generally unaffected by event risk, allowing them to serve as defensive investments.
   D. Commodity returns tend to be positively skewed, indicating that unexpected events benefit commodity investors.

8. Over the period January 2000 through December 2014, commodities, as represented by the S&P GSCI, exhibited all of the following attributes **EXCEPT**:
   A. commodity returns were positively skewed and leptokurtic.
   B. commodities were able to provide diversification for portfolios of global equities.
   C. commodities were negatively correlated with increases in equity market volatility.
   D. commodities tended to suffer negative returns along with other assets during market stress.

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Concept Checker Answers

1. **B** Increasing commodity prices represent an increase in the cost of raw materials to corporations. Thus, higher commodity prices have a negative impact on corporate profitability leading to lower stock prices. The result is negative correlation between commodities and traditional assets. (LO 12.1)

2. **A** In equilibrium, beta returns are generated entirely from the systematic risk of an investment. Therefore, return enhancement is only achievable through greater systematic risk exposure. Commodities have low systematic risk and low expected returns. Therefore, commodities do not enhance returns in equilibrium markets. Investors in this type of market should hold commodities according to their market weights. (LO 12.2)

3. **B** Commodity-linked notes (CLNs) combine a standard interest-paying debt instrument with either a commodity futures contract or an option on commodity prices. CLN cash flows include interest over the life of the instrument and a payment at maturity, each of which may be tied to the value of a commodity or basket of commodities. In some cases, the principal value of the CLN is protected, which puts a floor on the downside exposure of the commodity-linked final payment. Effectively, this call option allows for upside participation with limited downside risk. (LO 12.3)

4. **C** The excess return on a futures contact is generated from changes in futures prices. Excess returns on futures contracts with different maturities will vary as their relative prices change with the term structure of forward prices. Excess returns are a function of spot returns and changes in the basis. (LO 12.4)

5. **A** Investors should understand the three propositions of roll returns:
   1. *Roll return is NOT directly attributable to closing and opening positions to maintain exposure.* Roll return is not the difference in the price of different futures contracts used in a rollover process.

   2. *Backwardated markets do NOT always generate positive roll returns.* The cost of carry and term structure are not always static. In the short-run, the term structure can shift such that roll returns in a backwardated market are negative.

   3. *Positive roll returns do NOT always generate alpha.* For futures contracts on financial assets, alpha generation is not related to whether roll returns are positive or negative (so alpha may or may not be generated in either situation). Roll return on financial futures serve as a counterbalance in the total return to make the spot position and futures position equally attractive. For futures contracts on real assets, differences in storage costs and convenience yield may allow investors to earn alpha through roll returns. (LO 12.5)

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6. **B** The S&P GSCI is a long-only, tradable index of nearby physical commodity futures contracts. Futures contracts based on the S&P GSCI can be purchased. The index comprises the shortest maturity contract for each of the 24 physical commodities contracts included in the index. A unique attribute of the index is that futures contracts trade on the S&P GSCI itself. The S&P GSCI is production-weighted index (i.e., uses the relative output quantities of each index component to determine its index weight), using five-year averages of economic data to reflect the importance of each component to the global economy. The five groups of real assets in the S&P GSCI are precious metals, industrial metals, livestock, agriculture, and energy. Energy makes up over 70% of the index. (LO 12.5)

7. **D** Commodities generally have positive exposure to events. In other words, commodities tend to benefit from unexpected events. Events that affect commodities tend to reduce supply and increase prices, thereby benefiting investors. Events that increase supply or reduce demand for commodities occur infrequently. Events that do occur also tend to be uncorrelated. Therefore, commodity returns tend to be positively skewed and returns of individual commodities tend to be uncorrelated with each other. (LO 12.6)

8. **A** During this period, commodities exhibited:
   - Relatively low mean returns with high volatility.
   - Maximum drawdown of –69.4% and a worst single-month performance of –28.2%.
   - Significant impact from both the large price increases before the recent financial crisis and the very large market crash during the crisis.
   - Negative price reactions to market stress.
   - Modest diversification benefits with global equities or global bonds.
   - Negatively skewed and leptokurtic returns.
   - Moderate positive correlation with global bonds and global equities.
   - Moderate negative correlation with credit spreads and equity volatility. (LO 12.7)

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The following is a review of the Real Assets principles designed to address the learning objectives set forth by the CAIA Association®.

Operationally Intensive Real Assets

Topic 3.4

Exam Focus

This topic review examines operationally intensive real assets, including liquid alternative real assets, infrastructure, and intellectual property. You should first understand the impact that commodity prices have on firm performance overall, as well as the correlation between commodity prices and equity prices for the firms that produce commodities. Also, know the structure, tax characteristics, and valuation of a master limited partnership. It is important to understand how investable infrastructure is distinguished (via seven characteristics) from other assets, the vehicles that investors use to invest in infrastructure, and the associated risks and rewards of investment in infrastructure. Finally, understand the characteristics of intellectual property, what specifically drives the returns of film projects, and know how to value intellectual property using a simplified model.

Commodity Producers

LO 13.1: Demonstrate knowledge of commodity producers.

For example:
- **Describe how commodity prices affect operating performance of firms that transform natural resources into commodities.**
- **Describe the relationship between commodity prices and equity prices of commodity-producing firms.**
- **Discuss the empirical evidence on the correlation between commodity prices and the equity prices of commodity-producing firms.**

A **natural resource** is defined as a real asset that has had very few (if any) alterations by human beings. These assets are seen as a means of diversifying against both unexpected inflation and the general fluctuations of the economy. There are challenges to investing directly in a natural resource, which is why investors may focus on firms that develop natural resources. A natural resource investment lies on a spectrum, with one end representing pure plays on the resource and the other end representing investments in firms whose operations are more important than natural resources to the firm's performance.

Natural Resource Prices and the Impact on Operating Firm Performance

When evaluating investments in natural resources, a key element to evaluate is the degree to which risk and return characteristics for firms that process natural resources tie to direct investments in natural resources. The fact that airline stocks tend to rise when ticket prices fall indicates that the relationship between the price of the good which underlies production and the performance of the operating company that utilizes the good is often complicated. For stocks of companies in the technology, communications, manufacturers, and healthcare

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industries, there is only a moderate correlation between equity price changes and the underlying goods.

There are three primary factors that drive the correlations between price changes for the associated commodities of firms and the returns of these same firms:

- The price elasticity of the good's demand.
- The price elasticity of the good's supply.
- The extent that an operating firm has exposure to the commodity (i.e., does the firm hedge its exposure and how reliant is the firm's operations on the good).

In theory, it makes sense that a firm which provides goods and services tied to extracting and processing natural resources has a market price that is correlated to the natural resource prices or the processing that produces the commodities. If a commodity price increases, the implication is that demand exceeded supply; so in theory, this should also result in an increase in demand for the goods and services of the firms that are involved in the production of those commodities.

Evidence of the Correlation between the Equity Prices of Operating Firms and Commodity Prices

The reality is that the short-term and long-term performance of an operationally intensive firm tends to substantially differ from the price performance of the related commodity. As such, the share prices for these firms will be driven only partially by the price changes in the related commodity. For example, from 2002–2012, the price of gold increased 500% (from $300 per ounce to $1,800 per ounce), while shares of gold mining companies only tripled. In other words, the firms that explored, extracted, developed, and processed gold did not benefit as much from the huge increase in prices as the owners of gold reserves and gold bullion. In late 2008, during the initial stages of the recession and equity market downturn, gold afforded investors a level of protection from the equity downturn that even gold mining firms in the U.S. could not provide as gold prices moved slightly upward, while shares of gold mining companies dropped by 33%. Relative to the volatility of gold prices, the volatility of the equity markets during this time had a larger impact on the stock prices of operationally intensive firms involved in gold production.

Commodity Prices and Equity Returns of Associated Operating Firms

An investor looking at an operationally focused firm must understand that this investment is not a pure play on the real assets. The market's estimate on supply and demand factors tied to the long-term profitability of the firm's goods and services plays just as much of a role (if not more) than the prices of the related commodities.

A study of two oil industry exchange-traded funds (ETFs) over an eight-year period (July 2006 – June 2014) shows a relatively equivalent positive correlation between the returns of the ETFs and oil prices (0.68 and 0.69) and the returns of the ETFs and the overall equity market (0.69 and 0.74).

In addition, the correlation between oil prices and the overall stock market was 0.51. Therefore, we can see that oil firm returns have a higher correlation than oil does to the returns of the stock market. The implication is that a significant portion of the returns in the oil company sector is a by-product of the performance of the equity markets overall (and the general economy) rather than oil prices.

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Liquid Alternative Real Assets

LO 13.2: Demonstrate knowledge of liquid alternative real assets.

For example:

- Discuss the structure of master limited partnerships (MLPs) and characteristics of the MLP sector.
- Identify the tax characteristics of MLPs.
- Discuss valuation of MLPs.

MLPs: Structure and Sector

A **master limited partnership** (MLP) is a mechanism used to provide investment access to operationally intensive real assets. The ownership units of the MLPs are publicly traded (listed), with the limited partners as unit holders. The units represent direct ownership of a firm rather than shares in a corporation. MLPs are required to have at least 90% of their revenues coming from specific businesses, which are predominantly in the energy sector but may also be in timber, real estate, or other assets. The reason for the large proportion of energy MLPs can be attributed to their recent high returns, the size of the energy sector, and the favorable tax treatment of energy development projects.

Within the oil and gas sector, there are three operations sectors:

1. **Upstream operations**—focus on exploration and production.

2. **Midstream operations**—focus on process, transport, and storage. Largest segment due to its having very little commodity price risk.

3. **Downstream operations**—focus on refinement, distribution, and marketing.

MLP Tax Characteristics

From a taxation perspective, entities fall into three categories:

1. **Taxable corporations** (or *C corporations*): Profits are taxed at the corporate income tax level and then again as distributions on the individual income tax level. This is a concept called **double taxation**.

2. **Untaxable corporations** (or *investment companies*): As long as these companies distribute almost all of their profits to shareholders, they can avoid corporate level income taxes. Distributions are then taxed at the individual income tax level.

3. **Limited partnerships** (including MLPs): Profits are not subject to taxes at the partnership level. Rather, profits are taxed at the individual partner level because revenues, expenses, and profits flow directly to the partners. Distributions are not taxed.

Because income is taxable (and the distributions are not taxable) to the unit holders of an MLP, investors can benefit from tax-free distributions. In addition, large distributions may qualify as return of capital, which will lower the tax basis of the investment overall to the investor and result in a short-run deferral of taxes owed. However, full tax rates may apply on the recaptured gains that are part of the ultimate distributions.

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On an annual basis, MLP investors filing their taxes must report on their investment using a *K-1 form*. This form tends to be very complex and the need to utilize it often causes delays in filing federal tax forms. At the state level, many state income tax returns may need to be filed because MLP income may be subject to taxation in the states in which they operate. Also, unrelated business income tax (UBIT) may arise for U.S. not-for-profits and pension plans which invest in MLPs.

MLP Distribution Rates and Valuations

As mentioned above, MLP investors are taxed on income rather than on distributions. An MLP structure does not have to pay income taxes and it is able to make tax-free distributions to its investors. The ceiling on the distributions is literally whatever the MLPs cash flows can absorb. There are concerns in the investment community that MLP prices are over-inflated due to the tax-free nature of the often very high distributions and overestimations on the sustainability of these distributions. There are two valuation methods for MLPs:

1. The **present value of growth opportunities (PVGO)** valuation theory allows for a high valuation on an MLP if the investment offers strong potential for relatively high future income. Assuming the MLP continues to enter into very profitable transactions and the operations are solid, investors can argue that high distribution rates are sustainable.

2. The **Ponzi-like valuation theory** is used by analysts and investors who argue that MLP prices are over-inflated. In a Ponzi operation, cash inflows from new investors are distributed as cash outflows to old investors under the guise that they are coming from underlying investment successes. This type of operation often implies fraud, but that is not the case for MLPs. Instead, the concern is actually that over-enthusiastic investors may be implicitly inflating MLP prices based on unsustainable fundamentals. If high cash flows are driven by secondary offerings for MLP units, the high distributions may need to be cut if new acquisitions and financings slow or end.

Infrastructure as an Alternative Asset

LO 13.3: Demonstrate knowledge of infrastructure as an alternative asset.

For example:
- **Recognize the seven characteristics that distinguish investable infrastructure from other assets.**
- **Contrast economic and social infrastructure.**
- **Discuss the influence of government on infrastructure investments.**
- **Describe investment vehicles for investing in infrastructure.**
- **Describe the risks and rewards of infrastructure investments.**

Infrastructure can be broadly defined in finance as the underlying foundation of basic services, facilities, and institutions upon which a society depends.

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Characteristics of Investable Infrastructure

Investable infrastructure has seven key characteristics. However, none of these characteristics are necessary or sufficient to automatically classify an asset as investable. The seven general characteristics are:

1. **Public use of the asset or service.** This means the asset serves the general welfare or that a large segment of the population uses the asset or service.

2. **Monopolistic power to price.** If services are offered by a single provider, prices may be set without being subjected to competition. This increases the value of an infrastructure investment.

3. **Government related.** To what extent is the asset or service created, owned, managed, or regulated by the government?

4. **Provides an essential service.** For example, electricity is an essential service and thus is price inelastic. An investment in an essential service will likely provide stable cash flows.

5. **Generates cash.** An asset such as a toll road or hospital directly generates cash, compared to an interstate highway which is supported by taxes. Infrastructure investors prefer assets that directly generate cash.

6. **Conducive to privatization.** Some assets, such as highways, are not conducive to privatization. One of the characteristics of investable infrastructure is that it can be privatized.

7. **Capital intensive and long-term.** Infrastructure investments typically require significant capital and the assets are generally long-term (e.g., toll roads or hospitals).

Types of Infrastructure

Public assets, such as roads, bridges, parks, and hospitals, belong to the public. Similarly, public services are provided to citizens by the government and are financed by tax revenues and possibly fees. Examples include utilities, education, the postal service, police and fire protection, and the military. Transportation (e.g., roads, airports), utilities, and specialty sectors, such as forests, are classified as economic infrastructure, while schools, universities, hospitals, and jails are classified as social infrastructure.

Figure 1: Examples of Infrastructure Investments

Economic Infrastructure	*Social Infrastructure*
• Energy/utilities (e.g., water, energy generation/distribution/ transmission, pipelines, wastewater treatment). • Specialty sectors (e.g., storage facilities, forests). • Transport (e.g., ports, railways, and toll roads).	• Educational facilities. • Health care facilities. • Security/recreational facilities (e.g., prisons, stadiums, parks). • Public housing.

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Investable infrastructure is the intersection of public assets and services with the private sector. Such investment often takes the form of a sale or lease of an asset by the public sector to the private sector. Investments that must be constructed are called **greenfield projects**. Those projects that already exist and may be transferred from public to private ownership are called **brownfield projects**. This process of transferring existing assets from a government entity to a private operator is known as **privatization**. Existing assets are often privatized to raise capital for governments or to free up cash flow. A **public-private partnership (PPP)** occurs when the government maintains ownership but leases an asset, such as a hospital, to a private entity.

Greenfield investments may be quite risky as costs and potential cash flows are unknown. This is especially true in emerging markets. Brownfield investments with long histories and stable cash flows are much less risky for investors. The **exit strategy** is important to both types of investments. Exit strategies are similar to those in private equity markets. Investors can sell assets to other investors, sell to a strategic buyer, seek additional investors, securitize asset cash flows, or float an initial public offering (IPO).

Governmental Influence

The government influences infrastructure investing in several ways.

Positive influences include:

- **Significant need for infrastructure.** Developed countries have a need for new or improved infrastructure due to aging and constrained municipal and federal budgets. Developing economies that have high income growth and rapidly growing populations (e.g., China) have a great need for infrastructure investments as well.
- **Economic growth is tied to infrastructure.** The economic health of a society is tied to infrastructure, yet governments cannot afford to fund all the necessary and desired projects.
- **Proceeds from sales or leases can be used by governments to fund other projects.** Some governments will spend the proceeds on other areas or use the proceeds to reduce debt, which does not enhance the quality or amount of infrastructure.

Risks to private investors dealing with government include:

- **Regulatory risk.** Investors may have uncertainty regarding future government actions pertaining to the leased asset. In some cases, voters must approve the sale or lease of an asset. The government may still regulate assets even after they are sold.
- **Continued government influence.** In some cases, the government will monitor quality after a sale. They might also regulate prices that can be charged for a service, which can lead to reduced profits. Given the monopolistic nature of many of these assets, profits are generally stable.
- **Right to revoke a lease.** The government often retains the right to revoke a lease if the private entity does not meet certain standards regarding service and maintenance.

Types of Infrastructure Investments

Investors can gain exposure to infrastructure investments with the following indirect investment vehicles:

- **Listed stocks and listed funds of infrastructure stocks.** These stocks have high dividend yields (either because demand for infrastructure services is price inelastic or because there is less growth potential in infrastructure firms). The stocks also exhibit low return volatility. Low volatility is attributed to price inelasticity and the nature of these companies (i.e., monopolistic and regulated). Ironically, listed funds of infrastructure stocks have shown a greater correlation to equity markets and higher volatility than their unlisted counterparts.

- **Closed-end funds.** Structured like a private equity fund, these funds typically have 10- to 15-year lives. Management fees range from 1–2% of assets annually with carried interest of 10–20% over a preferred return of 8% paid at exit. Lower volatility and lower correlation to equity markets can be partially attributed to illiquidity and the appraisal-based valuation process. Leverage levels are higher than for listed equities and can reach 60–90% when markets are favorable to borrowing.
- **Unlisted (evergreen) open-end funds.** As with open-end stock and bond funds, investors buy from and sell to the fund itself. If demand to redeem shares exceeds the fund's ability to raise capital, gates may be put in place. *Gates* restrict investors from redeeming shares at will, and require redemption over a specified period.

In some cases, institutional investors have chosen to make direct investments in infrastructure. This method was pioneered by Canadian and Australian pension funds and requires a skilled in-house team capable of analyzing, structuring, negotiating, sourcing, and managing the investments.

