



March 2016

CAIA[®] Level I
Workbook

Chartered Alternative Investment
Analyst Association[®]

**March 2016
Level I Workbook**

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Preface

Welcome to the workbook to “Alternative Investments” Level 1, 3rd edition 2015. The CAIA[®] program, organized by the CAIA Association[®] and co-founded by the Alternative Investment Management Association (AIMA) and the Center for International Securities and Derivatives Markets (CISDM), is the only globally recognized professional designation in the area of alternative investments, the fastest growing segment of the investment industry.

The following is a set of materials designed to help you prepare for the CAIA Level I exam.

Workbook

The exercises are provided to help candidates enhance their understanding of the reading materials. The questions that will appear on the actual Level I exam will not be of the same format as these exercises. In addition, the exercises presented here have various levels of difficulty and therefore, they should not be used to assess a candidate’s level of preparedness for the actual examination.

March 2016 Level I Study Guide

It is critical that each candidate should carefully review the study guide. **It contains information about topics to be studied as well as a list of equations that the candidate MAY see on the exam.** The study guide can be found on the CAIA website, on the Curriculum page.

Errata Sheet

Correction notes appear in the study guide to address known errors existing in the assigned readings that are viewed as being substantive. Occasionally, additional errors in the readings and learning objectives are brought to our attention after publication. At those points we will then post the errata directly to a **separate errata sheet on the Curriculum and Study Materials section of the CAIA website.**

It is the responsibility of the candidate to review these errata prior to taking the examination. Please report suspected errata to curriculum@caia.org.

The Level II Examination and Completion of the Program

All CAIA candidates must pass the Level I examination before sitting for the Level II examination. A separate study guide is available for the Level II curriculum. As with the Level I examination, the CAIA Association administers the Level II examination twice annually. Upon successful completion of the Level II examination, and assuming that the candidate has met all the Association’s membership requirements, the CAIA Association will confer the CAIA Charter upon the candidate. Candidates should refer to the CAIA website, www.caia.org, for information about examination dates and membership requirements.

REVIEW QUESTIONS & ANSWERS

Chapter 1 What is an Alternative Investment?

1. Define investment.
 - Investment is deferred consumption.
2. List four major types of real assets other than land and other types of real estate.
 - Natural resources, commodities, infrastructure and intellectual property
3. List the three major types of alternative investments other than real assets in the CAIA curriculum.
 - Hedge Funds, Private Equity, Structured Products
4. Name the five structures that differentiate traditional and alternative investments.
 - Regulatory Structures, Securities Structures, Trading Structures, Compensation Structures, Institutional Structures
5. Which of the five structures that differentiate traditional and alternative investments relates to the taxation of an instrument?
 - Regulatory Structures
6. Name the four return characteristics that differentiate traditional and alternative investments.
 - Diversification, Illiquidity, Inefficiency, Nonnormality
7. Name four major methods of analysis that distinguish the analysis of alternative investments from the analysis of traditional investments.
 - Return Computation Methods, Statistical Methods, Valuation Methods, Portfolio Management Methods
8. Describe an incomplete market.
 - An incomplete market refers to the lack of investment opportunities that causes market participants to be unable to implement an investment strategy that satisfies their exact preferences such as risk preferences.
9. Define active management.
 - Active management refers to efforts of buying and selling securities in pursuit of superior combinations of risk and return.

10. What distinguishes use of the term pure arbitrage from the more general usage of the term arbitrage?

- Pure arbitrage is risk-free, while arbitrage, as a more general term, is not risk-free. Pure arbitrage is an attempt to earn risk-free profits through the simultaneous purchase and sale of identical positions trading at different prices in different markets. Whereas, arbitrage is used to represent efforts to earn superior returns even when risk is present because the long and short positions are not in identical assets or are not held over the same time period.

Chapter 2 The Environment of Alternative Investments

1. What is the term for a private management advisory firm that serves a group of related and ultra-high net worth investors?

- Family office

2. In a large financial services organization, what is the name used to denote the people and processes that play a supportive role in the maintenance of accounts and information systems as well as in the clearance and settlement of trades?

- Back office operations

3. Are dealer banks described as buy-side or sell-side market participants?

- Sell-side market participants

4. List several advantages of Separately Managed Accounts (SMAs) relative to funds.

- A fund investor owns shares of a company (the fund) that in turn owns other investments, whereas an SMA investor actually owns the invested assets as the owner on record.
- 2 A fund invests for the common purposes of multiple investors, while an SMA may have objectives tailored to suit the specific needs of the investor, such as tax efficiency.
- A fund is often opaque to its investors to promote confidentiality; an SMA offers transparency to its investor.
- Fund investors may suffer adverse consequences from redemptions (withdrawals) and subscriptions (deposits) by other investors, but an SMA provides protection from these liquidity issues for its only investor.

5. Which of the following participants is LEAST LIKELY to be classified as an outside service provider to a fund: Arbitrageurs, accountants, auditors or attorneys?

- Arbitrageurs

6. List four major legal documents necessary for establishing and managing a hedge fund.

- Private-placement memoranda, partnership agreement, subscription agreement, management company operating agreement

7. What is systemic risk?

- Systemic risk is the potential for economy-wide losses attributable to failures or concerns over potential failures in financial markets, financial institutions, or major participants.

8. What is the acronym for fund vehicles that are regulated and allow retail access of hedge-fund-like investment pools in the European Union?

- UCITS

9. In terms of financial regulation, what is the FCA?

- Financial Conduct Authority – the primary regulator of financial services in the UK.

10. What is progressive taxation of income?

- Progressive taxation places higher percentage taxation on individuals and corporations with higher incomes.

Chapter 3 Quantitative Foundations

1. What is the general term denoting compound interest when the interest is not continuously compounded?

- Discrete compounding

2. What is the primary challenge that causes difficulty in calculating the return performance of a forward contract or other position that requires no net investment? How is that challenge addressed?

- If the forward contract has a starting value of zero, it would cause division by zero. One solution to the problem of computing return for derivatives is to base the return on notional principal. Another is to include collateral.

3. Consider a position in a single forward contract. What distinguishes a fully collateralized position in this forward contract from a partially collateralized position?

- A fully collateralized position is paired with a quantity of capital equal in value to the notional principal of the contract whereas a partially collateralized position is paired with collateral lower in value than the notional value.

4. An IRR is estimated for a fund based on an initial investment when the fund was created, several annual distributions and an estimate of the fund's value prior to its termination. What type of IRR is this?

- Interim IRR

5. An investment has two solutions for its IRR. What can be said about the investment and the usefulness of the two solutions?

- There are two sign changes in the cash flow stream of the investment. None of the IRRs should be used.

6. Two investments are being compared to ascertain which investment would add the most value to a portfolio. Both investments have simplified cash flow patterns of an initial cost followed by positive cash flows. Why might the IRRs of the investment provide an unreliable indication of which investment adds more value?

- The major challenge with comparing IRRs across investments is when investments have scale differences. Scale differences are when investments have unequal sizes and/or timing of their cash flows.

7. An analyst computes the IRR of one alternative to be 20% and another to be 30%. When the analyst combines the cash flows of the two alternatives into a single investment, must the IRR of the combination be greater than 20% and less than 30%?

- No. The answer is not immediately apparent because the IRR of a portfolio of two investments is not generally equal to a value-weighted average of the IRRs of the constituent investments. If the cash flows from two investments are combined to form a portfolio, the IRR of the portfolio can vary substantially from an average of the IRRs of the two investments.

8. Is an IRR a dollar-weighted return or a time-weighted return? Why?

- The IRR is the primary method of computing a dollar-weighted return.

9. In which scenario will a clawback clause lead to payments?

- A clawback clause, clawback provision or clawback option is designed to return incentive fees to LPs when early profits are followed by subsequent losses.

10. What is the difference between a hard hurdle rate and a soft hurdle rate?

- A hard hurdle rate limits incentive fees to profits in excess of the hurdle rate. A soft hurdle rate allows fund managers to earn an incentive fee on all profits, given that the hurdle rate has been achieved.

Chapter 4 Statistical Foundations

1. Describe the difference between an ex ante return and an ex post return in the case of a financial asset.
 - Ex post returns are realized outcomes rather than anticipated outcomes. Future possible returns and their probabilities are referred to as expectational or ex ante returns.
2. Contrast the kurtosis and the excess kurtosis of the normal distribution.
 - Kurtosis serves as an indicator of the peaks and tails of a distribution. In the case of a normally-distributed variable the kurtosis is 3. Excess kurtosis is equal to kurtosis minus 3. Thus a normally distributed variable has an excess kurtosis of 0. Excess kurtosis provides a more intuitive measure of kurtosis relative to the normal distribution since it varies around zero to indicate kurtosis that is larger (positive) or smaller (negative) than the case of the normal distribution.
3. How would a large increase in the kurtosis of a return distribution affect its shape?
 - Kurtosis is typically viewed as capturing the fatness of the tails of a distribution, with high values of kurtosis, or positive values of excess kurtosis, indicating fatter tails (i.e., higher probabilities of extreme outcomes) than is found in the case of a normally distributed variable. Kurtosis can also be viewed as indicating the peakedness of a distribution, with a sharp narrow peak in the center being associated with high values of kurtosis, or positive values of excess kurtosis.
4. Using statistical terminology, what does the volatility of a return mean?
 - Volatility is often used synonymously with standard deviation in investments.
5. The covariance between the returns of two financial assets is equal to the product of the standard deviations of the returns of the two assets. What is the primary statistical terminology for this relationship?
 - The covariance will equal the product of the standard deviations when the correlation coefficient is equal to one.
6. What is the formula for the beta of an asset using common statistical measures?
 - $$\beta_i = \text{Cov}(R_m, R_i) / \text{Var}(R_m) = \sigma_{i,m} / \sigma_m^2 = \rho_{i,m} \sigma_i / \sigma_m$$
7. What is the value of the beta of the following three investments: a fund that tracks the overall market index, a riskless asset, and a bet at a casino table?

- $+1, 0, 0$ (assuming the casino bet is a traditional bet not based on market outcomes).

8. In the case of a financial asset with returns that have zero autocorrelation, what is the relationship between the variance of the asset's daily returns and the variance of the asset's monthly return?

- The variance of the monthly returns are T times the variance of the daily returns where T is the number of trading days in the month.

9. In the case of a financial asset with returns that have autocorrelation approaching positive one, what is the relationship between the standard deviation of the asset's monthly returns and the standard deviation of the asset's annual return?

- In the perfectly correlated case the standard deviation of a multiperiod return is proportional to T . In this case the annual vol is 12 times the monthly vol.

10. What is the general statistical issue addressed when the GARCH method is used in a time series analysis of returns?

- The tendency of an asset's variance to change through time.

Chapter 5 Measures of Risk and Performance Attribution

1. What are the two main differences between the formula for variance and the formula for semivariance?

- The semivariance uses a formula otherwise identical to the variance formula except that it only includes the negative deviations in the numerator and a smaller number of observations in the denominator.

2. What is the main difference between the formula for semistandard deviation and target semistandard deviation?

- Target semivariance is similar to semivariance except that target semivariance substitutes the investor's target rate of return in place of the asset's mean return.

3. Define tracking error and average tracking error

- Tracking error indicates the dispersion of the returns of an investment relative to a benchmark return, where a benchmark return is the contemporaneous realized return on an index or peer group of comparable risk.
- Average tracking error simply refers to the average difference between an investment's return relative to its benchmark. In other words, it is the numerator of the information ratio.

4. What is the difference between value at risk and conditional value-at-risk?

- Value at risk (VaR or VAR) is the loss figure associated with a particular percentile of a cumulative loss function. In other words, VaR is the maximum loss over a specified time period within a specified probability.
- Conditional value-at-risk (CVaR), also known as expected tail loss, is the expected loss of the investor given that the VaR has been equaled or exceeded. CVaR will exceed VaR (if the overall maximum potential loss exceeds the VaR).

5. Name the two primary approaches for estimating the volatility used in computing value-at-risk.

- Estimate the standard deviation (volatility) as being equal to the asset's historical standard deviation of returns
- Estimate volatility based on the implied volatilities from option prices

6. What are the steps involved in directly estimating VaR from historical data rather than through a parametric technique?

- Collect the percentage price changes
- Rank the gains/losses from the highest to the lowest
- Select the outcome (loss) reflecting the quantile specified by the VaR (e.g., for a VaR based on 95% confidence pick the observation with a loss larger than 95% of the other outcomes).

7. When is Monte Carlo analysis most appropriate as an estimation technique?

- It is best used in difficult problems where it is not practical to find expected values and standard deviations using mathematical solutions.

8. What is the difference between the formulas for the Sharpe and Treynor ratios?

- The Treynor ratio differs from the Sharpe ratio by the use of systematic risk rather than total risk in the denominator.

9. Define Return on VaR.

- Return on VaR (RoVaR) is simply the expected or average return of an asset divided by a specified VaR (expressing VaR as a positive number):

10. Describe the intuition of Jensen's alpha.

- Jensen's alpha is a direct measure of the absolute amount by which an asset is estimated to outperform, if positive, the return on efficiently priced assets of equal systematic risk in a single-factor market model.

Chapter 6 Foundations of Financial Economics

1. Jane studies past prices and volume of trading in major public equities and establishes equity market neutral positions based on her forecasts of prices. Jane consistently outperforms market indices of comparable risk. Does Jane's investment strategy and performance indicate:

- The underlying equity market is informationally inefficient at the weak level?
- The underlying equity market is informationally inefficient at the semi-strong level, both, or neither?
- The underlying equity market is informationally inefficient at both the weak level and the semi-strong level since any inefficiency at a "lower" level indicates inefficiency at a "higher" level because the underlying information sets are cumulative moving from weak to strong.

2. List two major factors that drive informational market efficiency through facilitating better investment analysis.

- Assets will also tend to trade at prices closer to their informationally efficient values when there is easier access to better information.
- Assets will also tend to trade at prices closer to their informationally- efficient values when there is less uncertainty about their valuation. In other words, when there are better valuation methods.

3. What is the term used to describe a framework for specifying the return or price of an asset based on its risk, as well as future cash flows and payoffs.

- Asset pricing model

4. What is the market portfolio and what is a market-weight?

- The market portfolio is a hypothetical portfolio containing all tradable assets in the world.
- The market weight of an asset is the proportion of the total value of that asset to the total value of all assets in the market portfolio.

5. What is an ex post excess return?

- A realized return (an observed historical return) expressed as an excess return by subtracting the riskless return from the asset's total return.

6. What factor is contained in the Fama-French-Carhart model that is not contained in the Fama-French model?

- Momentum

7. Is the Black-Scholes option pricing model a relative pricing model or an absolute pricing model?

- Relative pricing model since it describes an option price relative to the given underlying asset price.

8. What are the two components to the carrying costs of a financial asset?

- Opportunity costs of capital (financing cost) and storage or custody costs

9. What is the name of a model that projects possible outcomes in a variable by modeling uncertainty as two movements: an upward movement and a downward movement?

- Binomial tree model

10. What is the condition that would cause the term structure of forward prices for a financial security to be a flat line?

- When the interest rate and the dividend rate are equal (i.e. $r=d$)

Chapter 7 Benchmarking and Performance Attribution

1. What is the common name for a comparison group of funds with similar risk and return objectives and characteristics?

- Peer group (or comparison group)

2. Describe a theoretical, normative, time-series model of equity returns that might be used by a hedge fund to guide a high frequency trading strategy.

- Theoretical models tend to explain behavior accurately in more simplified situations where the relationships among variables can be somewhat clearly understood through logic.
 - Normative economic models tend to be most useful in helping explain underlying forces that might drive rational financial decisions under idealized circumstances and, to a lesser extent, under more realistic conditions.
 - Time-series models analyze behavior of a single subject or a set of subjects through time.
- For example, a model that hypothesized the impact of large orders in an equity market with risk-averse traders of limited capital in a world of informational asymmetries in which the large orders were driven by exogenous shocks to the institutions placing the orders would qualify.

3. Consider two hedge funds each of which attempt to benefit from identifying pairs of securities in which temporary mispricing is expected to correct as the prices converge. What would differentiate a normative model from a positive model?

- A normative model attempts to describe how people and prices ought to behave. A positive model attempts to describe how people and prices actually behave.

4. Compare the role of the intercept in the ex post versions of the CAPM and the single factor market model.

- In the ex post version of the CAPM the risk-free rate can serve as the intercept, or can be subtracted from the asset's return to form its excess return. In a single-factor market model the intercept is allowed to differ in theory from the riskless rate in order to indicate abnormally high or low returns due to mispricing. Thus the difference between a CAPM model and the single-factor risk model is that whether consistently abnormal returns are allowed to be captured in the intercept term or disallowed through a presumption of informational market efficiency.

5. What is the traditional difference indicated by the use of “a” to denote an intercept rather than α ?

- “a” is used to represent variables estimated in and outputted from a statistical procedure, in this case the y-intercept. α is used to represent the true and unobservable variables, in this case $\alpha = R_p - [R_f + (R_m - R_f) \beta]$.

6. An analyst is using a multi-factor return model to estimate the overperformance or underperformance of a fund. What would be the anticipated effect of omitting systematic risk factors to which the fund was negatively exposed in an “up” market?

- In an “up market” (i.e., a market in which major indices outperformed the riskless rate), the omission of systematic risk factors will cause an analysis to overestimate the risk-adjusted performance of assets positively exposed to the omitted factors and underestimate the performance of assets negatively exposed to the omitted risk factors.

7. Explain the relationship between the effect of omitted systematic risk factors and the overall direction of the market in a performance attribution.

- In an “up market” (i.e., a market in which major indices outperformed the riskless rate), the omission of systematic risk factors will cause an analysis to overestimate the risk-adjusted performance of assets positively exposed to the omitted factors and underestimate the performance of assets negatively exposed to the omitted risk factors. In a down market the anticipated effect would be the opposite. Most long-term studies are more likely to be up markets since risky assets on average outperform the riskless asset.

8. Summarize the primary conclusion of the differences in Fund A’s estimated intercepts in Exhibits 7.1, 7.2 and 7.3.

- Exhibits 7.1 and 7.2 indicate that Fund A is generating superior returns. However, Exhibit 7.3 indicated that Fund A’s return included exposures to size, value, and momentum factors in addition to its exposure to the market index. Note that the annual idiosyncratic performance (the intercept) is now estimated as being 2.91% lower than would be obtained in a perfectly efficient market. What was previously estimated as a 1.3% positive alpha using a single-factor model is now estimated as a -2.9% alpha using multiple factors. Apparently, the intercept of Fund A using a single-factor model was erroneously identified as an indication of superior return rather than as compensation for the omitted risk exposures that the fund was incurring by investing in small-capitalization value stocks with a high degree of momentum. This indication that performance was inferior is in marked contrast to the estimated superior performance shown in Exhibits 7.1 and 7.2 using a simple benchmark and single-factor approach, respectively.

9. List three reasons why the CAPM is an especially poor model with which to benchmark alternative investments.

- Multiperiod issues, nonnormality, illiquidity of returns and other barriers to diversification

10. Why might nonnormality of returns be a more important concern for managing a portfolio of alternative investments rather than a portfolio of traditional investments?

- Alternative investment returns often tend to skew to one side or the other and/or have excess kurtosis, with fatter tails on both sides. Nonnormality of returns tends to be greater for larger time intervals, and alternative investments by their nature often tend to be illiquid and are less likely to be managed with short-term portfolio adjustments. Another reason for the nonnormality of many alternative investment returns is the structuring of their cash flows into relatively risky and asymmetric patterns.

Chapter 8 Alpha, Beta, and Hypothesis Testing

1. Provide two common interpretations of the investment term alpha.

- Alpha refers to any excess or deficient investment return after the return has been adjusted for the time value of money (the risk-free rate) and for the effects of bearing systematic risk (beta).
- Alpha can also refer to the extent to which the skill, information, and knowledge of an investment manager generates superior risk-adjusted returns (or inferior risk-adjusted return in the case of negative alpha).
- Note that the first interpretation can include high returns from luck.

2. Provide two common interpretations of the investment term beta.

- Beta is the proportion by which an asset's excess return moves in response to the market portfolio's excess return (the return of the asset minus the return of the riskless asset).
- Beta refers to any of a number of measures of risk or the bearing of risk, wherein the underlying risk is systematic (shared by at least some other investments and usually unable to be diversified or fully hedged without cost) and is potentially rewarded with expected return without necessarily specifying that the systematic risk is the risk of the market portfolio.

3. Does ex ante alpha lead to ex post alpha?

- Not necessarily. While ex ante alpha may be viewed as expected idiosyncratic return, ex post alpha is realized idiosyncratic return. Simply put, ex post alpha is the extent to which an asset outperformed or underperformed its benchmark in a specified time period. Ex post alpha can be the result of luck and/or skill. To the extent that an investor suffers bad luck, ex ante will not guarantee ex post alpha.

4. What are the two steps to an analysis of ex ante alpha using historical data?

- An asset pricing model or benchmark must be used to divide the historical returns into the portions attributable to systematic risks (and the risk-free rate) and those attributable to idiosyncratic effects.
- The remaining returns, meaning the idiosyncratic returns (i.e., ex post alpha), should be statistically analyzed to estimate the extent, if any, to which the superior returns may be attributable to skill rather than luck.

5. List the three major types of model misspecification in the context of estimating systematic risk.
- Omitted (or misidentified) systematic return factors
 - Misestimated betas
 - Nonlinear risk-return relationships
6. What is the goal of an empirical investigation of abnormal return persistence?
- To identify ex ante alpha
7. What is the term for investment managers with products trying to deliver systematic risk exposure with an emphasis on doing so in a highly cost-effective manner?
- Beta drivers (or passive indexers)
8. Does an analyst select a p-value or a significance level in preparation for a test?
- The significance level. The p-value is the output of the statistical computations.
9. What is the relationship between selection bias and self-selection bias in hedge fund datasets?
- Selection bias is a distortion in relevant sample characteristics from the characteristics of the population, caused by the sampling method of selection or inclusion used by the data manager. If the selection bias originates from the decision of fund managers to report or not to report their returns, then the bias is referred to as a self-selection bias.
10. What are two methods of detecting outliers in a statistical analysis?
- Detection through visual inspection of plots
 - Ordered listings of the variables and regression residuals

Chapter 9 Regression, Multivariate, and Nonlinear Methods

1. What are the two distinguishing characteristics that make a regression a simple linear regression?

- One independent variable
- The relationship between the dependent and independent variable is linear

2. In a linear regression analysis of realized fund returns based on the single factor market model, what parameters or variables of the regression would be associated with a fund's estimated ex ante alpha, a fund's estimated beta and a fund's estimated idiosyncratic returns?

- Ex ante alpha is the intercept of the regression (relative to the riskless rate)
- A fund's estimated beta is the slope coefficient of the regression
- A fund's estimated idiosyncratic returns is the residuals (estimated error terms).

3. List the three primary assumptions used in a least squares regression to justify that the estimated parameters are unbiased and most likely.

- The model's error terms are assumed to be:
 - Normally distributed
 - Uncorrelated
 - Homoskedastic (i.e., have the same finite variance)

4. Why is multicollinearity an issue in a multiple regression model but not a single regression model?

- There is only one independent variable in a single regression model, but two or more independent variables are needed to have multicollinearity. A multiple regression model is a regression model with more than one independent variable. Multicollinearity is when two or more independent variables in a regression model have high correlation to each other.

5. The excess returns of a fund are being analyzed using a quadratic regression approach with an intercept and one independent variable: the squared value of the excess return of the overall market. What would be the likely interpretations of a result in which both the intercept and the slope coefficient are significantly positive?

- A positive slope coefficient indicates that a manager has been able to successfully time the market.
- A positive intercept indicates superior security selection.

6. In the context of a dummy variable approach to dynamic risk exposures, what is a “down market beta”?

- The down market beta, $\beta_{i,d}$ is the responsiveness of the fund’s return to the market return when the market return is less than the riskless rate (i.e., when the market’s excess return is negative or “down”).

7. A fund specializing in market timing of listed equities is estimated to have exhibited negative conditional correlation with the returns of a major equity market index. The fund alternates between net short positions and net long positions. What is primary interpretation of this finding?

- The manager is mis-timing the market by having higher risk exposure (higher betas or, more net long) when the market falls having less exposure when the market rises.

8. Why would an analyst use a rolling window analysis of the systematic risk exposures of an investment strategy rather than a single analysis based on the entire dataset?

- The analyst is concerned about style drift (specifically, systematic risk exposures that change through time). By using a short-term analysis that moves through time the analyst can get estimates of the change in risk exposures through time.

9. Consider a style analysis of fund returns based on Sharpe’s seminal approach. Based on past observations, how would you expect the goodness of fit of a regression to change based on whether the fund returns were from traditional mutual funds or from hedge funds?

- Traditional mutual fund returns are well explained by the returns of the asset classes that the funds hold but the same is not true for hedge funds. Empirical evidence indicates that the returns on most hedge funds are not well explained by passive return indices of their underlying assets. This is because hedge funds are more likely to have quickly and/or substantially changing risk exposures.

10. What are two major shortcoming of an empirical study that examines performance persistence of funds by comparing the correlation of returns in an earlier period with returns in a subsequent period when returns are based on appraised values?

- The results could be driven by serial correlation in returns that does not reflect true performance correlations
- The returns are not risk-adjusted

Chapter 10 Natural Resources and Land

1. What is a split estate and in what region are split estates uncommon?
 - A split estate is when the surface rights and mineral rights are separately owned. Split estates are relatively uncommon in the U.S. where private land owners tend to own both surface and mineral rights.
2. List the three factors that drive the underlying asset volatility used to price an exchange option.
 - The volatility of the price of the asset(s) being delivered
 - The volatility of the price of the asset(s) being received
 - The covariance or correlation coefficient between the prices.
3. What is the name of an option with no expiration date? Would that option typically be a European option or an American option?
 - A perpetual option. A perpetual option is an American option because if it were European it would never be able to be exercised and would be worthless.
4. What is the name of a lot of land that is vacant, approved for development but for which infrastructure construction has not commenced?
 - Paper lots
5. When and why are risk-neutral probabilities used?
 - Risk-neutral probabilities are often used in derivative pricing models. A risk-neutral probability may be useful to price derivatives even when investors are risk neutral because the derivative pricing model is being calculated relative to the price of the underlying asset and because the price of the underlying asset can often be viewed as already reflecting risk aversion.
6. What is the role of a Timberland investment management organization (TIMO)?
 - Timberland investment management organizations (TIMOs) provide management services to timberland owned by institutional investors such as pension plans, endowments, foundations, and insurance companies.

7. How do agency risks and political risks relate to institutional ownership of farmland?

- An investor in farmland does not necessarily actively manage the crops. As such, the investor relies on payment from the lessee (the agent) that operates the property. The risk that the lessor (the principal or investor) does not get paid by the agent is agency risk. Political risk is the economic uncertainty due to changes in government policy that may affect returns. The investor in farmland can be hurt by such political issues such as decreases in support payments or changes in land ownership rights.

8. Other than moneyiness of the best available use, what are three factors regarding the uses that would cause a multiple use option to have a low value?

- High similarity among the profitability of each alternative
- Low volatility of the profitability of each alternative
- Low correlation between the profitability of each alternative.

9. What is the effect of smoothed asset values on the measured risks of the asset?

- Smoothed asset values mask risk thereby biasing risk estimates downward.

10. What is contagion in a financial market?

- Contagion is the general term used in finance to indicate any tendency of major market movements, especially declines, to be transmitted from one financial market to other financial markets.