Figure 2: Advantages and Disadvantages of Infrastructure Investments

	Listed Stocks and Funds	*Closed-End Unlisted Funds*	*Open-End Funds*	*Direct Investments*
Advantages	Higher dividend yields than equities from other sectors, lower volatility than equities from other sectors, greater liquidity than unlisted funds, more transparent valuation than unlisted funds.	Lower volatility than listed funds, lower correlation with equity markets than listed funds, higher leverage possible than with listed funds.	Investors may subscribe or redeem shares from the fund.	More control than with indirect infrastructure investments.
Disadvantages	Greater correlation with equity markets than unlisted funds, higher volatility than unlisted funds, investors in global funds are subjected to currency risk.	No benchmark index data available due to private nature of unlisted funds.	Gates (restrictions on withdrawals) may be put in place if redemptions exceed the resources of the fund.	Requires sophisticated in-house teams to source, analyze, structure, negotiate, and manage investments.

Risk and Rewards of Infrastructure Investments

Infrastructure investments are difficult to classify because they share features with private equity, fixed income securities, and real estate investments. Approximately 50% of all infrastructure investors see infrastructure as its own asset class, approximately 33% of investors see infrastructure as part of their private equity investments, and the remainder consider infrastructure as part of their allocation to real estate.[1]

1 "Infrastructure Investing: A Key Source of Growth in the Global Economy," CFA Institute: Financial Analysts Seminar, July 2010.

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Similarities between infrastructure and fixed income include:

- High current yield due to high dividend payments.
- Steady cash flows due to the monopolistic nature of the investments.
- Long duration investments.
- Possibility of built-in inflation protection.

Similarities between infrastructure and real estate include:

- Investment in real assets.
- Investments that generate (often stable) cash flows.

Similarities between infrastructure and private equity include:

- Infrastructure operating companies can add value through financial engineering.
- Infrastructure operating companies may add value through increasing operating efficiencies in the purchased or leased assets.

The degree of risk associated with infrastructure investments depends on the age, type, geography, and extent of development risk assumed by the owner of the asset. Mature assets with stable cash flows (e.g., developed market, brownfield investments) tend to be the safest, while newer assets that have yet to establish cash flow stability (e.g., emerging market, greenfield investments) are riskier. The more well-established and convenient the exit strategy is for investors, the lesser the degree of risk. Exit strategies include selling assets in the secondary market to other investors, floating an IPO, securitizing the cash flows, or seeking out co-investors and strategic buyers.

Intellectual Property as an Alternative Asset

LO 13.4: Demonstrate knowledge of intellectual property as an alternative asset.

For example:
- **Discuss intellectual property as an investment.**
- **Describe characteristics of intellectual property.**
- **Recognize the factors that contribute to returns of film projects.**
- **Define and apply the simplified model for valuing intellectual property.**

Intellectual property (IP) is an intangible asset that can be owned. Examples of intellectual property include patents on new technologies and copyrights on written works. In its simplest form, IP refers to ownership rights to ideas and other forms of human creativity.

Characteristics of Intellectual Property

An **intangible asset** is a real asset that lacks a physical form. Some intangible assets are **excludable goods**, meaning others are prevented from using or enjoying them. In order for an intangible asset to qualify as IP, it must be excludable (allowing it to be owned) and therefore represent a private good. Patents and copyrights are examples of excludable intangible assets.

Intangible assets such as technology are as necessary for economic growth as labor, capital, and raw materials. Countries that make significant technological advancements often have much higher levels of wealth and standards of living than those countries that are unable to contribute ideas and innovations.

In recent years, companies and universities have increasingly been **unbundling** intellectual property and selling it or leasing it as a stand-alone investment. IP investments tend to include risk premiums for volatility, illiquidity, and complexity due to the nature of these assets.

Think of IP as being similar to private equity. There are the very early stage ideas such as exploratory research, pending patents, and new music and film production that are highly risky investments. Future cash flows are uncertain. These are like **call options** that largely expire unexercised (i.e., the investor does not recapture initial costs). However, as with call options, a few of these early stage ideas generate large returns (i.e., finish in the money). In the film industry for example, a 2005 study of more than 2,000 films finds that 80% of the profits in the sample were generated by little more than 6% of the films.[2]

In contrast, later stage IP, as with later stage start-up companies, are less risky and cash flows are more certain. Some IP, such as artwork, gains value over time. Other examples of IP are considered wasting assets. The benefits of a wasting asset accrue early and the value declines over time as excludability diminishes (e.g., a patent on a drug). IP investors may need additional legal expertise, as many deals regarding property rights are dynamic and complex.

IP Returns

There is sparse data regarding the risk and returns of unbundled IP, although visual arts, research and development (R&D), and the film industry have been thoroughly examined in order to assess risk/return. Despite sufficient data regarding historical returns, paintings and other visual mediums do not generally comprise a significant part of an institution's IP portfolio. Also, R&D investment is generally made within a company and is not unbundled, prohibiting institutional investors from investing in R&D.

However, film production does give some insight into the potential risk and rewards of IP investing, although different film types have different risk/reward profiles (e.g., genre, new story vs. sequel). The costs of producing a film are called **negative costs**. Negative costs are the all-in costs from script development through post production costs. Films also require marketing, printing, and other expenses to get the product into theaters. Revenues are generated from exhibiting the film in the theater, video, television, and so on. Financing in this industry is generally equity, debt, or both.

Intellectual Property Modeling

A **discounted cash flow approach** is the best way to value an IP investment. The model typically used is the constant growth model applied to common stock valuation. That is:

$$P_0 = \frac{D_1}{r - g}$$

where:
D_1 = dividend to be received at the end of year 1
r = investor's required rate of return (often referred to as *k*, the discount rate, rather than *r*)
g = growth rate in dividends and earnings

2 DeVany A., *Hollywood Economics*, Routledge: NY, 2004.

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In this case, the model is modified slightly to reflect the fact that for IP investments, growth is likely to be negative as a result of factors such as expiring patents and obsolescence. Thus, the value of an IP investment at time 0 is

$$V_{IP,0} = \frac{p \times CF_1}{r - g}$$

where:
p = probability of generating large positive cash flows
CF_1 = CF expected in year 1
r = investor's required rate of return
g = growth rate (likely to be negative in an IP investment)

Example: Calculating the value of intellectual property

Assume the probability of a positive cash flow is 45%, the required rate of return is 10%, the value of the IP is expected to decline by 3% per year and CF_1 = $1. **Calculate** the value of the IP.

Answer:

$$V_{IP,\,0} = \frac{0.45 \times \$1}{0.1-(-0.03)} = \$3.46$$

This implies that the IP should be valued at $3.46 for each dollar forecasted to be generated in period 1.

In the preceding example, the value would be below $1 if the probability of a positive large cash flow was significantly smaller (remember the 6% number discussed above in the film example). Also, the value of the IP will decline as the negative growth rate increases. When the value is below $1.00, it is indicative of an out-of-the-money call. The investor cannot expect to recapture their full investment.

Example: Calculating the value of intellectual property with low probability of positive cash flows

Assume the probability of a positive cash flow is 5%, the required rate of return is 10%, the value of the IP is expected to decline by 3% per year and CF_1 = $1. **Calculate** the value of the IP.

Answer:

$$V_{IP,\,0} = \frac{0.05 \times \$1}{0.1-(-0.03)} = \$0.38$$

The IP investment yields $0.38 for every $1.00 invested. This illustrates the point that IP investments are highly uncertain.

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As with the stock dividend discount model, the equation may be rearranged to solve for return (r) rather than value at time zero. In this case, the equation is:

$$r = \frac{p \times (CF_1)}{V_{IP,\,0}} + g$$

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Key Concepts

LO 13.1

An investment in natural resources covers a spectrum, with one end representing a pure play on the resource and the other end representing investments in firms whose operations tie in some way to natural resources.

The three primary factors that drive the correlations between commodity prices and the returns of related firms are:

- Extent that an operating firm has exposure to the commodity or has hedged its revenues and expenses.
- Price elasticity of the good's demand.
- Price elasticity of the good's supply.

Evidence has shown that in the short-term and long-term, performance of commodity-related firms differs from the price performance of the related commodity. Share prices for these firms are driven by commodity price changes, equity market conditions, and internal operations.

LO 13.2

A master limited partnership (MLP) allows for publicly-traded investments that provide access to operationally intensive real assets. The unit holders (i.e., limited partners) are direct owners of the MLP. The energy sector has the largest concentration of MLPs.

Limited partnerships (including MLPs) are not subject to taxes at the partnership level. Because only income is taxable (and not the distributions) to the limited partners of an MLP, investors can benefit from tax-free distributions. Having to use K-1 forms, potentially filing multiple state income tax forms, and unrelated business income tax risks are disadvantages from a tax perspective.

There are two valuation methods for MLPs:

- The present value of growth opportunities (PVGO) valuation theory allows for a high valuation on an MLP as it assumes the investment at any point is theoretically worth the present value of its future cash flows.
- Ponzi-like valuation theory builds on the concept of a Ponzi operation in which cash inflows from new investors are distributed as cash outflows to old investors under the guise that they are coming from underlying investment success. For MLPs, the concern is that over-enthusiastic investors may be implicitly inflating MLP prices based on unsustainable fundamentals.

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LO 13.3

The seven characteristics that help identify investable infrastructure include:

1. Public use of the asset or service.
2. Monopolistic power to price.
3. Government related.
4. Provides an essential good/service.
5. Generates cash.
6. Conducive to privatization.
7. Projects tend to be capital intensive and long-term.

Economic infrastructure includes energy and utilities, communications, and transportation. Social infrastructure includes education, health care facilities, prisons, parks, and public housing.

The government influences infrastructure investments both positively and negatively. On the positive side, there is a great need for infrastructure, economic growth is tied to infrastructure, and the proceeds of infrastructure sales and leases can be used for other projects. On the negative side, the government often stays involved even after the sale or lease of infrastructure to private investors. There is regulatory risk and the government may revoke the lease on an asset.

Indirect investment vehicles include listed stocks and listed funds of infrastructure stocks, closed-end funds and unlisted (evergreen) open-end funds. Investors can also directly invest in infrastructure if they have the capital and the expertise.

Similarities of infrastructure with fixed income include high current yields due to high dividend payments, steady cash flows due to the monopolistic nature of the investments, long duration investments, and the possibility of built-in inflation protection.

Similarities of infrastructure with real estate include investments in real assets and investments that generate (often stable) cash flows.

Similarities of infrastructure with private equity include infrastructure operating companies can add value through financial engineering and infrastructure operating companies may add value through increasing operating efficiencies in the purchased or leased assets.

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LO 13.4

Intellectual property (IP) is an intangible asset that can be owned. An intangible asset is a real asset but does not have a physical form. Some intangible assets are excludable goods, meaning others are prevented from using or enjoying them. Patents and copyrights are examples of excludable intangible assets. Some IP, such as artwork, gains value over time. Other examples of IP, such as patents, are considered wasting assets. Public markets for IP do not generally exist, and thus it is difficult to analyze IP's performance as an asset class. Financing in this industry is generally equity and debt.

Returns on film projects are driven by the level of negative costs (costs of film production), other expenses, revenues from film exhibitions and sales, financing costs, and film characteristics (e.g., genre, new story vs. sequel).

A discounted cash flow approach is the best way to value an IP investment. The model typically used is the constant growth model applied to common stock valuation.

The value of an IP investment is:

$$V_{IP,0} = \frac{p \times CF_1}{r - g}$$

where:
p = probability of generating large positive cash flows
CF_1 = CF expected in year 1
r = investor's required rate of return
g = growth rate (likely to be negative in an IP investment)

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Concept Checkers

1. Which of the following factors is *least likely* to influence the correlation between the returns of operating firms and the price changes of their associated goods?
   A. Cross elasticity with related goods.
   B. Price elasticity of the good's supply.
   C. Price elasticity of the good's demand.
   D. Operating firm's hedging of revenues and expenses.

2. Approximate historical correlations among oil prices, oil ETFs, and the overall equity market are:
   A. lower than –1.
   B. between –1 and 0.
   C. between 0 and 1.
   D. greater than 1.

3. Which of the following statements is *most accurate* regarding the operating divisions of the MLP oil and gas sector?
   A. Upstream operations focus on exploration and production.
   B. Downstream operations focus on process, transport, and storage.
   C. Midstream operations focus on refinement, distribution, and marketing.
   D. Endstream operations focus on site closures and new site development.

4. Which of the following statements regarding the tax characteristics of MLPs is *most accurate*?
   A. A disadvantage is double taxation.
   B. An advantage is the simplicity of filing the K-1 form.
   C. An advantage is that profits are taxed but actual distributions are not.
   D. A disadvantage is that the return of capital distributions is taxed initially and they lower the basis.

5. Which of the following would *most likely* make an infrastructure investment noninvestable?
   A. The project is short-term in nature.
   B. The infrastructure generates cash.
   C. The project is conducive to privatization.
   D. The infrastructure provides an essential service.

6. Infrastructure investments are similar to fixed income in all of the following ways **EXCEPT:**
   A. relatively steady cash flows.
   B. shorter duration investments.
   C. may be used to provide inflation protection.
   D. high current yields.

7. Which of the following valuation approaches/models is typically applied to intellectual property investments?
   A. Appraisals.
   B. Market prices.
   C. Discounted cash flow.
   D. Relative valuation models.

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8. Negative costs in the film industry will include expenses related to:
   A. printing.
   B. marketing.
   C. script development.
   D. promotional campaigns.

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Concept Checker Answers

1. **A** Cross elasticity is a concept in microeconomics where the change in demand for a good is measured as a result of a change in price for another good. This elasticity measure will not influence the correlation between operating firm returns and price changes for related goods. All of the other answer choices will influence this correlation. (LO 13.1)

2. **C** Historical evidence has shown strong positive correlations between oil prices and oil ETFs, oil prices and the equity market, and oil ETFs and the equity market. One would expect that over the course of any given period, they are most likely to find that these positive correlations remain (as opposed to negative correlations as choice B would indicate). Correlations can only be between -1 and 1. (LO 13.1)

3. **A** The focus of upstream operations is on exploration and production. Midstream operations focus on process, transport, and storage. Downstream operations focus on refinement, distribution, and marketing. Endstream operations do not represent an operating division. (LO 13.2)

4. **C** Profits flow down to MLP investors and they are taxed, regardless of whether any distributions have occurred. Distributions are not taxed. Double taxation is a significant disadvantage for C corporations rather than MLPs. The K-1 form is very complicated and often causes delays in the filing of investor tax returns. Return of capital distributions do lower tax basis for investors, but they are not taxed initially. (LO 13.2)

5. **A** Infrastructure investments are typically capital intensive and long-term in nature. A short-term project would not fit the investment profile. (LO 13.3)

6. **B** Both fixed income and infrastructure investments tend to have *long* durations. All of the other similarities between infrastructure investments and fixed income are accurate. (LO 13.3)

7. **C** A discounted cash flow approach is typically used to value intellectual property investments. However, the value is similar to an out-of-the-money option and the growth rate is generally negative. (LO 13.4)

8. **C** Script development is considered a negative cost, with all of the other costs falling outside of the category of negative costs. (LO 13.4)

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The following is a review of the Real Assets principles designed to address the learning objectives set forth by the CAIA Association®.

Liquid and Fixed-Income Real Estate

Topic 3.5

Exam Focus

Due to the amount of capital required to acquire real estate, mortgages are often used to finance real estate purchases. For the exam, be familiar with mortgage terminology and be able to perform basic mortgage calculations. In addition to the familiar fixed-rate and adjustable-rate mortgages, you must understand alternative mortgage structures such as interest-only mortgages, graduated payment mortgages, and balloon payment mortgages. Be able to define and calculate loan-to-value, interest coverage, debt service coverage, and fixed charges coverage ratios. Also know the characteristics and risks of residential and commercial MBSs. Understand the conditional prepayment rate and be able to apply the PSA prepayment benchmark to predict loan prepayments. Finally, understand the economic benefits of the real estate investment trust (REIT) structure and be able to categorize a REIT investment based on its stated characteristics.

Real Estate as an Investment

LO 14.1: Demonstrate knowledge of real estate as an investment.

For example:

- **List five common attributes of real estate that encourage its inclusion in investment portfolios.**
- **Discuss heterogeneity, lumpiness, and illiquidity of real estate.**
- **Discuss and contrast core, value-added, and opportunistic real estate investment styles.**

Real estate as an investment has been a significant portion of individual wealth for thousands of years. Until the last century, a majority of positions in institutional portfolios were real estate investments. As private real estate has grown, real estate as an investment has shifted from a major investment in institutional portfolios to one that is now considered an alternative investment. In this section, we will address the advantages and disadvantages of including real estate in investment portfolios and define and contrast the different types of real estate investment styles.

Potential Advantages and Disadvantages of Real Estate Investment

Five major potential *advantages* that encourage investors to add real estate to their investment portfolios are as follows:

1. Diversification with other investments (e.g., stocks and bonds).

2. Hedge against unexpected inflation.

3. Achieve absolute returns.

4. Earn cash inflows.

5. Income tax advantages.

Given that the first three advantages are tied to portfolio risk, achieving these attributes may come at a cost. For example, adjustments to real estate market prices suggest that risk-reducing activities may be offset by lower expected returns. On the other hand, risk-taking activities such as owning illiquid real estate may provide higher expected returns given the implicit liquidity premium.

Three major potential *disadvantages* that discourage investors from adding real estate to their investment portfolios (unless higher expected returns can be achieved from these characteristics) are as follows:

1. Heterogeneity.

2. Lumpiness.

3. Illiquidity.

The first disadvantage is **heterogeneity** (i.e., real estate features are unique to each asset). Due to differences among real estate investments in regard to location, design, use, and even lease agreement structures, due diligence of real estate investments can be challenging.

The second disadvantage is **lumpiness** (i.e., the inability to cheaply and easily buy and sell assets in sizes and quantities demanded by traders). Unlike buying and selling stocks, trading real estate can be problematic due to high transaction costs and high unit costs (from large investment sizes).

The third disadvantage is **illiquidity**. Given that real estate investments are not traded on an exchange and also suffer from high unit costs, illiquidity can be high compared to stocks and bonds.

Real Estate Investment Styles

Real estate can be organized into three distinct investment styles: core, value added, and opportunistic. These **styles of real estate investing**, established by the National Council of Real Estate Investment Fiduciaries (NCREIF), categorize real estate equity investments or real estate managers by volatility. Core real estate is considered least risky (i.e., focused on income) while opportunistic real estate is considered most risky (i.e., focused on price appreciation). These real estate styles allow investment managers to properly assess real estate opportunities, monitor for style drift, and conduct performance attribution with relevant benchmarks.

- **Core real estate** includes asset categories such as multi-family, office, retail, industrial, and hotels. These properties exhibit low volatility and generate a majority of returns from income (e.g., lease payments) rather than price appreciation. In this respect, core real estate displays bond-like characteristics due to reliable cash inflows and low levels of risk. Compared to other investment styles, core properties have higher levels of liquidity and lower levels of leverage. They also tend to be more developed, more recognizable, and held for longer periods of time.

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- **Value-added real estate** includes asset categories such as resorts, outlet malls, hospitals, low-income housing, and assisted-care facilities. This real estate investment style may also include core properties that are not fully leased, or properties undergoing renovations or repositioning in the marketplace. Value-added properties exhibit a moderate level of volatility and generate a majority of returns from price appreciation. Compared to core properties, value-added real estate produces lower amounts of reliable income and utilizes more leverage. Due to the uncertainty of value appreciation, value-added properties can potentially suffer long periods of poor returns if that appreciation is not realized.
- **Opportunistic real estate** involves developing raw property, redeveloping property that is in poor condition, or acquiring property that is soon to undergo significant improvements. Opportunistic properties derive almost all returns from price appreciation and exhibit high levels of volatility and leverage. The expected value appreciation typically occurs over a three- to five-year period. At that time, the investor will decide to either refinance the property or exit the position. Compared to the other investment styles, opportunistic real estate displays more equity-like characteristics.

Residential Mortgages

LO 14.2: Demonstrate knowledge of residential mortgages in the context of alternative investments.

For example:
- **Define mortgages, and differentiate between fixed- and variable-rate mortgages.**
- **Describe characteristics of fixed-rate mortgages, including amortization.**
- **Recognize the determinants of the monthly payment on a mortgage loan.**
- **Calculate monthly payments for fixed-rate and variable-rate mortgages.**
- **Calculate the outstanding mortgage balance.**
- **Describe the prepayment option embedded in fixed-rate mortgages.**
- **Describe characteristics of interest-only mortgages.**
- **Identify and apply the formula for valuation of interest-only mortgages.**
- **Describe characteristics of variable-rate mortgages.**
- **Identify and apply the formula for valuation of variable-rate mortgages.**
- **Describe other variations of mortgages.**
- **Calculate the monthly payments for a mortgage with a balloon payment.**
- **Describe default risk for residential mortgages.**

A **mortgage** is a loan secured by real property (i.e., residential dwelling and land) as collateral and may be repossessed by the lender (mortgagor) if the borrower (mortgagee) is in default.

A **fixed-rate, constant payment, fully amortized mortgage** requires the borrower to pay a constant periodic amount, usually monthly, that will completely pay off the loan amount with the last payment. The lender first credits each payment to the interest due and then applies the balance to reduce the principal of the loan. Therefore, while each debt service payment remains the same, the portion applied toward repayment of the principal grows and the interest due declines as the unpaid balance of the loan is reduced. Any payment of principal in excess of the scheduled principal repayment is called a prepayment. While the payments remain constant in nominal terms, the real cost of the payments typically declines over the life of the loan due to inflation.

While it is tempting to only look at the interest rate charges when determining the cost of the mortgage, this is incorrect. The effective cost of a mortgage should also take into account any other loan fees or charges incurred during the life of the mortgage.

Professor's Note: It is highly recommended that you learn to use the time value of money functions on your calculator for the calculations in this topic review. Knowing these functions will save you time on the exam and reduce your chances of making a calculation error.

Fixed-Rate Mortgages

Monthly Mortgage Payment Calculation

To calculate the monthly mortgage payment on a fixed-rate fully amortized loan, three components are needed: (1) the loan amount, (2) the interest rate per period, and (3) the length of the loan. A mortgage payment is an ordinary annuity. As such, the following formula may be used to calculate the mortgage payment:

$$MP = MB \times [i / (1 - (1 + i)^{-n})]$$

where:
MP = constant monthly mortgage payment
MB = mortgage balance (which is the total amount borrowed at the beginning of the loan)
i = monthly interest rate
n = number of months in loan term (e.g., 30-year mortgage = 30 × 12 = 360 months)

Alternatively, enter the following inputs to calculate the required payment using your financial calculator: PV = loan amount, FV = 0, N = total loan periods, I/Y = interest rate per period; then solve for PMT = payment per period.

Example: Fixed-rate loan payment calculation: Monthly mortgage payments

A couple plans to take out a 6%, 15-year, $350,000 fixed-rate fully amortized mortgage. **Calculate** the required monthly payment amount.

Answer:

To determine the monthly payment using the formula:

$$\text{mortgage payment} = 350{,}000 \times [0.005 / (1 - (1.005)^{-180})] = \$2{,}953.50$$

To determine the monthly loan payment using the financial calculator, input the relevant data in your calculator and compute the payment.

N = 15 × 12 = 180; I/Y = 6/12 = 0.5; PV = –$350,000; CPT → PMT = $2,953.50

Thus, the loan can be paid off in 180 monthly payments of $2,953.50. Please note that FV = 0 in this computation (i.e., the loan will be fully paid off (amortized) after the payments have been made).

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Calculating Monthly Interest, Principal, and the Outstanding Balance

Lenders charge borrowers a certain percentage of the principal as interest for the time period a debt is outstanding. The amount of interest due in a particular payment is the product of the outstanding balance and the periodic interest rate. The principal paid for any period is simply the periodic payment amount less the required interest payment. The outstanding balance for any period can be calculated with your financial calculator using the following inputs: N = payments remaining until maturity, I/Y = monthly interest rate, and PMT = monthly required payment; then solve for PV = present value.

Example: Fixed-rate loan payment calculation: Monthly mortgage payments

A couple took out a 6%, 15-year, $350,000 fixed-rate fully amortized mortgage. **Calculate** the principal and interest components for the 1st payment and the 61st payment.

Answer:

To calculate the interest required for a period, simply multiply the interest rate by the remaining principal from the previous period.

1st payment:

Payment: $2,953.50 (calculated in previous example)

Interest payment: $350,000.00 × 0.005 = $1,750.00

Principal payment: $2,953.50 – $1,750.00 = $1,203.50

Remaining principal: $350,000.00 – $1,203.50 = $348,796.50

61st payment:

This calculation is a little more difficult, because we are not given the principal balance from the previous period. To determine this, we input the remaining number of periods as *N* and compute the present value using the financial calculator.

N = 120; I/Y = 6/12 = 0.5; PMT = $2,953.50; CPT → PV = $266,031.85

Interest payment: $266,031.85 × 0.005 = $1,330.16

Principal payment: $2,953.50 – $1,330.16 = $1,623.34

Remaining principal: $266,031.85 – $1,623.34 = $264,408.51

Notice that the amount of the payment allocated to interest has declined from the 1st to the 61st payment and that the amount allocated to principal has increased, while the total payment has remained constant.

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Spreadsheets are also helpful when calculating loan payments and *amortization schedules*, the schedule of principal and interest over the life of the loan. The schedule shows monthly principal and interest payments for each month. The following example includes the amortization schedule for months 1 and 2 for the mortgage previously described.

Month	*Beginning Balance*	*Payment*	*Interest Payment*	*Principal Payment*	*Ending Balance*
1	350,000.00	2,953.50	1,750.00	1,203.50	348,796.50
2	348,796.50	2,953.50	1,743.98	1,209.52	347,586.98

Borrowers may make additional payments. These payments generally reduce the principal outstanding and do not allow borrowers to pay loan payments in advance or reduce the size of future loan payments. The payments are called **unscheduled principal payments.** These payments cause the balance to decline more rapidly than scheduled and result in the mortgage being paid off early as the amount of payments is reduced.

Unscheduled principal payments typically benefit borrowers in a falling interest rate environment (i.e., when market rates are lower than the rate on the loan) and benefit lenders in a rising rate environment (i.e., when market rates are higher than the rate on the loan). When market rates are lower than the loan rate, the borrower can save more by paying down the loan than they could earn investing the money in the market. In contrast, when the market rate is higher than the loan rate, the lender can reinvest additional cash flows at higher prevailing market rates, earning a return greater than that offered by the loan.

Making unscheduled principal payments is also known as the borrower's **prepayment option**. Similar to a callable bond, a mortgage borrower has a call option on the value of debt, which allows them to repurchase the mortgage at a fixed strike price. In other words, as interest rates fall, the borrower benefits when exercising the option to refinance their mortgage at a lower interest rate. In that respect, this prepayment option can also be viewed as a put option on interest rates (which increases in value as rates fall). Given that a mortgage borrower benefits from increased interest rate volatility, the mortgage lender, who has essentially written a prepayment option to the borrower, will implicitly account for this option through up-front fees or higher mortgage rates.

Interest-Only Mortgages

A borrower may choose an **interest-only mortgage** that calls for interest-only payments during the first part of the loan, and fully amortized payments during the second part of the loan. For example, a loan that pays interest only in the first 10 years followed by a fully amortizing 20-year period is known as a 10/20. Once the amortizing period arrives, the payment is calculated as in the fixed-rate example, but with the shorter remaining time horizon (i.e., 20 years instead of 30).

For example, assume the 15-year fixed-rate loan previously described was a 5/10, five years of interest only followed by a 10-year fully amortizing period. The interest-only payment is \$1,750 per month (\$350,000 × 0.005) in the first five years. The payment during the fully amortizing period increases from the \$2,953.50 calculated in the example to \$3,885.72 based on 120 months rather than 180 months.

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The borrower benefits from a lower initial payment in an interest-only loan but must make up the difference with a higher, later payment.

Variable-Rate Mortgages

Variable-rate mortgages, also known as *adjustable-rate mortgages* (ARMs), generally originate at one rate of interest, after which, the interest rate fluctuates up or down during the loan term based on the movement of a published index rate (e.g., U.S. Treasury bill rate). The sum of the **index rate** plus the **margin rate** (i.e., the amount of interest the lender charges above the index rate) determines the interest rate on the mortgage. For example, if the most recent one-year Treasury bill rate was 3.25%, the lender could add a 2% margin and charge the borrower a 5.25% interest rate on the outstanding loan balance.

Interest rate caps limit the amount the interest rate may increase in any one adjustment period. They also limit the amount by which the interest rate can increase over the entire life of the loan. An interest rate cap benefits the borrower at the expense of the lender and thus must be paid for in the form of a higher initial mortgage rate and/or index.

Example: Adjustable-rate loan payment calculation: Monthly mortgage payments and component determination

A couple plans to take out a 15-year, $350,000 adjustable-rate fully amortized mortgage. The initial index rate is 3% and the margin rate is 2.5%. **Calculate** the monthly payment amount that the couple must make in year 1 and **determine** how much of the first payment in year 1 is reserved for interest and how much is reserved for principal repayment.

Answer:

To determine the monthly loan payment, input the relevant data in your financial calculator and compute the payment.

N = 15 × 12 = 180; I/Y = 5.5/12 = 0.4583; PV = –350,000; CPT → PMT = $2,859.79

Component calculation for the 1st payment:

Interest payment: $350,000.00 × 0.004583 = $1,604.17

Principal payment: $2,859.79 – $1,604.17 = $1,255.62

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Example: Adjustable-rate loan payment calculation: Monthly mortgage payments and component determination

A couple took out a 15-year, $350,000 adjustable-rate fully amortized mortgage. The initial index rate is 3% and the margin rate is 2.5%. In year 2, the index rate has increased to 3.5%, while the margin rate has remained constant. **Calculate** the monthly payment amount that the couple must make in year 2 and **determine** how much of the first payment in year 2 is reserved for interest and how much is reserved for principal repayment.

Answer:

To determine the monthly loan payment, first we need to determine the principal remaining after year 1. To determine this, input the relevant data in your financial calculator and compute PV.

N = 14 × 12 = 168; I/Y = 5.5/12 = 0.458; PMT = $2,859.79; CPT → PV = $334,546.81

To determine the monthly loan payment, input the relevant data in your financial calculator and compute PMT.

N = 168; I/Y = 6/12 = 0.5; PV = –$334,546.81; CPT → PMT = $2,948.15

Component calculation for the 13th payment:

Interest payment: $334,546.81 × 0.005 = $1,672.73

Principal payment: $2,948.15 – $1,672.73 = $1,275.41

Additional Mortgage Types

In addition to the standard fixed-rate and adjustable-rate mortgage structures, several other mortgage structures exist, including the following:

- **Graduated payment mortgages** allow borrowers to make lower monthly payments for the first few years of the loan (typically the first five years) and larger payments for the remainder of the term, when the borrowers' income is expected to have increased. The interest on a graduated payment mortgage is fixed throughout the life of the loan. There may be a **negative amortization** (i.e., the principal balance increases) during the first few years of repayment.
- **Option adjustable-rate mortgage loans (option ARMs)** are a specialized version of adjustable-rate mortgages that are structured to provide borrowers payment flexibility. Typically, borrowers have the *option* to make the minimum payment, an interest-only payment, or a fully amortized payment. However, these loans may not be fully amortizing. This increases the default risk of some option ARMs.

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- **Balloon payment loan.** When a mortgage loan requires periodic payments that will not fully amortize the amount of the loan by the end of the loan term, the final payment is an amount that is larger (generally much larger) than the previous payments—a balloon payment. This is also referred to as a *partially amortized loan*.

Example: Balloon payment

Consider a $400,000 balloon payment mortgage that includes a 20-year maturity, a 6% interest rate, and a $50,000 balloon payment. **Calculate** the monthly required payment.

Answer:

For a $400,000, 6% loan amortized over 20 years with a $50,000 balloon payment, the monthly payment can be calculated using the time value of money function on your financial calculator:

- PV = –400,000
- N = 20 × 12 = 240
- I/Y = 6/12 = 0.5
- FV= 50,000
- CPT → PMT= $2,757.51

Because the payment amount is lower for a balloon mortgage than for a fully amortized loan, there will be a remaining loan balance at the end of the loan. The borrower can pay the balloon with accumulated cash, refinance the balloon with the same lender, refinance the balloon with another lender, or sell the property and make the balloon payment out of the sales proceeds.

Residential Mortgages and Default Risk

Historically, lenders and analysts alike focused more on interest rate risks in mortgage markets than on default risk. Banks and other mortgage lenders were making an increasing proportion of **subprime mortgages** leading up to the crisis (i.e., uninsured mortgages with high rates of delinquency and default). Loans were made with little or no documentation regarding earnings, with no down payments and with the assumption that housing prices would increase forever. However, the recent financial crisis changed that.

Typical analysis of the creditworthiness of borrowers focuses on ratios related to debt and income. For example, the **debt-to-income ratio** sums the total housing expenses and divides the sum by the monthly income of the borrower. A lender may limit housing costs to gross income to 28% (called the **front-end ratio**) and housing costs and other debts such as auto and credit card loans to 36% of gross income (called the **back-end ratio**).

A loan is considered well-collateralized if the **loan-to-value (LTV) ratio**, the amount of the loan relative to the market or appraised value of the property, is 80% or less. If the borrower puts up less than 20% equity, he will likely be required to purchase private mortgage insurance. The LTV ratio is:

$$\text{LTV} = \frac{\text{balance of the loan}}{\text{market value of the property}}$$

For example, if the value of residential property is $200,000 and the loan is $180,000, the LTV is 0.90, or 90% ($180,000 / $200,000).

Credit scores are also important in evaluating the creditworthiness of a residential borrower.

Commercial Mortgages

LO 14.3: Demonstrate knowledge of commercial mortgages in the context of alternative investments.

For example:
- **Describe characteristics of commercial mortgages.**
- **Identify, describe, and apply financial ratios (i.e., loan-to-value ratio, interest coverage ratio, debt service coverage ratio, and fixed charges ratio) employed in the analysis of commercial mortgages.**

Commercial Mortgage Characteristics

Unlike residential mortgages which are largely homogeneous, there are significant differences across commercial real estate loans. Commercial mortgages are structured similar to residential mortgages but differ in the following areas:

- **Borrowers.** Due to the large investment required, commercial properties and their associated mortgages are usually reserved for companies rather than individuals.
- **Income generation.** Unlike residential properties, commercial properties often generate cash flows for the borrower. Lenders must scrutinize the stability of these cash flows as they often are a key source of income used to make subsequent mortgage payments.
- **Balloon payment.** Typically, commercial mortgages are partially amortized requiring a balloon payment, while residential mortgages are fully amortized. The reason is that commercial real estate loans typically have maturities that are too short to fully amortize the loan.
- **Usage.** Commercial properties can be divided into two distinct groups: (1) long-term investment properties and (2) short-term development properties.
- **Covenants.** Because the financial circumstances surrounding a property can change after the inception of the loan, lenders will usually place several covenants in the loan documents to protect their interest in the property. While covenants exist for residential mortgages, commercial mortgage covenants are more detailed and abundant. All else equal, covenants protect lenders and thus lower loan rates for borrowers willing to work with lenders that demand them. Commercial loans contain more details regarding seniority in the event of default or financial difficulties. Covenants provide details regarding the recourse lenders have against borrowers in the event of default. **Recourse** refers to the actions a lender can take against a borrower in the case of default.
- **Cross-collateral provisions.** These provisions allow banks to reduce their risk by pooling collateral from multiple individual loans and applying the collateral to all the loans. For example, suppose a developer took on a mortgage on a duplex backed by the value of the duplex and also, took on a separate mortgage on an apartment. If a cross-collateral provision was included in the mortgage loans, both the apartment and the duplex would serve as collateral for both loans, and both loans would need to be entirely repaid before either property could be sold by the developer.

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Default Risk and Financial Ratios

Default risk is generally considered more important in commercial real estate deals than in residential mortgage loans. Many residential mortgages are insured, either by the government or by private mortgage insurance. A key difference between the ratio analysis of commercial real estate loans versus residential is the role rental income plays in servicing commercial real estate loans.