Chapter 11 Commodity Forward Pricing

1. List the primary advantage of forward contracts to the parties involved.
 - Forward contracts are ad hoc contracts negotiated between two parties with flexibility regarding details that help meet the needs and preferences of the parties. Futures contracts tend to be standardized.
2. What is the name of the credit-related event affecting a derivative contract that is mitigated at the settlement date by the mark-to-market process?
 - Crisis at maturity, when payment exchanges are deferred until settlement.
3. After a margin call, to what level must an investor return the account's margin?
 - To the initial margin requirement
4. What is another name for deferred contracts or back contracts?
 - Distant contracts
5. What are the three costs of carry that determine the price of a forward contract on a physical asset?
 - Storage costs, convenience yield (when viewed as a negative cost), and interest (financing) charges.
6. An analyst calculates the theoretical price of a forward contract on a physical commodity using the spot price and the cost-of-carry model. What is the primary reason that the forward price could be substantially smaller than the price generated by the model?
 - The analyst has underestimated the commodity's high convenience yield (i.e., a benefit -of-carry) such as in the case of a crop in short supply but with an anticipation of a large harvest.
7. Why might lumber have inelastic supply?
 - It is difficult to increase the amount of timber available rapidly due to the long time between planting and harvesting.
8. What is the name of the condition in which the expected spot price of a commodity in one year exceeds the one-year forward price of the commodity?
 - Normal backwardation

9. What is the name of the following quantity: the spot price of a commodity minus a forward price on the commodity?

- The basis of the commodity contract

10. An investor has established a calendar spread using forward contracts on a commodity. The investor is long the contract has a longer time to settlement. With carrying costs held constant, generally, what would be the effect on the calendar spread of an increase in the spot price of the commodity?

- Changes in the spot price will not affect calendar spreads as long as the sum of the carrying costs does not change. All forward prices will move up and down by the same quantity with the trader hedged against changes in the spot price by holding an equal number of long and short contracts.

Chapter 12 Commodities: Applications and Evidence

1. List four explanations that commodities should help diversify a portfolio of traditional assets.

- Unlike financial securities, commodities have prices that are not directly determined by the discounted value of future cash flows
- More so than traditional asset prices, nominal commodity prices should be positively correlated with inflation largely because commodity prices form part of the definition and computation of inflation
- Commodity price changes may be negatively correlated with the returns to stocks and bonds is that they may react very differently at different parts of the business cycle
- Low or negative correlation between commodity prices and financial assets is based on commodities being a major cost of corporate production and thus consistent with lowered corporate profits.

2. In an inflationary environment, would the real price of a commodity in 2015 based on 2010 prices be expected to be higher or lower than its nominal price in 2015?

- Lower. The 2015 real price of a commodity is adjusted for inflation and would roughly approximate its 2010 nominal price, whereas inflation would tend to cause the nominal 2015 price to be higher than the 2010 nominal price.

3. Consider an investor with a portfolio of risky assets in an economy in which markets are in the perfect equilibrium of the capital asset pricing model. What would determine the investor's allocation to commodity X?

- The market weight. The market weight of commodities is equal to the percentage of the total global value of commodities relative to the total global value of all assets.

4. Would inflation risk tend to be higher in an economy with high inflation? Why?

- Yes, though not necessarily. Inflation risk emanates from the divergence between realized and anticipated rates of inflation, known as unanticipated inflation. When anticipated inflation rates are high, unanticipated rates of inflation would also tend to be high.

5. Consider an economy in which markets are in equilibrium. If commodities offer diversification benefits and protection against inflation risk, would the expected return of commodity investments tend to be high or low?

- If markets are perfect and in equilibrium, market participants should expect receiving lower returns in exchange for enjoying lower risk. Thus, if commodities have substantial risk benefits they should tend to offer lower expected returns.

6. In the context of analyzing the returns of futures contracts, what is excess return?

- The excess return of a futures contract is the return generated exclusively from changes in futures prices. The term “excess return” is used elsewhere in investment with a different meaning: the total return minus the riskless rate.

7. What is the definition of roll return that is earned through holding futures contracts?

- Roll return or roll yield from holding futures contracts is defined as the portion of the return of a futures position attributable only from the change in the contract's basis through time.

8. What is the primary reason that causes a commodity futures market to be in contango or backwardation?

- The term structure takes on a positive or negative slope (contango or backwardated) based on carrying costs so that the risk-adjusted returns of spot positions and fully-collateralized futures positions will tend to be equal.

9. What happens to the basis of a futures contract as the contract approaches and reaches settlement?

- The basis of a futures contract or forward contract tends towards being zero at settlement (convergence).

10. List three important propositions regarding the accrual of roll return through holding futures contracts through time.

- Proposition 1: Roll return is not generated at the time that one position is closed and a new position is opened.
- Proposition 2: Realized roll return is not necessarily positive when markets are backwardated.
- Proposition 3: A position that generated a positive roll return does not indicate that the position's total returns were superior (i.e., that there was alpha).

Chapter 13 Operationally Intensive Real Assets

1. Name three factors that theory suggests should drive the extent to which natural resource price changes drive the performance of firms that process those natural resources.

- The price elasticity of the demand for the good
- The price elasticity of the supply for the good
- The extent to which an operating firm is exposed to or has hedged its expenses and revenues (i.e., its profits).

2. To what extent have gold prices driven the equity values of gold mining firms based on data from the U.S. during the financial crisis in late 2008?

- In the short run, it appeared that the operationally-intensive firms related to gold production were driven more by the volatility of the equity markets than by the volatility of gold prices.

3. Why are most listed MLPs in the U.S. involved in producing, processing and distributing energy products?

- MLPs receive tax treatment predicated on adhering to regulations, including that at least 90% of the entities' revenues come from specified businesses, such as energy (in the U.S.)

4. List two possible explanations for relatively high valuations of MLPs.

- A PVGO valuation theory (high anticipated growth)
- A Ponzi-like valuation theory (high, but potentially unsustainable distribution yields).

5. Do infrastructure assets need to have all seven of the elements that identify investable infrastructure? Why or why not?

- No. There are no clear, hard lines separating infrastructure from other assets. Gray areas exist. Most infrastructure assets lack one or more of the seven elements, but they must contain many or most.

6. What is the primary defining difference between greenfield projects and brownfield projects?

- A greenfield project is new, whereas a brownfield project is existing.

7. What is the term used to describe when a governmental entity sells a public asset to a private operator?

- Privatization

8. What are the common fees paid to managers of closed-end infrastructure funds?

- Management fees typically range from 1.0% to 2.0% annually, in addition to carried interest of 10% to 20% over a preferred return of 8% paid at the exit of the fund or liquidation of specific investments.

9. Is investable intellectual property a public good or a private good?

- Private good because the cash generated can be privately received and owned.

10. What are the four inputs to the simplified model of intellectual property values?

- p = the probability of generating large positive cash flows
- CF_1 = Denote the first-year cash flows of the project
- g = perpetual growth rate
- r = discount rate

Chapter 14 Liquid and Fixed-Income Real Estate

1. List three potential disadvantages of real estate as an investment

- Heterogeneity
- Lumpiness
- Illiquidity

2. Provide an example of a common real estate investment for each of the three styles of real estate investing.

- Core real estate: A large office building or apartment complex
- Value-added real estate: Hotels, resorts, assisted-care living facilities, low-income housing, outlet malls, hospitals
- Opportunistic real estate: Development of raw property, redevelopment of property that is in disrepair, or acquisition of property that experiences substantial improvement in prospects through major changes, such as urban renewal.

3. Define mortgage

- A mortgage loan is a loan secured by property.

4. How do unscheduled principal payments affect the lender of a fixed-rate mortgage at different levels of market interest rates?

- Unscheduled principal payments cause a wealth transfer between the borrower and the lender, depending on the relationship between the mortgage's interest rate and current market interest rates. When market rates are lower than the mortgage rate, unscheduled principal payments generally benefit the borrower and harm the lender. The lender receives additional cash flows that if reinvested at prevailing interest rates will earn less return than the mortgage offers. Borrowers can make unscheduled prepayments to reduce the total interest costs of their mortgage by an amount greater than the amount that they could earn from interest income in the market. Thus, borrowers have an incentive to make prepayments on mortgages when interest rates decline below the mortgage's rate.

5. How does increased interest rate volatility affect the borrower of a fixed-rate mortgage in which the borrower can make unscheduled principal payments?

- The option to prepay is a call option in which the mortgage borrower, much like a corporation with a callable bond, can repurchase its debt at a fixed strike price. Mortgage borrowers, like all call option holders on fixed income securities, benefit from increased interest rate volatility.

6. How does the interest rate risk of a variable-rate mortgage compare to that of a fixed-rate mortgage from the perspective of the lender?

- A variable-rate type of mortgage to a lender protects the lender from the valuation fluctuations due to interest rate changes experienced with fixed-rate mortgages. To the extent that rates adjust quickly and completely, the variable-rate loan tends towards having little or no interest rate risk.

7. What is the “option” in an option adjustable-rate mortgage loan?

- An option adjustable-rate mortgage loans (option ARM) is an adjustable-rate mortgage that provides borrowers with the flexibility to make one of several possible payments on their mortgage every month. The payment alternatives from which borrowers may select each month typically include an interest-only payment, one or more payments based on given amortization periods, or a prespecified minimum payment amount.

8. Are investors in commercial mortgages typically more or less concerned than investors in residential mortgages about: (a) rental income, (b) default risk, and (c) prepayment risk?

- More concerned (residences are owner-occupied)
- More concerned (residential mortgages are usually insured)
- Less concerned (commercial loans are less subject to prepayment without penalty).

9. Why are conditional prepayment rates important in the pricing of mortgage backed securities?

- Conditional prepayment rates are important to the pricing of mortgage backed securities because they provides a measure of the speed of prepayments which in turn drives the longevity of the cash flows of the underlying mortgages.

10. Describe the three major advantages of REIT ownership relative to direct real estate ownership.

- REITs provide management services in the selection and operation of properties.
- REITS provide liquid access to an illiquid asset class. Investors can add to or trim their exposure to real estate quickly and easily through purchase and sale of shares in REITs.
- REITs avoid taxation of income at the corporate level. This would be an advantage to an investor otherwise holding the real estate in a taxable corporation.

Chapter 15 Real Estate Equity Investments

1. What is the complement option type to financial options?
 - A real option. A real option is an option on a real asset rather than a financial security. The real option may be a call option to purchase a real asset, a put option to sell a real asset, or an exchange option involving exchange of nonfinancial assets.
2. What is the name of the point in a decision tree at which new information arrives?
 - An information node denotes a point in a decision tree at which new information arrives.
3. List the two major approaches to valuing private commercial real estate equity.
 - The income approach and valuations based on comparable sale prices
4. Define effective gross income.
 - The effective gross income is the potential gross income reduced for the vacancy loss rate.
5. How does the numerator of a pretax discounting approach differ from the numerator of an after-tax discounting approach?
 - In the pretax discounting approach, pre-tax cash flows are used in the numerator. In the after-tax discounting approach the estimated after-tax cash flows are used in the numerator.
6. How does the equity residual approach to real estate valuation differ from a discounted cash flow approach applied to the assets of a real estate project?
 - The equity residual approach focuses on the perspective of the equity investor by subtracting the interest expense and other financing outflows due to mortgage holders (in the numerators) and by discounting the remaining cash flows using an interest rate reflective of the required rate of return on the equity of a leveraged real estate investment (in the denominator). The discounted cash flow approach discounts all cash flows from assets using a rate commensurate with the risk of the assets, not the equity.
7. What are the characteristics that distinguish syndications from other real estate investment vehicles?
 - Syndications are formed by a group of investors
 - Syndications are usually formed to undertake a particular real estate project.

8. A real estate project is estimated to offer a 10% after-tax rate of return when the depreciation allowed for tax purposes is equal to the true economic depreciation. In what direction would the expected rate of return change if the depreciation allowed for tax purposes were accelerated relative to the true economic depreciation, and why?

- When depreciation for tax accounting purposes is accelerated in time relative to true economic depreciation, the after-tax return generally increases and exceeds the pretax return reduced by the stated income tax rate.

9. What is the effect of using appraised prices of real estate values to estimate risk when the appraisals are based on lagged information (of varying lengths of time lag)?

- In the case of real estate returns, if appraisals are used in place of true market values, and if the appraisals provide dampened price changes, then the resulting return series consistently underestimates the volatility of the true return series, as well as understates the correlation of the returns of the real estate to the returns of other assets in the investor's portfolio.

10. What data (i.e., information) are required to construct a hedonic price index for real estate?

- Hedonic approaches use prices from real estate transactions along with the characteristics (e.g., size, location, construction) of those properties to attribute price changes to property characteristics.

Chapter 16 Structure of the Hedge Fund Industry

1. List the three primary elements that differentiate a hedge fund from other investment pools.
 - A hedge fund is privately organized in most jurisdictions
 - A hedge fund usually offers performance-based fees to its managers
 - A hedge fund usually can apply leverage, use derivatives or utilize other investment flexibility
2. Describe consolidation in the hedge fund industry in recent years.
 - Consolidation in the hedge fund industry has been manifested in much higher percentages of assets being invested with the biggest funds. Institutional investors are showing a clear preference for the largest funds.
3. Define high-water-mark in the context of hedge fund fee computation.
 - The high-water mark (HWM) is the highest NAV of the fund on which an incentive fee has been paid.
4. How can managerial co-investing contribute to optimal contracting?
 - The idea is that by having their own money in the fund, through co-investing, managers will work hard to generate high returns and control risk, i.e. helping to align the interests of the hedge fund managers with that of the investors. Specifically, managerial co-investing may mitigate “gaming” emanating from large incentive fees.
5. What is an example of a perverse incentive caused by incentive fees?
 - If a fund experiences negative returns within a reporting period, the fund's managers may view the fund as likely to close, in which case the managers may have a strong incentive to take excessive risks in an attempt to recoup losses and stay in business. Even if the managers do not fear that the fund will close, if the fund's NAV falls substantially below its HWM, the managers may foresee no realistic chance of earning incentive fees in the near term unless the fund's risk is increased. Thus, an incentive fee structure may encourage enormous and inappropriate risk taking by the managers.

6. How does the annuity view of hedge fund fees differ from the option view of hedge fund fees?

- The annuity view of hedge fund fees represents the prospective stream of cash flows from fees available to a hedge fund manager through the long term.
- The option view of incentive fees uses option theory to demonstrate the ability of managers to increase the present value of their fees by increasing the volatility of the fund's assets.

7. What is the primary difference between a fund of funds and a multistrategy fund?

- In a multistrategy fund, there is a single layer of fees, and the submanagers are part of the same organization. The underlying components of a fund of funds are themselves hedge funds with independently organized managers and with a second layer of hedge fund fees to compensate the manager for activities relating to portfolio construction, monitoring, and oversight.

8. Define short volatility exposure.

- Short volatility exposure is any risk exposure that causes losses when underlying asset return volatilities increase.

9. When do convergent strategies generate profit?

- Convergent strategies profit when relative value spreads move tighter, meaning that two securities move toward relative values that are perceived to be more appropriate. This tends to be associated with calm markets rather than turbulent markets.

10. What is fee bias?

- Fee bias is when index returns overstate what a new investor can obtain in the hedge fund marketplace because the fees used to estimate index returns are lower than the typical fees that a new investor would pay.

Chapter 17 Macro and Managed Futures Funds

1. Distinguish discretionary fund trading from systematic fund trading.

- Discretionary fund trading is where the decisions of the investment process are made directly by the judgment of human traders.
- Systematic fund trading, often referred to as black-box model trading because the details are hidden in complex software, is where the ongoing trading decisions of the investment process are automatically generated by computer programs.

2. Describe the strategy of a global macro fund.

- Global macro funds have the broadest investment universe: They are not limited by market segment, industry sector, geographic region, financial market, or currency and therefore tend to offer high diversification. They search diverse markets for perceived opportunities to achieve attractive returns.

3. What does market risk mean in the context of macro investing?

- Market risk refers to exposure to directional moves in general market price levels. The definition in this context is not restricted to equity market risk.

4. Describe the strategy of a managed futures.

- Managed futures refers to the active trading of futures and forward contracts on physical commodities, financial assets, and exchange rates. The purpose of the managed futures industry is to enable investors to receive the risk and return of active management within the futures market, while enhancing returns and diversification.

5. What is a commodity trading advisor (CTA)?

- Commodity trading advisers (CTAs) are professional money managers who specialize in the futures markets.

6. List three questions in evaluating a systematic trading system.

- What is the trading system, and how was it developed?
- Why and when does the trading system work, and why and when might it not work?
- How is the trading system implemented?

7. In a market trending upward, explain how the value of a simple moving average compares to the value of an exponential moving average?

- Exponential moving averages place higher weights on more recent observations for typical values of the exponential weighting parameter. If prices are trending upward the exponential moving average will tend to recognize an upward trend more quickly and more profoundly due to the higher weight on the more recent (and higher) prices.

8. Does whipsawing tend to occur in a trending market or a sideways market?

- Sideways markets where upward and downward movements tend to alternate.

9. What is a breakout strategy?

- Breakout strategies focus on identifying the changes from a sideways market to the commencement of a new trend by observing the range of recent market prices (e.g., looking back at the range of prices over a specific time period).

10. List the six major potential risks of managed futures funds.

- Transparency risk
- Capacity risk
- Liquidity risk
- Model risk
- Regulatory risk
- Lack of trends risk

Chapter 18 Event-Driven Hedge Funds

1. List the three primary categories of single-strategy event-driven hedge funds.
 - Activist Hedge Funds
 - Merger Arbitrage Funds
 - Distressed Securities Funds
2. Why are event-driven hedge funds often characterized as selling insurance?
 - Event-driven hedge funds are often characterized as selling insurance because they purchase shares during the period near an event (such as a proposed merger announcement) and the eventual resolution of uncertainty regarding the event. This act may be viewed as providing event risk insurance to the equity market.
3. Why would activist hedge fund managers need to understand corporate governance?
 - Corporate governance is central to the activist hedge fund's investment strategy as it is the means to assert change or threat of change into the management of the target corporation.
4. List the five dimensions of shareholder activists.
 - Financial versus social activists
 - Activists versus pacifists
 - Imitators versus followers
 - Friendly versus hostile activists
 - Active activists versus passive activists
5. What is the economic term for a person or entity who allows others to pay initial costs and then benefits from those expenditures?
 - A free rider

6. Is Form 13F a U.S.-required form that is targeted towards activist hedge funds?

- No, Form 13F is a required quarterly filing of all long positions by all U.S. asset managers with over \$100 million in assets under management, including hedge funds and mutual funds, among other investors.

7. What is the difference between a spin-off and a split-off?

- A spin-off occurs when a publicly traded firm splits into two publicly traded firms, with shareholders in the original firm automatically becoming shareholders in the new firm.
- A split-off occurs when Company A splits off (divests) Company B and the investors in Company A have the choice to retain their ownership in Company A or exchange their shares in A for shares in the newly created firm (Company B).

8. What are the positions utilized in a traditional merger arbitrage strategy?

- Traditional merger arbitrage generally uses leverage to buy the stock of the firm that is to be acquired and sell short the stock of the firm that is to be the acquirer in a stock-for-stock merger.

9. What is financing risk in the context of an event-driven investment strategy?

- Financing risk is the economic dispersion caused by failure or potential failure of an entity, such as an acquiring firm, to secure the funding necessary to consummate a plan such as an acquisition.

10. How is short selling of equity in a distressed firm similar to an option position?

- Shares in highly leveraged firms resemble call options, therefore short-selling distressed equities is analogous to writing naked call options on the firm's assets and generates a negatively skewed return distribution. An investor has a naked option position when the investor is short an option position for which the investor does not also have a hedged position.

Chapter 19 Relative Value Hedge Funds

1. Describe the positions utilized in a classic convertible bond arbitrage trade.
 - The classic convertible bond arbitrage trade is to purchase a convertible bond that is believed to be undervalued and to hedge its risk using a short position in the underlying equity.
2. What are the three terms used to describe convertibles bonds differentiated by whether the implicit option in the bond is in-the-money, at-the-money or out-of-the-money?
 - Equity-like convertible, hybrid convertibles, busted convertibles, (respectively)
3. What is the difference between delta and theta in measuring the price sensitivity of an option?
 - Delta is the change in the value of the option with respect to a change in the value of the underlying, whereas theta is the change in the value of the option with respect to the time to expiration of the option (i.e., passage of time).
4. What is the term that describes when additional equity is issued at below market values causing the per share value of the holdings of existing shareholders to be diminished?
 - Dilution
5. List the components of the returns of a traditional convertible arbitrage strategy.
 - Convertible Bond Arbitrage Income:
(Bond Interest – Stock Dividends + Short Stock Rebate – Financing Expenses)

+

• Convertible Bond and Stock Net Capital Gains and Losses:
(Capital Gains on Stock and Bond – Capital Losses on Stock and Bond)

6. What is the key difference between a volatility swap and a variance swap?

- Variance swaps are forward contracts wherein one party agrees to make a cash payment to the other party linearly based on the realized variance of a price or rate in exchange for receiving a predetermined cash flow. A volatility swap mirrors a variance swap except that the payoff of the contract is linearly based on the standard deviation of a return series rather than the variance.

7. What is the primary term for financial arrangements that protect an investor's portfolio from tail risk?

- Portfolio insurance

8. What are the differences between duration, modified duration and effective duration?

- Duration is a measure of the sensitivity of a fixed-income security to a change in the general level of interest rates. Traditional duration may also be viewed as a weighted average of the longevity of the cash flows of a fixed-income security.
- Modified duration is equal to traditional duration divided by the quantity $[1 + (y/m)]$, where y is the stated annual yield, m is the number of compounding periods per year, and y/m is the periodic yield. With continuous compounding, m is infinity, and traditional duration equals modified duration. Modified duration scales traditional duration to adjust for the compounding assumption used in the interest rate computations.
- Effective duration is a measure of the interest rate sensitivity of a position that includes the effects of embedded option characteristics. As such it is not generally equal to the weighted average longevity of the cash flows.

9. What is the difference between a yield curve and a term structure of interest rates?

- The yield curve plots yields to maturity of coupon bonds, while the term structure of interest rates generally is used to denote actual or hypothetical yields of zero-coupon bonds.

10. For what type of interest rate shift is a duration-neutral position best protected?

- A duration-neutral position is protected from value changes due to shifts in the yield curve that are small (infinitesimal), immediate (instantaneous), and parallel (additive).

Chapter 20 Equity Hedge Funds

1. Name the three major types of equity hedge funds and describe their typical systematic risk exposures.
 - Equity long/short hedge funds
 - Equity market-neutral fund
 - Short-bias funds
2. Describe the role of a market maker in the context of taking and/or providing liquidity in a market with anxious traders.
 - A market maker is a market participant that offers liquidity, typically both on the buy side by placing bid orders and on the sell side by placing offer orders. A market maker meets imbalances in supply and demand for shares caused by idiosyncratic trade orders from anxious traders. Typically, the market maker's purpose for providing liquidity is to earn the spread between the bid and offer prices by buying at the bid price and selling at the offer price.
3. Why is an empirical test of informational market efficiency a test of joint hypotheses?
 - The test is a joint hypothesis of the appropriateness of the particular model of returns (in determining what constitutes an abnormal return) and a test of whether a particular investment has generated statistically significant abnormal returns.
4. What is standardized unexpected earnings and how is it used?
 - Standardized unexpected earnings (SUE) is a measure of earnings surprise, with some measure of unexpected earnings in the numerator and some measure of earnings volatility in the denominator.
5. What have empirical studies generally concluded about the relationship between the net stock issuance of a firm and the subsequent returns of the firm's shareholders?
 - There is evidence that positive or negative net stock issuance is one of the most profitable anomalies. Companies that issue large amounts of new shares, such as more than 20% of the shares currently outstanding, frequently see their stock price substantially underperform the market.

6. What is the name of the measure that describes managerial skill as the correlation between managerial return predictions and realized returns?

- The information coefficient, which measures managerial skill as the correlation between managerial return predictions and realized returns

7. In the context of the fundamental law of active management, what is a nonactive bet?

- Nonactive bets are positions held to reduce tracking error rather than to serve as return-enhancing active bets. In other words, these are not active bets in the sense that they are intended to add alpha to the portfolio; rather, they are added to keep the active manager's return from straying too much from the benchmark.

8. What is the name of the modelling approach that combines the factor scores of a number of independent anomaly signals into a single trading signal?

- Multiple-factor scoring models, which combine the factor scores of a number of independent anomaly signals into a single trading signal.

9. Consider a skilled manager implementing a pairs trading strategy. What is the concern that tends to limit the size of the positions that the manager might take in attempting to increase expected alpha?

- The limits to arbitrage, which refers to the potential inability or unwillingness of speculators, such as pairs traders, to hold their positions without time constraints or to increase their positions without size constraints. Very large positions with high degrees of leverage increase the probability of financial ruin and the inability to survive short-term displacements.

10. What distinguishes mean neutrality from variance neutrality in equity market-neutral strategies?

- Mean neutrality is when a portfolio is shown to have zero beta exposure or correlation to the underlying market index. In other words, when the market experiences a move in one direction, mean-neutral portfolios are no more likely to move in the same direction as in the opposite direction. Variance neutrality is when portfolio returns are uncorrelated to changes in market risk.

Chapter 21 Funds of Hedge Funds

1. List the four functions of fund of funds management.

- Strategic and Manager Selection
- Portfolio Construction
- Risk Management and Monitoring
- Due Diligence

2. Name four benefits to investing in funds of funds that may lead to higher net returns to limited partners without causing higher risk.

- Economies of Scale
- Informational Advantage
- Access to Certain Managers
- Negotiated fees

3. Name five benefits to investing in funds of funds that may lead to lower investment risk to limited partners without sacrificing expected return.

- Diversification
- Liquidity
- Regulation
- Currency Hedging
- Educational Role

4. Describe the double layer of fees in funds of funds.

- FoF managers effectively pass on to their investors all fees charged by the underlying hedge funds in their portfolios, while also charging an extra set of fees for their own work as well as for an additional layer of service providers.
- Many FoFs charge a 1% management fee and a 10% performance fee on top of the average underlying hedge fund management fee of 2% and incentive fee of 20% for the hedge funds.

5. In theory, how would the volatility of an equally-weighted portfolio of sixteen uncorrelated, zero-beta and equally-risky funds compare to the volatility of a single such fund?

- The volatility of an equally-weighted portfolio of sixteen uncorrelated, zero-beta and equally-risky funds would be reduced (as shown in Equation 21.1) through division by the square root of the number of funds (16). Division by four generates a 75% risk reduction.

6. Why might the incentive fees of a multistrategy fund differ substantially from the incentive fees of an otherwise similar fund of funds even if the stated fees are equal?

- Multistrategy funds net the profits and losses of all underlying investment to determine any profit on which an incentive fee is paid. Funds of funds structures pay out incentive fees to each underlying manager separately, meaning that the profitable fund managers receive full incentive fees but there is no offset to aggregate incentive fees due to underlying managers with losses.

7. Why might the operational risks of a multistrategy fund differ substantially from the operational risks of a fund of funds?

- While funds of funds diversify operational risk across 10 to 20 independent managers and organizations, a multistrategy fund has a single operational infrastructure. Market risk may also be a concern, as a catastrophic loss in even one of the multistrategy fund's underlying strategies may sink the entire fund. Conversely, the failure of one of a fund of funds' 20 managers may subject investors to only a 5% loss and not affect the fund's other investments.