As with residential mortgages, the **loan-to-value ratio (LTV)** ratio is an important measure of creditworthiness. The LTV ratio is the remaining balance of the loan divided by the (market) value of the property:

$$\text{LTV} = \frac{\text{balance of the loan}}{\text{market value of the property}}$$

For example, if the value of the commercial property is $1,000,000 and the loan is $600,000, the LTV ratio is 0.60, or 60% (= $600,000 / $1,000,000).

Professor's Note: The LTV is comparable to the long-term debt-to-assets ratio used in corporate finance to indicate the capital structure (percentage of debt and equity) of the firm. The initial LTV ratio is determined by the risk of the property and the investor's credit worthiness (i.e., it indicates the percentage of the purchase price the lender is willing to provide). Generally, the less creditworthy the investor or the riskier the property, the greater the equity required from the investor and the lower the LTV.

At the purchase of the property, the typical required LTV for a commercial mortgage is 75% or lower. It is important to note that the LTV usually varies over time as the property ages and the owner makes payments on the loan.

The **interest coverage ratio**, calculated as the property's net operating income (NOI) divided by the amount of annual interest payable, is similar to the interest coverage ratio used in corporate finance:

$$\text{interest coverage ratio} = \frac{\text{NOI}}{\text{annual interest payment}}$$

Generally, a high interest coverage ratio indicates less risk to the lender because net operating income can drop significantly before the borrower will experience difficulty making interest payments. A typical required interest coverage ratio for a commercial mortgage is 1.2 or greater.

For example, assume the $600,000 loan previously discussed is a 10-year, 8%, interest-only mortgage, and the NOI for the property is $125,000. The interest-only payment on the loan is $48,000 per year (= 0.08 × $600,000), and the interest coverage ratio is 2.60 (= 125,000 / 48,000).

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The **debt service coverage ratio (DSCR)** is calculated as the property's NOI divided by the *total loan payment*, including interest and principal:

$$\text{DSCR} = \frac{\text{NOI}}{\text{total loan payment}}$$

Similar to the interest coverage ratio, the DSCR demonstrates the amount by which net operating income can fall before the owners cannot meet the required debt payments. The difference is the interest coverage ratio is concerned only with the coverage of interest payments while the DSCR is concerned with all loan payments including amortizing the loan principal. If the previously mentioned $600,000 loan had been fully *amortized* over the 10-year period, each payment would include interest and a partial return of principal on the outstanding mortgage balance. The required annual payment for a 10-year, $600,000, 8% loan is $89,418. The inputs on a financial calculator are: PV = 600,000; N = 10; I/Y = 8; CPT → PMT = –89,417.69.

The debt service coverage ratio, which considers the entire debt payment, is 1.40 (= $125,000 / $89,418).

The **fixed charges ratio** is yet another way of measuring the ability of the borrower to meet their financial obligations:

$$\text{fixed charges ratio} = \frac{\text{NOI}}{\text{all fixed payments}}$$

The fixed charges ratio includes *all* fixed payments (e.g., first mortgage payment, lease payments, payments on other debt). To continue our example, assume in addition to the $600,000 amortized first mortgage, the owners have an equipment lease requiring $5,000 annual payments and a second mortgage that requires payments of $10,000 annually. Fixed charges total $104,418 (= $89,418 + $5,000 + $10,000), and the fixed charges ratio for the property is 1.20 (= $125,000 / $104,418).

Commercial loan default rates are cyclical. For example, there were a large number of defaults in the loans made during the real estate boom of the late 1980s. Loan standards were relaxed during this period. Commercial loans are more likely to be restructured and worked out than residential mortgage loans, in part due to the larger sizes of the loans.

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Mortgage-Backed Securities Market

LO 14.4: Demonstrate knowledge of mortgage-backed securities.

For example:

- **Discuss residential mortgages and their prepayment options.**
- **Discuss and apply methods of measuring unscheduled prepayment rates.**
- **Describe and apply conditional prepayment rates (CPRs) and the resulting Public Securities Association (PSA) benchmark.**
- **List prepayment factors not associated with changing interest rates.**
- **Identify and describe commercial mortgage-backed securities, and compare and contrast them with residential mortgage-backed securities.**

A **mortgage-backed security (MBS)** is an investment structure that promises payments that are secured by a pool of mortgages. The mortgages are held by a trustee of the issuing institution. The simplest type is a **pass-through MBS**. Interest and principal payments are sent to the financial institution and then passed through to the owners of the MBS, after deducting fees for servicing and guaranteeing payments to owners. **Collateralized mortgage obligations (CMOs)**, a subcategory of MBSs, are different than pass-through MBS in that investors self-select into *tranches* that have different priorities in terms of principal and interest payments.

The Government National Mortgage Association (Ginnie Mae), the Federal National Mortgage Association (Fannie Mae), and the Federal Home Loan Mortgage Corporation (Freddie Mac) dominate the U.S. **residential mortgage-backed securities (RMBS)** market. In essence, these market participants buy mortgages from loan originators, pool the mortgages, and then sell MBSs that are backed by the pooled mortgages. The process of pooling and selling mortgages is called **securitization**. Liquidity is provided to mortgage originators in this process.

Residential Mortgage Prepayment Options

Several distinct issues confront investors of RMBSs. One of the most important is prepayment risk. Borrowers generally have a prepayment option that allows them to prepay a mortgage in part or in full without penalty. Homeowners may decide to buy a new home or may refinance an existing mortgage when rates fall. In either case, the new mortgage does not replace the existing mortgage in the mortgage pool backing the MBS. As such, owners of MBSs are exposed to prepayment risk through unscheduled principal payments, which must be distributed to MBS holders. This means that the timing and longevity of principal and interest payments are uncertain.

Professor's Note: It is important to note that prepayments affect not only the principal received by the MBS holder, but also the interest. If the investor is receiving cash flows based on 8%, 30-year fixed-rate mortgages, and significant prepayments that occur because rates fall to 6%, the investor no longer receives the 8% he was expecting. In other words, the investor no longer has the ability to earn 8%. The cash flows have to be reinvested at the new, lower rate. Prepayments affect the timing of the principal as well as the longevity of the interest payments received by an investor.

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The path that interest rates take affects prepayments. If rates have fallen significantly and then fall even further, the level of prepayments will likely be lower the second time around. Many borrowers will have already refinanced after the first drop in rates. This occurrence is referred to as **refinancing burnout**. Prepayments are therefore difficult to predict even under an explicit interest rate forecast.

The right to prepay a mortgage is an option. The borrower profits from the option by exercising it (i.e., prepaying the mortgage when rates fall). Prepayments occur when reinvestment opportunities for lenders are least attractive. Borrowers are less likely to prepay when rates have increased and the prepayment will benefit the lender.

Unscheduled Prepayment Rates

The most successful MBS investor attempts to earn superior returns by predicting prepayment rates and investing in MBSs that are mispriced because they do not reflect prepayments appropriately. Models have been developed to derive interest rate scenarios, relate scenarios to prepayments, and then price MBSs.

Conditional Prepayment Rate

The speed of prepayments is measured by calculating the **conditional prepayment rate (CPR)**. The exact calculation of the CPR involves calculating the principal balances and uses monthly compounding. Intuitively, the CPR is the annual reduction in the mortgage principal if the same percentage is repaid each month for an entire year.

The Public Securities Association (PSA) studied prepayments in a number of mortgage pools to determine if patterns exist. As a result of the study, they established the **PSA prepayment benchmark**.

The PSA benchmark assumes the CPR of a 30-year mortgage is 0.2% per month, and increases by 0.2% per month until month 30. At that point, the PSA benchmark remains constant at 6% for the rest of the life of the mortgage (30 months × 0.2% per month).

The idea behind the PSA benchmark is that only a few borrowers repay early, but as time goes on, the proportion of borrowers refinancing, buying new homes, and so on, increases. If refinancing occurs at the PSA benchmark, the MBS is said to be 100% PSA. If prepayments are occurring 1.5 times faster than the benchmark, it is said to be 150% PSA and if prepayments are slower, say one-half as fast, it is said to be 50% PSA. For example, if a mortgage has a steady CPR of 0.5% per month, in month 1 it would be 250% PSA (0.5 / 0.2), and in month 2 it would be 125% PSA (0.5 / 0.4). Remember the CPR is increasing 0.2% per month, so in month 3 the 0.5% rate of prepayments would be slower than the benchmark (0.5 / 0.6 = 83%).

Professor's Note: The PSA was renamed the Bond Market Association in 2006. It recently merged with the Securities Industry Association and is now called the Securities Industry and Financial Markets Association.

RMBS Pricing Using PSA Rates

RMBSs may be priced based on projected prepayments. The expected cash flows are discounted back to the present. However, the selection of a discount rate is complex because

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prepayments are related to the path that interest rates take. As a result, option pricing models are appropriate for pricing RMBSs.

However, option pricing models that assume borrowers exercise their prepayment option based solely on interest rate changes should not be used as there are **idiosyncratic prepayment factors** that affect prepayments. For example, some people do not refinance even though rates have fallen and option pricing models would expect the borrower to exercise the option to refinance. Also, some investors prepay mortgages when rates have increased because of employment changes and other factors that cause homeowners to sell. All of these are **unsystematic factors** that drive behavior.

Systematic factors are also important. In periods of strong economic growth, many people may receive raises and new jobs, resulting in moves to bigger houses and different neighborhoods, despite the path of interest rates. Also, as noted above, refinancing burnout may occur if rates have dropped multiple times in the recent past.

Other factors that affect prepayment speeds include:

- Types of loans in the pool.
- Maturities of mortgages in the pool.
- Rates of fixed-rate mortgages in the pool.
- Terms of ARMs in the pool.
- Geographic location of the loans. For example, properties located where storms or earthquakes occur may prepay at different speeds than properties located away from such risks.

Commercial Mortgage-Backed Securities

Commercial mortgage-backed securities (CMBSs) are backed by commercial real estate. Recent growth in this sector was been fueled by rising real estate prices but slowed during the financial crisis. As with RMBS, the CMBS market provides liquidity to commercial real estate lenders.

CMBSs exhibit the following structural characteristics/issues:

- **Tranches.** CMBS, like RMBS, are structured to include multiple tranches. A **tranche** is a slice of a larger asset or security.
- **Credit ratings differ across tranches.** Senior tranches often have AAA ratings. In comparison, the most junior tranches (called first loss tranches) may have junk bond ratings (i.e., below investment grade) or may be unrated.
- **Tranche characteristics.** Senior tranches are viewed as fixed-income securities, while junior tranches are viewed based on the riskiness of the underlying commercial loans. This means the credit quality and collateral of the underlying pool of mortgages is of the greatest interest to junior tranche CMBS investors.
- **Narrow tranches.** Pricing is difficult when tranches are narrow (i.e., have low default thresholds).

Because most of these loans are set for a specific term and provide lockout provisions that prohibit early prepayment, CMBS investors are exposed to less prepayment risk than RMBS investors. The key risk faced by CMBS investors is default risk (i.e., credit risk). Senior tranches are to some degree protected from default risk as junior tranches first bear the cost of defaults.

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Compared to RMBSs, CMBSs are subject to a greater degree of default risk. This is because CMBSs are not standardized. Factors that affect default probabilities include:

- Property type.
- Property location.
- Quality of both borrowers and tenants.
- Lease terms.
- Property management.
- Property seasoning.
- Year of origination.

Loan-to-value (LTV) ratios range from 65% to 80% in CMBS markets. LTV ratios greater than 75% indicate higher risk. The LTV ratios of the underlying commercial loans are even more important than the overall CMBS LTV ratio. Rating agencies generally will not assign high ratings if more than 15% of the underlying loans have LTV ratios greater than 75%. Diversification of the underlying pool is also important. Rating agencies do not tend to give the highest rating to a CMBS if an individual loan comprises more than 5% of an issue.

Real Estate Investment Trusts

LO 14.5: Demonstrate knowledge of real estate investment trusts (REITs).

For example:
- **Define a real estate investment trust (REIT).**
- **List the key advantages of REITs.**
- **Discuss potential disadvantages of REITs as well as their main income restrictions.**

Real estate investment trusts (REITs) trade on stock exchanges like any other company, but instead of manufacturing a product or selling a product or service, REITs invest in real estate. Investments in real estate are made directly either through properties or mortgages. At least 75% of the income received by a REIT must come from investments in real estate or other real estate interests such as mortgages.

REITs are liquid and provide a simple way for investors to gain exposure to real estate in portfolios. Like mutual funds, they pool capital from many small investors. They buy properties that smaller investors could not afford individually. The three types of REITs are described in the following figure.

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Figure 1: Types of REITs

REIT Type	*Characteristics*	*Classification*
Equity REIT	Owns equity of underlying properties and is responsible for property renovations, development, and management. Returns are derived from rental and lease payments (positively correlated with inflation) as well as increases in property values.	75% or more of assets in the equity of private real estate deals.
Mortgage REIT	Invests in loans used to finance property purchases and is effectively a mortgage lender. Returns are derived from interest earned on loans in the portfolio.	75% or more invested in real estate debt.
Hybrid REIT	Combines equity and mortgage investments and earns returns from both sources. The proportion of equity versus mortgage investments may or may not be explicit.	REITs that invest in both equity and debt and do not meet the 75% cutoff to be classified as either an equity or a mortgage REIT.

Investing in REITs can be beneficial to an investor under the right circumstances. Several advantages that must be considered include:

- **No corporate taxation.** REITs do not pay corporate taxes, but instead pass all income and capital gains through to shareholders who pay taxes according to their personal tax rates. Thus, REITs avoid double taxation. This pass-through structure significantly benefits tax-exempt investors (e.g., pensions, endowments, and foundations) but is problematic for investors in high tax brackets.
- **Liquidity.** REIT shareholders are able to trade their shares on stock exchanges (e.g., NYSE, AMEX, and NASDAQ). This means that investors can easily access an illiquid asset class. The alternative to gain exposure to real estate is a direct investment in properties.
- **May be margined.** Investors can generally make leveraged purchases of REITs through a brokerage margin account.
- **Asset allocation.** Investors can adjust their strategic allocation by adding real estate to a traditional portfolio or can adjust their tactical allocation by changing their exposure to certain real estate sectors. They can do so quickly and easily because REITs are traded on exchanges.
- **Professional management.** REIT managers possess skills such as evaluating, acquiring, managing, financing, and developing real estate properties that investors do not have.
- **Income.** Due to the requirement to distribute 90% of their income, REITs produce steady income for shareholders through high dividend payouts.
- **Corporate governance.** Independent boards of directors protect REIT shareholder interests by monitoring managers. No more than 50% of a REIT's shares may be held by five or fewer investors.

Regarding the first potential advantage of no corporate taxation, there are some caveats with respect to income restrictions that REITs must comply with in order to enjoy this benefit. First, 75% of income generated must be from real estate activities. Second, 90% of tax income must be paid out in the form of dividends. Also, there are other ownership structure restrictions, such as limits on the percentage of shares held by small investment groups.

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REITs also possess some potential disadvantages that investors must consider, including management fees and the inability to influence management. Analysts also argue that REITs are generally more volatile than investments in private real estate, because REITs may exhibit similar volatility to other exchange-traded instruments. However, it could also be argued that REITs more accurately reflect the actual price risk of real estate as opposed to other valuation techniques, such as appraisals.

Risk and Returns of Mortgage REITs

LO 14.6: Demonstrate knowledge of historical performance of mortgage REITs.

For example:

- **Recognize inferences that can be drawn from comparing definable characteristics of mortgage REITs with their historical stand-alone and portfolio performance.**

Mortgage REIT returns averaged a solid 11.1% over the sample period. However, the standard deviation of returns was higher than any other asset class listed with the exception of commodities. The minimum return was –24.1% and the maximum drawdown was –69.1%. The data also indicates negative skewness and leptokurtosis.

Figure 2: Returns of Mortgage REITs, January 2000 to December 2014[1]

Asset Class (Index)	*Average Return*	*Standard Deviation*	*Sharpe Ratio*	*Maximum and Minimum Returns*	*Skewness*	*Maximum Drawdown*
Mortgage REITs (FTSE NAREIT Mortgage REITs)	11.1%	20.4%	0.4	14.2% and –24.1%	–1.3*	–69.1%
World Equities (MSCI World)	4.4%	15.8%	0.1	11.2% and –19.0%	–0.7*	–54.0%
Global Bonds (Barclays Capital Global Aggregate Bond)	5.7%	5.9%	0.6	6.6% and –3.9%	0.1	–9.4%
U.S. High-Yield Bonds (Barclays Capital U.S. Corporate High Yield)	7.7%	10.0%	0.6	12.1% and –15.9%	–1.0*	–33.3%
Commodities (S&P GSCI Total Return)	3.8%	23.3%	0.1	19.7% and –28.2%	–0.5*	–68.4%

* Significance at 95% confidence

If you take into consideration the time period analyzed, the numbers are not so surprising. The beginning of the period saw extremely strong prices in real estate, which led to high

1 Chambers, Donald R. et al., *Alternative Investments: CAIA Level I, 3rd Edition* (Wiley Finance, 2015)

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returns. In 2007, the bottom dropped out of the real estate market, but it has somewhat recovered since that year. The high volatility is a result of these extreme conditions. If we considered a different period such as 1990 to 2005, the data would look quite different.

Following the pattern of returns previously described, $1,000 invested in mortgage REITs in January 2000 would have quickly risen to slightly more than $5,000 by mid-2003, but because of the financial crisis, ended the period at approximately $3,900. In comparison, the same $1,000 would have led to an ending value of $2,200 for global bonds and $1,600 for world equities.

Correlation results indicate positive correlation with global equity and bond markets (0.37 and 0.24, respectively) and nearly zero correlation with commodities (0.03). In addition, mortgage returns are negatively correlated with the VIX (–0.43). This indicates that greater uncertainty in equity markets is negatively related to mortgage returns.

Casual observation indicates that mortgage REITs performed very poorly during the quantitative hedge fund crisis in the summer of 2007 and performed somewhat poorly during the financial crisis, but generated positive returns during the post internet bubble, the 9/11 terrorist attacks, and the recent financial crisis recovery. Also, there appears to be some diversification benefits to adding mortgages to a traditional asset portfolio.

Professor's Note: It is never safe to assume the future will repeat the past. However, this return analysis is consistent with the fundamental knowledge regarding the risks and returns of mortgage investing. Mortgages have limited upside potential when real estate prices increase but considerable downside potential when real estate prices are falling. Mortgage REITs exhibited solid performances in the early period of rising property values, but plummeted when real estate prices plummeted. This is consistent with the notion of having a short put option on the underlying real estate. Viewing mortgage investing in this way may help investors better understand the risks and rewards of the asset class.

Key Concepts

LO 14.1

Potential advantages from adding real estate to an investment portfolio include: (1) diversification with other investments, (2) hedge against unexpected inflation, (3) achieve absolute returns, (4) earn cash inflows, and (5) enjoy income tax advantages.

Potential disadvantages from adding real estate to an investment portfolio (unless higher returns can be achieved) include: (1) heterogeneity, (2) lumpiness, and (3) illiquidity.

Real estate can be organized into three styles of investing (from least risky to most risky):

- Core real estate generates a majority of returns from income rather than price appreciation.
- Value-added real estate generates a majority of returns from price appreciation, with some returns from income.
- Opportunistic real estate derives almost all returns from price appreciation (which is expected over a three- to five-year period).

LO 14.2

A fixed-rate, constant payment, fully amortized mortgage requires the borrower to pay a constant amount, usually monthly, that will completely pay off the loan amount with the last equal payment.

In a variable-rate mortgage, the interest rate fluctuates up or down during the loan term based on the movement of a published index. The sum of the index rate plus the margin rate determines the interest rate on the mortgage. Interest rate caps and floors limit the amount the interest rate may increase or decrease in any one adjustment period and over the life of the loan.

Alternative mortgage structures include:

- Graduated payment mortgages allow borrowers to make lower monthly payments for the first few years of the loan and larger payments for the remainder of the term.
- Option adjustable-rate mortgage loans (option ARMs) are a specialized version of adjustable-rate mortgages structured to provide borrowers payment flexibility.
- Balloon payment loans allow for lower payments than a fully amortized loan but require a large final payment to pay off the loan.
- Interest-only mortgage loans require interest-only payments during the first part of the loan and fully amortized payments during the second part of the loan.

Historically, interest rate risks and prepayment risks were the focus of mortgage investors, but the recent financial crisis makes clear that default risk is also important. Lenders look at coverage ratios as well as loan-to-value ratios.

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LO 14.3

Commercial mortgages are structured similar to residential mortgages but have several important differences. Commercial mortgages involve corporate borrowers, properties that generate cash flows, partially amortized mortgages, numerous covenants, and cross-collateral provisions. Commercial mortgages may be used for either development or investment purposes.

Several ratios are used to measure the risk of a commercial real estate loan:

- The LTV ratio is calculated as the remaining balance of the loan divided by the (market) value of the property.
- The interest coverage ratio is calculated as the property's net operating income (NOI) divided by the amount of annual interest payable.
- The debt service coverage ratio (DSCR) is calculated as the property's NOI divided by the total loan payment, including interest and principal.
- The fixed charges coverage ratio is calculated as the NOI of the property divided by all of the borrower's fixed payments.

LO 14.4

A mortgage-backed security (MBS) is a security that is secured by a pool of mortgages. Pass-through securities and collateralized mortgage obligations (CMOs) are common types of MBS.

Investors in residential MBSs (RMBSs) must analyze the prepayment behavior of the underlying pool of mortgages because it is the most important factor affecting the cash flows of an RMBS.

The speed of prepayments is measured by the conditional prepayment rate (CPR). The PSA benchmark assumes that the CPR of a 30-year mortgage is 0.2% per month, and increases by 0.2% per month until month 30, at which point it reaches a maximum of 6%.

A commercial mortgage-backed security (CMBS) is backed by commercial real estate. The key risk of a CMBS is default risk. The structure is similar to an RMBS, but defaults are borne by junior tranches. The tranches also have different credit ratings and different associated interest rates.

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LO 14.5

Real estate investment trusts (REITs) trade on stock exchanges like other companies. REITs invest in real estate directly, either through properties or through mortgages.

At least 75% of the income received by a REIT must come from investments in real estate or other real estate interests such as mortgages. REITs can be classified into three broad types:

- Equity REITs. Own equity of underlying properties. Returns are derived from rents and increases in property values.
- Mortgage REITs. Invest in loans used to finance property purchases. Returns are derived from interest earned on loans in the portfolio.
- Hybrid REITs. Combine equity and mortgage investments.

Advantages of REITs include:

- No corporate taxation. REITs pass all income and capital gains through to shareholders. REITs do not pay corporate taxes, investors pay taxes according to their personal tax rates.
- May be margined.
- Liquidity. REIT shareholders are able to trade their shares on stock exchanges.
- Asset allocation. Investors can adjust asset allocations quickly and easily since REITs are traded on exchanges.
- Professional management. REIT managers possess skills such as evaluating, acquiring, managing, financing, and developing real estate properties that investors do not have.
- Income. Due to the requirement to distribute 90% of their income, REITs produce steady income for shareholders through high dividend payouts.
- Corporate governance. Independent boards of directors protect REIT shareholder interests by monitoring managers, and no more than 50% of a REITs shares may be held by five or fewer investors.

Disadvantages of REITs include: management fees, inability to influence management, and greater volatility compared to private real estate.

LO 14.6

Mortgage REIT returns averaged 11.1% from 2000–2014, which exceeds the returns of world equities, global bonds, U.S. high-yield bonds, and commodities. The standard deviation of returns was high, 20.4%, and the maximum drawdown was 69.1%, higher than any of the listed asset classes. There is evidence of negative skewness and leptokurtosis. Correlations with world equities and bonds are positive (0.37 and 0.24, respectively).

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Concept Checkers

1. When considering the three styles of real estate investing, which style exhibits the lowest level of volatility, and which style generates the lowest amount of returns from income?

	Lowest Volatility	Lowest Returns from Income
A.	Core	Opportunistic
B.	Value-added	Core
C.	Value-added	Opportunistic
D.	Opportunistic	Core

2. A borrower is interested in a $150,000 home. If a 20% down payment is required and the balance is financed at 9% over the next 30 years, what is the monthly mortgage payment?
   A. $799.33.
   B. $895.21.
   C. $965.55.
   D. $1,037.93.

3. Which of the following is **NOT** a way in which commercial mortgages differ from residential mortgages?
   A. Commercial mortgages are typically partially amortized, while residential mortgages are typically fully amortized.
   B. Commercial mortgages typically contain fewer covenants, due to the greater sophistication of the borrowers.
   C. Commercial properties are more likely to generate cash flows.
   D. Commercial borrowers tend to be companies, while residential borrowers tend to be individuals.

4. The key risk that residential mortgage-backed security holders must manage is:
   A. default risk.
   B. liquidity risk.
   C. prepayment risk.
   D. maturity risk.

5. Which of the following is **NOT** an advantage of investing in real estate investment trusts (REITs)?
   A. REITs produce a reliable income stream.
   B. Shareholders can easily trade shares and obtain liquidity.
   C. Shareholder interests are protected through board oversight.
   D. Returns on mortgage REITs follow a normal distribution, making analysis relatively simple.

6. Which of the following statements is **TRUE** regarding mortgage REIT performance?
   A. Average mortgage REIT returns were higher than world equities and global bonds.
   B. Mortgage REITs exhibited very low variability of returns.
   C. Correlation with world equities was negative.
   D. The Sharpe ratio was greater than 1.0.

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Concept Checker Answers

1. **A** Core properties exhibit low volatility and generate a majority of returns from income. Opportunistic properties derive almost all returns from price appreciation and exhibit high levels of volatility. Value-added properties exhibit moderate levels of volatility and generate a majority of returns from price appreciation. (LO 14.1)

2. **C** N = 30 × 12 = 360; I/Y = 9 / 12 = 0.75; PV = –150,000(1 – 0.2) = –120,000; FV = 0; CPT → PMT = $965.55 (LO 14.2)

3. **B** While covenants exist for residential mortgages, covenants for commercial mortgage are more detailed and abundant. The other answer choices are correct. (LO 14.3)

4. **C** Prepayment risk is the key risk of residential mortgage-backed securities. (LO 14.4)

5. **D** Return data for mortgage REITs indicates that they do not follow a normal distribution as returns are negatively skewed and are leptokurtic. (LO 14.5)

6. **A** Mortgage REIT returns were higher than any of the asset classes provided for comparison at 11.1%. The standard deviation of returns was high (20.4%) and correlation with equities was positive. The Sharpe ratio was 0.4. (LO 14.6)

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The following is a review of the Real Assets principles designed to address the learning objectives set forth by the CAIA Association®.

Real Estate Equity Investments

Topic 3.6

Exam Focus

This topic review covers equity investments in real estate. Be able to explain the stages of real estate development. Understand real estate development as a real option and be able to apply decision trees to real estate development project decisions. There are several approaches used to value real estate equity investments, including the income approach and the comparable sales price approach. Know the six risk factors relevant to real estate investments. Be able to describe different types of real estate investments including commingled funds, syndications, joint ventures, real estate limited partnerships, open-end real estate mutual funds, options and futures on real estate indices, exchange-traded funds (ETFs), closed-end investment funds, and equity real estate investment trusts (REITs). Understand the financial implications of depreciation and the depreciation tax shield. Be able to explain how using appraisals to value properties may result in data smoothing and understand the effects of data smoothing on real estate returns.

Real Estate Development Projects

LO 15.1: Demonstrate knowledge of real estate development in the context of alternative investments.

For example:

- **Describe the processes of developing real estate.**
- **Describe the valuing of real estate development as a string of real options.**
- **Apply a decision tree and backward induction to value real estate development projects.**

Equity investments are residual claims as lenders are paid before shareholders. The value of the underlying real estate property less the mortgage claims is the value of a **real estate equity investment.**

Real estate development projects are different from an investment in stand-alone real estate properties in two key ways:

1. In the development process, a real estate asset is improved or a new one is created.
2. There is significant uncertainty associated with development, because it is a complex process.

In development projects, both the revenues and costs are difficult to estimate. Projects range from the acquisition of raw land through the completion of new property construction, such as a shopping mall or medical complex, to the renovation and improvement of existing properties.

Stages of the real estate development process include:

Stage 1: Acquiring the land or the site of the development project.
Stage 2: Forecasting the revenues, costs, and profitability of a planned project.
Stage 3: Designing the building. This step may include hiring architects, builders, and other professionals.
Stage 4: Securing approval through government building permits and public support of the project.
Stage 5: Raising capital to finance the project.
Stage 6: Building the structure.
Stage 7: Leasing, managing, and possibly *selling* the property.

Real Estate Development as a Real Option

A **real option** is an option on a real asset, such as land. Real estate development projects can be viewed as a string of real options. Real options in real estate include:

- Call options to buy real estate.
- Put options to sell real estate.
- Exchange options involving the exchange of noncash assets.

Consider the stages of a potential real estate project:

Stage 1: Feasibility study. Assess the potential profitability of a planned development project.
Stage 2: *Purchase property.* Following a favorable feasibility study, purchase suitable property.
Stage 3: *Construction.* Construct building(s) following the purchase of land.

Each step in the process toward owning a completed development project can be viewed as a call option. For example, after the property has been purchased, the move to the construction stage may be viewed as a call option. The developer has the option to spend additional funds to improve the property.

Real Estate Project Example with Real Options

Consider a decision to purchase a piece of farmland. The farmland is adjacent to property that will be used to build a much-needed bridge across the Ohio River if voters approve the bridge project. The vote to build the bridge will not happen for one year. The developer is certain that the value of the property will increase dramatically if the bridge is built. The land can be used for a shopping center if the bridge is built. Traffic patterns will require drivers to pass the shopping center. If the bridge is built, the developed property will be worth \$9,000,000. The decision to buy the land must be made now. Assume the following costs to develop the land:

Year 1:	Buy land, plans, and permits	\$500,000
Year 2:	Construct shell	\$700,000
Year 3:	Construct interiors	\$3,000,000
Total:		\$4,200,000

First, assume there is a 40% chance the bridge will be built and the developed property will be worth \$9,000,000. There is a 60% chance the bridge will not be built and the developed center will be worth \$1,000,000. Thus, the expected value of the shopping center is \$4,200,000. For simplicity, assume interest rates are 0%. Therefore, the expected value

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of the project is $4,200,000, and the cost to construct the project is $4,200,000 (= 0.4 × $9 million + 0.6 × $1 million). It would seem that the net present value (NPV) of the project is zero since the cost to construct and the expected value are equal. Ignoring option theory, this project would be rejected barring a change in the probability of the bridge being built.

Professor's Note: The assumption of 0% interest simplifies the analysis. It allows us to discuss the NPV of the project as a simple comparison between costs and benefits without discounting the cash flows. The cash flows of actual projects would be discounted at an appropriate required rate of return.

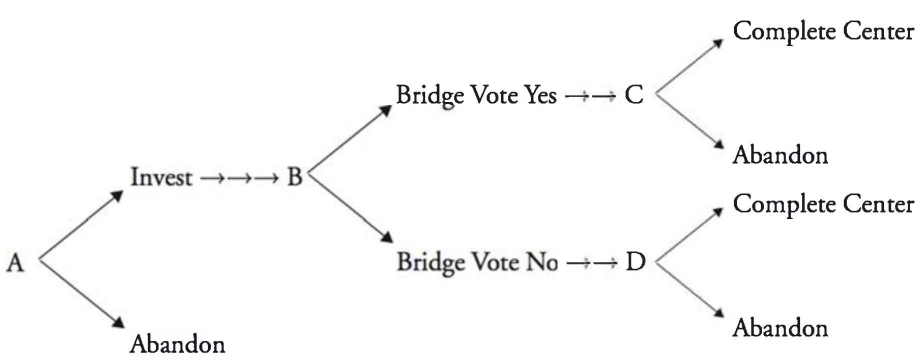
Each step of this project has real options. For example, the project could be abandoned if the decision on the bridge is no and continuation of the project is deemed unprofitable.

Should this project be pursued by the developer? The developer can make the initial $500,000 investment for the land, building plans, and permits. If, after the investment, the decision to build the bridge is yes, the remaining $3,700,000 investment may be made. In that case, the profit is $4,800,000 (= $9,000,000 – $4,200,000). If, on the other hand, the vote on the bridge is no, the project can be abandoned at a total loss of $500,000. The investor will also likely recoup some of the loss by selling the property.

Decision Trees

In the above example, there were two decision points: (1) to decide to begin the project and (2) to decide whether to abandon the project. In an actual real estate investment project, there are several decision points. A **decision tree** like the one see in Figure 1 can be used to analyze complex decisions.

Figure 1: A Decision Tree for the Shopping Center



Points A, C, and D represent **decision nodes.** At these nodes, decisions to proceed or abandon must be made. Node B is an **information node**; it indicates a point where new information arrives (i.e., the bridge will or will not be built based on the results of the vote). The value of the decision tree is to map the decisions that must be made when new information arrives. In some cases, decisions may be deferred to wait for new information in order to reduce uncertainty.

Backward Induction and Decision Trees

Using a decision tree, the **backward induction** process involves working backwards from the final decision nodes on the decision tree toward the first decision nodes based on an analysis of the valuation of the project at each node.

Each path in the decision tree has been valued based on possible information (e.g., the vote on the bridge is yes or the vote on the bridge is no). For example, at Node C, the investor would prefer to complete the center because the bridge will be built and the expected value of the development is $9,000,000. However, at Node D, the investor would prefer to abandon the project before additional investments since the bridge will not be built. At Node D, the value of the project is –$500,000, the maximum loss if the project is abandoned after the initial investment.

Using the above example, consider the shopping center decision tree with valuations at each node.

Figure 2: The Shopping Center Decision Tree with Nodes Valued

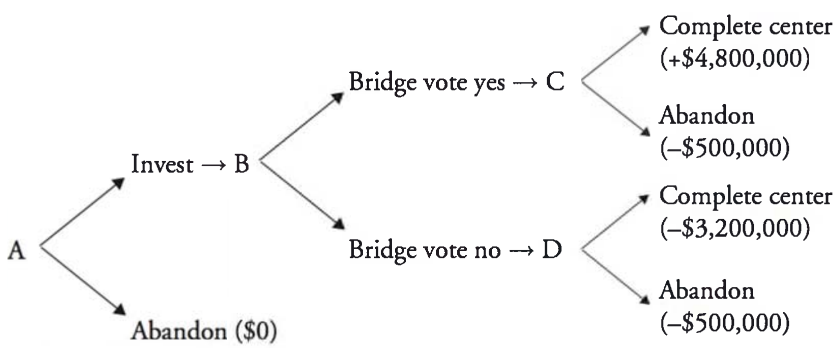


Figure 3: The Shopping Center Decision Tree with Final Decision Included

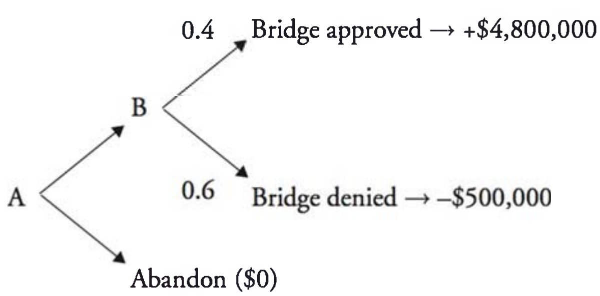
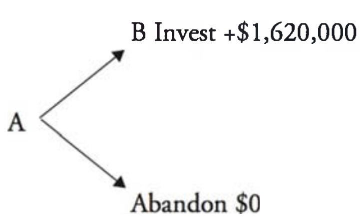


Figure 4: The Shopping Center Decision Tree with Final Decision and New Information



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In this case, the expected profit from proceeding with the year 1 plan is $1,620,000. Therefore, the decision is clear; the developer should invest in the land—the year 1 decision. The investor can revise plans as new information arrives. The decision tree allows the investor to reassess after new information has been included in the analysis and uncertainty has been resolved.

In sum, when options are priced, a development project that might appear unattractive on the surface may in fact be worthy of investment.

Real Estate Valuation Approaches and Risk Assessment

LO 15.2: Demonstrate knowledge of valuation and risks of real estate equity.