8. What is a seeding fund?

- Seeding funds, or seeders, are funds of funds that invest in newly created individual hedge funds, often taking an equity stake in the management companies of the newly-minted hedge funds.

9. What investment pools in the US and Europe provide liquid access of investors to alternative investment strategies?

- UCITS in the EU and some '40 Act funds in the U.S.

10. List the four major categories of funds of funds.

- Market-Defensive Fund of Funds
- Conservative Fund of Funds
- Strategic Fund of Funds
- Diversified Fund of Funds

Chapter 22 Introduction to Private Equity

1. What option position most resembles the payouts of private equity investments?

- Long a call option

2. Fill in the blanks of the following sentence using the terms private equity fund, private equity firm and underlying business enterprises: A 1 serves as the general partner to a 2 that invests its money in 3 .

- Private equity firm
- Private equity fund
- Underlying business enterprises

3. What type or types of securities does a venture capitalist purchase in establishing a position in an underlying business venture?

- Privately held stock or equity-linked securities (i.e., preferred stocks or debt securities that can be converted into equity)

4. What is the term that best describes the grouping of market participants into clienteles that focus their activities within specific areas of the market rather than operating throughout an entire market?

- Market segmentation

5. What is an equity kicker and how does it serve the interests of a venture capitalist?

- An equity kicker is an option to acquire some type of equity participation in the firm, such as options to buy shares of common stock that is packaged with a debt financing transaction. The equity kicker portion provides the venture capitalist with an interest in the upside of the company, while the debt component provides a steady payment stream.

6. What is the primary difference between a positive covenant and a negative covenant?

- Negative covenants are promises by the debtor not to engage in particular activities, such as paying dividends or issuing new debt. Positive covenants are promises to do particular things, such as maintaining a specified cash level.

7. What does it mean when a loan is termed a syndicated loan?

- Syndicated loans mean that a group of entities, often investment banks, is underwriting a loan or loans.

8. Discuss the following statement: empirical evidence indicates that investors in listed BDCs are subject to greater return volatility and enjoy less diversification benefits than investors in private equity that is not publicly traded.

- Since private equity lacks liquid market price data, such empirical evidence is likely formed by comparing liquid market prices with illiquid pricing data. Analysis of prices for private equity based on illiquid trading data or professional judgment can be argued to understate risk. Returns based on illiquid trading data or professional judgment are likely smoothed and therefore analysis based on those data should be expected to underestimate true return volatilities and correlations.

9. What is the primary difference between a traditional PIPE and a toxic PIPE?

- Traditional PIPEs allow investors to buy common stock at a fixed price. A toxic PIPE is a PIPE with adjustable conversion terms that can generate high levels of shareholder dilution in the event of deteriorating prices in the firm's common stock.

10. Describe two major differences between typical hedge fund fees and typical private equity fund fees related to clawbacks and hurdle rates.

- Hedge funds usually have no provisions for the clawback of management or incentive fees. Private equity funds typically have clawback provisions requiring the return of fees on prior profits when subsequent losses are experienced.
- Hedge funds rarely have a preferred rate (hurdle rate) of return (e.g., 6%) that must be exceeded before the hedge fund manager can collect an incentive fee. Most private equity funds have a hurdle rate.

Chapter 23 Equity Types of Private Equity

1. List major contrasts between venture capital and buyouts.

- Whereas VC funds target nascent, start-up companies, buyouts target more established and mature companies.
- VC is necessary to get a prototype product or service out the door. In a buyout, the capital is necessary not for product development but to take the company private so that it can concentrate on maximizing operating efficiencies. Venture capital relies on new technology or innovation; buyouts look to see where they can add operating efficiencies or expand product distribution
- A VC firm typically acquires a substantial but minority position in the company. Control is not absolute. Conversely, in a buyout, all of the equity is typically acquired, and control is absolute.
- Venture capital and buyout firms target different internal rates of return. While both are quite high, not surprisingly, VC targets are higher. The reason is simple: There is more risk funding a nascent company with brand-new technology than an established company with regular and predictable cash flows.

2. In what way does a venture capital investment resemble a call option?

- Investing in a start-up company is similar to the purchase of a call option. The price of the option is the capital that the venture capitalist invests in the start-up company. If the company fails, the venture capitalist forfeits the option premium, the capital invested. However, if the start-up company is successful, the venture capitalist shares in all of the upside, much like a call option.

3. What are the two key objectives to the business plan of an entrepreneur seeking capital?

- To provide the information necessary to attract financing from a venture capitalist, and
- To serve as an internal game plan for the development of the start-up company.

4. What is a venture capital fund?

- A venture capital fund is a private equity fund that pools the capital of large sophisticated investors to fund new and start-up companies.

5. What is the name of the options that a venture capital fund manager often has to demand that the investors contribute additional capital?

- Capital calls

6. What differentiates the seed capital financing stage from first stage of venture capital financing?

- The seed capital stage is the first stage where VC firms invest their capital into a venture and is typically prior to having established the viability of the product. This phase of financing usually raises \$1 million to \$5 million. First- or early-stage venture capital denotes the funding after seed capital but before commercial viability has been established. Early-stage VC financing is usually \$2 million or more.

7. What are the three main risks that contribute to the required risk premia for venture capital?

- The business risk of a start-up company
- Substantial liquidity risk.
- Idiosyncratic risk due to the lack of diversification associated with a VC portfolio.

8. What is the primary difference between a management buy-in LBO and a management buyout LBO?

- A management buyout is led by the target firm's current management, whereas a management buy-in is led by an outside management team. Thus the buy-out retains all or most top management while the buy-in replaced all or most top management.

9. What are the two primary conflicts of interest that emanate from the potentially lucrative compensation schemes offered to exiting management teams in a management buy-in?

- Incumbent management has a strong incentive to resist any buyout attempt that displaces them as managers if the buyout does not provide them with generous compensation even if the buyout benefits shareholders.
- Incumbent management has a strong incentive to encourage buyouts that offer them generous compensation even if the buyout benefits shareholders.

10. List the five general categories of LBOs designed to create value.

- Efficiency buyouts
- Entrepreneurship stimulators
- The overstuffed corporation
- Buy-and build strategies T
- Turnaround strategies

Chapter 24 Debt Types of Private Equity

1. Briefly describe mezzanine financing.

- Mezzanine debt derives its name from its position in the capital structure of a firm: between the ceiling of senior secured debt and the floor of equity. Mezzanine finance defies generalization. Mezzanine financing is highly customized, often focused on equity appreciation while still maintaining the characteristics of (usually, high yield) debt, i.e. principal and interest payments.

2. Does mezzanine debt with an equity kicker exhibit the J-curve return pattern of private equity? Why or why not?

- With a mezzanine fund, the J-curve effect is not a factor. One of the distinct advantages of mezzanine financing is its immediate cash-on-cash return. Mezzanine debt bears a coupon that requires twice-yearly interest payments to investors. As a result, mezzanine financing funds can avoid the early negative accounting returns associated with venture capital or leveraged buyout funds.

3. What would be the primary justification for believing that the use of mezzanine financing can lower a firm's weighted average cost of capital?

- The justifications for advantages to mezzanine debt are based on inefficiencies and imperfections in the capital markets for the size companies that tend to utilize mezzanine financing.

4. How does mezzanine debt tend to differ from high-yield bonds and leveraged loans in seniority, term, and liquidity?

- Seniority: Mezzanine debt is usually lower in seniority than high-yield bonds and, especially, leveraged loans
- Term: Mezzanine debt is usually 4-6 years, similar to leveraged loans but shorter than high-yield bonds
- Liquidity: Mezzanine debt has minimal liquidity, especially compared the relatively high liquidity of leveraged loans.

5. What are the two key distinctions between mezzanine funds and other private equity funds?

- There are two key distinctions between other private equity funds and mezzanine funds. The first is the return expectations. Mezzanine funds seek total rates of return in the 15% to 20% range. Compare this to LBO funds that seek returns in the 20% to 30% range and venture capital funds that seek returns in the 30% to 50% range. Second, mezzanine funds are staffed with different expertise than a venture capital fund. Most venture capital funds have staff with heavy technology-related experience, including former senior executives of software, semiconductor, and Internet companies. In contrast, mezzanine funds are inundated with financial engineers, experienced at structuring and negotiating loans that incorporate the use of equity kickers and/or warrants.

6. By what standards or measures is distressed debt usually distinguished from non-distressed debt?

- Distressed debt is often defined as debt that has deteriorated in quality since issued and that: has a market price less than half its principal value, yields 1,000 or more basis points over the riskless rate, or has a credit rating of CCC (Caa) or lower.

7. Provide two major sources of distressed debt.

- A company with a deteriorated financial condition
- Debt issued by a private equity firms or leveraged buyout firm

8. What is the name of the more junior debt securities that are most likely to be converted into the equity of the reorganized company?

- Fulcrum securities

9. What is the primary distinction between Chapter 7 bankruptcy and Chapter 11 bankruptcy in the U.S.?

- Chapter 7 bankruptcy is where the company is no longer viewed as a viable business and the assets of the firm are liquidated. Chapter 11 bankruptcy attempts to maintain operations of a distressed corporation that may be viable as a going concern.

10. Who is the initial investor in debtor-in-possession financing?

- Senior and subordinated creditors

Chapter 25 Introduction to Structuring

1. What is the similarity between a structured product and the capital structure of an operating firm?

- Both are used to structure risk (and longevity). The capital structure of an operating firm is used to structure risk in the business enterprise, whereas the structure product is used to structure risk of a financial portfolio.

2. What is the primary role of structuring in an economy?

- The primary economic role of structured products is usually market completion – making available a broader spectrum of investment opportunities.

3. How could a financial market become less complete?

- By having a reduction in the number of unique investment opportunities or an increase in the number of uncertainties facing investors.

4. From an investor's viewpoint, what is the difference between owning a tranche in a sequential-pay CMO and a tranche in a targeted amortization class CMO in a rising interest rate environment?

- In a sequential-pay CMO the order of prepayment does not change: the senior most tranche is paid first, the next senior tranche second, and so on. In the targeted amortization class CMO the tranches receive payments in accordance with a more complex priority that changes with major changes in prepayment speeds such that various tranches may experience substantial increases or decreases in seniority in receiving cash distributions.

5. What is the extension risk and contraction risk of the PO tranche to a CMO?

- Typically, principal-only tranches are positively exposed to extension risk in that their values decline when their payments extend in longevity (i.e., prepayments slow) since PO holders receive no coupons. Conversely, principal-only tranches are negatively exposed to contract risk; typically, as interest rates decline, the speed of prepayments accelerates and the values of PO's rise.

6. What are the two major types of investor motivations to investing in a tranche of a CMO rather than investing directly in mortgages similar to the mortgages of the CMO's collateral pool?

- Risk management: Investors may be better able to manage risk through structured products (e.g., by selecting tranches with specific longevities)
- Return enhancement: Investors may be better able to establish positions that will enhance returns if the investor's market view is superior

7. Name two prominent time periods when structured mortgage products are believed to have increased systemic risk and led to a financial crisis? What is the major difference between the underlying economic events that led to the losses in these two crises?

- 1994 and 2007
- In 1994, the combination of extended maturities and higher interests caused market values of many CMO tranches to collapse based more on interest rate risk than default risk. In 2007, the creditworthiness of the CMOs caused the market values of many tranches to fall substantially. In both situations, the dramatic fall in market values caused investors and institutions to liquidate their positions which exacerbated the crisis by lowering CMO valuations even further.

8. In Merton's structural model, how is debt with default risk viewed as having exposure to a put option?

- The risky debt of a levered firm can be viewed as being equivalent to owning a riskless bond and writing a put option that allows the stockholders to put the assets of the firm to the debt holders without further liability (i.e., in exchange for the debt).
- $\text{Debt of Levered Firm} = + \text{Riskless Bond} - \text{Put Option on Firm's Assets}$

9. In Merton's structural model, what is the conflict of interest between stockholders and debt holders with regard to asset risk and how does this conflict relate to structured products?

- There is an inherent conflict between the stockholders and the bondholders with regard to the optimal level of risk for the firm's assets. The equity holders, with their long position in a call option prefer higher levels of risk, especially when the value of the firm's assets is near or below the face value of the debt. Conversely, bond holders prefer safer projects and reduced asset volatility as seen through their short position in a put option. The conflict of interest may be viewed as a zero sum game in which managers can transfer wealth from bondholders to stockholders by increasing the risk of the firm's assets (or vice versa).
- The conflict of interest between stockholders and bondholders in the capital structure of a firm is analogous to the case of structured products with multiples tranches. The manager of the collateral pool can cause wealth transfers between tranches by altering the risk of the assets. In most structures, high levels of asset risk benefit junior tranche holders at the expense of senior tranche holders.

10. What are three major option strategies that resemble the ownership of a mezzanine tranche?

- A collar position, a bull call spread and a bull put spread

Chapter 26 Credit Risk and Credit Derivatives

1. Why is the market for fixed income securities other than riskless bonds often termed the spread product market?

- Because other U.S. dollar-denominated fixed income products, such as bank loans, high-yield bonds, investment-grade corporate bonds, or emerging markets debt, trade at yields containing a credit spread relative to U.S. Treasury securities.

2. What are the three factors that determine the expected credit loss of a credit exposure?

- Probability of default (PD), which specifies the probability that the counterparty may fail to meet its obligations
- Exposure at default (EAD), which specifies the nominal value of the position that is exposed to default at the time of default
- Loss given default (LGD), which specifies the economic loss in case of default

3. What is the relationship between the recovery rate and the loss given default?

- Loss given default (LGD) = $(1-R)$, where R = the recovery rate

4. List the two key characteristics that can make risk-neutral modeling a powerful tool for pricing financial derivatives.

- The risk-neutral modeling approach provides highly simplified and easily tractable modeling, and
- Often derivative prices generated by risk-neutral modeling must be the same as the prices in an economy where investors are risk-averse.

5. List the four stages in the evolution of credit derivative activity.

- The first, or defensive, stage, which started in the late 1980s was characterized by ad hoc attempts by banks to lay off some of their credit exposures. The second stage, which began about 1991 was the emergence of an intermediated market in which dealers applied derivatives technology to the transfer of credit risk and investors entered the market to seek exposure to credit risk. The third stage was maturing into resembling other forms of derivatives with major regulatory guidance. Dealers began warehousing risks and running hedged and diversified portfolios of credit derivatives. The fourth stage centered on the development of a liquid market.

6. What is the primary difference between a total return swap on an asset with credit risk and a credit default swap on that same asset?

- In the case of a credit default swap, the credit protection buyer makes fixed payments, known as the swap premium, to the credit protection seller. In the case of a total return swap, the credit protection buyer makes payments to the credit protection seller based on the total market return of the underlying asset. The total market return is comprised of any coupon payments and any change in the underlying bond's market price.

7. List the seven kinds of potential trigger events in the standard ISDA agreement.

- Bankruptcy
- Failure to pay
- Restructuring
- Obligation acceleration
- Obligation default
- Repudiation/moratorium
- Government intervention.

8. How can one party to a CDS terminate credit exposure (other than counterparty risk) to a CDS without the consent of the counterparty to the CDS?

- By entering an offsetting position, by assigning the contract to a dealer or other approved counterparty (with permission of the original counterparty, or by reaching an agreement with the original counterparty to mutually terminate the contract.

9. If a speculator believes that the financial condition of XYZ Corporation will substantially deteriorate relative to expectations reflected in market prices, should the speculator purchase a credit call option on a spread or a price?

- Spread. Deterioration in credit increases credit spreads and lowers risky bond price.

10. What CDS product should an investor consider when attempting to hedge the credit risk of a very large portfolio of credit risks rather than the hedge a few issues?

- CDS index products

Chapter 27 CDO Structuring of Credit Risk

1. How would the exposure to credit risk of the most senior and most junior tranches of a CDO tend to compare to the average credit risk of the collateral pool?

- In one sense the tranches should have credit risks that are dispersed above and below the credit risk of the underlying assets. The amount of credit risk in the senior tranches would be lower than in the collateral pool. The credit risk of the most junior tranche would be higher than the credit risk of the collateral pool. Diversification and credit enhancements make the relationship complex.

2. List two major economic motivations to the CDO structuring of non-investment grade debt.

- Risk management: Investors may be better able to manage risk through structured products by selecting tranches that match their preferences.
- Return enhancement: Investors may be better able to establish positions that will enhance returns if the investor's market view is superior

3. What is the weighted average rating factor (WARF) of a portfolio?

- The weighted average rating factor (WARF) as described by Moody's is a numerical scale from 1 (for AAA-rated credit risks) to 10,000 (the worst credit risks) that reflects the estimated probability of default.

4. What is the primary difference between the motivations of creating a balance sheet CDO and creating an arbitrage CDO?

- Balance sheet CDOs are created to assist a financial institution in divesting assets from its balance sheet. Arbitrage CDOs are created to attempt to exploit perceived opportunities to earn superior profits through money management.

5. What is the primary difference between a cash-funded CDO and a synthetic CDO?

- The distinction focuses on whether the SPV obtains the risk of the portfolio using actual (cash) holdings of assets or through derivative positions. A cash-funded CDO holds the portfolio of risky securities as collateral for the trust, whereas the synthetic CDO obtains the risk exposure through the use of a credit derivative.

6. Is subordination an internal or external credit enhancement?

- It is an internal credit enhancement involving the structure of the product.

7. How many tranches can be in a single-tranche CDO?

- In a single-tranche CDO, the CDO may have multiple tranches but the sponsor issues (sells) only one tranche from the capital structure to an outside investor.

8. Suppose that the total value of the collateral pool of a CDO remains constant but the riskiness of the pool increases. If the value of the senior-most tranches decreases, what should happen to the combined value of the other tranches?

- The combined value of the other tranches will increase.

9. What is the explanation based on option theory as to why the junior-most tranche of a CDO would fall in value when the collateral pool of assets becomes more diversified?

- The junior-most tranche of a CDO is similar to a long call position on the collateralized asset. As the collateral pool of assets becomes more diversified, thus less risky, the value of the long call position declines due to its negative vega.

10. What is the primary purpose of using a copula approach to analyze a CDO?

- To ascertain the risks of tranches due to potential default risk in the CDO portfolio

Chapter 28 Equity-Linked Structured Products

1. List the six primary types of structured product wrappers.
 - Over-the-counter contracts (OTC), medium term notes/certificates/warrants, funds, life insurance policies, structured deposits, Islamic wrappers
2. What can cause the after-tax rate of return of a product with tax deferral and tax deduction to be higher than the after-tax return of an otherwise identical product with tax deferral only?
 - When the income tax rate at withdrawal (e.g., retirement) is lower than the income tax rate of the investor when the contribution was made.
3. What does a participation rate indicate in a structured product?
 - The participation rate indicates the ratio of the product's payoff to the value of the underlying reference, asset or index.
4. How does a long position in an up-and-in call differ from a short position in a down-and-out put?
 - Both option positions are bullish, but the up-and-in call has a payoff that is positively correlated with the underlying asset only in the region above the strike price and barrier, while bullish payoff region of the short put position is below its strike price. The up-and-in call has unlimited profit potential while the profit potential of the short position in the down-and-out put is limited to the premium received.
5. What is the name of an option that offers a payout in a currency based on the numerical value of an underlying asset with a price that is expressed in another currency?
 - A quanto option is an option with a payoff based on one currency using the numerical value of the underlying asset expressed in a different currency.
6. What simple option portfolio mimics the payout to an absolute returns structured product?
 - A long position in an at-the-money straddle, which generate profits via large movements in either direction (of the price of the underlier).

7. List the three major approaches to estimating the value of a highly complex structured product.

- Partial differential equation approach (PDE approach)
- Simulation, such as Monte Carlo simulation
- The building blocks approach (i.e., portfolio approach)

8. Describe the difference between an analytical solution and a solution estimated with numerical methods.

- Analytical solutions such as the Black-Scholes model are exact, because the model can be solved using a finite set of common mathematical operations. A solution estimated with numerical methods is not exact. It utilizes a potentially complex set of procedures to form an estimate.

9. In an informationally efficient market can a structured product be engineered to offer both any payoff diagram shape and any payoff diagram level?

- No. The level drives whether the opportunity has a positive, negative or zero net present value.

10. Briefly summarize the evidence on whether the offering prices of structured products are over-priced or underpriced relative to the values of similar exposures composed of market-traded products.

- Based on evidence, the offering prices of some structured products are over-priced to the values of similar exposures composed of market-traded products.
- Deng and others (2011) find that the fair price of ARBNs “is approximately 4.5% below the actual issue price on average”.
- McCann and Luo estimate that “between 15% and 20% of the premium paid by investors is a transfer of wealth from unsophisticated investors to insurance companies and their sales forces”.

Chapter 29 Cases in Tail Events

1. Were the losses to investors of Amaranth Fund to be expected given the high risks of the fund's investment strategy?

- No, Amaranth was a multistrategy fund with a stated strategy that would not lead investors to expect such losses. For example, external investors would not expect that 50% of its capital was dedicated to one specific market/trade. Amaranth had very large, highly levered and concentrated positions but apparently had no formal stop-loss or concentration limits. This suggests that Amaranth's internal people likely severely underestimated the probability of long-term and large unidirectional price movements against its positions.

2. What was the primary premise of Long Term Capital Management's trading strategies?

- The primary premise of Long Term Capital Management's trading strategies was the expectation that the spread in prices or rates between two similar securities would converge over time. LTCM would buy the cheaper security and short the more expensive security (while applying tremendous leverage) and wait for the spread between the two similar securities to narrow before closing the trades.

3. How could Carlyle Capital Corporation suffer large losses from a strategy dominated by long positions in AAA-rated securities?

- Carlyle Capital Corporation used significant leverage in order to initiate its long positions in AAA-rated securities. When the creditworthiness of AAA-rated mortgage securities came under question, the value of the AAA-rated mortgage securities decreased and Carlyle Capital Corporation received margin calls from its creditors that it could not fulfil. It is alleged that the AAA-ratings were undeserved.

4. How is behavioral finance related to fund failures?

- Behavioral finance attempts to explain the potential influence of cognitive, emotional, and social factors in opposition to evidence and reason. For example, these factors can lead fund managers to take enormous risks to try to offset losses in the face of evidence that a strategy is not working. These biases can also lead investors with overconfidence to select managers that are more likely to commit fraud because the managers are playing to the emotions of the investors.

5. What is believed to be the cause of the Flash Crash in 2010?

- Initially the SEC reported that a “backdrop of unusually high volatility and thinning liquidity” just as “a large fundamental trader (a mutual fund complex) initiated a program to sell a total of 75,000 E-Mini S&P contracts (valued at approximately \$4.1 billion) as a hedge to an existing equity position.” Subsequently, it has been alleged that the flash crash was caused by spoofing – the placing of intentionally deceptive offers designed to move markets by a trader (or group of traders) holding massive positions that hope to benefit from the market moves.

6. What pattern of trading orders is believed to have caused Knight Capital Group’s demise?

- According to an analysis by Nanex, a Knight algorithm appeared to have been repeatedly buying at the offer and selling at the bid, causing Knight to lose a small amount of money (the spread) on each trade – losing huge sums due to the trades being repeated over and over again.

7. What primary issue could a prospective investor have researched in order to avoid losses from investing in Bayou Fund?

- A prospective investor could have researched the background of the principals of the fund, which would have uncovered evidence of dishonesty. In addition, the prospective investor could have researched the auditing firm and found that Richmond-Fairfield had only one employee, a Bayou employee, and only one client, Bayou.

8. Why should an investor who exits a fraudulent scheme before it collapses be concerned about the losses of the investors who did not exit prior to the collapse?

- Courts can order investors who are enriched by a fraud to return the profits as restitution to those who suffered losses, even if the investors were unaware of the investment's fraudulent nature.

9. Why were the closing market prices of Lancer’s positions argued to be unreliable?

- It is alleged that Lauer manipulated the market price of thinly traded shares by placing trades at key points in time to print (“paint”) high prices in the stock’s trading record and thereby justifying placing high values on the fund’s holdings. Not only were the public shares not regularly trading at these prices but also the restricted shares held by Lancer were likely to be worth even less than the registered shares.

10. List four major lessons from the chapter’s cases in tail events.

- A consistent theme across many of the cases is the danger of using large amounts of leverage.
- Over-confidence of traders can lead to high risk and high losses.
- Highly-quantitative financial systems using high-tech capabilities may contain risks that are difficult to predict, and
- The large fees and assets of the hedge fund world attract both geniuses and charlatans.

Chapter 30 Investment Process, Operations, and Risk

1. Distinguish between a fund's stated, actual and permitted investment strategies.

- The stated investment strategy of a fund is the investment strategy that a diligent investor would expect the fund to pursue, based on a reasonable analysis of information made available by the fund.
- The actual investment strategy of a fund at a particular point in time is the investment strategy being implemented by the fund.
- The permitted investment strategies of a fund delineate the range of investment strategies that the fund's managers have communicated and are mandated as allowable for the fund to implement.

2. What is style drift and what is another name for style drift?

- Style drift (or strategy drift) is the change through time of a fund's investment strategy, based on purposeful decisions by the fund manager in an attempt to improve risk-adjusted performance in light of changing market conditions.

3. What is the term that describes the explicit or implicit set of procedures through which investment decisions are made?

- The investment management governance process

4. Contrast the broad and narrow interpretations of market risk in the context of the risk of the investment process.

- The broad interpretation of market risk in the context of the risk of the investment process describes any systematic or idiosyncratic dispersion in economic outcomes attributable to changes in market prices and rates. In contrast, the narrow interpretation of market risk is used synonymously with systematic risk to refer to the portion of an asset's total risk that is attributable to changes in the value of the market portfolio or to a return factor that drives general market returns.

5. Contrast the broad and narrow interpretations of operational risk.

- The broad interpretation includes any economic dispersion caused by investment, operational or business or activities. The narrow interpretation focuses only on the potential losses from the fund's operational activities, such as the middle-office and back-office operations.

6. Explain why or why not a rogue trader can be viewed as gaming the system.

- A rogue trader can be viewed as gaming the system because a rogue trader intentionally establishes substantial positions well outside of the fund's investment mandate to maintain or improve his or her career. That is, the rogue trader, by establishing positions well outside the fund's investment mandate, strategically circumvents the intention of the rules of a particular system to gain benefits.

7. List the three major components to controlling operational risk.

- Prevention
- Detection
- Mitigation.

Chapter 31 Due Diligence of Fund Managers

1. List the seven parts of a complete due diligence process.
 - Structure
 - Strategy
 - Administrative
 - Performance
 - Risk
 - Legal
 - References
2. What are the three fundamental screening questions regarding an investment process?
 - What is the investment objective of the fund?
 - What is the investment process of the fund manager?
 - What is the nature and source of any value added by the fund manager?
3. What is the distinction between information gathering and information filtering?
 - Information gathering indicates the ability of the manager to create access to information or to have access to better information than other managers. Information filtering is the fund manager's ability to use data available to others but to be better able to glean tradable insights from it.
4. What is the purpose of viewing a league table in a review of outside service providers?
 - The purpose of viewing a league table in review of a funds outside service providers is to independently verify the reputation and suitability of the fund manager's outside service providers. League tables are ranked listings of organizations.
5. Which of the following types of actions should be reviewed in an administrative review: civil, criminal, and regulatory actions?
 - All three type of actions (civil, criminal and regulatory actions) should be reviewed in an administrative review.