For example:
- **Recognize and apply the discounted cash flow approach (i.e., income approach) to valuing real estate, including the calculation of net operating income and the discount rate.**
- **Discuss the use of comparable sale prices for valuing real estate.**

Real estate valuation consists of determining the value of a real estate asset in the open market. There are several approaches used to value real estate equity investments. The *discounted cash flow approach* and the *comparable sales price approach* are two of the most common for equity in commercial real estate. Both are discussed in detail below. If the analyst is valuing the business rather than the property, the **profit approach** is generally used. An **equity residual approach** is another model that is sometimes used in real estate valuation. This approach involves subtracting interest expense and other cash flows owed to mortgage holders and then discounting the remaining cash flows to find an estimate of the value of the equity in the project.

The Income or Discounted Cash Flow Approach

The **discounted cash flow (DCF) method**, also known as the **income approach**, is the most common method used for appraising (i.e., valuing) projects. The cash flows are discounted back to the present and a comparison is made between the present value costs of the project versus the present value benefits. However, estimating accurate cash flows, especially in purely speculative development projects, is difficult. Both costs and potential revenues are uncertain. The longer the term of the project, the more difficult it is to estimate accurate cash flows. To calculate the value of a real estate property, we need three components: net operating income (NOI), discount rate (k), and net sale proceeds (NSP).

$$V_0 = \frac{NOI_1}{(1+k)^1} + \frac{NOI_2}{(1+k)^2} + \ldots + \frac{NOI_i}{(1+k)^i} + \frac{NSP}{(1+k)^i}$$

Several factors are required to appraise a real estate development project, including:

- Local market conditions.
- The anticipated demand for the space.
- Other competing developments in the area/region.
- Investment market conditions.

- Overall supply considerations.
- The quality of the building specification, which affects costs.
- The time expected to complete the project. Time or cost overruns affect profitability.

All of these factors will influence the cost and revenue projections that are used in the DCF method of appraising long-term projects.

The DCF approach involves estimating revenues and expenses over the life of a project. The **potential gross income**, the income if all offices and spaces are occupied, is estimated. The **effective gross income** is potential gross income less the vacancy loss. The *vacancy loss* is calculated by multiplying the **vacancy loss rate** by the potential gross income.

Fixed and variable expenses (known collectively as **operating expenses**) are subtracted from effective gross income to determine cash flows from the project. **Fixed expenses** include property taxes and insurance. **Variable expenses**, such as utilities and maintenance, vary with the level of occupancy. The terms of the lease are also important. For example, if a **net lease** is used, the tenant is responsible for nearly all operating expenses. Capital improvements are irregular. Some companies include a capital reserve to cover unexpected costs. Depreciation is a noncash expense. It is important because it is a before-tax expense that reduces taxable income. However, depreciation must be added back to net income to calculate cash flow.

Using the above components, we can now calculate **net operating income (NOI)**:

potential gross income
– vacancy losses (= vacancy loss rate × potential gross income)
effective gross income

effective gross income
– operating expenses (= fixed expenses + variable expenses)
net operating income

The *discount rate* (k) is often estimated using a **risk premium approach**. A discount rate for any asset can be thought of as the risk-free rate of interest plus risk premium(s). For example, the 8% discount rate in the following example could include the risk-free rate plus a risk premium for liquidity and a risk premium for overall risks (such as credit risk). If the risk-free rate is 4%, the liquidity risk premium is 1%, and the risk premium for other risks is 3%, then the discount rate is 8% (i.e., 4% + 1% + 3% = 8%). In general, the discount rate is calculated as follows.

k = risk-free rate + liquidity premium + risk premiums

The **net sale proceeds** (NSP) refer to the estimated sale price of the property less any associated commissions or fees.

The advantage of the DCF method is that it is consistent with respect to the time value of money. The method states cash flows on a comparable basis by discounting and comparing cash flows in the same time period.

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The DCF decision rule is that if the net present value (NPV) of the project is greater than zero, the project should go forward. NPV is equal to the sum of the discounted cash inflows, including any outflows to invest in the project. Alternatively, if the internal rate of return (IRR) is greater than the discount rate, the project should move forward.

Example: Discounted cash flow approach

Using the cash flow data in Figure 5, **calculate** the NPV and IRR for the real estate project and **determine** whether the project should be pursued. Assume that the appropriate discount rate for the project is 8%.

Figure 5: Real Estate Project Cash Flows (in U.S. $)

Year	*0*	*1*	*2*	*3*
Project expenditures:				
Land[1]	–1,200,000			
Construction[2]		–2,300,000	–5,300,000	–5,100,000
Fees[3]		–550,000	–475,000	–375,000
Other costs[4]		–25,000	–32,000	–30,000
Letting and sales costs[5]				–450,000
Expected sales price				22,575,000
Net cash flow	–1,200,000	–2,875,000	–5,807,000	16,620,000

[1] Land expenditures may include the cost of the site, transactions costs and fees, survey costs, legal costs, and financing fees.

[2] Construction costs may also include contingency fees and demolition costs.

[3] Fees may include architectural, consulting, engineering, and project management fees.

[4] Other costs may include marketing costs, statutory costs, and road/site costs.

[5] Letting and sales costs include agent and legal fees for both.

Answer:

The NPV of the project is calculated as the sum of the discounted values (i.e., present values) of all cash flows associated with the development project.

$$\begin{aligned}\text{NPV} &= -1{,}200{,}000 + \frac{-2{,}875{,}000}{(1.08)^1} + \frac{-5{,}807{,}000}{(1.08)^2} + \frac{16{,}620{,}000}{(1.08)^3} \\ &= \$4{,}352{,}888\end{aligned}$$

Using a financial calculator with the cash flows from Figure 5, we can compute the IRR. The financial calculator may also be used to compute NPV.

IRR = 37.89%

Decision: Since the NPV is positive and the IRR is greater than the discount rate, the project should be developed (i.e., accepted).

Professor's Note: In this example, the project is developed and then sold, so the only positive cash flow is the sales price at the end of Year 3. If the development involved industrial, office, or retail space that the developer intended to hold and lease, there would be a stream of positive cash flows after the completion of the project, reflecting rental/lease income.

In the previous example, it is not stated whether cash flows are pretax or after tax. If pretax, the discount rate must be appropriate for before-tax cash flows (i.e., the discount rate will be higher because the cash flows are higher). This is called a **pretax discounting approach**.

Capital budgeting theory suggests that cash flows should be after tax rather than before tax. If an **after-tax discounting approach** is used, after-tax cash flows are used in the numerator of the discounted cash flow formula and the discount rate used is also calculated on an after-tax basis.

Valuations Based on Comparable Sales Prices

In some cases, such as a single-family residence, a DCF approach to valuation does not make sense. The **comparable sales price approach** is the most common model used for this type of investment. Data regarding the sales prices of comparable assets in the area are examined and adjusted based on differences in the properties. This works well if properties are similar and there are several recent sales. This approach is not appropriate for highly specialized properties or properties that are not comparable due to zoning differences, topography, or other factors that make a property unique. If the comparable sales price approach is not suitable, estimating the replacement cost of the property may be substituted.

Alternative Real Estate Investment Vehicles

LO 15.3: Demonstrate knowledge of alternative real estate investment vehicles.

For example:
- **Identify and describe private equity real estate funds.**
- **Identify and describe commingled real estate funds.**
- **Identify and describe syndications.**
- **Identify and describe joint ventures.**
- **Describe limited partnerships, and apply the concepts of gearing and loan-to-value (LTV) ratios.**
- **Identify and describe open-end real estate mutual funds.**
- **Discuss options and futures on real estate indices.**
- **Identify and describe exchange-traded funds based on real estate indices.**
- **Identify and describe closed-end real estate mutual funds.**
- **Discuss equity real estate investment trusts.**

Private Equity Real Estate Funds

Private equity real estate funds invest pooled investor capital in private real estate. Private equity real estate funds include commingled real estate funds, syndications, and joint ventures. Investment strategies include real estate development and redevelopment. The life

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of a private equity real estate fund is typically 10 years with a two- to three-year investment period. Investments may be made in the form of equity or debt.

Advantages of private equity real estate funds to investors include:

- Access to private real estate. This is important to small institutional investors who want exposure to real estate, as well as large institutional investors who want to limit exposure to the property-specific risks of any single property.
- Access to fund managers with specialized knowledge and expertise.

Disadvantages of private equity real estate funds to investors include:

- Investors lose direct control over portfolio decisions including selling, leveraging, leasing, and strategic portfolio decisions. This is true for open-end real estate mutual funds and REITs as well.
- Lack of liquidity. These investments are often purchased and held to liquidation. As in a private equity stock fund, an exit strategy may not exist prior to liquidation of the fund.
- Fund performance is difficult to measure due to potentially incorrect underlying asset valuations. As a result, investors may be unable to realize the level of performance reported by the fund.

Commingled Real Estate Funds

Commingled real estate funds (CREFs) are a specific type of private equity real estate funds. CREFs consist of privately placed commingled (i.e., pooled) capital that is invested in real estate. CREFs were the first type of real estate funds established in the United States. Negotiable ownership certificates, which are not exchange traded, represent the investor's proportional share of ownership in the underlying commercial properties. They are generally closed-end in structure and are often sold by banks, investment companies, and insurance companies to pension funds.

Advantages of CREFs to investors include:

- Access to private real estate assets that the firm or pension fund would otherwise be unable to purchase due to capital constraints. Even if large enough to invest directly, the investor may prefer commingled funds because of an unwillingness to take on the unique risks of the underlying properties.
- Access to fund managers with specific geographic or property type expertise.

Disadvantages of CREFs to investors include:

- The same disadvantages as described under open-end and private equity funds, namely, a lack of liquidity, a loss of direct control, and potentially stale real estate valuations.
- Not available to small individual investors due to significant capital requirements.
- Potential inability to realize the level of performance reported by the fund.

Syndications

Syndications are financing mechanisms that allow investors to raise capital and hire an expert with the intention of undertaking a real estate venture. They may acquire, develop, operate, or manage property. They may also be formed to market real estate investments.

Syndications are most often structured as limited partnerships, but they may also operate as REITs or corporations. If syndications are structured as a limited partnership, depreciation tax deductions may be passed directly through to individual investors, thereby avoiding

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double taxation. This is a key advantage of syndication. Syndicators collect fees and may maintain an ownership interest in the syndicated property.

Joint Ventures

Real estate joint ventures are formed between two or more parties who wish to undertake a real estate project. An example might be a real estate developer partnering with a firm or institutional investor that would like to venture into real estate but lacks the necessary expertise. Like syndications, they may be structured as limited partnerships.

Limited Partnerships

As described earlier, many types of private equity real estate funds are organized as limited partnerships. **Real estate limited partnerships** combine the benefits of partnerships, including tax (i.e., no corporate taxation) and income distribution benefits, with the limited liability feature of a corporate investment. General partners manage the funds while limited partners, typically pension funds, endowments, and high net worth individuals, provide the capital.

Advantages of limited partnerships include:

- Limited liability for limited partners. Limited partners are liable only for the amount invested.
- The ability to adopt a more aggressive investment style that includes greater leverage (called gearing) than other types of real estate funds.
- Like other types of funds, may provide access to fund managers with specific skills and expertise.
- General partners, called fund sponsors, often contribute capital to the fund.
- The structure allows for the possibility of special cash distributions to partners.

Disadvantages of limited partnerships include:

- Returns vary greatly based on the investment style of the fund. The amount of **gearing** (i.e., the use of leverage in a fund) also affects returns. Gearing has become commonplace in real estate funds.
- Geared funds will experience magnification of both positive returns and losses. This is the double-edged sword of leverage.
- Funds may generate tax liabilities for partners even though no cash distributions have been made to cover the taxes owed.
- Illiquidity.
- Not available to small individual investors because limited partnerships require significant capital.

A common ratio used to measure the level of gearing in a fund is the *loan-to-value (LTV) ratio*, often referred to as the *debt-to-assets ratio*. The LTV ratio is computed as debt/assets or debt / (equity + debt).

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Example: Gearing

Assume Blue Star Fund has \$250 million in assets and \$150 million of debt. Red Flag Fund has debt of \$100 million and equity of \$100 million. **Determine** the amount of gearing used in each fund using the LTV ratio (i.e., debt-to-assets ratio) and the debt-to-equity (D/E) ratio.

Answer:

The LTV ratio and debt-to-equity ratio of Blue Star are:

$$LTV_{\text{Blue Star}} = \$150 / \$250 = 60\%$$

$$D/E_{\text{Blue Star}} = \$150 / (\$250 - \$150) = 1.5$$

The LTV ratio and debt-to-equity ratio of Red Flag are:

$$LTV_{\text{Red Flag}} = \$100 / (\$100 + \$100) = 50\%$$

$$D/E_{\text{Red Flag}} = \$100 / \$100 = 1.0$$

Open-End Real Estate Mutual Funds

Open-end real estate mutual funds sell shares to stockholders to raise capital and then invest this capital in real estate assets.

Advantages of open-end real estate funds to investors include:

- Investors gain access to real estate investments with limited amounts of capital, similar to REITs.
- Funds generally buy and sell shares to and from investors upon request, allowing investors to enter and exit the fund at will.
- The investor gains exposure to the real estate asset class with more liquidity than is available from the underlying real estate assets.
- Funds are regulated by the Securities and Exchange Commission (SEC).

Disadvantages of open-end real estate funds to investors include:

- Funds often reserve the right to defer investor share redemptions to avoid liquidity problems, resulting in a potential lack of liquidity for investors (relative to closed-end funds). This often occurs when a significant percentage of shareholders want to redeem shares at once. The underlying real estate market may be facing liquidity issues at the same time, making it difficult for the fund to liquidate assets and generate cash to redeem shares.

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- Calculated net asset values may trail true market values of the underlying real estate assets. **Stale prices**, prices that lag true market prices, may lead existing investors to sell in falling markets and new investors to buy in rising markets. This could lead to liquidity problems for the fund in declining markets, resulting in the sale of deeply discounted properties to generate liquidity. Also, new investors profit by timing or **arbitraging stale prices** at the expense of long-term shareholders of the fund.
- Potential commissions, fees, and transactions costs are levied by funds.
- Open-end mutual funds are tax inefficient relative to exchange-traded funds.

Options and Futures on Real Estate Indices

Additional alternative public real estate investment choices have been introduced in recent years. They provide alternative mechanisms for investors to gain exposure to real estate risk and returns without having to buy or sell the underlying assets (i.e., the real estate). **Real estate derivatives** are expected to increase the liquidity and transparency of the real estate market going forward.

Options and futures on real estate indices allow investors to gain exposure to real estate as an asset class without actually investing in real estate, either directly or indirectly. The payoff of the option or futures contract is linked to a real estate return index. However, the underlying properties are illiquid and diverse. In addition, market participants who use derivatives for hedging purposes may find that their value is not highly correlated with the risk exposures of their real estate portfolios (i.e., derivatives possess basis risk).

Exchange-Traded Funds Based on Real Estate Indices

Exchange-traded funds (ETFs) are tradable investment securities that track a particular index. The ETF holds the assets, or a sub-sample of the assets, included in the index. They trade at approximately the net asset value (NAV) of the underlying assets and are traded on exchanges. ETFs have gained in popularity because they are relatively low in cost, tax efficient, and provide some of the benefits of stocks, such as high liquidity, the ability to take a short position, and the prospect of dividend payments. In some cases, there may be calls and puts available as well. The *Dow Jones U.S. Real Estate Index* is a popular real estate index that is tracked by ETFs.

Closed-End Real Estate Mutual Funds

Closed-end real estate mutual funds are exchange-traded mutual funds. Unlike open-end funds, they have a fixed number of shares outstanding. Shares are offered to the public via an initial public offering (IPO). One key advantage is that a closed-end fund does not need to maintain liquidity to redeem shares, as an open-end fund must do. Closed-end funds are also more liquid for investors, who can simply sell shares in the secondary market. There has been significant growth in closed-end real estate mutual funds.

Advantages of closed-end real estate funds and ETFs for investors include:

- They have increased liquidity since they are exchange traded.
- Closed-end funds and ETFs can be purchased with margin.
- Generally investors can take long and short positions.
- They have increased transparency because they are valued in public markets.
- They are regulated by the SEC.

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Disadvantages of closed-end real estate funds and ETFs for investors include:

- For both ETFs and closed-end funds, the liquidity advantage is less important to long-term investors.
- Investors may find it difficult to obtain access to specific sectors of the real estate market through ETFs and closed-end funds.
- Closed-end funds trade at a variable discount to NAV and are tax inefficient relative to ETFs.

Equity Real Estate Investment Trusts

An **equity REIT** must have 75% or more of the underlying real estate holdings representing equity claims on real estate rather than mortgage claims. An equity REIT pools investor capital and makes direct investments in real estate. The REIT is the equity owner of the underlying properties. Revenues are generated through leasing and rental agreements with tenants. Equity REITs also benefit from increasing property values in the underlying asset pool.

Equity REIT returns are highly correlated with the overall stock market, but they are more highly correlated with small-cap stocks than with large-cap stocks. This raises the question of whether the underlying property returns are actually correlated with small-cap stocks or if this correlation can be attributed to the similar size of REITs and small-cap stocks (i.e., stocks with capitalizations ranging from $500 million to $5 billion). REIT returns are tied to businesses paying rental and lease payments. These businesses generally are unrelated to real estate, implying that the correlation is not likely due to the underlying assets. However, assuming the higher correlation is a result of similar size runs counter to efficient market theories. Theory indicates that prices reflect economic fundamentals, not size or capitalization. It would appear that REIT returns are more related to stock market fluctuations and less to fluctuations in underlying property values.

Advantages of equity REITs to investors were discussed in the previous topic review and include:

- *Potential inflation hedge*—REITs may provide a hedge against inflation since rental and leasing income tends to increase with inflation.
- *No corporate taxation*—REITs do not pay corporate taxes but instead pass all income and capital gains through to shareholders who pay taxes according to their personal tax rates. Thus, REITs avoid double taxation.
- *Liquidity*—REIT shareholders are able to trade their shares on stock exchanges (e.g., NYSE, AMEX, and NASDAQ).
- *May be margined*—Investors can generally make leveraged purchases of REITs through a brokerage margin account.
- *Asset allocation*—Investors can adjust asset allocations quickly and easily since REITs are traded on exchanges.
- *Professional management*—REIT managers possess skills, such as evaluating, acquiring, managing, financing, and developing real estate properties, that investors do not have.
- *Income*—Due to the requirement to distribute 90% of their income, REITs produce steady income for shareholders through high dividend payouts.
- *Corporate governance*—Independent boards of directors protect REIT shareholder interests by monitoring managers.

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Real Estate Depreciation

LO 15.4: Demonstrate knowledge of depreciation of real estate.

For example:

- **Describe and apply various methods of depreciation of real estate (i.e., without income taxation, with depreciation disallowed for tax purposes, with economic depreciation allowed for tax purposes, with accelerated depreciation allowed for tax purposes, and with expensing of capital expenditures for tax purposes) in the analysis of returns.**

An important benefit that results from an investment in fixed or long-term assets is the tax savings that arise from depreciating the asset. **Depreciation** is the reduction in the value of an asset with the passage of time. Depreciation can be the actual wear and tear on the asset or the accounting value that represents the decline in value.

Depreciation is a noncash expense. The tax savings that results from depreciation can have a substantial effect on after-tax cash flows. The tax savings is known as the **depreciation tax shield**. The value of the tax shield is the present value of the tax savings from depreciation. The benefit of a tax shield is clear for taxable investors, but even non-taxable investors should be alert to tax effects because prices of real estate assets may reflect an embedded premium for their tax advantages.

Depreciation methods vary and affect the after-tax internal rate of return (IRR) of a project. The following sections illustrate the effects of depreciation on before-tax and after-tax cash flows and returns.

Example: Real estate IRR with depreciation and without taxation

Consider a real estate project that costs $200 million. The property will be sold at the end of year 3 for $145.8 million. The property is worth $200 million when purchased and will decline in value by 10% per year due to wear and tear. The property will generate cash flows equal to 20% of the value of the property in the current year. Assuming a 0% tax rate, **compute** the IRR of the project. Note that all cash flows occur at year-end.

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Answer:

	Today (Time 0)	*Year 1*	*Year 2*	*Year 3*
True property value	$200	$180	$162	$145.8
Operating CF		36	32.4	29.16
Depreciation		–20	–18	–16.2
Taxes		0	0	0
Net income		16	14.4	12.96
Sales proceeds				145.8
Total CF (incl. dep.)	–200	36	32.4	174.96

On the TI BAII Plus calculator, the following inputs should be used:

$CF_0 = -200.00$; $CF_1 = 36.00$; $CF_2 = 32.40$; $CF_3 = 174.96$;
CPT → IRR = 8.00%

Now consider a case where the costs and cash flows are the same. However, the investor must pay 40% taxes. Note that the statutory income tax rate for real estate returns is often higher than the **effective tax rate**. This happens when firms defer taxes without penalty. In addition, in this example, we will assume that depreciation is not allowed as an expense that reduces taxable income.

Example: Real estate IRR with taxation and no allowable depreciation

Consider a real estate project that costs $200 million. The property will be sold at the end of year 3 for $145.8 million. The property is worth $200 million when purchased and will decline in value by 10% per year due to wear and tear; depreciation is not allowed. The property will generate cash flows equal to 20% of the value of the property in the current year. Assuming a 40% tax rate, **compute** the IRR of the project. Note that all cash flows occur at year-end.

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Answer:

	Today (Time 0)	*Year 1*	*Year 2*	*Year 3*
True property value	$200	$180	$162	$145.8
Operating CF		36.00	32.40	29.16
Pretax profit		36.00	32.40	29.16
Less taxes (40%)		14.40	12.96	11.66
Net income		21.60	19.44	17.50
Sales proceeds				145.8
Capital loss tax shield				21.68
Total CF	–200	21.60	19.44	184.98

The capital loss tax shield is calculated as the loss in value of the property from purchase to sale multiplied by the tax rate. ($200 – $145.8) × 40% = $21.68

On the TI BAII Plus calculator, the following inputs should be used:

CF_0 = –200.00; CF_1 = 21.60; CF_2 = 19.44; CF_3 = 184.98;
CPT → IRR = 4.61%

The IRR declines to less than 5% when depreciation is not allowed for tax purposes. The *first principle of depreciation* is that when depreciation is not allowed as a tax-deductible expense (or when the rate is slower than the true economic depreciation rate), the after-tax IRR will be less than the pretax IRR reduced by the tax rate. In this case, it falls from 8.00% in the previous example to 4.61% in this case.

The intuition behind this principle is that investors are paying taxes earlier than they are due, providing an interest-free loan to the government. Here, the effective tax rate is higher than the stated rate.

In the next example, we will again assume a tax rate of 40% but will assume that accounting depreciation equals economic depreciation and is a tax-deductible expense.

Example: Real estate IRR with taxation and depreciation

Consider a real estate project that costs $200 million. The property will be sold at the end of year 3 for $145.8 million. The property is worth $200 million when purchased and will decline in value by 10% per year due to wear and tear. The property will generate cash flows equal to 20% of the value of the property in the current year. Assuming a 40% tax rate, **compute** the IRR of the project. Note that all cash flows occur at year-end.

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Answer:

	Today (Time 0)	*Year 1*	*Year 2*	*Year 3*
True property value	$200	$180	$162	$145.8
Operating CF		36.00	32.40	29.16
Less depreciation		20	18	16.2
Pretax profit		16.00	14.40	12.96
Less taxes (40%)		6.40	5.76	5.18
Net income		9.6	8.64	7.78
Sales proceeds				145.8
Total CF (incl. dep.)	–200	29.60	26.64	169.78

On the TI BAII Plus calculator, the following inputs should be used:

CF_0 = –200.00; CF_1 = 29.60; CF_2 = 26.64; CF_3 = 169.78;
CPT → IRR = 4.80%

In this case, the after-tax IRR of 4.80% is approximately 60% (i.e., 1 – tax rate) of the before-tax IRR of 8.00%. The effective tax rate is equal to the stated tax rate when tax-deductible depreciation equals economic depreciation. This is the *second principle of depreciation*.

Depreciation for tax accounting purposes does not change the total taxes paid across the years (i.e., taxes summed through the years), just the timing of the taxes paid. Given the time value of money, the sooner a firm depreciates an asset for tax purposes, the earlier the tax savings and the higher the IRR will be.

Accelerated depreciation methods allow a firm to write off the value of an asset more quickly than the true economic decline in the asset, receiving the tax benefit from depreciation sooner. In the case of real estate, some assets are even increasing in value while they are being written off for tax purposes.

Example: Real estate IRR with taxation and accelerated depreciation

Consider a real estate project that costs $200 million. The property will be sold at the end of year 3 for $145.8 million. The property is worth $200 million when purchased and will decline in value by 10% per year due to wear and tear. The property will generate cash flows equal to 20% of the value of the property in the current year. For the sake of simplicity, assume the accelerated depreciation on the property is $28 million per year each year.

Assuming a 40% tax rate, **compute** the IRR of the project. Note that all cash flows occur at year-end.

Answer:

Because the accounting depreciation allowance is greater than the economic depreciation of the asset, the asset will be sold at a profit and thus the firm will have to pay taxes on the gain. The gain is reflected in the dollar difference between the two depreciation methods. The accelerated depreciation is $84 million while the economic depreciation is $54.2 million. The gain is $29.8 million (i.e., $84 – $54.2) and the taxes are $11.92 million.

	Today (Time 0)	*Year 1*	*Year 2*	*Year 3*
True property value	$200	$180	$162	$145.8
Operating CF		36.00	32.40	29.16
Less depreciation		28.00	28.00	28.00
Pretax profit		8.00	4.40	1.16
Less taxes (40%)		3.20	1.76	0.464
Net income		4.80	2.64	0.696
Sales proceeds				145.8
Less capital gains tax (40%)				11.92
Total CF (incl. dep.)	–200	32.80	30.64	162.58

On the TI BAII Plus calculator, the following inputs should be used:

$CF_0 = -200.00$; $CF_1 = 32.80$; $CF_2 = 30.64$; $CF_3 = 162.58$;
CPT → IRR = 4.89%

The after-tax IRR is slightly higher (4.89%) in the accelerated depreciation example than in the nonaccelerated example (4.80%). This is the *third principle of depreciation*. In this case, the government is providing an interest-free loan to the firm, in contrast to the earlier example where the firm was not allowed to depreciate the asset for tax purposes and the firm provided an interest-free loan to the government.

In this final extreme example, assume that capital expenditures are fully expensed for tax purposes. This means the full purchase price of the asset, $200, will be expensed at time zero. The asset will again be sold at a gain. In this case, since the asset is fully *depreciated*, the full sales price of the asset is a gain and will be subject to the 40% tax rate.

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Example: Real estate IRR with taxation and allowable capital expenditures

Consider a real estate project that costs $200 million. The property will be sold at the end of year 3 for $145.8 million. The property is worth $200 million when purchased and will decline in value by 10% per year due to wear and tear. The property will generate cash flows equal to 20% of the value of the property in the current year. The full purchase of the property will be expensed for tax purposes at time zero. Assuming a 40% tax rate, **compute** the IRR of the project. Note that all cash flows occur at year-end.

Answer:

	Today (Time 0)	*Year 1*	*Year 2*	*Year 3*
True property value	$200	$180	$162	$145.8
Operating CF	–200	36.00	32.40	29.16
Pretax profit	–200	36.00	32.40	29.16
Less taxes (40%)	+80	14.4	12.96	11.66
Net income	–120	21.6	19.44	17.50
Sales proceeds				145.8
Less capital gains tax (40%)				–58.3
Total CF (incl. dep.)	–120	21.60	19.44	104.98

On the TI BAII Plus calculator, the following inputs should be used:

CF_0 = −120.00; CF_1 = 21.60; CF_2 = 19.44; CF_3 = 104.98;
CPT → IRR = 8.00%

Note that the IRR in this fully expensed outflow example is 8.00%, the same as in the first, nontax example. The intuition is that the ability to expense the cost of the asset provides the same value to the firm as not paying taxes (i.e., all cash inflows and outflows are reduced by 40%). Although the scale of the cash flows is reduced by 40%, the relative values and timing remain the same. This illustrates the *fourth principle of depreciation*, when outlays can be fully expensed for tax accounting purposes, the after-tax return will generally be approximately equal to the before-tax return.

Summary of Depreciation and Taxes

The depreciation tax shield offered by many real estate investments must be considered in the decision to include real estate in a portfolio. Investors in higher tax brackets benefit most from tax-advantaged investments while low income tax bracket individuals benefit the least. However, there are other benefits from real estate investments, such as diversification, which tax-exempt and lower-taxed individuals should consider when evaluating real estate as an alternative asset class.

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Real Estate Equity Risks and Returns

LO 15.5: Demonstrate knowledge of real estate equity risks and returns as represented by real estate indices.

For example:
- **Discuss real estate indices based on appraisals.**
- **Identify and describe data smoothing and its major effects.**
- **Discuss real estate indices based on adjusted privately traded prices.**
- **Discuss real estate indices based on market prices.**

There are three basic approaches to computing real estate indices including: (1) appraisals, (2) adjusted privately traded prices, and (3) market prices.

Real Indices Based on Appraisals

In an **appraisal**, prices are professionally estimated rather than generated from purchases and sales (i.e., market prices) and typically utilize either the DCF method or the comparable sales price method. As noted earlier in the topic, appraised values introduce the potential for data smoothing.

The National Council of Real Estate Investment Fiduciaries (NCREIF) publishes a real estate index, the **NCREIF Property Index** (NPI), based on appraised values. Members submit data quarterly and the NCREIF aggregates the data to compute the NPI. Members often only perform annual appraisals and report the same value for subsequent quarters unless a significant change in value has occurred.

The NPI is calculated:

- Based on appraised property values. Appraisals are typically made using one of the following methods:
  - Comparable sales method.
  - Discounted cash flow method. This method has become the most widely accepted practice in the industry.
- On an **unleveraged** basis. As a result, returns are less volatile than returns to leveraged real estate investments.
- Without interest charge deductions.
- On a before-tax basis.
- As a value-weighted index of the individual property returns.

The NPI is often used as a proxy for performance of direct investments in commercial real estate. It is a proxy for the returns earned by large investors and institutions holding real estate portfolios. Apartment complexes, offices, retail spaces, and industrial properties form the basis of institutional real estate portfolios and as such, are segmented by the NCREIF in published sub-indices.

Data Smoothing and Its Effects

Data smoothing occurs when the true volatility of a return series is diminished by some method, such as using appraised values rather than market values to calculate returns.

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Appraised values may be different from true values for two reasons. First, appraisals often result in price changes that are less than true changes because appraisers tend to undervalue assets when prices are high relative to recent prices and overvalue assets when prices are low relative to recent prices. In other words, appraisers are reluctant to recognize large changes in the value. They assume or suspect that the newly reported price, either substantially higher or substantially lower than the previous price, is exaggerated. They tend to **anchor** new prices to old prices and may adjust the price to fall in line with their own beliefs and the new data. The result is data smoothing.

Second, information is often delayed and appraisers are slow in incorporating new information into values. Appraised values are lagged because both the comparable sales price approach and the discounted cash flow approach are backward looking rather than forward looking.

Problems that result from data smoothing are:

- The smoothed index will lag the true values of the underlying properties.
- Volatility of index returns is consistently underestimated. Lower volatility will result in higher risk-adjusted return measures (i.e., a higher Sharpe ratio) and may make real estate look more attractive on a risk-adjusted basis than it really is.
- Correlation with other asset returns is consistently underestimated. This is because the NPI will not react as quickly to macroeconomic events (due to the lag in prices) as stock and bond indices. The result is underestimated systematic risk, overestimated benefits from diversification, and finally an over-allocation of real estate to the portfolio.

Real Estate Indices Based on Adjusted Privately Traded Prices

Even if market prices are available, real estate trades infrequently. It is unrealistic to construct an index using only the most recent prices of properties because values will be stale. However, infrequent observations may be combined to form a lagged perception of market changes, similar to the concept of a moving average used to gauge the direction of the current trend in stock prices by technical traders.

In real estate, prices of properties that have been sold are used to estimate hypothetical selling prices of properties that have not sold. Thus, a sub-sample of properties that have sold is used to infer the price behavior of all the properties in the underlying real estate index.

This method of constructing an index may result in data smoothing as well. Observed price changes may lag true price changes in both up and down markets. In a rising market, buyers may be unwilling to pay the higher prices and, thus, properties that change hands may over-represent those that have increased less. In declining markets, sellers may be reluctant to take losses, thus, sales over-represent those properties that have declined in value less.

A **hedonic price index** uses the underlying characteristics of an asset to estimate prices of the assets in the index. For example, a hedonic regression uses factors, such as the size of a property, the quality, the location, and other factors, to explain real estate prices. This means that the characteristics of the sub-sample of properties used to estimate the values of other properties that have not sold does not have to be identical. Thus, if large apartment buildings are selling, they are overrepresented in the subsample. However, the hedonic price index approach attributes price changes to underlying characteristics (i.e., large in this case) and allows the information from the subsample to be projected to a larger group of

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properties with different characteristics. Using this method, an analyst could estimate the value of a large house using data on the sales of smaller homes, for example.

Real Estate Indices Based on Market Prices

REIT returns are based on market prices, unlike private real estate. The **FTSE NAREIT US Real Estate Index Series** consists of a collection of REIT indices (equity, mortgage, and hybrid) that cover various sectors of the U.S. commercial real estate market. These indices and similar ones from other providers are widely used to measure real estate returns.

In the next section, equity REIT returns are used to describe real estate investment returns. As previously noted, REIT indices tend to move more with fluctuations in the stock market than with changes in the underlying real estate assets. This raises questions about the usefulness of using REIT returns for empirical analysis of overall real estate returns. However, the general conclusion is that the problems with measuring private returns outweigh potential problems with using REITs to represent real estate returns.

Professor's Note: There is a running theme throughout the real estate material regarding the way private real estate returns are calculated and what this means for volatility and correlation measures. As discussed previously, using appraised values and private transaction-based methodologies leads to data smoothing. This results in artificially low volatility of returns. Also, correlation with other assets is underestimated. On the other hand, REIT returns, which rely on frequent market prices, appear to be more highly correlated with the stock market than with the returns of the underlying assets (i.e., properties). This gives rise to a dilemma: which type of data (i.e., private transactions or REITs) is more representative of the true returns, volatility, and correlation experienced by real estate investors? REIT returns win out in this topic but keep these issues in mind as you analyze the returns described in the next section.

Equity REITs: Performance and Implications

LO 15.6: Demonstrate knowledge of historical performance of equity REITs.

For example:
- **Recognize inferences that can be drawn from comparing definable characteristics of equity REITs with their historical stand-alone and portfolio performance.**

One of the only ways smaller investors can invest in mortgages is via equity REITs. In this section, the returns to equity REITs are used to indicate the returns to investments in real estate in general. The equity REIT returns reported in Figure 6 are based on the FTSE NAREIT Equity REITs Index.

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Figure 6: Returns of Equity REITs, January 2000 – December 2014

Asset Class (Index)	*Average Return*	*Standard Deviation*	*Sharpe Ratio*	*Maximum and Minimum Returns*	*Skewness*	*Maximum Drawdown*
Equity REITs (FTSE NAREIT Equity REITs)	14.6%*	22.2%	0.56	31.0% and –31.7%	–0.9*	–68.3%
World Equities (MSCI World)	4.4%*	15.8%	0.14	11.2% and –19.0%	–0.7*	–54.0%
Global Bonds (Barclays Capital Global Aggregate Bond)	5.7%*	5.9%	0.60	6.6% and –3.9%	0.1	–9.4%
U.S. High-Yield Bonds (Barclays Capital U.S. Corporate High Yield)	7.7%*	10.0%	0.56	12.1% and –15.9%	–1.0*	–33.3%
Commodities (S&P GSCI Total Return)	3.8%*	23.3%	0.07	19.7% and –28.2%	–0.5*	–69.4%

* Significance at 95% confidence

Equity REIT returns averaged a strong 14.6% over the sample period, higher than any other asset class listed. The asset class also had the largest maximum gain, 31.0%. However, the standard deviation of returns was higher than any other asset class as well, with the exception of commodities. The minimum return was –31.7% and the maximum drawdown was –68.3%. Like mortgage REITs, the data also indicate negative skewness and leptokurtosis.