6. How does gaming relate to a historical performance review?

- The performance review is an analysis of past investment results that forms the heart of many due diligence reports. The due diligence review should ascertain whether financial performance has been gamed. Gaming in this context is investment activity that is driven by a desire to generate favorable measures of performance rather than truly enhanced performance. An example would be smoothing of returns that masks true volatility levels.

7. List the three important questions in a risk management review.

- What are the types and levels of risk involved in the fund manager's strategy?
- What risks are measured, monitored, and managed?
- How are risks measured, monitored, and managed?

8. What are the functions of a chief risk officer?

- The chief risk officer (CRO) oversees the fund manager's program for identifying, measuring, monitoring, and managing risk.

9. What is the distinction between a hard lockup period and a soft lockup period?

- In a hard lockup period, withdrawals are contractually not allowed for the entire duration of the lockup period. In a soft lockup period, investors may be allowed to withdraw capital from the fund before the expiration of the lockup period, but only after the payment of a redemption fee, which is frequently 1% to 5% of the withdrawal amount.

10. What does the omega-score attempt to measure?

- The omega-score attempts to measure the failure risk for a fund.

Chapter 32 Portfolio Management, Alpha, and Beta

1. What are the two major problems with estimating the beta of a hedge fund using historical return data?

Using past data to measure beta causes estimation risk (inaccuracy). Another major problem with estimating beta using historical data is that the true beta being measured may be changing through time.

2. How does “separating alpha and beta” differ from “distinguishing alpha and beta”?

Distinguishing alpha and beta involves measurement and attribution and the process of identifying how much of an asset's return is generated by alpha and how much is generated by beta. Separating alpha and beta involves portfolio management and refers to attempts to independently manage a portfolio's alpha and beta toward desired levels.

3. Define portable alpha.

Portable alpha is the ability of a particular investment product or strategy to be used in the separation of alpha and beta – the ability to bring the alpha into a portfolio while being able to control the portfolio's aggregate beta to the desired level.

4. A manager is using the concept of portable alpha to invest \$25 million in utility stocks when the manager's benchmark is a broad equity index. Why would the manager enter futures contracts with a notional value that differed markedly from \$25 million?

Note that the porting of alpha in this case requires hedging against any risks of utility stocks due to factors other than the broad equity market (such as high interest rate sensitivity) as well as bringing the risk exposure of the broad equity index up to a beta of one. In practice the strategy might involve a moderately-sized short futures position in futures contracts designed to offset the interest rate sensitivity of the utility stocks and a moderately-sized long position in a futures contract on a broad equity index to bring the aggregated market beta to one.

5. A portfolio manager uses the concept of portable alpha to invest in REITs even though the manager's benchmark is a major bond index. Given that the manager is able to port the alpha perfectly, what would be the net expected return of the funds invested in REITs but ported to the bond index?

If the alpha is ported perfectly, the total return to this strategy is the combined return of the major bond index and the performance of the REITs relative to the performance of the REIT index (i.e., its alpha). To the degree that the actively managed REIT portfolio is not perfectly correlated (i.e. if alpha is ported imperfectly) with the REIT benchmark, there will be some tracking error, and therefore the total risk of the portfolio is likely to exceed the total risk of the major bond index.

6. In the traditional approach to portfolio allocation, what drives the strategic asset allocation decision of an investor?

The top-level decision is a long-term target allocation decision, known as the strategic asset allocation decision. It is based on the investor's objectives and the perceived risks and returns of the asset classes.

7. How does a strategic asset allocation differ from a tactical asset decision?

The strategic asset allocation decision is the long-term target asset allocation based on investor objectives and long-term expectations of returns and risk. Tactical asset allocation is the process of making transient portfolio decisions to alter the systematic risks of the portfolio through time in an attempt to earn superior risk-adjusted returns.

8. How do the drivers of portfolio allocation differ using the new investment model rather than the traditional approach to asset allocation?

A traditional approach to portfolio management is focused on imposing a top-down asset allocation with specified weights to each investment category. The new investment model is focused on managing alpha and beta optimally and separately. Thus investors will tend to seek alpha where it can best be found (prioritizing assets that appear to offer the highest alpha) and manage risk separately with the most efficient products available.

9. What is the major difference between an actively managed portfolio and a passively managed portfolio?

A passively managed portfolio does not engage in active trading that attempts to generate improved return performance, whereas an actively managed portfolio involves trading with the intent of generating improved return performance.

10. List the conditions that are sufficient for a market to be a zero-sum game.

- Investors have the same investment horizon.
- Investors have the same level of risk tolerance.
- Investors are allowed the same access to all asset classes (there is no market segmentation).
- Investors have the same expectations about return and asset class risk premiums.
- Investors pay the same tax rate, or equivalently, there is no tax.
- Investments can be divided and traded without cost.

Applications

INTRODUCTION

This workbook discusses the solutions to the applications in the **3rd Edition CAIA Level I: Alternative Investments** using the Texas Instruments BA II Plus Professional calculator.

1. The calculator keystroke instructions are very detailed. Users should note that concepts such as using the financial functions and using the calculator memories are detailed in solutions to the applications (especially in Chapter 3) but are not repeated each time the concepts are used. Therefore, readers with limited knowledge of the TI BA II Plus calculator might benefit from working through the applications in the order in which they appear in the workbook.

2. Before we begin solving these applications, we need to set the calculator to the decimal free format as well as $P/Y = 1$. Follow these steps:

Press 2nd → Format → 9 → Enter → CE/C

Press 2nd → P/Y = 1 → Enter → CE/C

3. Clearing values from previous calculations is critical. Turning the calculator off and on, or hitting CE/C clears the screen but it does not clear the financial registers. There are two special ways to clear the financial registers of the calculator.

First, to clear the values in the second row of keys:

Press CF → 2nd → CE/C [clear work]

Second, to clear the values in the third row of keys:

Press 2nd → FV

Failure to clear the financial registers is likely to lead to errors when the financial functions of the calculator are used in subsequent problems.

Application 3.3.3a (page 54): Investment A is expected to cost \$100 and to be followed by cash inflows of \$10 after one year and then \$120 after the second year, when the project terminates. The IRR is based on anticipated cash flows and is an anticipated lifetime IRR. The IRR of the investment is 14.7%.

$$CF_0 + \frac{CF_1}{(1+IRR)^1} + \frac{CF_2}{(1+IRR)^2} + \frac{CF_3}{(1+IRR)^3} + \dots + \frac{CF_T}{(1+IRR)^T} = 0 \quad (3.9)$$



EXPLANATION

It is much easier to solve this problem with your financial calculator doing the search. However, to perform the search by hand, note that $CF_0 = -\$100$, $CF_1 = \$10$, and $CF_2 = \$120$. Putting this into the equation:

$$\$100 + \frac{\$10}{(1+IRR)^1} + \frac{\$120}{(1+IRR)^2} = 0$$

A method to solve for IRR that does not use the advanced features of the calculator is the “trial and error” method. That is put in an interest rate (as a decimal) for IRR and solve. If the NPV is higher than zero, increase the interest rate. If the NPV is lower than zero, decrease the interest rate. Continue guessing the rate until the NPV converges “close enough” to zero. In this situation, let’s guess 10%.

$$\$100 + \frac{\$10}{(1+.10)^1} + \frac{\$120}{(1+.10)^2} = 0$$

This works out to have a NPV of \$8.26. Therefore, we need to increase the interest rate. Let’s try an interest rate of 15%.

$$\$100 + \frac{\$10}{(1+.15)^1} + \frac{\$120}{(1+.15)^2} = 0$$

With an interest rate of 15%, the NPV is (\$0.56). The NPV is less than zero, so the IRR is lower than 15%. Using an interest rate of 14.66% (a contrived “guess” that is the answer), as shown below, the NPV is zero. Therefore, the IRR is about 14.66%.

$$\$100 + \frac{\$10}{(1+.1466)^1} + \frac{\$120}{(1+.1466)^2} = 0$$

Now let’s turn to having the calculator do the search.

CALCULATIONS

Using third row of keys...

Step One: Press 2nd → CLR TVM

Step Two: Press 2 → N

Step Three: Press 100 → +/- → PV

Step Four: Press 10 → PMT

Step Five: Press 110 → FV

(Note: Application 3.3.3a mentions the future value is 120. When doing the TVM calculation of the calculator with a payment (PMT) we need to remember that we get the PMT of 10 for two periods. That is, 10 in period 1 and 10 in period 2. Period 2 also includes the FV of 110. Therefore, in Period 2 the total payment is 120, which reflects the information and verbiage in the Application.)

The key point is this: the value placed into FV must equal the final cash flow minus the value already included in PMT!

Step Six: Press CPT → I/Y

Answer: 14.66

WORKOUT AREA: Here are sample problems – cover one of the values and see if you can solve it using the others. Thus, the following table can be used to create 28 sample problems!

IRR	CF ₀	CF ₁	CF ₂
14.66%	(\$100.00)	\$10.00	\$120.00
73.98%	(\$130.00)	\$25.00	\$350.00
29.53%	(\$250.00)	\$15.00	\$400.00
26.88%	(\$350.00)	\$50.00	\$500.00
16.14%	(\$75.00)	\$1.00	\$100.00
31.27%	(\$500.00)	\$85.00	\$750.00
83.15%	(\$350.00)	\$95.00	\$1,000.00

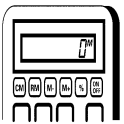
Application 3.3.3b (page 54): Fund B expended \$200 million to purchase investments and distributed \$30 million after one year. At the end of the second year, it is being appraised at \$180 million. The IRR is a since-inception IRR and is 2.7%.

$$CF_0 + \frac{CF_1}{(1+IRR)^1} + \frac{CF_2}{(1+IRR)^2} + \frac{CF_3}{(1+IRR)^3} + \dots + \frac{CF_T}{(1+IRR)^T} = 0 \quad (3.9)$$



EXPLANATION

Please see the explanation in this workbook for **Application 3.3.3a**.



CALCULATIONS

Step One: Press 2nd → CLR TVM

Step Two: Press 2 → N

Step Three: Press 200 → +/- → PV

Step Four: Press 30 → PMT

Step Five: Press 150 → FV

Step Six: Press CPT → I/Y

Answer: 2.66



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

IRR	CF ₀	CF ₁	CF ₂
2.66%	(\$200.00)	\$30.00	\$180.00
12.58%	(\$180.00)	\$25.00	\$200.00
8.70%	(\$200.00)	\$15.00	\$220.00
6.96%	(\$350.00)	\$150.00	\$240.00
15.80%	(\$150.00)	\$1.00	\$200.00
8.19%	(\$200.00)	\$50.00	\$180.00
13.61%	(\$300.00)	\$200.00	\$160.00

Application 3.3.3c (page 54): Investment C had been in existence three years when it was purchased by BK Fund for \$500. In the three years following the purchase, the investment distributed cash flows to the investor of \$110, \$120, and \$130. Now in the fourth year, the investment has been appraised as being worth \$400. The IRR is based on realized cash flows and an appraised value. The IRR may be described as a point-to-point IRR and is 15.0%.

$$CF_0 + \frac{CF_1}{(1+IRR)^1} + \frac{CF_2}{(1+IRR)^2} + \frac{CF_3}{(1+IRR)^3} + \dots + \frac{CF_T}{(1+IRR)^T} = 0$$



EXPLANATION

Please see the explanation in this workbook for **Application 3.3.3a**.



CALCULATIONS

Since there are at least three unique cash inflows, the second row of calculator keys will not handle the problem. While the problem can be solved using a trial and error search by the user, this problem should be solved using the third row of keys. Using the third row of keys involves entering cash flows one-by-one into the financial registers.

Step One: Press 2nd → CLR WORK

Step Two: Press CF → “CF0 =” 500 → +/- → ENTER

Step Three: Press ↓ → “C01” 110 → ENTER

Step Four: Press ↓ → “F01” 1 → ENTER

Step Five: Press ↓ → “C02” 120 → ENTER

Step Six: Press ↓ → “F02” 1 → ENTER

Step Seven: Press ↓ → “C03” 130 → ENTER

Step Eight: Press ↓ → “F03” 1 → ENTER

Step Nine: Press ↓ → “C04” 400 → ENTER

Step Ten: Press ↓ → “F04” 1 → ENTER

Step Eleven: Press IRR → CPT

Answer: 15.05

NOTE: The F01, F02 and so forth are shortcut keys that allow the user to enter the cash flow once and select F0n>1 when the flow is repeated.



WORKOUT AREA: *Here are sample problems – cover the IRR values and see if you can solve them using the others*

IRR	CF ₀	CF ₁	CF ₂	CF ₃	CF ₄
15.05%	(\$500.00)	\$110.00	\$120.00	\$130.00	\$400.00
26.10%	(\$200.00)	\$25.00	\$50.00	\$100.00	\$250.00
34.48%	(\$200.00)	\$50.00	\$100.00	\$150.00	\$150.00
-6.68%	(\$350.00)	\$25.00	\$25.00	\$25.00	\$200.00
65.29%	(\$150.00)	\$0.00	\$300.00	\$0.00	\$300.00
36.13%	(\$200.00)	\$50.00	\$50.00	\$50.00	\$400.00
15.86%	(\$300.00)	\$10.00	\$10.00	\$10.00	\$500.00

Note that in the fourth example that the \$25 cash flow is repeated three times. The keystrokes entering the cash flows can be simplified by entering \$25 as C01 and then F01 as 3 (i.e., frequency of that cash flow is three consecutive, equally-spaced occurrences). Then the final \$200 would be entered as C02 (the second distinct cash flow) and its frequency (F02) could be left at the default value of 1

Application 3.5.3a (page 63): Fund A at the end of its term has risen to a total net asset value (NAV) of \$300 million from its initial size of \$200 million. Assuming no hurdle rate and an 80%/20% carried-interest split, the general partner is entitled to receive carried interest equal to how much?

The answer is \$20 million. The answer is found by multiplying the GP's share (20%) by the total profit (\$100 million). The total profit is found as the difference in the NAVs. The NAVs are calculated after adding revenues and deducting expenses. (Annual management fees are being ignored at this point.)



EXPLANATION

Total profit (ending NAV minus Initial NAV), no hurdle rate, and the carried interest split are needed to determine how much the general partner is entitled to receive. In this case, \$300 million minus \$200 million equals \$100 million. \$100 million in profit multiplied by 20%, which is the percentage of carried interest the general partner is entitled to, equals \$20 million.




CALCULATIONS

Step One: Press 300 → - → 200 → x → 0.2 (Note: the 300 and 200 figures are in millions, as seen in the application.)

Step Two: Press =

Answer: \$20 million



WORKOUT AREA: Here are sample problems – cover one of the values and see if you can solve it using the others

General Partners' Share (millions)	Beginning NAV (millions)	Ending NAV (millions)	Carried-Interest Split	
			Limited Partner	General Partner
\$20.00	\$200.00	\$300.00	80.0%	20.0%
\$120.00	\$100.00	\$500.00	70.0%	30.0%
\$20.00	\$450.00	\$500.00	60.0%	40.0%
\$25.00	\$150.00	\$200.00	50.0%	50.0%
\$120.00	\$200.00	\$400.00	40.0%	60.0%
\$105.00	\$850.00	\$1,000.00	30.0%	70.0%
\$480.00	\$250.00	\$850.00	20.0%	80.0%

Application 3.5.3b (page 63): Fund B terminates and ultimately returns \$132 million to its limited partners, and the total initial size of the fund was \$100 million. Assuming a carried-interest rate of 20%, the general partner is entitled to receive carried interest equal to how much?

The answer is \$8 million. Note that if \$32 million is the profit only to the LP, the total profit of the fund was higher. The answer is found by solving the following equations: LP profit = $0.8 \times$ total profit; so \$32 million = $0.8 \times$ total profit; therefore, total profit = \$40 million. The second equation is GP carried interest = $0.2 \times$ total profit; therefore, carried interest = \$8 million.



EXPLANATION

We are given only the net profit to the limited partners, \$32 million (i.e. \$132 million minus \$100 million). To determine the carried interest that the general partner is entitled to, the total profit is needed. Therefore, we divide \$32 million by 80%, which is the carried interest percentage that the limited partners are entitled to. The quotient is \$40 million which indicates the total profit. Multiplying the total profit by the 20%, which is the carried interest percentage that the general partners are entitled to, equals \$8 million in carried interest to the general partners. Again, the annual management fee is set to zero in this problem for simplicity.



CALCULATIONS

Step One: Press $32 \rightarrow \div \rightarrow 0.8$ (Note: the 32 and 100 figures are in millions, as seen in the application.)

Step Two: Press = "40"

Step Three: Press $40 \rightarrow \times \rightarrow 0.2$

Step Four: Press =

Answer: \$8 million



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

General Partners' Share <i>(millions)</i>	Initial Fund Size <i>(millions)</i>	Return to Limited Partners <i>(millions)</i>	Total Profit	Carried-Interest Split	
				Limited Partner	General Partner
\$8.00	\$100.00	\$132.00	\$40.00	80.0%	20.0%
\$7.50	\$100.00	\$125.00	\$35.71	70.0%	30.0%
\$5.00	\$450.00	\$500.00	\$55.56	90.0%	10.0%
\$12.50	\$150.00	\$200.00	\$66.67	75.0%	25.0%
\$10.00	\$350.00	\$400.00	\$62.50	80.0%	20.0%
\$30.00	\$850.00	\$1,000.00	\$187.50	80.0%	20.0%
\$15.00	\$250.00	\$350.00	\$117.65	85.0%	15.0%

Application 3.5.4a (page 64): Consider a fund that makes two investments, A and B, of \$10 million each. Investment A is successful and generates a \$10 million profit, whereas Investment B is a complete write-off (a total loss). Assume that the fund managers are allowed to take 20% of profits as carried interest. How much carried interest will they receive if profits are calculated on a fund-as-a-whole (aggregated) basis, and how much will they receive if profits are calculated on a deal-by-deal (individual transaction) basis?

On the fund-as-a-whole basis, the fund broke even, so no incentive fees will be distributed. On the deal-by-deal basis, Investment A earned \$10 million, so \$2 million in carried interest will be distributed to the managers.



EXPLANATION

On a fund-as-a-whole basis, Investment A generated a profit of \$10 million, while Investment B lost \$10 million. Therefore, the net of the two investments in the whole fund is \$0. Therefore, there is no carried interest to distribute to either the limited partners or general partners.

On a deal-by-deal basis, Investment A generated a profit of \$10 million and the general partners are entitled to their proportion of the carried interest, which is 20%. Therefore, \$10 million multiplied by 20% for a product of \$2 million. Investment B does not generate a profit; in fact it loses \$10 million. Thus, there is no carried interest and limited partners and general partners do not receive a distribution.



CALCULATIONS

On a fund-as-a-whole basis

Step One: Press $10 \rightarrow - \rightarrow 10 \rightarrow x \rightarrow 0.2$ (Note: the 10 and 100 figures are in millions, as seen in the application.)

Step Two: Press =

Answer: \$0


On a deal-by-deal basis

Step One: Press $10 \rightarrow x \rightarrow 0.2$ (Note: the 10 figure is in millions, as seen in the application.)

Step Two: Press =

Answer: \$2 million

WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*



Mgr Fees on Deal-by-Deal Basis	Mgr Fees on Fund-as- a-Whole Basis	Investment A Profit (millions)	Investment B Profit (millions)	Carried-Interest Split	
				Limited Partner	General Partner
\$2.00	\$0.00	\$10.00	-\$10.00	80.0%	20.0%
\$10.50	\$10.50	\$10.00	\$25.00	70.0%	30.0%
\$1.50	\$0.00	-\$25.00	\$6.00	75.0%	25.0%
\$3.00	\$0.00	\$15.00	-\$35.00	80.0%	20.0%
\$5.00	\$4.00	\$25.00	-\$5.00	80.0%	20.0%
\$3.90	\$3.90	\$13.00	\$13.00	85.0%	15.0%
\$5.00	\$4.00	-\$5.00	\$25.00	80.0%	20.0%

Application 3.5.5a (page 65): Consider a fund that calculates incentive fees on a fund-as-a-whole basis and makes two investments, A and B, of \$10 million each. Investment A is successful and generates a \$10 million profit after three years. Investment B is not revalued until it is completely written off after five years. Assume that the fund managers are allowed to take 20% of profits as carried interest calculated on an aggregated basis. How much carried interest will they receive if there is no clawback provision, and how much will they receive if there is a clawback provision?

Without a clawback provision, the fund earned \$10 million after three years and distributed a \$2 million carried interest to the managers. When the second investment failed, the incentive fee is not returned. In the case of a clawback provision, the fund distributed a \$2 million incentive fee to the managers after three years, but when the second investment failed, the incentive fee is returned to the limited partners, since there is no combined profit.



EXPLANATION

With no clawback provision, Investment A generates \$10 million of profit after three years. Therefore, the fund managers can take profits after three years when Investment A generated the \$10 million profit. Fund managers are entitled to \$10 million multiplied by 20%, the carried interest percentage for general partners, for a product of \$2 million. Now, 2 years later when Investment B fails to generate a profit the fund managers do not receive any more carried interest and do not have to give back the prior \$2 million distributed in carried interest from Investment A. This is the result of the fund not having a clawback provision.

With a clawback provision, the scenario begins similarly. Investment A generates \$10 million of profit after three years. Therefore, the fund managers can take profits after three years when Investment A generated the \$10 million profit. Fund managers are entitled to \$10 million multiplied by 20%, the carried interest percentage for general partners, for a product of \$2 million. However, when Investment B fails the \$2 million distributed to general partners is returned to the limited partners (in theory!) because Investment A's profit plus Investment B's profit equals zero (i.e. there is no combined profit). If there was a combined profit, then the general partners would be entitled to 20% of that combined profit, which may require either an additional distribution to the general partners or a clawback (i.e. if the combined profit was below \$2 million)

CALCULATIONS

Without a clawback provision

Step One: Press $10 \rightarrow x \rightarrow 0.2$ (Note: the 10 figure is in millions, as seen in the application.)

Step Two: Press =

Answer: \$2 million

With a clawback provision

Step One: Press $10 \rightarrow x \rightarrow 0.2$ (Note: the 10 figure is in millions, as seen in the application.)

Step Two: Press = "2"

Step Three: Press $10 \rightarrow x \rightarrow 0.2$ (Note: the 10 figure is in millions, as seen in the application.)

Step Four: Press = "2"

Step Five: Press $2 \rightarrow - \rightarrow 2$

Step Six: Press =

Answer: \$0

WORKOUT AREA: Here are sample problems – cover one of the values and see if you can solve it using the others

Without Clawback	With a Clawback	Investment A Profit (millions)	Investment B Profit (millions)	Carried-Interest Split	
				Limited Partner	General Partner
\$2.00	\$0.00	\$10.00	-\$10.00	80.0%	20.0%
\$10.50	\$10.50	\$10.00	\$25.00	70.0%	30.0%
\$1.20	\$0.00	-\$25.00	\$6.00	80.0%	20.0%
\$2.25	\$0.00	\$15.00	-\$35.00	85.0%	15.0%
\$5.00	\$4.00	\$25.00	-\$5.00	80.0%	20.0%
\$3.90	\$3.90	\$13.00	\$13.00	85.0%	15.0%
\$2.50	\$2.00	-\$5.00	\$25.00	90.0%	10.0%

Application 3.5.6a (page 66): Consider a \$10 million fund with a 20% incentive fee that lasts a single year and earns a \$2 million profit. Ignoring a hurdle rate, the fund manager would receive \$400,000, which is 20% of \$2 million. But with a hard hurdle rate of 10%, the fund manager receives the 20% incentive fees only on profits in excess of the 10% return, meaning \$200,000. The first \$1 million of profit goes directly to the limited partners. The fund manager collects an incentive fee only on profits in excess of the \$1 million, which is the profit necessary to bring the limited partners' return up to the hurdle rate. Thus, the manager receives an incentive fee of \$200,000.



EXPLANATION

This application describes a \$10 million fund that generated a \$2 million profit, with a 10% hurdle rate, where the general partners receive 20% incentive fees (also called carried interest or performance fees). Ignoring the 10% hurdle rate, the fund managers received \$2 million multiplied by 20% or \$400,000. With the 10% hurdle rate in place, the fund managers only receive the 20% incentive fee on profits in excess of a 10%, that is in excess of 10% multiplied by \$10 million or \$1 million. With the hurdle rate the general partners receive 20% multiplied by \$1 million for an incentive fee of \$200,000. Keep in mind that if the fund had returned \$1 million or less, the general partners would not be entitled to any incentive fee.

CALCULATIONS – INCLUDING MEMORY INSTRUCTIONS

Ignoring the hurdle rate

Step One: Press $2 \rightarrow x \rightarrow 0.2$ (*Note: the 2 figure is in millions, as seen in the application.*)

Step Two: Press =

Answer: \$400,000

With a 15% hurdle rate (\$2 million in profits and 20% incentive fee)

Step One: Press $2 \rightarrow x \rightarrow 0.15 \rightarrow =$ (*Note: the 2 figure is in millions*)

Next store the above total fees (0.3 million) that are waived due to the hard hurdle rate in memory...

Step Two: Press “STO” $\rightarrow 0 \rightarrow \text{CE/C}$ to store this value in memory #0

Note that hitting “STO” begins the process of storing a number in memory, but that process is not complete until the user has selected a memory bank numbered from 0 to 9. The above example selected memory location zero by typing 0 immediately after STO

Step Three: Press $2 \rightarrow x \rightarrow 0.20 =$ to calculate total fees without a hurdle rate

Step Four: Press $- \rightarrow \text{RCL} \rightarrow 0 \rightarrow =$ to subtract the memory from the previous result

Answer: 0.1 indicating \$100,000

WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Distribution to Fund Manager					
Hard Hurdle Rate	No Hurdle Rate	Initial Investment	Ending Fund Value	Hurdle Rate	Incentive Fee
(millions)	(millions)	(millions)	(millions)		
\$0.20	\$0.40	\$10.00	\$12.00	10.0%	20.0%
\$0.00	\$0.00	\$25.00	\$20.00	15.0%	20.0%
\$5.10	\$6.00	\$30.00	\$50.00	10.0%	30.0%
\$1.00	\$2.50	\$15.00	\$20.00	20.0%	50.0%
\$0.89	\$0.90	\$0.50	\$5.00	10.0%	20.0%
\$0.70	\$1.00	\$10.00	\$15.00	15.0%	20.0%
\$10.00	\$12.50	\$100.00	\$150.00	10.0%	25.0%
\$1.23	\$1.25	\$50.00	\$75.00	1.0%	5.0%

Application 3.5.7a (page 67): Fund A with an initial investment of \$20 million liquidates with \$24 million cash after one year. The hurdle rate is 15%, and the incentive fee is 20%. What is the distribution to the fund manager if the fund uses a hard hurdle? What is the distribution to the fund manager if the fund has a soft hurdle and a 50% catch-up rate?

The first \$20 million is returned to the limited partners in both cases. With a hard hurdle, the limited partners receive the first \$3 million of profit, which is 15% of the \$20 million investment. The fund manager receives 20% of the remaining profit of \$1 million, which is \$200,000. The limited partners receive 80% of the remaining \$1 million, which is \$800,000, for a total profit of \$3.8 million. With a soft hurdle, the limited partners receive the first \$3 million of profit, which is 15% of the \$20 million investment. To fulfill the catch-up provision, the fund manager receives 50% of the remaining profit up to the point of being paid 20% of all profit. In this case, 50% of all of the remaining profit, or \$1 million, is \$500,000. Since \$500,000 is less than 20% of the entire \$4 million profit, the fund manager is unable to fully catch up. Had the total profits exceeded \$5 million, the catch-up of the fund manager would have been completed. With \$5 million of profit, the GP would receive 50% of the profits above \$3 million, or \$1 million (50% of the \$2 million profit in excess of the profit necessary to meet the hurdle rate for the LPs). The \$1 million of catch-up equals 20% of \$5 million. Profits in excess of \$5 million would then be split 20% to the fund manager and 80% to the limited partners.



EXPLANATION

Since the fund is liquidating this is not simply a distribution of profits. Thus the first \$20 million (i.e. the initial investment) is distributed to investors or limited partners. The additional \$4 million (\$24 million minus \$20 million) is the profit that is subject to the hurdle rate and incentive fees, if applicable.

With the hard hurdle rate in effect we need to apply the 15% hurdle rate to the \$20 million initial investment, 15% multiplied by \$20 million for a product of \$3 million. Therefore, limited partners are entitled to \$3 million before general managers can receive the incentive fee on the remainder. In this case, the fund generated a profit of \$4 million the fund managers will collect an incentive fee on the difference, \$4 million minus \$3 million or \$1 million. \$1 million multiplied by 20% (the fund managers' incentive fee) equals \$200,000. The limited partners receive the other \$800,000 or \$1 million multiplied by .8 as well as the other \$3 million in profit, for a total profit of \$3.8 million. At the end of liquidation, fund managers will receive \$200,000 and limited partners will receive \$23.8 million (i.e. \$20 million of initial investment and \$3.8 million in profit).

Let's consider this same application with a soft hurdle rate of 15% and a 50% catch up rate. This scenario begins similarly. We need to apply the 15% hurdle

rate to the \$20 million initial investment, 15% multiplied by \$20 million for a product of \$3 million. Therefore, limited partners are entitled to \$3 million before general managers can receive the incentive fee on the remainder. The fund generated a profit of \$4 million the fund managers will collect fees on the difference, \$4 million minus \$3 million or \$1 million. In this scenario, the 50% catch up provision is utilized until the fund managers receive 20% of total profits. After the 20% of total profits is received using the catch up provision, the fund managers would collect 20%. Therefore, the fund managers will collect 50% of the \$1 million left over after the hurdle rate is satisfied, or \$500,000. \$500,000 divided by \$4 million is 12.5%, which means that the fund managers were unable to fully catch up. If the fund has returned \$5 million, the fund managers would have been about to fully catch up (i.e. the catch-up provision would be satisfied). If the fund had earned over \$5 million in profit the catch up provision would have been satisfied and the 20% incentive fee would apply for fund managers.



CALCULATIONS

With a 15% hard hurdle rate

Step One: Press $20 \rightarrow \times \rightarrow .15$ (Note: the 10 figure is in millions, as seen in the application.)

Step Two: Press = "3"

Step Three: Press $24 \rightarrow - \rightarrow 20$

Step Four: Press = "4"

Step Five: Press $4 \rightarrow - \rightarrow 3$

Step Six: Press = "1"

Step Seven: Press $1 \rightarrow \times \rightarrow .2$

Step Eight: Press =

Answer: \$200,000

With a 15% soft hurdle rate and a 50% catch up provision

Step One: Press $20 \rightarrow \times \rightarrow .15$ (Note: the 10 figure is in millions, as seen in the application.)

Step Two: Press = "3"

Step Three: Press $24 \rightarrow - \rightarrow 20$

Step Four: Press = "4"

Step Five: Press $4 \rightarrow - \rightarrow 3$

Step Six: Press = "1"

Step Seven: Press 1 → x → .5

Step Eight: Press = “.5”

Step Nine: Press \$500,000 → ÷ → \$4,000,000

Step Ten: Press = “.125”

Answer: \$500,000



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Distribution to Fund Manager

Hard Hurdle Rate (millions)	Soft Hurdle Rate (millions)	Initial Investment (millions)	Ending Fund Value (millions)	Hurdle Rate	Incentive Fee	Catch- up Rate
\$0.20	\$0.50	\$20.00	\$24.00	15.0%	20.0%	50.0%
\$2.63	\$3.75	\$50.00	\$75.00	15.0%	15.0%	30.0%
\$0.70	\$1.00	\$20.00	\$30.00	15.0%	10.0%	25.0%
\$1.13	\$1.25	\$10.00	\$15.00	5.0%	25.0%	50.0%
\$2.45	\$2.50	\$5.00	\$30.00	10.0%	10.0%	25.0%
\$0.87	\$0.90	\$2.00	\$8.00	10.0%	15.0%	30.0%
\$0.80	\$1.20	\$20.00	\$26.00	10.0%	20.0%	50.0%

--

Application 4.4.3a (page 92): The daily returns of Fund A have a variance of 0.0001. What is the variance of the weekly returns of Fund A assuming that the returns are uncorrelated through time?

Using Equation 4.27 and five days in a week, the variance is 0.0005.

$$V(R_T) = T \times V(R_1) \quad \text{when, } \rho_{t,t-k} = 0 \quad (4.27)$$



EXPLANATION

The daily returns have a variance of 0.0001 and are uncorrelated through time. The uncorrelated through time allows us to use equation 4.27. Therefore, the variance of weekly returns of Fund A is equal to 0.0001 multiplied by 5 (number of trading days in a week) for a product of 0.0005. Simply put, *variance* grows linearly with time horizon when returns are uncorrelated.



CALCULATIONS

Step One: Press 0.0001 \rightarrow x \rightarrow 5

Step Two: Press =

Answer: 0.0005



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Short-term Variance	# of ST Periods in LT	Longer-term Variance
.0001	5	.0005
.0002	5	.0010
.0005	4	.0020
.0100	12	.1200

Application 4.4.4a (page 93): The daily returns of Fund A have a standard deviation of 1.4%. What is the standard deviation of a position that contains only Fund A and is leveraged with \$3 of assets for each \$1 of equity (net worth)?

Using Equation 4.31, the standard deviation of the levered returns is 4.2%.

$$\sigma_l = L \times \sigma_u \quad (4.31)$$



EXPLANATION

Utilizing equation 4.31, we multiply 1.4% (the standard deviation) by 3/1 or 3 for a product of 4.2%, which is the standard deviation of levered returns. Simply put, being levered with \$3 of assets to \$1 of equity causes the volatility of the equity to be 3 times the volatility.



CALCULATIONS

Step One: Press 3 → / → 1

Step Two: Press x → 0.014

Step Three: Press =

Answer: 0.042 or 4.2%



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Standard Deviation of Levered Returns	Daily Standard Deviation of Returns	Leverage	
		Assets	To Equity
4.20%	1.40%	\$3	\$1
1.53%	2.30%	\$2	\$3
4.17%	5.00%	\$5	\$6
20.00%	10.00%	\$2	\$1
16.50%	3.30%	\$5	\$1
43.00%	4.30%	\$10	\$1
0.93%	1.20%	\$7	\$9

Application 4.4.4b (page 93): The daily returns of Fund A have a standard deviation of 1.4%. What is the standard deviation of a position that contains 40% Fund A and 60% cash?

Using Equation 4.33, the standard deviation of the unlevered returns is 0.56%.

$$\sigma_p = w \times \sigma_m \quad (4.33)$$



EXPLANATION

To solve this application, it is important to understand that cash has a standard deviation of 0. Therefore, we can utilize equation 4.33 and multiply 40% (the proportion of the fund with a standard deviation of 1.4%) by 1.4% for a product of 0.56%, which is the standard deviation of the unlevered returns.



CALCULATIONS

Step One: Press 0.4 → x → 0.014

Step Two: Press =

Answer: 0.0056 or 0.56%



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Standard Deviation of Unlevered Returns	Daily Standard Deviation of Returns	Fund Allocation	Cash Allocation
0.56%	1.40%	40%	60%
1.15%	2.30%	50%	50%
3.00%	5.00%	60%	40%
7.00%	10.00%	70%	30%
2.64%	3.30%	80%	20%
3.87%	4.30%	90%	10%
1.20%	1.20%	100%	0%

Application 4.4.4c (page 94): The daily returns of Fund A have a standard deviation of 1.2%. What is the standard deviation of the returns of Fund A over a four-day period if the returns are uncorrelated through time? What is the maximum standard deviation for other correlation assumptions?

With zero autocorrelation, the standard deviation of four-day returns is 2.4% (based on the square root of the number of time periods). Simply As the correlation approaches +1, the upper bound would be 4.8%.

$$\sigma_T = \sigma_1 \times \sqrt{T} \quad \text{when } \rho_{t,t-k} = 0$$

$$\sigma_T = \sigma_1 \times T \quad \text{when } \rho_{t,t-k} = 1$$



EXPLANATION

The key to understanding these problems is that this is when the returns are uncorrelated through time volatility grows with the square root of the time horizon. In this case, we can use the equations:

$$\sigma_T = \sigma_1 \times \sqrt{T} \quad \text{when } \rho_{t,t-k} = 0$$

Therefore, we multiply the standard deviation of daily returns of 1.2% by the square root of 4, the number of days in the period (NOTE: the unit number is days. If the standard deviation were of annual returns, we would multiply the standard deviation by the square root of the number of years in the period). This will give us a product of 2.4%, which is the standard deviation of four-day returns.

To find the maximum standard deviation we need to assume that the correlation of returns approaches 1, or perfect correlation. When that happens, we can use the equation:

$$\sigma_T = \sigma_1 \times T \quad \text{when } \rho_{t,t-k} = 1$$

Applying this equation, we multiply 1.2% by 4 for a product of 4.8%.

CALCULATIONS

Assuming uncorrelated returns through time

Step One: Press $0.012 \rightarrow x \rightarrow 4$

Step Two: Press $\sqrt{x} \rightarrow =$

Answer: 0.024 or 2.4%

Assuming perfectly correlated returns

Step One: Press $0.012 \rightarrow x \rightarrow 4$

Step Two: Press $=$

Answer: 0.048 or 4.8%

WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Standard Deviation of Returns for Specified Time Frame	Daily Standard Deviation of Returns	Time Frame (trading days)	Correlation
2.40%	1.20%	4	0
4.80%	1.20%	4	1
10.84%	2.80%	15	0
42.00%	2.80%	15	1
8.73%	3.30%	7	0
23.10%	3.30%	7	1
1.70%	1.20%	2	0

Application 5.2.1a (page 107): Let's return to the example of JAC Fund's \$1 million holding of the ETF with an expected return of zero. Estimating roughly that the daily standard deviation of the ETF is 1.35%, for a 99% confidence interval, the 10-day VaR is found through substituting the known values into the equation:

$$\text{Parametric VaR} = N \times \sigma \times \sqrt{\text{Days}} \times \text{Value} \quad (5.4)$$

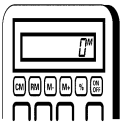
$$\begin{aligned} &2.33 \times \sigma \times \sqrt{\text{Days}} \times \text{Value} \\ &2.33 \times 1.35\% \times \sqrt{10} \times \$1,000,000 \end{aligned} \quad (5.5)$$

The first three values multiplied together produce the percentage change in the value that is being defined as a highly abnormal circumstance. In this case, the answer would be very roughly 10%, indicating that there is a 1% chance that the ETF could fall 10% or more in 10 business days. This percentage is then multiplied by the position's value (the fourth term) to produce the dollar amount of the VaR. In the example, the 10% loss on the \$1 million stock holdings would produce a VaR of approximately \$100,000.



EXPLANATION

In order to solve this application we need to use equation 5.4. In this case, with a 99% confidence interval the z-score is 2.33. Following equation 5.4, we multiply 2.33 by .1.35% by the square root of 10 (the days in the period) to get a product of 9.94%. 9.94% represents the percentage change in the value. To complete this solution we multiply 9.94% by \$1,000,000 for an answer of \$99,469.44. The z-score is a value that is assumed to be provided rather than being memorized or calculated.



CALCULATIONS

Step One: Press $2.33 \rightarrow \times \rightarrow 0.0135$

Step Two: Press $\times \rightarrow 10 \rightarrow \sqrt{x}$

Step Three: Press $\times \rightarrow 1,000,000$

Step Four: Press =

Answer: 99469.44



WORKOUT AREA: *Here are sample problems – cover one of the values (except confidence interval) and see if you can solve it using the others*

Parametric VaR	Percentage Change in the Holdings Value	Daily Standard Deviation of Returns	Confidence Interval	Z-Score	Time Frame (days)	Funds Holding
\$99,469.44	9.95%	1.35%	99%	2.33	10	\$1,000,000
\$70,439.73	7.04%	1.35%	95%	1.65	10	\$1,000,000
\$1,209,222.86	24.18%	2.68%	99%	2.33	15	\$5,000,000
\$856,316.62	17.13%	2.68%	95%	1.65	15	\$5,000,000
\$361,576.66	18.08%	3.47%	99%	2.33	5	\$2,000,000
\$256,052.14	12.80%	3.47%	95%	1.65	5	\$2,000,000
\$700,165.00	70.02%	6.01%	99%	2.33	25	\$1,000,000

Application 5.3.1a (page 111): Consider a portfolio that earns 10% per year and has an annual standard deviation of 20% when the risk-free rate is 3%. The Sharpe ratio is $(10\% - 3\%)/20\%$, or 0.35. When using annual returns and an annual standard deviation of returns, the Sharpe ratio may be interpreted as the annual risk premium that the investment earned per percentage point in annual standard deviation. In this case, the investment's return exceeded the riskless rate by 35 basis points for each percentage point in standard deviation. In an analysis of past data, the mean return of the portfolio is used as an estimate of its expected return, and the historical standard deviation of the sample is used as an estimate of the asset's true risk. Throughout the remainder of this analysis of performance measures, the analysis may be viewed as interchangeable between using historical estimates and using expectations.

$$SR = [E(R_p) - R_f] / \sigma_p \quad (5.6)$$



EXPLANATION

The Sharpe ratio in this application is calculated by finding the difference between 10% and 3% (the portfolio return and the risk free rate otherwise known as excess return), then dividing by 20% for a quotient of 0.35. This follows equation 5.6.



CALCULATIONS

Step One: Press 0.1 → - → 0.03

Step Two: Press ÷ → 0.2

Step Three: Press =

Answer: 0.35



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Sharpe Ratio	Annual Return	Annual Standard Deviation	Risk-Free Rate
0.35	10.00%	20.00%	3.00%
0.13	5.00%	23.00%	2.00%
0.33	12.00%	32.00%	1.50%
0.73	25.00%	30.00%	3.00%
0.38	15.00%	34.00%	2.00%
0.99	22.00%	19.00%	3.10%
0.20	3.00%	10.00%	1.00%

Application 5.3.1b (page 112): Ignoring compounding for simplicity, and assuming statistically independent returns through time, the Sharpe ratios based on semiannual returns and quarterly returns are, using the same annual values as illustrated earlier, as follows:

$$\text{Annual: } (10\% - 3\%) / 20\% = .350 \quad (5.8)$$

$$\text{Semiannual: } [(10\% - 3\%) / 2] / (20\% \sqrt{0.5}) = .247 \quad (5.9)$$

$$\text{Quarterly: } [(10\% - 3\%) / 4] / (20\% \sqrt{0.25}) = .175 \quad (5.10)$$

Note that the Sharpe ratio declines from 0.350 to 0.175, which is a 50% decrease, as the time interval for measurement is reduced by 75%, from annual to quarterly.

$$\sigma_T = \sigma_1 \times \sqrt{T} \quad \text{when } \rho_{t,t-k} = 0$$

$$SR = [E(R_p) - R_f] / \sigma_p \quad (5.6)$$



EXPLANATION

Recall the values in **Application 5.3.1a**, a portfolio earns 10% per year and has an annual standard deviation of 20% when the risk-free rate is 3%. Let's also assume that returns are statistically independent through time. The key for this application is the understand how to adjust an annual statistic for different time periods.

The solution for the annual Sharpe ratio is as explained for **Application 5.3.1a**.

The solution for the semiannual Sharpe ratio is calculated by finding the difference between 10% and 3% (the annual excess return), then dividing by 2 in order to find the semiannual excess return. Next, we need to divide the semiannual excess return by the product of the annual standard deviation multiplied by the square root of $\frac{1}{2}$ or 0.5 (the semiannual standard deviation). The end result is a semiannual Sharpe ratio of .247.

The solution for the quarterly Sharpe ratio is calculated by finding the difference between 10% and 3% (the annual excess return), then dividing by 4 in order to find the quarterly excess return. Next, we need to divide the quarterly excess return by the product of the annual standard deviation multiplied by the square root of $\frac{1}{4}$ or 0.25 (the semiannual standard deviation). The end result is a semiannual Sharpe ratio of .175.

CALCULATIONS

Annual Sharpe Ratio

Please see the calculation for **Application 5.3.1a**

Semiannual Sharpe Ratio

Step One: Press 0.1 → - → 0.03

Step Two: Press ÷ → 2

Step Three: Press = “0.035”

Step Four: Press 0.5 → \sqrt{x}

Step Five: Press x → 0.2

Step Six: Press = “0.1414”

Step Seven: Press 0.035 → ÷ → 0.1414

Answer: 0.247

Quarterly Sharpe Ratio

Step One: Press 0.1 → - → 0.03

Step Two: Press ÷ → 4

Step Three: Press = “0.0175”

Step Four: Press 0.25 → \sqrt{x}

Step Five: Press x → 0.2

Step Six: Press = “0.1”

Step Seven: Press 0.0175 → ÷ → 0.1

Answer: 0.175

WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Annual Sharpe Ratio	Semiannual Sharpe Ratio	Quarterly Sharpe Ratio	Annual Return	Annual Standard Deviation	Risk-Free Rate
0.35	0.25	0.18	10.00%	20.00%	3.00%
0.13	0.09	0.07	5.00%	23.00%	2.00%
0.33	0.23	0.16	12.00%	32.00%	1.50%
0.73	0.52	0.37	25.00%	30.00%	3.00%
0.38	0.27	0.19	15.00%	34.00%	2.00%
0.99	0.70	0.50	22.00%	19.00%	3.10%
0.20	0.14	0.10	3.00%	10.00%	1.00%

Application 5.3.3a (page 114): Consider a portfolio that earns 10% per year and has a beta with respect to the market portfolio of 1.5 when the risk-free rate is 3%. The Treynor ratio is $(10\% - 3\%)/1.5$, or 0.0467 (4.67%). The Treynor ratio may be interpreted as the risk premium that the investment earns per unit of beta. In this example, the investment's expected return is 4.67% higher than the riskless rate for each unit of beta.

$$TR = [E(R_p) - R_f] / \beta_p \quad (5.11)$$



EXPLANATION

To solve for the Treynor ratio, let's apply equation 5.11, 10% minus 3% divided by 1.5 equals 4.67%. Once again we are finding the excess return (portfolio return minus the risk free rate) and dividing it by a measure of risk, in this case it is beta, which is a measure of systematic risk.



CALCULATIONS

Step One: Press 0.1 → - → 0.03

Step Two: Press ÷ → 1.5

Step Three: Press =

Answer: 0.0467



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Treynor Ratio	Annual Return	Beta	Risk-Free Rate
4.67%	10.00%	1.5	3.00%
9.67%	12.00%	1	2.33%
2.00%	4.00%	0.5	3.00%
6.67%	15.00%	1.8	3.00%
8.46%	25.00%	2.6	3.00%
12.78%	20.00%	1.33	3.00%
2.50%	10.00%	3	2.50%

Application 5.3.5a (page 116): Consider a portfolio that earns 10% per year when the investor's target rate of return is 8% per year. The semistandard deviation based on returns relative to the target is 16% annualized. The Sortino ratio would be $(10\% - 8\%) / 16\%$, or 0.125.

$$\text{Sortino Ratio} = [E(R_p) - R_{\text{Target}}] / TSSD \quad (5.12)$$



EXPLANATION

Apply equation 5.12 to find the Sortino ratio we must subtract 10% and 8%, then divide the difference by 16% for a quotient of 0.125. Once again we are finding the excess return (portfolio return minus the target rate of return) and dividing it by a measure of risk, in this case it is semistandard deviation, which is a measure of downside risk.



CALCULATIONS

Step One: Press $0.1 \rightarrow - \rightarrow 0.08$

Step Two: Press $\div \rightarrow .16$

Step Three: Press $=$

Answer: 0.125



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Sortino Ratio	Annual Return	Semistandard Deviation	Target Rate of Return
12.50%	10.00%	16.00%	8.00%
75.00%	25.00%	20.00%	10.00%
-10.00%	3.00%	10.00%	4.00%
8.70%	12.00%	23.00%	10.00%
105.56%	24.00%	18.00%	5.00%
110.00%	19.00%	10.00%	8.00%
-40.00%	8.00%	5.00%	10.00%

Application 5.3.6a (page 116): If a portfolio consistently outperformed its benchmark by 4% per year, but its performance relative to that benchmark typically deviated from that 4% mean with an annualized standard deviation of 10%, then its information ratio would be 4%/10%, or 0.40.

$$\text{Information Ratio} = [E(R_p) - R_{\text{Benchmark}}] / TE \quad (5.13)$$



EXPLANATION

To calculate the information ratio we need to divide 4% (the amount that the portfolio outperformed the benchmark per year) by 10% (the annual standard deviation of returns of the portfolio) for an answer of 0.40.



CALCULATIONS

Step One: Press 0.04 → ÷ → 0.1

Step Two: Press =

Answer: 0.40



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Portfolio Return minus Benchmark		
Information Ratio	Return	Standard Deviation
0.40	4.00%	10.00%
1.25	25.00%	20.00%
0.30	3.00%	10.00%
0.52	12.00%	23.00%
1.33	24.00%	18.00%
1.90	19.00%	10.00%
1.60	8.00%	5.00%

Application 5.4.1a (page 117): A portfolio is expected to earn 7% annualized return when the riskless rate is 4% and the expected return of the market is 8%. If the beta of the portfolio is 0.5, the alpha of the portfolio is 1%, found by substituting into Equation 5.15 and solving:

$$\alpha_p = E(R_p) - R_f - \beta_p[E(R_m) - R_f] \quad (5.15)$$

$$\alpha_p = 7\% - 4\% - [0.5(8\% - 4\%)] = 1\%$$



EXPLANATION

In order to solve this application, we need to apply equation 5.15. First, subtracted 0.08 (the expected return of the market) by 0.04 (the riskless rate). Multiply the difference of 0.4 by 0.5 (the portfolio's beta) for a product of 0.02. Subtract 0.07 by 0.04 for a difference of 0.03. Subtract 0.03 by 0.02 for a difference of 0.01 or 1% (Jensen's alpha).



CALCULATIONS

Step One: Press 0.08 → - → 0.04

Step Two: Press x → 0.5

Step Three: Press = "0.02"

Step Four: Press 0.07 → - → 0.04

Step Five: Press = "0.03"

Step Six: Press 0.03 → - → 0.02

Step Seven: Press =

Answer: 0.01



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Jensen's Alpha	Portfolio Expected Annualized Return	Risk-Free Rate	Expected Annual Return of the Market	Portfolio Beta
0.01	7.00%	4.00%	8.00%	0.5
0.01	15.00%	2.00%	10.00%	1.5
-0.12	10.50%	1.50%	12.00%	2
-0.07	8.30%	3.00%	15.00%	1
0.16	25.00%	2.00%	8.00%	1.2
0.13	20.00%	1.50%	5.00%	1.7
0.28	30.00%	4.00%	3.00%	2.4

Application 5.4.2a (page 119): Consider a portfolio with $M^2 = 4\%$. The portfolio is expected to earn 10%, while the riskless rate is only 2%. What is the ratio of the volatility of the market to the volatility of the portfolio? Inserting the given rates generates $4\% = 2\% + [(\text{ratio of volatilities}) \times 8\%]$. The ratio of the volatility of the market to the volatility of the portfolio must be 25%.

$$M^2 = R_f + \{(\sigma_m / \sigma_p)[E(R_p) - R_f]\} \quad (5.17)$$

where R_f is the riskless rate, σ_m is the volatility of the market portfolio, σ_p is the volatility of the portfolio or asset for which M^2 is being calculated, and $E(R_p)$ is the mean or expected return of the portfolio.



EXPLANATION

In order to solve this problem, we need to manipulate equation 5.17, like so:

$$M^2 = R_f + \left\{ \left(\frac{\sigma_m}{\sigma_p} \right) [E(R_p) - R_f] \right\}$$

$$M^2 - R_f = \left\{ \left(\frac{\sigma_m}{\sigma_p} \right) [E(R_p) - R_f] \right\}$$

$$\frac{M^2 - R_f}{E(R_p) - R_f} = \frac{\sigma_m}{\sigma_p}$$

Now, we can plug in the data provided $M^2 = 4\%$, $E(R_p) = 10\%$, and $R_f = 2\%$.

$$\frac{0.04 - 0.02}{0.1 - 0.02} = \frac{\sigma_m}{\sigma_p}$$

$$\frac{0.02}{0.08} = \frac{\sigma_m}{\sigma_p}$$

$$0.25 = \frac{\sigma_m}{\sigma_p}$$

The ratio of volatilities is 0.25.

CALCULATIONS

Step One: Press 0.04 → - → 0.02

Step Two: Press = "0.02"

Step Three: Press 0.1 → - → 0.02

Step Four: Press = "0.08"

Step Five: Press 0.02 → ÷ → 0.08

Step Six: Press =

Answer: 0.25

WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

M ²	Portfolio Expected Annualized Return	Risk-Free Rate	Ratio of the Volatility of the Market to the Volatility of the Portfolio
4.00%	10.00%	2.00%	25.00%
3.00%	15.00%	2.00%	7.69%
8.00%	10.50%	1.50%	72.22%
5.00%	8.30%	3.00%	37.74%
7.50%	20.00%	1.00%	34.21%
5.10%	30.00%	4.00%	4.23%

Application 6.2.2a (page 126): Using the CAPM equation, when the risk-free rate is 2%, the expected return of the market is 10%, and the beta of asset *i* is 1.25, what is the expected return of asset *i*? By placing each of these variables on the right side of Equation 6.1 and solving the left side, the expected return of asset *i* is 12%.

$$E(R_i) = R_f + b_i [E(R_m) - R_f] \quad (6.1)$$

where $E(R_i)$ is the expected return on asset *i*, β_i is the market beta of asset *i*, $E(R_m)$ is the expected return on the market portfolio, and R_f is the riskless rate of return.



EXPLANATION

Apply equation 6.1 to solve the CAPM equation for the expected return of asset *i*. Subtract 10% (expected return of the market) by 2% for a difference of 8%. Multiply 8% by 1.25 (beta of the asset) for a product of 10%. Lastly, add the risk-free rate of 2% to 10% for a sum of 12%, which is the expected return of asset *i*.