As an equity REIT investor, the high reward is coupled with high risk. The results indicate very high average returns over the period but also extremely high volatility. An investment of $1,000 in equity REITs in January 2000 would have risen to slightly less than $6,000 by the end of 2014. In comparison, the same $1,000 would have led to an ending value of $2,200 for global bonds and $1,600 for world equities. The data include periods of extremes, however, and these results should not necessarily be expected in the future.

Correlation results indicate high positive correlation with global equity (0.63) and high-yield bond markets (0.63), modest positive correlation with global bonds (0.29), and low positive correlation with commodities (0.19). Equity REIT returns are negatively correlated with the Chicago Board Options Exchange Market Volatility Index (VIX) (–0.43). This negative correlation indicates that greater uncertainty in equity markets is negatively related to equity REIT returns.

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Key Concepts

LO 15.1

Stages of the real estate development process include:

1. Acquiring the land or the site.
2. Forecasting the project cash flows.
3. Designing the building/site.
4. Securing permits and public approval of the project.
5. Securing financing.
6. Building the structure.
7. Leasing, managing, and/or selling the property.

Real options in real estate development projects include:

- Call options to buy real estate.
- Put options to sell real estate.
- Exchange options involving the exchange of noncash assets.

A decision tree can be used to analyze complex decisions. This is an important analysis tool when viewing real estate as a string of call options. The backward induction process involves working backwards from the final decision nodes on the decision tree toward the first decision nodes based on an analysis of the valuation of the project at each node.

LO 15.2

The discounted cash flow (DCF) approach involves estimating revenues and expenses over the life of a project and then discounting the cash flows to time zero at the required rate of return. The DCF decision rule is that if the net present value (NPV) of the project is greater than zero, the project should go forward. NPV is equal to the sum of the discounted cash inflows, including any outflows to invest in the project. Alternatively, if the internal rate of return (IRR) is greater than the discount rate, the project should move forward. If two different methods give different results, NPV is the criterion of choice. If scale is a problem, the differential cash flow approach can be used.

Key inputs in the discounted cash flow approach to appraising real estate development projects are cost projections, revenue projections, and the discount rate. Factors such as local market conditions, the anticipated demand for the space, other competing developments in the area/region, investment market conditions, overall supply considerations, the quality of the building specification, and the time expected to complete the project all affect risk and cash flow projections.

The comparable sales price approach values properties using data regarding the sales prices of comparable assets in the area are examined and used to value properties.

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LO 15.3

Private equity real estate funds invest pooled investor capital in private real estate. Investment strategies include real estate development and redevelopment.

Real estate investment vehicles include: commingled funds, syndications, joint ventures, real estate limited partnerships, open-end real estate mutual funds, options and futures on real estate indices, exchange-traded funds, closed-end investment funds, and equity real estate investment trusts (REITs).

LO 15.4

Depreciation is the reduction in the value of an asset with the passage of time. Depreciation can be the actual wear and tear on the asset or the accounting value that represents the decline in value.

The tax savings that result from depreciation can have a substantial effect on after-tax cash flows of a real estate investment. The tax savings is known as the depreciation tax shield. Depreciation methods vary and affect the net present value and internal rate of return of a real estate investment.

LO 15.5

There are three basic approaches to computing real estate indices including (1) appraisals, (2) adjusted privately traded prices, and (3) market prices.

In an appraisal, prices are professionally estimated rather than generated from purchases and sales (i.e., market prices). Appraised values introduce the potential for data smoothing. The NCREIF Property Index (NPI) is a popular real estate index that relies on appraised values.

Data smoothing occurs when the true volatility of a return series is diminished by some method, such as using appraised values rather than market values to calculate returns.

Problems that result from data smoothing are:

- The smoothed index will lag the true values of the underlying properties.
- Volatility of index returns is consistently underestimated.
- Correlation with other asset returns is consistently underestimated.

In real estate, prices of properties that have been sold are used to estimate hypothetical selling prices of properties that have not sold. A sub-sample of properties that have sold is used to infer the price behavior of all the properties in the underlying real estate index.

A hedonic price index uses the underlying characteristics of an asset to estimate prices of the assets in the index. For example, a hedonic regression uses factors, such as the size of a property, the quality, the location, and other factors, to explain real estate prices.

LO 15.6

Overall, the data on equity REITs indicate high returns, high risks, and low to modest diversification benefits during the 2000–2014 period.

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Concept Checkers

1. Which method is most useful for analyzing a real estate development investment decision?
   A. Payback period.
   B. Decision tree.
   C. Constant growth dividend discount model.
   D. Hedonic regression.

2. Which of the following inputs is required by the discounted cash flow (DCF) approach to appraise a development project?
   A. Psychological trend analysis of prospective tenants.
   B. An assessment of political boundaries of the community.
   C. The anticipated demand for space.
   D. The quality of local school districts.

3. Which of the following is a common advantage of open-end real estate mutual funds, private equity funds, and commingled funds? These fund types:
   A. are regulated by the SEC.
   B. buy and sell shares to and from investors upon request.
   C. provide access to real estate investments that might otherwise be unavailable.
   D. allow for direct control over the real estate portfolio investments.

4. Which of the following statements regarding depreciation is *most accurate*?
   A. The lowest internal rate of return (IRR) results when the cost of the asset is expensed in the year it is purchased.
   B. When accelerated depreciation methods are used for tax purposes, the effective tax rate is lower than the stated tax rate.
   C. The highest IRR results when the economic depreciation is equal to depreciation for tax purposes.
   D. A firm is not legally allowed to depreciate an asset faster for tax purposes than its true economic rate of depreciation.

5. Which of the following is *most likely* to be a result of using appraised values in real estate valuation?
   A. Price and return data that are less variable than true market prices and returns.
   B. Higher after-tax returns.
   C. Lower commissions paid to real estate brokers.
   D. Returns that are prohibited from being used to compute real estate indices by regulators.

6. Which of the following statements regarding equity REITs is *most accurate*? Equity REITs:
   A. are computed using prices that have been gathered using the appraisal method.
   B. exhibit extremely low volatility due to data smoothing.
   C. exhibit higher returns than the stock, bond, and commodity indices provided for comparison.
   D. are looked at suspiciously by analysts because they are easily manipulated via data smoothing.

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Concept Checker Answers

1. **B** Decision trees are useful in analyzing real estate investment decisions because real estate developments may be viewed as a string of options. Real options in real estate include:
   - Call options to buy real estate.
   - Put options to sell real estate.
   - Exchange options involving the exchange of noncash assets. (LO 15.1)

2. **C** The anticipated demand for space affects the revenue projections of the project. Project revenues are a direct component of the DCF appraisal approach. The other answer choices are important considerations in a feasibility study but do not directly affect the DCF analysis. (LO 15.2)

3. **C** Open-end real estate mutual funds, private equity funds, and commingled funds all provide access to real estate, especially for smaller firms that might not otherwise be able to invest. Of the choices provided, only open-end funds are regulated by the SEC. They also buy and sell shares to and from investors. None of the above investments allow for direct control over real estate investments. (LO 15.3)

4. **B** Deprecation provides a tax shield. Typically, the faster you can depreciate an asset, the lower your effective tax rate and the higher the IRR of the project. Expensing the cost of an asset provides the greatest tax shield. (LO 15.4)

5. **A** Appraised values often result in data smoothing of prices and hence returns that are less volatile than true prices and returns. (LO 15.5)

6. **C** Equity REIT returns averaged 14.6% over the period January 2000 to December 2014. This was higher than any other asset class listed for comparison. The high reward was coupled with high risk. The standard deviation of returns was 22.2%. (LO 15.6)

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FORMULAS

simple interest: $R = \left(1 + \frac{R^{m=2}}{2}\right)^2 - 1$

converting continuous compounded rates to simple interest rates: $R = e^{R^{m \to \infty}} - 1$

converting simple interest rates to continuously compounded rates:

$$\ln(1+R) = \ln(e^{R^{m \to \infty}}) = R^{m \to \infty}$$

geometric mean return using simple interest rates = $\left(\prod_{t=1}^{T}(1+R_t)\right)^{1/T} - 1$

geometric mean return using continuously compounded rates: $e^M - 1$

arithmetic mean log return: $M = \frac{\ln(1+R_1)+\ln(1+R_2)+\ln(1+R_3)+\ln(1+R_4)}{4}$

fully collateralized return: $R_{fcoll} = \ln(1 + R) + R_f$

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partially collateralized return: $R_{pcoll} = [l \times \ln(1 + R)] + R_f$

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internal rate of return: $CF_0 + \frac{CF_1}{(1+IRR)} + \frac{CF_2}{(1+IRR)^2} + \ldots + \frac{CF_T}{(1+IRR)^T} = 0$

mean of the distribution: $E(R) = \mu = \sum_{i=1}^{n} p_i R_i^1$

variance of the distribution: $\sigma^2 = E[(R_i - \mu)^2]$

standard deviation of the distribution: $\sigma = \sqrt{\sigma^2}$

skewness of the distribution = $\frac{E\left[(R-\mu)^3\right]}{\sigma^3}$

kurtosis of the distribution = $\frac{E\left[(R-\mu)^4\right]}{\sigma^4}$

excess kurtosis = $\frac{E\left[(R-\mu)^4\right]}{\sigma^4} - 3$

sample variance: $s_p^2 = \frac{\sum_{i=1}^{n}(R_i - \bar{R})^2}{n-1}$

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sample standard deviation: $s_P = \sqrt{\dfrac{\sum_{i=1}^{n}(R_i - \bar{R})^2}{n-1}}$

population covariance: $Cov(R_i, R_j) = \sigma_{i,j} = E[(R_i - \mu_i)(R_j - \mu_j)]$

sample covariance: $Cov(R_i, R_j) = \dfrac{\sum_{t=1}^{T}(R_{i,t} - \bar{R}_i)(R_{j,t} - \bar{R}_j)}{T-1}$

Pearson correlation coefficient: $\rho_{i,j} = \dfrac{Cov(R_i, R_j)}{\sigma_i \sigma_j}$

Spearman rank correlation: $\rho_s = 1 - \dfrac{6\sum d_i^2}{n(n^2-1)}$

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CAPM beta: $\beta_i = \dfrac{Cov(R_i, R_m)}{Var(R_m)} = \dfrac{\sigma_{i,m}}{\sigma_m^2}$

autocorrelation: k-order autocorrelation $= \dfrac{E[(R_t - \mu)(R_{t-k} - \mu)]}{\sigma_t \sigma_{t-k}}$

diminishing autocorrelation under constant variance: $\rho_{t,t-k} = (\rho_{t,t-1})^k$

Durbin-Watson statistic: $DW = \dfrac{\sum_{t=2}^{T}(e_t - e_{t-1})^2}{\sum_{t=1}^{T} e_t^2}$

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Durbin-Watson approximation: $DW \approx 2(1 - \rho_{t,t-1})$

portfolio variance: $Var(R_p) = \sum_{i=1}^{n}\sum_{j=1}^{n} w_i w_j Cov(R_i, R_j)$

variance of a 2-asset portfolio: $Var(R_p) = w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\rho_{1,2}\sigma_1\sigma_2$

Jarque-Bera statistic: $JB = \dfrac{n}{6}\left(S^2 + \dfrac{K^2}{4}\right)$

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ARCH model variance forecast: variance forecast in period $t+1 = a_0 + a_1\varepsilon_t^2$

GARCH variance forecast: variance forecast in period $t+1 = \alpha_0 + \alpha_1\varepsilon_t^2 + \alpha_2\sigma_t^2$

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$$\textbf{semivariance} = \frac{\sum_{\text{for } R_t<E(R)} [R_t - E(R)]^2}{T}$$

$$\textbf{sample semivariance} = \frac{\sum_{\text{for } R_t<E(R)} [R_t - E(R)]^2}{T-1}$$

$$\textbf{semistandard deviation} = \sqrt{\frac{\sum_{\text{for } R_t<E(R)} [R_t - E(R)]^2}{T}}$$

$$\textbf{sample semistandard deviation} = \sqrt{\frac{\sum_{\text{for } R_t<E(R)} [R_t - E(R)]^2}{T-1}}$$

$$\textbf{tracking error} = \sqrt{\frac{\sum_{t=1}^{T}(R_t - R_B - M)^2}{T-1}}$$

parametric VaR = $z \times \sigma \times \sqrt{\text{days}} \times \text{value}$

VaR assuming perfect positive correlation: $\text{VaR}_p = \text{VaR}_1 + \text{VaR}_2$

VaR assuming perfect negative correlation: $\text{VaR}_p = |\text{VaR}_1 - \text{VaR}_2|$

VaR assuming zero correlation: $\text{VaR}_p = \sqrt{\text{VaR}_1^2 + \text{VaR}_2^2}$

Sharpe ratio: $SR_p = \dfrac{E(R_p) - R_f}{\sigma_p}$

monthly Sharpe ratio: Monthly SR = $\dfrac{[E(R_p) - R_f]/12}{\sigma_p/\sqrt{12}}$

Treynor ratio: $TR = \dfrac{E(R_p) - R_f}{\beta_p}$

Sortino ratio = $\dfrac{E(R_p) - R_T}{TSSD}$

information ratio: $IR_p = \dfrac{E(R_p) - R_{benchmark}}{TE_p}$

return on value at risk: $RoVaR = \dfrac{E(R_p)}{VaR}$

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Jensen's alpha: $\alpha_p = R_p - \left[R_f + \beta_p\left(R_m - R_f\right)\right]$

M² measure: $M^2 = R_f + \dfrac{\sigma_m}{\sigma_p}\left[E\left(R_p\right) - R_f\right]$

ex ante asset pricing models: $E(R_i) = R_f + \beta_i[E(R_m) - R_f]$

ex post asset pricing model $= R_{i,t} - R_f = \beta_i(R_{m,t} - R_f) + \varepsilon_{i,t}$

ex ante multifactor asset pricing model:

$$E(R_i) - R_f = \beta_{i,1}[E(R_1) - R_f] + \beta_{i,2}[E(R_2) - R_f] + \beta_{i,K}[E(R_K) - R_f]$$

ex post multifactor asset pricing model:

$$R_{i,t} - R_f = \beta_{i,1}(R_{1,t} - R_f) + \beta_{i,2}(R_{2,t} - R_f) + \ldots + \beta_{i,K}(R_{K,t} - R_f) + \varepsilon_{i,t}$$

Fama-French model: $E(R_i) - R_f = \beta_1(R_m - R_f) + \beta_2 E(SMB) + \beta_3 E(HML)$

Fama-French-Carhart model:

$$E(R_i) - R_f = \beta_1(R_m - R_f) + \beta_2 E(SMB) + \beta_3 E(HML) + \beta_4 E(UMD)$$

no-arbitrage rate relationship: $F_{T-t} = (T \times R_{T-t} \times R_t)/(T - t)$

cost of carry relationship: $F(T) = S +$ carrying costs

forward price of a financial asset: $F(T) = S \times e^{(r-d) \times T}$

put-call parity: call + risk-free bond – put = underlying asset

general option pricing model: $P_o = P_1\, N(d) - P_s\, N(d - v)$

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Black-Scholes call option formula:

$$c = SN(d_1) - e^{-rT}\, KN(d_2)$$

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where:
$d_1 = [\ln(S/e^{-rT}\, K)/v] + (v/2)$
$v = \sigma_s\sqrt{T}$
$d_2 = d_1 - v$

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Black forward option pricing model:

$$c = e^{-rT}\,[FN(d_1) - KN(d_2)]$$

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where:
$d_1 = [\ln(F/K)/v] + (v/2)$
$d_2 = d_1 - v$

currency option pricing model:

$$\text{option price} = e^{-r^{*}T}S^{*}N(d_1) - e^{-rT}SN(d_2)$$

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test statistic: $\dfrac{\text{estimated value} - \text{hypothesized value}}{\text{standard error of statistic}}$

dummy variable regression exposure model:

$$R_{it} - R_f = a_i + \left\{\left[b_{i,d} + \left(D_1 \times b_{i,diff}\right)\right] \times \left(R_{mt} - R_f\right)\right\} + e_{it}$$

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forward price of a physical asset: $F(T) = S \times e^{(r+c-y) \times T}$

commodity forward price inequality: $F(T) \leq S \times e^{(r+c-y) \times T}$

forward basis: basis $= S - F(T)$

calendar spread: $F(T + t) - F(T)$

roll yield: $F_0 - F_{-1} - (S_0 - S_{-1})$

ex ante alpha: $E(R_i) - R_f = \alpha_i + \beta_i[E(R_m) - R_f]$

$$\alpha_i = E(R_i) - \{R_f + \beta_i[E(R_m) - R_f]\}$$

ex post alpha $= \varepsilon_i = R_i - [R_f + \beta_i(R_m - R_f)]$

multifactor ex post alpha $= \varepsilon_{pt} = R_{pt} - R_f - \beta_{p1}(R_{1t} - R_f) - \beta_{p2}(R_{2t} - R_f) - \beta_{p3}(R_{3t} - R_f)$

single-factor ex post alpha $= \varepsilon_{pt} + \beta_{p2}(R_{2t} - R_f) + \beta_{p3}(R_{3t} - R_f)$

expected return on land: $E(R) = [P_d \times E(R_d)] + [(1 - P_d) \times E(R_{nd})]$

discounted cash flow: $P_0 = \dfrac{D_1}{r - g}$

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value of IP investment: $V_{IP,0} = \dfrac{p \times CF_1}{r - g}$

mortgage payment calculation: MP = MB × [i / (1 – (1 + i)$^{-n}$)]

loan-to-value ratio: $LTV = \dfrac{\text{balance of the loan}}{\text{market value of the property}}$

interest coverage ratio = $\dfrac{\text{NOI}}{\text{annual interest payment}}$

debt service coverage ratio: $DSCR = \dfrac{\text{NOI}}{\text{total loan payment}}$

fixed charges ratio = $\dfrac{\text{NOI}}{\text{all fixed payments}}$

discounted cash flow (income) approach:

$$V_0 = \frac{NOI_1}{(1+k)^1} + \frac{NOI_2}{(1+k)^2} + \ldots + \frac{NOI_i}{(1+k)^i} + \frac{NSP}{(1+k)^i}$$

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