CALCULATIONS

Step One: Press 0.1 → - → 0.02

Step Two: Press x → 1.25

Step Three: Press + → 0.02

Step Four: Press =

Answer: 0.12



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Expected Return of the Asset	Risk-Free Rate	Expected Return of the Market	Beta of Asset <i>i</i>
12.00%	2.00%	10.00%	1.25
16.75%	2.50%	12.00%	1.5
27.00%	3.00%	15.00%	2
40.00%	4.00%	20.00%	2.25
25.00%	2.00%	25.00%	1
17.03%	1.50%	15.00%	1.15
6.25%	2.50%	10.00%	0.5

Application 6.2.3a (page 128): Returning to the previous example in which the risk-free rate is 2% and the beta of asset i is 1.25, if the actual return of the market is 22%, the ex post CAPM model would generate a return due to non-idiosyncratic effects of 27% for the asset: $2\% + [1.25(22\% - 2\%)]$. If the asset's actual return is 30%, then the extra 3% would be attributable to idiosyncratic return, ε_{it}

$$R_{it} - R_f = \beta_i(R_{mt} - R_f) + \varepsilon_{it} \quad (6.3)$$



EXPLANATION

This is similar to **Application 6.2.2a**, but instead of using expected return, actual returns are used in the model. We need to apply a slightly modified equation 6.3 as shown below:

$$R_{it} = R_f + \beta_i(R_{mt} - R_f) + \varepsilon_{it}$$

Subtract 22% (actual return of the market) from 2% (the risk-free rate) for a difference of 20%. Multiply 20% by 1.25 for a product of 25%. Then add 2% to 25% for a sum of 27%, which is the asset's return due to non-idiosyncratic effects. If the asset actually returned 30% (i.e. $R_{it} = 30\%$), then 3% difference between 27% (asset's return due to non-idiosyncratic effects) and 30% (actual asset return), would be attributable to idiosyncratic return, ε_{it} . Thus, $\varepsilon_{it} = 3\%$.



CALCULATIONS

Step One: Press $0.22 \rightarrow - \rightarrow 0.02$

Step Two: Press $\times \rightarrow 1.25$

Step Three: Press $+$ $\rightarrow 0.02$

Step Four: Press $=$

Answer: 0.27

To find the idiosyncratic return

Step One: Press $0.3 \rightarrow - \rightarrow 0.27$

Step Two: Press $=$

Answer: 0.03



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Actual Return of the Asset	Actual Return of the Asset Attributable to Non-Idiosyncratic Effects	Risk-Free Rate	Actual Return of the Market	Beta of Asset i	ϵ_{it}
30.00%	27.00%	2.00%	22.00%	1.25	3.00%
23.00%	16.75%	2.50%	12.00%	1.5	6.25%
29.00%	27.00%	3.00%	15.00%	2	2.00%
22.00%	40.00%	4.00%	20.00%	2.25	-18.00%
41.00%	25.00%	2.00%	25.00%	1	16.00%
28.30%	17.03%	1.50%	15.00%	1.15	11.28%
10.60%	6.25%	2.50%	10.00%	0.5	4.35%

Application 6.3.5a (page 134): A researcher wishes to test for statistically significant factors in explaining asset returns. Using a confidence level of 90%, how many statistically significant factors would the researcher expect to identify by testing 50 variables, independent from one another, that had no true relationship to the returns?

The answer is five, which is found by multiplying the number of unrelated variables (50) by the probability of mistakenly concluding that the variables were true factors (10%). What if research were performed with a confidence level of 99.9% but with 100 researchers, each testing 50 different variables on different data sets?



EXPLANATION

The key to the solution of this application is that the variables are independent from each other. Since the confidence level is 90%, we need to find the probability of mistakenly concluding that the variables were true factors which is $1 - 0.9$ or 10%. Then multiply 10% (the probability of mistakenly concluding that the variables were true factors) by 50 (the number of variables) for a product of 5, which is the number of statistically significant variables that had no true relationship to the returns.

The next part of the application begins the same way. Since the confidence level is 99.9%, we need to find the probability of mistakenly concluding that the variables were true factors which is $1 - 0.999$ or 0.1%. Then multiply 0.1% (the probability of mistakenly concluding that the variables were true factors in one test) by 50 (the number of variables) for a product of 0.05. Now, the difference with this scenario is that the test of 50 variables was performed 100 times each by a different researcher. Therefore, we need to multiply 0.05 by 100 for a product of 5, which is the number of statistically significant variables that had no true relationship to the returns.



CALCULATIONS

If there is 1 researcher conducting the test with a 90% confidence level

Step One: Press 1 → - → .9

Step Two: Press x → 50

Step Three: Press =

Answer: 5

If there are 100 researchers conducting the test with a 99.9% confidence level

Step One: Press 1 → - → .999

Step Two: Press x → 50

Step Three: Press x → 100

Step Four: Press =

Answer: 5



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Number of Statistically Significant Variables that Had No True Relationship to the Returns	Number of Researchers	Number of Variables Tested	Confidence Level	Probability of Mistakenly Concluding True Factors
5	1	50	90.0%	10.00%
5	100	50	99.9%	0.10%
100	20	100	95.0%	5.00%
87.5	25	35	90.0%	10.00%
15	1	300	95.0%	5.00%
6.5	2	65	95.0%	5.00%
1.5	10	150	99.9%	0.10%
56.25	15	75	95.0%	5.00%

Application 6.4.5a (page 138): Nine-month riskless securities trade for \$97,000, and 12-month riskless securities sell for \$ P (both with \$100,000 face values and zero coupons). A forward contract on a three-month, riskless, zero-coupon bond, with a \$100,000 face value and a delivery of nine months, trades at \$99,000. What is the arbitrage-free price of the 12-month zero-coupon security (i.e., P)?

The 12-month bond offers a ratio of terminal wealth to investment of $(\$100,000/P)$. The nine-month bond reinvested for three months using the forward contract offers $(\$100,000/\$97,000)(\$100,000/\$99,000)$. Setting the two returns equal and solving for P generates $P = \$96,030$. The 12-month bond must sell for \$96,030 to prevent arbitrage.



EXPLANATION

Essentially, we need to solve this equation:

$$\left(\frac{\$100,000}{P} \right) = \left(\frac{\$100,000}{\$97,000} \right) \left(\frac{\$100,000}{\$99,000} \right)$$

This is because we need to ensure that the equation holds:

$$\left(\frac{\$100,000}{P} \right) = \left(\frac{\$100,000}{\$97,000} \right) \left(\frac{\$100,000}{\$99,000} \right)$$

$$\left(\frac{\$100,000}{P} \right) = 1.041341$$

$$\left(\frac{\$100,000}{P} \right) = 1.041341$$

$$P = \left(\frac{\$100,000}{1.041341} \right)$$

$$P = \$96,030.00$$

Therefore, the 12-month bond must sell for \$96,030 to prevent arbitrage.

Note that there is nothing special about the use of three months, nine months and twelve months in this example. View the exercise as having a maximum length (in this case twelve months) that is broken in to two sub-intervals. The idea is that the price ratio (terminal value/initial value) of the entire time interval must equal the product of the two price ratios of the subintervals.

CALCULATIONS

Step One: Press 100000 → ÷ → 97000

Step Two: Press = "1.030927835"

Step Three: Press 100000 → ÷ → 99000

Step Four: Press x → 1.030927835

Step Five: Press = "1.041341247"

Step Six: Press 100000 → ÷ → 1.041341247

Answer: 96030.00

WORKOUT AREA: *Here are sample problems – cover one of the values (except the leftmost column) and see if you can solve it using the others*

Face Value of Zero Coupon Securities	Price of Longest Security	Price of Shorter Security	Price of Forward Contract
\$100,000	\$96,030	\$97,000	\$99,000
\$100,000	\$97,000	\$98,000	\$98,980
\$100,000	\$95,000	\$98,000	\$96,939
\$100,000	\$94,000	\$97,000	\$96,907
\$100,000	\$93,000	\$94,000	\$98,936
\$100,000	\$92,000	\$93,000	\$98,925
\$100,000	\$91,000	\$95,000	\$95,789

Application 6.4.5b (page 139): A three-year riskless security trades at a yield of 3.4%, whereas a forward contract on a two-year riskless security that settles in three years trades at a forward rate of 2.4%. Assuming that the rates are continuously compounded, what is the no-arbitrage yield of a five-year riskless security?

Inserting 3.4% as the shorter-term rate in Equation 6.9 and 2.4% as the left side of equation 6.9, the longer-term rate, R_T , can be solved as 3.0%, noting that $T = 5$ and $t = 3$. Note that earning 3.0% for five years (15%) is equal to the sum of earning 3.4% for three years (10.2%) and 2.4% for two years (4.8%). The rates may be summed due to the assumption of continuous compounding.

$$F_{T-t} = (T \times R_T - t \times R_t) / (T - t) \quad (6.9)$$



EXPLANATION

We need to manipulate equation 6.9 to solve for R_T .

$$\begin{aligned} F_{T-t} &= \frac{(T \times R_T - t \times R_t)}{(T - t)} \\ F_{T-t} \times (T - t) &= (T \times R_T - t \times R_t) \\ F_{T-t} \times (T - t) + t \times R_t &= T \times R_T \\ R_T &= \frac{F_{T-t} \times (T - t) + t \times R_t}{T} \end{aligned}$$

We have solved for R_T . Now, $R_t = 3.4\%$, $F_{T-t} = 2.4\%$, $T = 5$, and $t = 3$

$$\begin{aligned} R_T &= \frac{0.024 \times (5 - 3) + 3 \times 0.034}{5} \\ R_T &= \frac{0.024 \times (2) + 3 \times 0.034}{5} \\ R_T &= \frac{0.048 + 3 \times 0.034}{5} \\ R_T &= \frac{0.048 + 0.102}{5} \\ R_T &= \frac{0.15}{5} \\ R_T &= 0.03 \end{aligned}$$

Therefore, $R_T = 3.0\%$. If we multiply 3.0% by 5 the product is 15% which is the sum of the two products of 3.4% by 3 and 2.4% by 2. These rates can be summed because of the assumption of continuous compounding.



CALCULATIONS

Step One: Press 5 → - → 3

Step Two: Press x → 0.024

Step Three: Press = “0.048”

Step Four: Press 3 → x → 0.034

Step Five: Press + → 0.048

Step Six: Press ÷ → 5

Step Seven: Press =

Answer: 0.03



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Short Maturity	Short Rate	Forward Rate	Long Maturity	Long Rate
3	3.40%	2.40%	5	3.00%
3	7.00%	5.00%	5	6.20%
3	3.30%	1.50%	5	2.58%
2	4.00%	3.50%	3	3.83%
1	6.00%	6.50%	6	6.42%
4	5.00%	4.80%	5	4.96%
1	2.00%	3.00%	2	2.50%

Application 6.4.7a (page 141): A stock currently selling for \$10 will either rise to \$30 or fall to \$0 in one year. How much would a one-year call sell for if its strike price were \$20? The payoff of the call (\$10) would be one-third the payoff of the stock. Therefore, the call must sell for \$3.33 (\$10 stock price \times 1/3).



EXPLANATION

The key piece to understand in this application is that the payoff of the call (\$10 or \$30 - \$20) is 1/3 (\$10/\$30) of the ending stock price of \$30.

To solve this application, we need to find the payoff of the call by subtracting the future stock price of \$30 by the strike price of \$20 for a difference of \$10. Then divide \$10 (pay off the call) by \$30 (future stock price), which equals 1/3. Then multiply the 1/3 by \$10 (current stock price) for a product of \$3.33, which is the price of the call.



CALCULATIONS

Step One: Press \$30 \rightarrow - \rightarrow \$20

Step Two: Press \div \rightarrow \$30

Step Three: Press \times \rightarrow \$10

Step Four: Press =

Answer: 3.33



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

1 Year Call Price	1 Year Call Strike Price	Current Stock Price	1 Year Stock Price	
			Potential	1 Year Stock Price Bottom
\$3.33	\$20.00	\$10.00	\$30.00	\$0.00
\$10.00	\$25.00	\$20.00	\$50.00	\$0.00
\$6.00	\$40.00	\$10.00	\$100.00	\$0.00
\$9.00	\$20.00	\$15.00	\$50.00	\$0.00
\$2.86	\$30.00	\$20.00	\$35.00	\$0.00
\$1.67	\$5.00	\$2.50	\$15.00	\$0.00
\$8.00	\$30.00	\$10.00	\$150.00	\$0.00

Application 6.5.1a (page 143): A stock sells for \$100 and is certain to make a cash distribution of \$2 just before the end of one year. A forward contract on that stock trades with a settlement in one year. Assume that the cost to finance a \$100 purchase of the stock is \$5 (due at the end of the year). What is the no-arbitrage price of this forward contract?

A one-year forward contract on the stock must trade at \$103. At settlement, a long position in the forward contract obligates the holder to pay \$103 in exchange for delivery of the stock. If the investor uses the cash market, after one year the investor will pay the same amount for the asset (\$103). The \$103 at the end of the year includes the cost of buying the stock in the spot market with 100% financing (which accrues to \$105 at settlement) and the benefit of receiving the \$2 dividend.



EXPLANATION

The price of the forward contract needs to be the same as the expected price to purchase the stock in the spot market after one year assuming risk neutrality (i.e., the stock price grows at the 5% riskless rate (ignoring the dividend)). A stock sells for \$100, so we need to pay \$100 in the spot market for that stock. To finance that purchase it costs \$5, so purchase stock in the spot market and hold it one year costs \$105. However, the stock will distribute a \$2 dividend to investors, making the actual costs \$105 minus the \$2 dividend or \$103. The cost of purchasing the stock in one year in the spot market is \$103 so the forward contract, which settles in \$100 worth of the stock in one year should trade at the same price to prevent arbitrage.



CALCULATIONS

Step One: Press $100 \rightarrow + \rightarrow \5

Step Two: Press $- \rightarrow \$2$

Step Three: Press $=$

Answer: \$103



WORKOUT AREA: *Here are ample problems – cover one of the values and see if you can solve it using the others*

No-Arbitrage Price of Forward Contract	Stock Price	Cash Dividend	Purchase of Stock Cost to Finance \$100
\$103.00	\$100.00	\$2.00	\$5.00
\$53.00	\$50.00	\$3.00	\$6.00
\$77.00	\$75.00	\$0.00	\$2.00
\$88.00	\$90.00	\$5.00	\$3.00
\$153.00	\$150.00	\$2.00	\$5.00
\$1.00	\$7.00	\$8.00	\$2.00
\$0.00	\$2.50	\$3.00	\$0.50

Application 6.5.3a (page 145): If the spot price of an equity index that pays no dividends is \$500 and if the riskless interest rate is zero, what is the one-year forward price on the equity index?

The forward contract of every time to delivery has a forward price of exactly \$500. Market participants would be indifferent between buying and selling the index in the spot market with instant delivery or in the forward market with delayed delivery because there are no interest payments and dividends to consider.

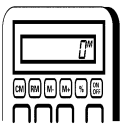
$$S = F(T) \text{ for all } T \text{ (Times to Delivery)} \quad (6.12)$$

$$F(T) = S \times e^{(r-d)T} \quad (6.11)$$



EXPLANATION

Applying equation 6.11, we find that the exponential of $(0-0) \times 1$ equals 1. The spot price of the equity index of \$500 multiplied by 1 equals \$500, which is the one-year forward price on the equity index. The spot price equals the one year forward price because the riskless interest rate is zero and the dividend rate is zero. Note: the workout area includes examples where the dividend rate is no-zero, just like in Application 6.5.3.b.



CALCULATIONS

Step One: Press 0 → - → 0

Step Two: Press x → 1

Step Three: Press 2^{nd} → e^x

Step Four: Press x → 500

Step Five: Press =

Answer: \$500



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others.*

One-year Forward		Dividends of Equity	
Price of Equity	Spot Price of an Equity	Risk-Free Rate	Index
Index	Index		
\$500.00	\$500.00	0.00%	0.0%
\$250.00	\$250.00	5.00%	5.0%
\$101.01	\$100.00	3.00%	2.0%
\$49.01	\$50.00	2.00%	4.0%
\$76.13	\$75.00	2.50%	1.0%
\$24.75	\$25.00	4.00%	5.0%
\$362.47	\$350.00	3.50%	0.0%

Application 6.5.3b (page 146): Assuming a continuously compounded annual interest rate of 5%, if the spot price of an equity index with 2% dividends is \$500, what would be the forward price on the equity index with settlement in three months? The price of every forward contract on that index for every time to settlement would be $\$500e^{(0.05-0.02)T}$. The three-month forward price would be $\$500e^{(0.03 \times 0.25)}$, or \$503.76. Six-month and 12-month forward prices would be \$507.56 and \$515.28, respectively (found by inserting 0.50 and 1.00 for T , and 0.03 for $r - d$).

$$F(T) = S \times e^{(r-d)T} \quad (6.11)$$



EXPLANATION

Similarly to **Application 6.5.3a** we need to utilize equation 6.11. In this scenario we are varying T for three-months (0.25), six-months (0.50), and twelve-months (1). Before we do that, let's fill out equation 6.11 with the information we have:

$$\$500e^{(0.05-0.02)T}$$

Now we can solve for all three scenarios, by varying T as outlined above.

$$\text{Three-Months: } \$500e^{(0.05-0.02)(0.25)} = \$500e^{(0.03)(0.25)} = \$503.76$$

$$\text{Six-Months: } \$500e^{(0.05-0.02)(0.50)} = \$500e^{(0.03)(0.50)} = \$507.56$$

$$\text{Twelve-Months: } \$500e^{(0.05-0.02)(1)} = \$500e^{(0.03)(1)} = \$515.23$$

NOTE: The examples that follow include cases of the dividend rate exceeding the riskless rate. In effect, these cover Application 6.5.3C as well.



CALCULATIONS

Three-Months

Step One: Press $0.05 \rightarrow - \rightarrow 0.02$

Step Two: Press $x \rightarrow 0.25$

Step Three: Press $2^{\text{nd}} \rightarrow e^x$

Step Four: Press $x \rightarrow 500$

Step Five: Press $=$

Answer: \$503.76

Six-Months

Step One: Press $0.05 \rightarrow - \rightarrow 0.02$

Step Two: Press $x \rightarrow 0.50$

Step Three: Press $2^{\text{nd}} \rightarrow e^x$

Step Four: Press $x \rightarrow 500$

Step Five: Press $=$

Answer: \$507.56

Twelve-Months

Step One: Press $0.05 \rightarrow - \rightarrow 0.02$

Step Two: Press $x \rightarrow 1$

Step Three: Press $2^{\text{nd}} \rightarrow e^x$

Step Four: Press $x \rightarrow 500$

Step Five: Press $=$

Answer: \$515.23



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

3-Month Forward					
Price of Equity Index	6-Month Forward Price of Equity Index	One-year Forward Price of Equity Index	Spot Price of an Equity Index	Risk-Free Rate	Dividends of Equity Index
\$503.76	\$507.56	\$515.23	\$500.00	5.00%	2.00%
\$250.00	\$250.00	\$250.00	\$250.00	5.00%	5.0%
\$100.25	\$100.50	\$101.01	\$100.00	5.00%	2.0%
\$49.75	\$49.50	\$49.01	\$50.00	5.00%	4.0%
\$75.28	\$75.56	\$76.13	\$75.00	5.50%	1.0%
\$24.94	\$24.88	\$24.75	\$25.00	5.00%	5.0%
\$363.08	\$356.18	\$362.47	\$350.00	5.50%	0.0%

Application 6.5.3c (page 146): Assuming a continuously compounded annual interest rate of 2%, if the spot price of an equity index with 3% dividends is \$500, what would be the forward price of a contract with settlement in three months? The price of every forward contract of every time to delivery would be $\$500e^{(-0.01)T}$, with $(r - d) = -1\%$. The three-month forward price would be $\$500e^{0.01 \times 0.25}$, or \$498.75. Six-month and 12-month forward prices would be \$497.51 and \$495.01, respectively (found by inserting 0.50 and 1.00 for T).

$$F(T) = S \times e^{(r-d)T} \quad (6.11)$$



EXPLANATION

Please see the explanation for **Application 6.5.3b**. Note that the applications only differ by whether the riskless rate is higher than the dividend yield or vice versa.



CALCULATIONS

Three-Months

Step One: Press $0.02 \rightarrow - \rightarrow 0.03$

Step Two: Press $x \rightarrow 0.25$

Step Three: Press $2^{\text{nd}} \rightarrow e^x$

Step Four: Press $x \rightarrow 500$

Step Five: Press $=$

Answer: \$498.75

Six-Months

Step One: Press $0.02 \rightarrow - \rightarrow 0.03$

Step Two: Press $x \rightarrow 0.50$

Step Three: Press $2^{\text{nd}} \rightarrow e^x$

Step Four: Press $x \rightarrow 500$

Step Five: Press $=$

Answer: \$497.51

Twelve-Months

Step One: Press $0.02 \rightarrow - \rightarrow 0.03$

Step Two: Press $x \rightarrow 1$

Step Three: Press $2^{\text{nd}} \rightarrow e^x$

Step Four: Press $x \rightarrow 500$

Step Five: Press $=$

Answer: \$495.02



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

3-Month Forward Index	6-Month Forward Price of Equity Index	One-year Forward Price of Equity Index	Spot Price of an Equity Index	Risk-Free Rate	Dividends of Equity Index
\$498.75	\$497.51	\$495.02	\$500.00	2.00%	3.00%
\$100.00	\$100.00	\$100.00	\$100.00	5.00%	5.0%
\$150.19	\$150.38	\$150.75	\$150.00	2.50%	2.0%
\$75.09	\$75.19	\$75.38	\$75.00	1.00%	0.5%
\$94.76	\$94.53	\$94.05	\$95.00	5.00%	6.0%
\$35.35	\$35.71	\$36.43	\$35.00	4.00%	0.0%
43.72	\$44.44	\$43.89	\$45.00	2.50%	5.0%

Application 7.3.1a (page 166): Find the systematic and idiosyncratic returns for the following: Assume that the risk-free rate is 2%, the realized return of asset i in year t was 16%, the realized return of the market portfolio was 14% (which was 12% more than the riskless rate), and the beta of asset i is 1.25.

The systematic portion of its realized return must be 15%, which is found using the first terms on the right-hand side of the equation: $1.25(14\% - 2\%)$. Since the realized return of asset i in excess of the risk-free rate (the left-hand side of the equation) was 14% (found as the realized return of 16% minus the risk-free return of 2%), and since the systematic component of its realized return was 15% (found earlier), the idiosyncratic portion of asset i 's return must be -1% , found by inserting the -1% in the following equation: $16\% - 2\% = 1.25(14\% - 2\%) - 1\%$.

$$R_{it} - R_{ft} = \beta_i(R_{mt} - R_{ft}) + \varepsilon_{it} \quad (6.3)$$



EXPLANATION

We need to apply equation 6.3 to solve this application. On the right side of the equation, subtract 14% (actual return of the market) from 2% (the risk-free rate) for a difference of 12%. Multiply 12% by 1.25 (beta) for a product of 15%, the systematic portion of its realized return. On the left side of the equation, we see that 16% (the realized return of asset i in year t) subtracted from 2% (the risk-free rate) equals 14%. The difference between 14% and 15% is -1% , which must equal the idiosyncratic portion of asset i 's return, ε_{it} . Thus, $\varepsilon_{it} = -1\%$.



CALCULATIONS

Step One: Press $0.14 \rightarrow - \rightarrow 0.02$

Step Two: Press $\times \rightarrow 1.25$

Step Three: Press $=$ “.15” (systematic return)

Step Four: Press $0.16 \rightarrow - \rightarrow 0.02$

Step Five: Press $=$ “.14”

Step Six: Press $0.14 \rightarrow - \rightarrow 0.15$

Step Six: $=$

Answer: -0.01 (idiosyncratic return)



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Systematic Returns	Idiosyncratic Returns	Risk-Free Rate	Realized Return of Asset <i>i</i> in Year <i>t</i>	Realized Return of the Market Portfolio	Beta of Asset <i>i</i>
15.00%	-1.00%	2.00%	16.00%	14.00%	1.25
7.00%	15.00%	3.00%	25.00%	10.00%	1
16.25%	-8.75%	2.50%	10.00%	15.00%	1.3
9.60%	-1.60%	4.00%	12.00%	12.00%	1.2
12.00%	1.00%	2.00%	15.00%	10.00%	1.5
6.75%	26.75%	1.50%	35.00%	15.00%	0.5
10.00%	17.00%	3.00%	30.00%	8.00%	2

Application 8.2.1a (page 178): Consider Sludge Fund, a fictitious fund run by unskilled managers that generally approximates the S&P 500 Index but does so with an annual expense ratio of 100 basis points (1%) more than other investment opportunities that mimic the S&P 500. Using Equation 8.1 and assuming that the S&P 500 is a proxy for the market portfolio, the ex ante alpha of Sludge Fund would be approximately –100 basis points per year. This can be deduced from assuming that $\beta_i = 1$ and that $[E(R_{i,t}) - E(R_{m,t})] = -1\%$ due to the expense ratio. Sludge Fund could be expected to offer an ex ante alpha, meaning a consistently inferior risk-adjusted annual return, of –1% per year. This example illustrates that ex ante alpha can be negative to indicate inferior expected performance, although alpha is usually discussed in the pursuit of the superior performance associated with a positive alpha.

$$E(R_{i,t} - R_f) = \alpha_i + \beta_i[E(R_{m,t}) - R_f] \quad (8.1)$$

where α_i is the ex ante alpha of asset i .



EXPLANATION

The application to this solution can be deduced as $\alpha_i = -1\%$. Let's consider the facts. The expected Fund return and the expected Market return are the same, except that the fund has an expense ratio of 1%. The beta of the fund to the market is 1. Therefore, the only difference between the market and the fund is a 1% expense ratio that weighs on the fund performance. Therefore, the $\alpha_i = -1\%$.

Now let's calculate this mathematically by manipulating equation 8.1:

$$\begin{aligned} E(R_{i,t} - R_f) &= \alpha_i + \beta_i[E(R_{m,t}) - R_f] \\ \alpha_i &= \beta_i[E(R_{m,t}) - R_f] - E(R_{i,t} - \text{ExpenseRatio} - R_f) \end{aligned}$$

With the modified equation 8.1, it becomes more clear how the expense ratio impacts alpha. Let's solve for α_i .

$$\begin{aligned} \alpha_i &= \beta_i[E(R_{m,t}) - R_f] - E(R_{i,t} - \text{ExpenseRatio} - R_f) \\ \alpha_i &= 1[0.1 - 0] - (0.1 + 0.01 - 0) \\ \alpha_i &= 0.1 - (0.11) \\ \alpha_i &= -0.01 \end{aligned}$$

As you can see, $\alpha_i = -1\%$.



CALCULATIONS

Step One: Press $1 \rightarrow \times \rightarrow 0.1$

Step Two: Press = “0.1”

Step Three: Press $0.1 \rightarrow + \rightarrow 0.01 - \rightarrow 0$

Step Four: Press = “0.11”

Step Five: Press $0.1 \rightarrow - \rightarrow 0.11$

Step Six: Press =

Answer: -0.01 or -1%

Application 8.2.2a (page 179): Consider Trim Fund, a fund that tries to mimic the S&P 500 Index and has managers who are unskilled. Unlike Sludge Fund from the previous section, Trim Fund has virtually no expenses. Although Trim Fund generally mimics the S&P 500, it does so with substantial error due to the random incompetence of its managers. However, the fund is able to maintain a steady systematic risk exposure of $\beta_i = 1$. Last year, Trim Fund outperformed the S&P 500 by 125 basis points. Using Equation 8.2, assuming that $\beta_i = 1$ and that $(R_{it} - R_{mt}) = +1.25\%$, it can be calculated that $\varepsilon_{it} = +1.25\%$. Thus, Trim Fund realized a return performance for the year that was 1.25% higher than its benchmark, or its required rate of return. In the terminology of this chapter, Trim Fund generated an ex post alpha of 125 basis points, even though the fund's ex ante alpha was zero.

$$R_{it} - R_f = \beta_i(R_{mt} - R_f) + \varepsilon_{it} \quad (8.2)$$



EXPLANATION

Let's examine this application from a mathematic context as opposed to deducing the ex-post alpha from the given information.

To solve ex-post alpha we need to rearrange equation 8.2:

$$R_{it} - R_f = \beta_i(R_{mt} - R_f) + \varepsilon_{it}$$

$$\frac{R_{it} - R_f}{\beta_i} = (R_{mt} - R_f) + \varepsilon_{it}$$

$$\varepsilon_{it} = \frac{R_{it} - R_f}{\beta_i} - R_{mt} + R_f$$

Now, not all the values are given. However, we know that $R_{it} - R_{mt} = 1.25\%$ so can use example figures that reflect that difference. $\beta_i = 1$, $R_{it} = 10\%$, $R_{mt} = 11.25\%$, and $R_f = 0\%$. Now using these figures to calculate ε_{it} .

$$\varepsilon_{it} = \frac{0.1125 - 0}{1} - 0.10 + 0$$

$$\varepsilon_{it} = \frac{0.1125}{1} - 0.10$$

$$\varepsilon_{it} = 0.0125$$

As shown, $\varepsilon_{it} = 0.0125$



CALCULATIONS

This application uses deductive reasoning more than calculation. Some example numbers have been provided in the EXPLANATION section, which will be used here in the CALCULATIONS section.

Step One: Press $0.1125 \rightarrow - \rightarrow 0$

Step Two: Press $\div \rightarrow 1$

Step Three: Press $- \rightarrow 0.10 + \rightarrow 0$

Step Four: Press $=$

Answer: 0.0125

Application 9.1.7a (page 207): Consider a regression with an alpha estimate of 0.5% (with a standard error of 0.3) and a beta estimate of 1.1 (with a standard error of 0.3). Are the regression parameters statistically significant? The t -statistic of the alpha is 1.67, whereas the t -statistic of the beta is 3.67, each found by dividing the parameter estimates by the corresponding standard error. At a 5% significance level (Note: the significance level is 5%, the confidence interval is 95%), the t -statistic needs to exceed 1.96 to be deemed statistically significant (assuming a very large number of degrees of freedom). In this case, the alpha is not deemed to be significantly different from zero because the t -statistic is less than 1.96 (the critical value); however, the beta does differ significantly from zero, as its t -statistic exceeds 1.96.

t -statistic < Z-Score; not deemed to be significantly different from zero

t -statistic > Z-Score; does differ significantly from zero



EXPLANATION

We are looking for a 5% statistical significance of an alpha estimate and a beta estimate with a confidence level of 95%. We need to know that the alpha estimate is 0.5% with a standard error of 0.3 and the beta estimate is 1.1 with a standard error of 0.3. In addition, we need to know the z-score of a 5% confidence level is 1.96. Now, we need to calculate the t -statistic of the alpha estimate and beta estimate and compare those numbers with the z-score of a 95% confidence level or 1.96. If the estimate's t -statistic exceeds the z-score for the set confidence interval, the estimate is statistically significant. If the estimate's t -statistic is less than the z-score for the set confidence interval, the estimate is not deemed statistically significant.

To calculate the t -statistic for the alpha estimate we need to divide 0.5 by 0.3 which equals 1.67. 1.67 is less than the z-score of 1.96 for the set confidence interval. The alpha estimate is not deemed statistically significant.

To calculate the t -statistic for the beta estimate we need to divide 1.1 by 0.3 which equals 3.67. 3.67 is greater than the z-score of 1.96 for the set confidence level. The beta estimate is deemed statistically significant.



CALCULATIONS

Calculate the t-statistic for the alpha estimate

Step One: Press $0.5 \rightarrow \div \rightarrow 0.3$

Step Two: Press =

Answer: 1.67

Calculate the t-statistic for the beta estimate

Step One: Press $1.1 \rightarrow \div \rightarrow 0.3$

Step Two: Press =

Answer: 3.67



WORKOUT AREA: *Here are sample problems – cover one of the values in the four leftmost columns and see if you can solve it using the others*

Alpha Estimate Statistically Significant?	Beta Estimate Statistically Significant?	T-Statistic of Alpha	T-statistic of Beta	Alpha Estimate	Alpha Standard Error (%)	Beta Estimate	Beta Standard Error	Confidence Interval	Z-Score
not deemed to be significantly different from zero	does differ significantly from zero	1.67	3.67	0.50%	0.3	1.1	0.3	95.0%	1.96
does differ significantly from zero	does differ significantly from zero	1.67	3.67	0.50%	0.3	1.1	0.3	90.0%	1.65
not deemed to be significantly different from zero	does differ significantly from zero	1.67	3.67	0.50%	0.3	1.1	0.3	99.0%	2.58
does differ significantly from zero	not deemed to be significantly different	3.33	1.67	1.00%	0.3	0.5	0.3	95.0%	1.96
does differ significantly from zero	does differ significantly from zero	5.00	5.00	1.50%	0.3	1.5	0.3	95.0%	1.96
does differ significantly from zero	does differ significantly from zero	6.67	4.00	2.00%	0.3	1.2	0.3	95.0%	1.96
not deemed to be significantly different from zero	not deemed to be significantly different from zero	-5.00	0.83	-1.50%	0.3	0.25	0.3	95.0%	1.96

Application 9.4.2a (page 215): A 50-week rolling window analysis is performed with exactly four years of data (208 weeks). How many analyses would be performed, and how many statistically independent analyses would there be?

The 208 weeks of data would generate 158 windows of analysis, but there would be only four independent analyses, such as 1–50, 51–100, 101–150, and 151–200.



EXPLANATION

The number of windows of analyses performed is equal to 208 (weeks in the four years of data observed) minus 50 (the number of weeks in the rolling window analysis) or 158. Please note the agreement of the time frames, which is weeks. The number of independent analyses performed is a rounded division problem. (i.e. 208 divided by 50, which equals 4.16). We round 4.16 down to the nearest whole number so, there are 4 whole independent analyses.



CALCULATIONS

Calculate the number of windows of analyses performed

Step One: Press $208 \rightarrow - \rightarrow 50$

Step Two: Press $=$

Answer: 158

Calculate the number of independent analyses performed

Step One: Press $208 \rightarrow \div \rightarrow 50$

Step Two: Press $=$

Answer: 4.16, round down to 4



WORKOUT AREA: *Here are sample problems – cover one of the values in the two rightmost columns and see if you can solve it using the others*

Number of weeks in Analysis	Rolling Window	Number of Windows of Analysis	Number of Independent Analyses
208	50	158	4
300	25	275	12
4.3	1	3.3	4
400	25	375	16
500	20	480	25
250	60	190	4
450	10	440	45

Application 10.2.3a (page 234): Using the same values except that the construction costs are fixed at \$86,667 (the original expected value), find the value of the land. The math is the same except the up-state payoff to the option is \$73,333 (\$160,000 – \$86,667) and the value of the option is \$24,444 (\$73,333 x 1/3). Thus, having fixed construction costs increases the volatility of the spread, which in turn increases the value of the option. The implication is that land values benefit from decreased correlation between construction costs and improved real estate values.

$$\text{Current Value} = \text{Expected Value} = (\text{UpValue} \times \text{UpProb}) + [\text{DownValue} \times (1 - \text{UpProb})] \quad (10.2)$$



EXPLANATION

Equation 10.2 is required to solve this problem. The first point to understand with this application is that it assumes we are under no obligation to develop the land. That is important to note as it impacts the DownValue state. If we were under an obligation to develop, then we would subtract the value of the land if the economy falters (\$70,000.00) by the construction cost if the economy falters (\$86,667.00, which is the same construction cost if the economy improves). However, we find that if we subtract \$70,000.00 from \$86,667.00 for a difference of (\$16,667.00). Therefore, under any probability we would not want to lose money on an investment and since we do not have the obligation to develop the land, the downstate will be \$0 with a probability of 2/3 (the probability of the economy falters as outlined in the application). Now, we need to address the expected value of the UpValue. The UpValue is the difference between the \$160,000.00 (the value of land if the economy improves) and \$86,667.00 (the construction cost if the economy improves) or \$73,333.00. To compute the expected value of the upstate we need to multiply the UpValue or up state payoff by 2/3 (the probability that the up state payoff will occur or in this application it is the probability that the economy improves) for an expected value of \$24,444.33. Lastly, we need to sum the expected value of the up state payoff and the expected value of the down state payoff, \$24,444.33 plus \$0 equals an option price of the land of \$24,444.33.



CALCULATIONS

Find the Option Price of the Land

Step One: Press 70000 → - → 86667

Step Two: Press = “-16667”

Step Three: Press 160000 → - → 86667

Step Four: Press = “73333”

Step Five: Press 0 → x → 0.6667

Step Six: Press = “0”

Step Seven: Press 73333.33 → x → 0.3333

Step Eight: Press = “24444.33”

Step Nine: Press 24444.33 → + → 0

Step Ten: Press =

Answer: 24444.33

WORKOUT AREA: *Here are sample problems – cover one of the values in the leftmost column and see if you can solve it using the others*

Option Price of the Land	Current Value of Property	Value of Land if Economy Improves	Value of Land if Economy Falters	Construction Cost if Economy Improves	Construction Cost if Economy Falters	Risk-Neutral Probability of Economy Improvement	Risk-Neutral Probability of Economy Faltering	Expected Value of the land if the Economy Improves	Expected Value of the land if the Economy Falters
\$24,444.33	\$100,000.00	\$160,000.00	\$70,000.00	\$86,667.00	\$86,667.00	33.33%	66.67%	\$24,444.33	-\$11,111.33
\$20,000.00	\$100,000.00	\$160,000.00	\$70,000.00	\$100,000.00	\$80,000.00	33.33%	66.67%	\$20,000.00	-\$6,666.67
\$46,875.00	\$100,000.00	\$150,000.00	\$75,000.00	\$75,000.00	\$37,500.00	25.00%	75.00%	\$18,750.00	\$28,125.00
\$93,750.00	\$100,000.00	\$250,000.00	\$125,000.00	\$125,000.00	\$62,500.00	50.00%	50.00%	\$62,500.00	\$31,250.00
\$87,500.00	\$100,000.00	\$200,000.00	\$100,000.00	\$100,000.00	\$50,000.00	75.00%	25.00%	\$75,000.00	\$12,500.00
\$27,500.00	\$100,000.00	\$100,000.00	\$50,000.00	\$50,000.00	\$25,000.00	10.00%	90.00%	\$5,000.00	\$22,500.00
\$28,500.00	\$100,000.00	\$95,000.00	\$47,500.00	\$47,500.00	\$23,750.00	20.00%	80.00%	\$9,500.00	\$19,000.00

Application 10.2.3b (page 234): Return to the original values and find the value of the land, assuming that economic uncertainty increases such that improved properties either rise to \$180,000 or fall to \$60,000, with all other values remaining the same. Following the same math, the risk-neutral probabilities are the same (the up probability is 1/3). The value to developing is \$80,000 in the up state and \$0 in the down state (the construction costs exceed the developed value). The option price rises to \$26,667 ($\$80,000 \times 1/3$). This value is higher than in the original example and demonstrates that volatility favors the option holder. Higher volatility increases the upside profit potential without increasing the loss potential due to the limited downside risk afforded by long option positions.

$$\text{Current Value} = \text{Expected Value} = (\text{UpValue} \times \text{UpProb}) + [\text{DownValue} \times (1 - \text{UpProb})] \quad (10.2)$$



EXPLANATION

Please see the explanation for **Application 10.2.3a**.



CALCULATIONS

Find the Option Price of the Land

Step One: Press 60000 → - → 80000

Step Two: Press = “-20000”

Step Three: Press 180000 → - → 100000

Step Four: Press = “26666.67”

Step Five: Press 0 → x → 0.6667

Step Six: Press = “0”

Step Seven: Press 80000 → x → 0.3333

Step Eight: Press = “26666.67”

Step Nine: Press 26666.67 → + → 0

Step Ten: Press =

Answer: 26666.67



WORKOUT AREA: *Here are sample problems – cover one of the values in the leftmost column and see if you can solve it using the others*

Option Price of the Land	Current Value of Property	Value of Land if Economy Improves	Value of Land if Economy Falters	Construction Cost if Economy Improves	Construction Cost if Economy Falters	Risk-Neutral Probability of Economy Improvement	Risk-Neutral Probability of Economy Faltering	Expected Value of the land if the Economy Improves	Expected Value of the land if the Economy Falters
\$26,666.67	\$100,000.00	\$180,000.00	\$60,000.00	\$100,000.00	\$80,000.00	33.33%	66.67%	\$26,666.67	-\$13,333.33
\$106,666.67	\$100,000.00	\$200,000.00	\$190,000.00	\$100,000.00	\$80,000.00	33.33%	66.67%	\$33,333.33	\$73,333.33
\$52,500.00	\$100,000.00	\$250,000.00	\$100,000.00	\$100,000.00	\$80,000.00	25.00%	75.00%	\$37,500.00	\$15,000.00
\$25,000.00	\$100,000.00	\$150,000.00	\$50,000.00	\$100,000.00	\$80,000.00	50.00%	50.00%	\$25,000.00	-\$15,000.00
\$167,500.00	\$100,000.00	\$300,000.00	\$150,000.00	\$100,000.00	\$80,000.00	75.00%	25.00%	\$150,000.00	\$17,500.00
\$133,000.00	\$100,000.00	\$350,000.00	\$200,000.00	\$100,000.00	\$80,000.00	10.00%	90.00%	\$25,000.00	\$108,000.00
\$0.00	\$100,000.00	\$100,000.00	\$50,000.00	\$100,000.00	\$80,000.00	20.00%	80.00%	\$0.00	-\$24,000.00

Application 10.2.4a (page 235): Land that remains undeveloped is estimated to generate an expected return of 5%, and land that is developed is estimated to generate an expected single-period return of 25%. If the probability that a parcel of land will be developed is 10% over the next period, what is its expected return? Inserting the values into Equation 10.3 generates $[(0.10 \times 0.25) + (0.90 \times 0.05)] = 7\%$.

$$E(R_t) = [P_d \times E(R_d)] + [(1 - P_d) \times E(R_{nd})] \quad (10.3)$$



EXPLANATION

As you can see by the similarity between equation 10.2 and 10.3,

$$\text{Value} = (\text{UpValue} \times \text{UpProb}) + [\text{DownValue} \times (1 - \text{UpProb})] \quad (10.2)$$

this application is much like Application 10.2.3b except instead of UpValue and DownValue, there is DevelopedReturn and UndevelopedReturn. Let's begin by computing the undeveloped expected value. We know that the return of the undeveloped parcel of land is 5% and the probability that the land remains undeveloped is 90%, found by subtracting 10% (the probability that the land will be developed) from 1. If we multiply 5% (the return of the undeveloped parcel of land) by 90% (the probability that the land will remain undeveloped) the product is the expected value of the undeveloped parcel of land or 4.5%. Now the expected return of the developed land is calculated by multiplying 25% (the return of the land once developed) by 10% (the probability that the land will be developed) for a product of 2.5% (the expected return of the developed land). We are ready to compute the overall expected value of the parcel of land which is equal to the sum of 2.5% and 4.5% or 7%. 7% is the expected value of the parcel of land.



CALCULATIONS

Find the expected return of the Land

Step One: Press $0.05 \rightarrow x \rightarrow 0.90$

Step Two: Press = "0.045"

Step Three: Press $0.25 \rightarrow x \rightarrow 0.10$

Step Four: Press = "0.025"

Step Five: Press $0.045 \rightarrow + \rightarrow 0.07$

Step Six: Press =

Answer: 0.07



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Expected Return	Undeveloped Land Return	Developed Land Return	Probability of Development
7.00%	5.00%	25.00%	10.00%
7.68%	5.50%	20.00%	15.00%
11.00%	10.00%	30.00%	5.00%
9.00%	2.50%	35.00%	20.00%
6.07%	4.00%	27.00%	9.00%
7.13%	6.00%	21.00%	7.50%
9.50%	8.00%	33.00%	6.00%

Application 10.2.4b (page 235): Land that remains undeveloped is estimated to generate an expected return of 5%, and land that is developed is estimated to generate an expected single-period return of 25%. If 20% of land in a database is developed in a particular year, by how much will an index based on land that remains undeveloped understate the average return on all land? Inserting the realized values into Equation 10.3 in place of the expected values generates that the mean return of a portfolio (with 20% development) is $[(0.20 \times 0.25) + (0.80 \times 0.05)] = 9\%$. The historical index of returns based on land that remained undeveloped was 5%. The negative survivorship bias was 4%.

$$E(R_t) = [P_d \times E(R_d)] + [(1 - P_d) \times E(R_{nd})] \quad (10.3)$$



EXPLANATION

We are calculating the expected returns of a land portfolio that contains both developed and undeveloped land. Let's begin by computing the undeveloped land expected returns. We know that the expected return of undeveloped parcels of land is 5.0% and the proportion of that the land remains undeveloped is 80% (found by subtracting 20.0% from 1). If we multiply 5.0% (the expected return of the undeveloped parcels of land) by 80.0% (the proportion of land left undeveloped) the product is the expected return of the undeveloped parcels of land or 4.0%. Now the expected return of the developed land is calculated by multiplying 25.0% (the expected return of the land once developed) by 20.0% (the proportion of land developed) for a product of 5% (the expected return of the developed land). We are ready to compute the overall return of the land portfolio which is equal to the sum of 4.0% (expected return on undeveloped parcels of land) and 5.0% (expected return on developed parcels of land) or 9.0%. 9% is the expected value of land portfolio. Since the historical average index return of land that remained undeveloped is 5%, the index will understate the returns of the land portfolio by 4%. The answer is found by subtracting 5% (historical average index return of land that remained undeveloped) from 9% (returns of the land portfolio) for a difference of 4%.



CALCULATIONS

Find the expected return of the Land

Step One: Press $0.05 \rightarrow x \rightarrow 0.80$

Step Two: Press = "0.04 "

Step Three: Press $0.25 \rightarrow x \rightarrow 0.20$

Step Four: Press = "0.05"

Step Five: Press $0.04 \rightarrow + \rightarrow 0.05$

Step Six: Press =

Answer: 0.09



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Expected Return	Undeveloped Land Return	Developed Land Return	Probability of Development
9.00%	5.00%	25.00%	20.00%
7.68%	5.50%	20.00%	15.00%
12.38%	6.50%	30.00%	25.00%
14.70%	6.00%	35.00%	30.00%
18.55%	7.00%	40.00%	35.00%
6.53%	4.50%	45.00%	5.00%
6.30%	4.00%	27.00%	10.00%

Application 10.4.1a (page 239): If the annual revenue in Exhibit 10.4 is expected to rise to \$40,000 and the market cap rate rises to 8%, then with all other values remaining constant, the farmland's price would rise to \$400,000 $[(\$40,000 - \$6,000 - \$2,000)/0.08]$. With a price of \$360,000 and an annual operating income of \$40,000, what would the cap rate be? From Equation 10.4:

Value of Real Estate = Annual Operating Income / Cap Rate (10.4)

$$\begin{aligned} \$360,000 &= \$40,000 / \text{cap rate} \\ \text{cap rate} &= \$40,000 / \$360,000 = 11.11\% \end{aligned}$$



EXPLANATION

There is a lot of extra information provided in this application, but the key aspects are contained in the last sentence. The price or value of the farmland is \$360,000 and the annual income is \$40,000, so manipulating equation 10.4 to read:

$$\text{Cap Rate} = \text{Annual Operating Income} / \text{Value of Real Estate}$$

We can solve for Cap rate:

$$\text{Cap Rate} = \text{Annual Operating Income} / \text{Value of Real Estate}$$

$$\text{Cap Rate} = \$40,000 / \$360,000$$

$$\text{Cap Rate} = 11.11\%$$

The cap rate is 11.11%



CALCULATIONS

Find the Cap rate

Step One: Press 40000 → ÷ → 360000

Step Two: Press =

Answer: 0.1111



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Cap Rate	Annual Oper. Inc.	Farmland Price
11.11%	\$40,000.00	\$360,000.00
12.33%	\$45,000.00	\$365,000.00
13.51%	\$50,000.00	\$370,000.00
14.67%	\$55,000.00	\$375,000.00
15.79%	\$60,000.00	\$380,000.00
16.88%	\$65,000.00	\$385,000.00
8.75%	\$35,000.00	\$400,000.00

Application 11.1.2a (page 254): Futures contracts on crude oil are often denominated in 1,000-barrel sizes. In other words, each contract calls for the holder of a short position at the delivery date of the futures contract to deliver to the long side 1,000 barrels of the specified grade of oil using stated delivery methods. Assume that a trader establishes a long position of five contracts in crude oil futures at the then-current futures market price of \$100 per barrel. Both the trader on the long side of the contract and the trader on the short side of the contract post collateral (margin) of, say, \$10 per barrel. At the end of the day, the market price of the futures contract falls to \$99. How much money will each side of the contract have (assuming that the required collateral was the only cash and that there were no other positions)?

The five contracts call for delivery of 5,000 barrels (five contracts \times 1,000 barrels). The long side of the contract loses \$5,000 as a result of the decline in price of \$1 per barrel. Each side posted collateral of \$50,000 (5,000 barrels \times \$10 per barrel). The long side experiences a decline in collateral position (cash) to \$45,000, and the short side experiences an increase in collateral position (cash) to \$55,000.



EXPLANATION

The difference between the current futures market price of \$100 and the future futures market price of \$99 is \$1. Since each contract represent 1,000 barrels, and the long side purchased 5 contracts. Therefore, the long side has 5,000 barrels of crude oil that has moved against its long position by \$1 each. The long position lost 5,000 multiplied by \$1 or \$5,000. The short position is exactly the opposite so it gained \$5,000. The futures margin is \$10 per barrel. So each position, both long and short, posted \$10 multiplied by 5,000 or \$50,000 of margin. Since we already determined that this futures price move to \$99 from \$100, impacted each position by \$5,000, we know that the long position decreased by \$5,000 to \$45,000. While the short position increase by \$5,000 to \$55,000.



CALCULATIONS

Step One: Press 100 \rightarrow - \rightarrow 99

Step Two: Press = "1"

Step Three: Press 5 \rightarrow x \rightarrow 1000

Step Four: Press = "5000"

Step Five: Press 1 \rightarrow x \rightarrow 5000

Step Six: Press = "5000"

Step Seven: Press 10 → x → 5000

Step Eight: Press = “50000”

Step Nine: Press 50000 → - → 5000


Step Ten: Press =

Answer: 45000 (Long Futures Contract Position)

Step Eleven: Press 50000 → + → 5000

Step Twelve: Press =

Answer: 55000 (Short Futures Contract Position)



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Assume the following information is unchanged: margin per barrel is \$10 and initial futures price of oil is \$100. Each side of the position puts up the required minimum initial margin.

Long Initial Collateral	Short Initial Collateral	Number of Contracts	Next Day Market Price of Futures Contract	Next Day Long Collateral	Next Day Short Collateral
\$50,000.00	\$50,000.00	5	\$100.00	\$50,000.00	\$50,000.00
\$100,000.00	\$100,000.00	10	\$100.00	\$100,000.00	\$100,000.00
\$50,000.00	\$50,000.00	5	\$99.00	\$45,000.00	\$55,000.00
\$100,000.00	\$100,000.00	10	\$102.00	\$120,000.00	\$80,000.00
\$50,000.00	\$50,000.00	5	\$95.00	\$25,000.00	\$75,000.00
\$100,000.00	\$100,000.00	10	\$106.00	\$160,000.00	\$40,000.00

Application 11.1.6a (page 257): To lock in sales prices for its anticipated production, HiHo Silver Mining Company wishes to take short positions in five silver futures contracts, settling in each quarter for the next four quarters (20 contracts total). If the initial margin requirement is \$11,000 per contract, what is the firm's total initial margin requirement?

The firm must have \$220,000 of available collateral to establish the positions.



EXPLANATION

The initial margin requirement is \$11,000 per contract. HiHo Silver Mining Company is purchasing 20 futures contracts. The product of 20 by \$11,000 is \$220,000, which is the collateral needed to establish the position.



CALCULATIONS

Step One: Press 11000 → x → 20

Step Two: Press =

Answer: 220000



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

<u>Collateral Needed to Establish Position</u>	<u>Contracts Total</u>	<u>Initial Margin Per Contract</u>
\$220,000.00	20	\$11,000.00
\$350,000.00	35	\$10,000.00
\$1,125,000.00	45	\$25,000.00
\$650,000.00	50	\$13,000.00
\$975,000.00	65	\$15,000.00
\$90,000.00	100	\$900.00
\$2,100,000.00	105	\$20,000.00

Application 11.1.7a (page 258): Returning to the previous example of an oil trader with a long position of five contracts established at an initial futures price of \$100 per barrel, the five contracts call for delivery of 5,000 barrels (five contracts \times 1,000 barrels). The trader posts exactly the required initial margin of \$50,000 (\$10,000 per contract). Suppose that the maintenance margin requirement is \$25,000 (\$5,000 per contract) and that the price of oil drops \$6 per barrel. What is the trader's margin balance after the price decline? Also, describe any margin call that might be made and what it would require.

The long side of the contract loses \$6,000 per contract (\$30,000) as a result of the decline in price of \$6 per barrel. The initial collateral of \$50,000 falls to a remaining margin balance of \$20,000 (\$4,000 per contract). The trader receives a margin call, since the remaining margin is less than the maintenance margin requirement. The amount of the margin call is \$30,000 to bring the margin back to the initial margin requirement.



EXPLANATION

The trader's margin balance is \$20,000. We arrive at that answer by multiplying the price drop, (\$6), by 5,000 barrels (the quantity in barrels covered by the 5 futures contracts of 1,000 barrels). Now, add (\$30,000) to the \$50,000 required initial margin balance for a sum of \$20,000. Since the margin balance is below the maintenance margin requirement of \$25,000, the trader would receive a margin call, which would require an additional \$30,000 to bring the margin back to the initial margin requirement.



CALCULATIONS

Step One: Press 6 \rightarrow +/- \rightarrow \times \rightarrow 5000

Step Two: Press + \rightarrow 50000

Step Three: Press =

Answer: 20000 (Margin balance after price drop)

Step Four: Press 50000 \rightarrow - \rightarrow 20000

Step Five: Press =

Answer: 30000 (Amount of margin call)



WORKOUT AREA: Here are sample problems – cover one of the values and see if you can solve it using the others. Assume trader is long the futures contracts and at “today’s” futures prices has enough collateral to exactly meet the initial margin requirement (\$10 per barrel) as indicated in the first four columns. Based on the new futures price in the fifth column, find the new collateral balance in the sixth column. Then, find the maintenance margin requirement in the seventh column by assuming a maintenance requirement of \$5 per barrel. Finally, determine if a margin call is necessary and, if so, how much additional collateral is required

Number of Contracts	Number of Barrels	Init Marg Bal	Initial Price Futures Contract	Next Day Price of Futures	New Actual Margin	Maintenance Requirement	Margin Call?	Capital Needed to Meet Margin Requirement
5	5,000	\$50,000	\$100	\$94	\$20,000	\$25,000	Yes	\$30,000
10	10,000	\$100,000	\$95	\$90	\$50,000	\$50,000	No	
15	15,000	\$150,000	\$99	\$85	-\$60,000	\$75,000	Yes	\$210,000
20	20,000	\$200,000	\$85	\$80	\$100,000	\$100,000	No	
5	5,000	\$50,000	\$60	\$64	\$70,000	\$25,000	No	
10	10,000	\$100,000	\$45	\$10	\$250,000	\$50,000	Yes	\$350,000
15	15,000	\$150,000	\$40	\$39	\$135,000	\$75,000	No	

Application 11.3.2a (page 263): A six-month forward contract on a commodity trades at a spot price of \$50. The commodity has marketwide convenience yields of 3%, storage costs of 2%, and financing costs (interest rates) of 7%. What is the price of the six-month forward contract on the commodity? The forward price is \$51.52, found by placing $0.5(7\% + 2\% - 3\%)$ in as the exponent.

$$F(T) = e^{(r+c-y)T} S \quad (11.2)$$



EXPLANATION

Application 11.3.2a involves solving for the left side of Equation 11.2 given all of the values on the right side. Note that the solution involved the exponential function (e^x). To solve for e^x simply enter the value of x into the calculator and then press the e^x button (example e^{x+y} when x has a value of 2.1 and y has a value of 3.1 has the keystrokes: $2.1 + 3.1 = e^x$).

Proficiency in applications involving Equation 11.2 may include the ability to solve for one of the values on the right side of Equation 11.2 given all of the other values (including the left side). This can be accomplished by rearranging the formula so that the missing value is alone on the left side. For S this is easy: $S = F(T) e^{-(r+c-y)T}$ (note that a term with a negative exponent is equivalent to placing the term in a denominator (e.g., $e^{-(r+c-y)T} = 1/e^{(r+c-y)T}$). For r , c , and y the term must be brought out of the exponent by taking the natural logarithm of each side of the equation. Dividing $F(T)$ by S in Equation 11.2 and taking the natural logarithm of each side produces: $\ln[F(T)/S] = (r+c-y)T$. This resulting equation can be easily factored to solve for r , c , y , or T . For example, to solve for r the equation is: $r = \{\ln[F(T)/S] - (c-y)T\} / T$. Consider a problem where $F(T) = \$52$, $S = \$50$, $c = 6\%$, $y = 4\%$ and $T = 0.25$. Therefore $r = [\ln(52/50) - (.06 - .04) * 0.25] / 0.25$. The answer is ***. Note that the natural logarithm of x is found with the keystrokes; $x \ln$.



CALCULATIONS

Step One: Press $0.07 \rightarrow + \rightarrow 0.02$

Step Two: Press $- \rightarrow 0.03$

Step Three: Press $x \rightarrow 0.5$

Step Four: Press $2^{\text{nd}} \rightarrow e^x$

Step Five: Press $x \rightarrow 50$

Step Six: Press $=$

Answer: \$51.52



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

F(T)	S	r	c	y	T
51.52	50	7.00%	2.00%	3.00%	0.50
40.59	38	3.00%	5.00%	2.00%	1.10
27.03	26	2.00%	2.00%	1.00%	1.30
13.34	14	1.00%	2.00%	4.00%	4.80
2.04	2	3.00%	5.00%	3.00%	0.37
10.00	10	2.00%	2.00%	4.00%	7.00
22.03	22	4.00%	2.00%	5.00%	0.15

Application 11.3.3a (page 265): Suppose that an important grain, such as corn, is trading in the spot or cash market at \$8 per bushel because bad weather caused a decrease in supply during the previous harvest. Market participants expect a bountiful harvest in about six months, which is expected to drive market prices down to \$5 per bushel. Forward prices with delivery dates after the next harvest are trading in the range of \$5 per bushel. How could arbitrageurs attempt to profit from these prices?

Arbitrageurs might theorize that they can (1) borrow corn, (2) sell the corn for \$8 per bushel in the cash market, (3) take a long position in a forward contract with a delivery in six months at a forward price of roughly \$5, and (4) take delivery of the corn in six months at a price of \$5. They would use the delivered corn from the forward contract to return the corn previously borrowed and pocket a riskless \$3 profit (ignoring financing costs). But they would find that nobody with an available corn supply would be willing to lend the corn at little or no cost. The reason is that entities holding inventories of corn might need the corn in the next six months. If these entities had a surplus of corn, they could sell it for \$8 in the spot market and use a long position in a forward contract to lock in a \$5 cost to replenish their inventory when needed (in six months).

$$F(T) \leq e^{(r+c-y)T} S \quad (11.3)$$



EXPLANATION

Essentially, the arbitrageur is selling the more expensive corn right now, in order to buy it back for \$3 cheaper in the future. The idea does not take into consideration convenience yield. If the entities holding the corn did not have an immediate use for the corn, it would be likely that the suppliers themselves would sell the corn immediately in order to eliminate the storage costs, but also to profit from the spread between the spot and 6 month futures price. But because the entities holding the corn have tremendously high convenience yields (e.g., keeping their livestock alive), they are willing to hold corn inventories at market prices that greatly exceed the forward price.

Therefore equation 11.3 indicates that the forward price must not exceed the value $e^{(r+c-y)T}$ (because arbitrageurs could buy the spot and sell the forward at a profit) but the forward price can be less than $e^{(r+c-y)T}$ because arbitrageur will likely be unable to short the spot price (without paying the lender a fee equal to the lender's convenience yield).

Application 11.5.5a (page 273): Consider a calendar spread that is long the two-year forward contract and short the one-year forward contract on a physical commodity with a spot price of \$100. Assume that the number of contracts in the long position equals the number of contracts in the short position. The trader put the spread on in anticipation that storage costs, c , will rise. Assume that the forward prices adhere to Equation 11.2 and that $r = 2\%$, $c = 3\%$, and $y = 5\%$. Note that these values were chosen for the simplicity that $r + c - y = 0\%$ so that the forward prices equal the spot prices. What would the profit or loss be to the trader if spot prices rose \$1? What would the profit or loss be to the trader if the storage costs rose one percentage point (from 3% to 4%)?

Changes in the spot price will not affect calendar spreads as long as none of the carrying costs change from $r + c - y = 0$. All forward prices will continue to match the spot price, and the basis of all contracts will remain zero. The trader is hedged against changes in the spot price by holding an equal number of long and short contracts. In the second scenario, when storage costs rise from 3% to 4%, $r + c - y$ will no longer equal 0, and forward prices will rise relative to spot prices. In this example, the longer delivery date of the long position (two years) will cause the forward price of the two-year forward to rise in price by more than the one-year forward, netting the trader a profit from correctly speculating that the storage costs would rise. Specifically, the two-year forward rises from \$100 to \$102.020, and the one-year forward rises from \$100 to \$101.005, netting the trader a profit of \$1.015 from being long the two-year forward and short the one-year forward. Note that the values are based on continuous compounding.

$$F(T) = e^{(r+c-y)T} S \quad (11.2)$$

$$\text{Calendar Spread} = F(T+t) - F(T) \quad (11.5)$$

where t is the length of time separating the settlement dates of the contracts.



EXPLANATION

Let's take stock of the situation. We have two positions short and long with the same number of contracts in each (let's say 1,000 units of the underlying commodity). In addition, the spot price equals the forward price because $r + c - y = 0\%$. Therefore, if there is a \$1 spot price increase, the long position would profit by \$1,000, but the short position would lose \$1,000, breaking even.

Now using the same situation, if the storage costs increase to 4% from 3% $r + c - y = 1\%$. Thus the spot price is not equal to the forward price as it was in the prior situation. Using equation 11.2,

$$F(T) = e^{(r+c-y)T} S$$

The two-year long forward price increases to:

$$F(T) = e^{(r+c-y)T} S$$

$$F(T) = e^{(0.02+0.04-0.05)2} \$100$$

$$F(T) = e^{(0.01)2} \$100$$

$$F(T) = \$102.02$$

The one-year short forward price increases to:

$$F(T) = e^{(r+c-y)T} S$$

$$F(T) = e^{(0.02+0.04-0.05)1} \$100$$

$$F(T) = e^{(0.01)1} \$100$$

$$F(T) = \$101.01$$

This nets the trader a \$1.01 (\$2.02-\$1.01) profit because the trader is long the two-year forward contract that increased by \$2.02 and short the one-year forward contract that increased by \$1.01. Note that the above numbers are rounded.

A spread can be viewed as being the same as a trade that has established a long position and a short position with the same number of contracts. A trader with long and short positions of equal total size in terms of number of contracts is protected from a parallel shift (the quantity $r+c-y$ stays constant) in the forward curve, but not necessarily from a non-parallel shift. A rise or fall in $(r+c-y)$ will disproportionately affect longer term contracts. A calendar spread is exposed to a shift in $r+c-y$.



CALCULATIONS

Price of two-year long position

Step One: Press $0.02 \rightarrow + \rightarrow 0.04$

Step Two: Press $- \rightarrow 0.05$

Step Three: Press $x \rightarrow 2$

Step Four: Press $2^{\text{nd}} \rightarrow e^x$

Step Five: Press $x \rightarrow 100$

Step Six: Press $=$

Answer: \$102.02

Price of one-year short position

Step One: Press $0.02 \rightarrow + \rightarrow 0.04$

Step Two: Press $- \rightarrow 0.05$

Step Three: Press $x \rightarrow 1$

Step Four: Press $2^{\text{nd}} \rightarrow e^x$

Step Five: Press $x \rightarrow 100$

Step Six: Press $=$

Answer: \$101.01



WORKOUT AREA: Here are sample problems – cover one of the values and see if you can solve it using the others. Assume for simplicity that at the start $r+c-y=0$ so that all forward prices equal the spot and that the trader has a spread with an equal number of long and short contracts. Although this is hedged if carrying costs remain constant (since all forward prices would move up or down by the same amount), when carrying costs change, the forward prices can shift by different amounts causing the hedge to fail (i.e., the value of the spread changes). Verify that you can calculate the last three columns given the first four columns and the fact that the positions were established with $r+c-y=0$ so that the forward prices were \$50 for the first three problems.

Spot Price	$r+c-y$	Maturity of Long	Maturity of Short	Price Long	Price Short	Profit or Loss
\$50	rises 1%	1	2	\$50.50	\$51.01	(\$0.51)
\$50	rises 2%	2	1	\$52.04	\$51.01	\$1.03
\$50	falls 1%	1	3	\$49.50	\$48.52	\$0.98
\$40	falls 3%	4	2	\$35.48	\$37.67	(\$2.19)
\$40	rises 3%	5	3	\$46.47	\$43.77	\$2.70
\$25	no change	3	5	\$25.00	\$25.00	\$0.00

Application 11.5.5b (page 274): Consider a calendar spread that is long the two-year forward contract and short the one-year forward contract on a physical commodity with a spot price of \$100. Each contract calls for delivery of one unit of the spot asset (currently trading at \$100). The trader put the spread on in anticipation that storage costs, c , will rise. Assume that the forward prices adhere to Equation 11.2 and that $r = 7\%$, $c = 3\%$, and $y = 0\%$. Note that $r + c - y = 10\%$. Assume that the trader hedges \$1,000,000 notional value in the long position with the same notional value in the short position. What short position in the one-year forward contract would hedge the \$1,000,000 notional value position in the two-year contract? What would the profit or loss be to the trader if the spot price changed or if the storage costs fell one percentage point (from 3% to 2%)?

The initial value of the two-year contract is \$122.14, and the initial value of the one-year contract is \$110.52. The hedge involves \$1,000,000 notional value in each contract, so the position in the one-year forward (with its lower price) requires 10.52% more contracts (a total of 9,048.4 contracts) than the position in the two-year forward (a total of 8,187.3 contracts).

Because both forward positions were constructed to have the same notional value in absolute terms, a change in the spot price will leave the portfolio value unchanged (everything else being equal). But if storage costs fall, the trader will suffer a loss. Falling storage costs cause forward prices to fall relative to the spot price.

In this example, the longer delivery date of the long position (two years) will cause the forward price of the two-year forward to fall by more than that of the one-year forward, netting the trader a loss from incorrectly speculating that the storage costs would rise. Specifically, the two-year forward falls from \$122.14 to \$119.72, and the one-year forward falls from \$110.52 to \$109.42. Including the different numbers of contracts in the two positions, the trader suffers a loss of \$9,851 from being long the two-year forward (now worth \$980,199) and short the one-year forward (now worth -\$990,050). Note that the values are based on continuous compounding and ignore transaction costs.

$$F(T) = e^{(r+c-y)T} S \quad (11.2)$$

$$\text{Calendar Spread} = F(T+t) - F(T) \quad (11.5)$$

where t is the length of time separating the settlement dates of the contracts.



EXPLANATION

Similar application to **Application 11.5.5a**, however, in this case instead of the $r + c - y = 0\%$ (which means that all forward prices are equal), $r + c - y = 10\%$ and forward prices are not equal. To form a hedge against parallel shifts in the forward curve (such as when the spot price changes but carrying costs do not change) a trader would need to have the total notional value of all long positions equal to the total notional value of all short positions. In the first case ($r+c-y=0$), covered in the previous application, hedging is simple: the two contracts have the same price and so a hedge is formed by having the same number of contracts long and short.

In the case of $r+c-y = 10\%$ the contract prices differ for different settlement dates. Therefore in order to hedge with equal notional amounts of long and short positions, the price of each contract has to be considered in determining the number of contracts. The goal is to set the notional value (number of contracts multiplied by the price per contract) equal for both the long and short positions. In the case of a long position with \$1,000,000 of notional value, the number of one-year short forward contracts that would hedge the long position is $\$1,000,000 / \$110.52 = 9,048.37$. Now for any fluctuation in the spot price, the portfolio's value is hedged (holding carrying costs constant).

The problem of a change in the spot price is fixed. However, as before, the portfolio is not hedged against a change in carrying costs. If the storage costs decrease to 2% from 3%, let's analyze what would happen to the portfolio's profit. The two-year long forward contract price would be:

$$\begin{aligned}F(T) &= e^{(r+c-y)T} S \\F(T) &= e^{(0.07+0.02-0.00)2} \$100 \\F(T) &= e^{(0.09)2} \$100 \\F(T) &= \$119.72\end{aligned}$$

That is significantly less than then the \$122.14 original two-year long forward contract price. Therefore, this position loses $\$119.72 - \$122.14 = (\$2.42)$. Calculating the price for the short forward contract in the same manner:

$$\begin{aligned}F(T) &= e^{(r+c-y)T} S \\F(T) &= e^{(0.07+0.02-0.00)1} \$100 \\F(T) &= e^{(0.09)1} \$100 \\F(T) &= \$109.42\end{aligned}$$

The short position earns a profit of $\$110.52 - \$109.42 = \$1.10$. Therefore, the trader incurs a loss of $\$9,860.08$ ($\$1.10 \times 9048.37 + (\$2.42) \times 8187.31$).



CALCULATIONS

Short hedging position

Step One: Press 0.07 \rightarrow + \rightarrow 0.03

Step Two: Press - \rightarrow 0.00

Step Three: Press x \rightarrow 1

Step Four: Press 2^{nd} $\rightarrow e^x$

Step Five: Press x \rightarrow 100

Step Six: Press = "110.52"

Step Seven: Press 1000000 \rightarrow \div \rightarrow 110.52

Answer: 9048.37

Price of two-year long position with 2% storage costs

Step One: Press 0.07 \rightarrow + \rightarrow 0.02

Step Two: Press - \rightarrow 0.00

Step Three: Press x \rightarrow 2

Step Four: Press 2^{nd} $\rightarrow e^x$

Step Five: Press x \rightarrow 100

Step Six: Press =

Answer: 119.72

Price of one-year short position with 2% storage costs

Step One: Press 0.07 \rightarrow + \rightarrow 0.02

Step Two: Press - \rightarrow 0.00

Step Three: Press x \rightarrow 1

Step Four: Press 2^{nd} $\rightarrow e^x$

Step Five: Press x \rightarrow 100

Step Six: Press =

Answer: 109.42

Profit loss with change in portfolio with 2% storage costs

Step One: Press 110.52 \rightarrow - \rightarrow 109.42

Step Two: Press = "1.10"

Step Three: Press 119.42 \rightarrow - \rightarrow 122.14

Step Four: Press = "2.42"

Step Five: Press 1.10 \rightarrow x \rightarrow 9048.37

Step Six: Press = "9953.21"

Step Seven: Press 2.42 \rightarrow +/- \rightarrow x \rightarrow 8187.31

Step Eight: Press = "-19813.29"

Step Nine: 9953.21 \rightarrow + \rightarrow 19813.29 \rightarrow +/-

Step Ten: Press =

Answer: -9851.16



WORKOUT AREA: Here are sample problems– assumes that positions are established when $r+c-y=10\%$. Try to calculate the number of contracts needed to create \$1,000,000 of notional value for both the long side and short side. Then try to determine the new forward prices after carrying costs shift. Finally, verify the profit or loss. Note that the first row is from the previous example.

Assumes $r+c-y$ is 10% to start:								
Spot		Maturity	Maturity	Number	Number	New	New	Profit
price	$r+c-y$	of Long	of Short	of Long	of Short	Price Long	Price Short	or Loss
\$100	0.09	2	1	8,187.31	9,048.37	\$119.72	\$109.42	(\$9,851.16)
\$100	0.12	2	1	8,187.31	9,048.37	\$127.12	\$112.75	\$14.38
\$50	0.09	1	3	18,096.75	14,816.36	\$54.71	\$65.50	(\$10.79)
\$50	0.07	4	2	13,406.40	16,374.62	\$66.16	\$57.51	\$8.64
\$40	0.13	5	3	15,163.27	18,520.46	\$76.62	\$59.08	\$17.54
\$30	0.10	3	5	24,693.94	20,217.69	\$40.50	\$49.46	\$0.00

Application 13.4.3a (page 318): Loosely following some of the values indicated earlier in this section for films, assume that the probability of substantial success for an investment in IP (p) is 6%, the rate at which expected cash flows diminish each year after their initial potential (g) is 5%, and the required rate of return (r) is 12%. How much would this investment in IP be worth per dollar of projected possible first-year cash flow (CF_1)? This example normalizes the analysis to a value of \$1 for CF_1 . Using Equation 13.1 produces $(0.06 \times \$1)/[0.12 - (-0.05)]$, which equals approximately \$0.35. Roughly estimated, the value of the IP might be only 35 cents for each dollar of initial annual cash inflow that would be generated, assuming that the initial cash flow is a potential cash flow and therefore represents a very successful outcome.

$$V_{ip,0} = p \times CF_1 / (r - g) \quad (13.1)$$



EXPLANATION

Essentially, this formula is the perpetuity growth model (albeit with a negative growth rate) multiplied by the probability of success for the investment as shown in equation 13.1:

$$V_{ip,0} = p \times \frac{CF_1}{(r - g)}$$

To solve this equation to find out how much this investment in IP will be worth per dollar of first-year cash flows, we need to plug in the appropriate value, $p = 6\%$, $g = -5\%$, $r = 12\%$, and $CF_1 = \$1$.

$$V_{ip,0} = p \times \frac{CF_1}{(r - g)}$$

$$V_{ip,0} = 0.06 \times \frac{1}{(0.12 - -0.05)}$$

$$V_{ip,0} = 0.06 \times \frac{1}{(0.17)}$$

$$V_{ip,0} = 0.06 \times 5.88$$

$$V_{ip,0} = 0.35$$



CALCULATIONS

Step One: Press 0.12 \rightarrow - \rightarrow 0.05 \rightarrow +|-

Step Two: Press = "0.17"

Step Three: Press 1 \rightarrow \div \rightarrow 0.17

Step Four: Press x \rightarrow 0.06

Step Five: Press =

Answer: 0.35



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Application 13.4.3a

Value per Dollar of IP Investment	p	g	r	CF_1
\$0.82	14.00%	-5.00%	12.00%	\$1.00
\$0.28	5.00%	-2.00%	16.00%	\$1.00
\$0.83	10.00%	-3.00%	9.00%	\$1.00
\$0.53	8.00%	1.00%	16.00%	\$1.00
\$2.50	20.00%	2.00%	10.00%	\$1.00
\$0.08	1.00%	-5.00%	8.00%	\$1.00
\$6.00	12.00%	-1.00%	1.00%	\$1.00

Application 13.4.3b (page 318): Assume that Equation 13.2 is an appropriate valuation model and that $CF_1/V_{ip,0}$ is 3.0, p is 0.06, and g is -0.05 . What is the investment's annual rate of return? Inserting the values generates the result that r is 13%.

$$r = p \times (CF_1 / V_{ip,0}) + g \quad (13.2)$$



EXPLANATION

To solve this application we need to use equation 3.2:

$$r = p \times \left(\frac{CF_1}{V_{ip,0}} \right) + g$$

With equation 3.2 at hand, we need to plug in the given figures and solve for r . In this application $p = 0.06$, $g = -0.05$, and $\frac{CF_1}{V_{ip,0}} = 3.0$.

$$r = 0.06 \times (3.0) + -0.05$$

$$r = 0.18 + -0.05$$

$$r = 0.13$$

The answer is $r = 13\%$.



CALCULATIONS

Step One: Press 3.0 \rightarrow \times \rightarrow 0.06 \rightarrow $+\mid-$

Step Two: Press + \rightarrow 0.05 \rightarrow $+\mid-$

Step Three: Press =

Answer: 0.13



WORKOUT AREA: Here are sample problems – cover one of the values and see if you can solve it using the others

Annual Rate of Return	p	g	CF_1/V_{ip}
13.00%	6.00%	-5.00%	3.00
16.00%	5.00%	-4.00%	4.00
47.00%	10.00%	-3.00%	5.00
9.00%	8.00%	1.00%	1.00
52.00%	25.00%	2.00%	2.00
-3.00%	1.00%	-5.00%	2.00
59.00%	12.00%	-1.00%	5.00

Application 14.2.1a (page 324): Assume that a borrower takes out a \$100,000, 25-year mortgage (300 months), at a 6% annual nominal interest rate (a monthly interest rate of 6%/12, or 0.5%). What is the mortgage's monthly payment? The monthly payments (principal plus interest) can be calculated using Equation 14.1 directly, as follows:

$$MP = \$100,000 \times \{0.005 / [1 - (1.005)^{-300}]\} = \$644.30$$

Using a financial calculator, the monthly mortgage payment is calculated by inputting the following values: n (number of periods) = $12 \times 25 = 300$ months, i (interest rate per period) = $6\%/12 = 0.5\%$, PV (present value) = $\pm \$100,000$, FV (future value) = $\$0$, and solving for (compute) PMT (payment). The PV is entered as either a positive or a negative number, depending on the calculator that is used. Note that some financial calculators require that the interest rate of 0.5% be entered as .005 and some as .5. Also, some financial calculators require prior clearing, use, or output of negative numbers and may or may not require input of other values, such as the FV . Spreadsheets contain functions analogous to the financial calculator functions that are demonstrated throughout this chapter. In Excel, the payment can be calculated using $=pmt$ (annual rate/12, number of months, loan amount). Note that payment amounts in practice are rounded to the nearest cent.

$$MP = MB \times \{i / [1 - (1 + i)^{-n}]\} \quad (14.1)$$



EXPLANATION

The mathematical way to solve this problem is using equation 14.1 as follows:

$$\begin{aligned} MP &= MB \times \{i / [1 - (1 + i)^{-n}]\} \\ MP &= \$100,000 \times \{0.005 / [1 - (1 + 0.005)^{-300}]\} \\ MP &= \$100,000 \times \{0.005 / [1 - (1.005)^{-300}]\} \\ MP &= \$100,000 \times \{0.005 / [1 - 0.22396568]\} \\ MP &= \$100,000 \times \{0.005 / 0.77603432\} \\ MP &= \$100,000 \times \{0.0064430\} \\ MP &= \$644.30 \end{aligned}$$

The monthly payment is \$644.30 (rounded). However, there is a way to use the time value of money (TVM) functions on the TI-BA II Plus to solve this problem as well.



CALCULATIONS

Step One: Press 2nd → CLR TVM

Step Two: Press 12 → x → 25 → = → N

Step Three: Press 6 → ÷ → 12 → = → I/Y

Step Four: Press 100000 → +/- → PV

Step Five: Press 0 → FV

Step Six: Press CPT → PMT

Answer: 644.30



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Loan Monthly		Annual	Time Frame	Amortization
			(Years, Compounded Monthly)	
Payment	Loan Value	Interest Rate		Balance
\$644.30	\$100,000.00	6.00%	25	\$0.00
\$632.07	\$100,000.00	6.50%	30	\$0.00
\$1,085.26	\$100,000.00	5.50%	10	\$0.00
\$1,509.27	\$100,000.00	7.00%	7	\$0.00
\$739.69	\$100,000.00	4.00%	15	\$0.00
\$632.65	\$100,000.00	4.50%	20	\$0.00
\$1,774.74	\$100,000.00	2.50%	5	\$0.00

Application 14.2.1b (page 325): What would be the outstanding mortgage balance at the start of month 61 in terms of remaining principal of a \$100,000, 25-year mortgage (300 months), at a 6% annual nominal interest rate? As shown in Exhibit 14.1, the outstanding mortgage balance at the start of month 61 in terms of remaining principal is \$89,932.18, five years after the loan has been taken out. This amount does not correspond exactly to a present value computation of the balance using the exact payment amount of \$644.30 (using a financial calculator: $n = 12 \times 20 = 240$, $i = 6.0\%/12 = 0.5\%$, $PMT = \$644.30$, $FV = \$0$, solve for PV). The reason is that mortgage payments are values that in practice are rounded to the nearest cent, and mortgage amortization computations (such as Exhibit 14.1) are based on this rounded payment amount (\$644.30) rather than a more exact payment amount (\$644.3014). For simplicity, this discrepancy caused by rounding error is disregarded in the computations that follow. Notice that over time, the proportion of interest payment to principal payment declines, and increasingly a larger portion of the total payment is allocated to paying down the principal.

$$MP = MB \times \{i / [1 - (1 + i)^{-n}]\} \quad (14.1)$$



EXPLANATION

We can use equation 14.1 to solve this equation once again, after a bit of manipulating:

$$MP = MB \times \{i / [1 - (1 + i)^{-n}]\}$$

$$\frac{MP}{\{i / [1 - (1 + i)^{-n}]\}} = MB$$

After we have manipulated the equation, we can solve for the mortgage balance:

As you can see owing to the minor rounding of the payment, we can arrive at a nontrivially different mortgage balance when compounded through the years.



CALCULATIONS

Step One: Press 2nd → CLR TVM

Step Two: Press 12 → x → 20 → = → N

Step Three: Press 6 → ÷ → 12 → = → I/Y

Step Four: Press 644.3021 → PMT

Step Five: Press 0 → FV

Step Six: Press CPT → PV

Answer: 89,932.18



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Loan Monthly Payment	Initial Loan Value	Annual Interest Rate	Month of Mortgage Life	Original Maturity	Remaining Principal
\$644.30	\$100,000.00	6.00%	61	25	\$89,932.09
\$706.78	\$100,000.00	7.00%	30	25	\$96,111.76
\$908.70	\$100,000.00	10.00%	40	25	\$96,543.64
\$584.59	\$100,000.00	5.00%	50	25	\$90,892.54
\$474.21	\$100,000.00	3.00%	10	25	\$97,961.80
\$768.91	\$100,000.00	8.50%	15	30	\$99,111.70
\$675.21	\$100,000.00	6.50%	20	25	\$97,335.16

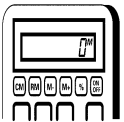
Application 14.2.1c (page 327): Suppose that the market interest rate for the mortgage in Exhibit 14.1 rises to 7.5%. What is the market value of the mortgage, assuming it is the start of month 61? The market value is equal to \$79,978.33 (using a financial calculator: $n = 12 \times 20 = 240$, $i = 7.5\%/12 = 0.625\%$, $PMT = \$644.30$, $FV = \$0$, solve for PV). At a new and lower market interest rate of 4.5%, the market value of the mortgage is equal to \$101,841.56 (found as before except that $i = 4.5\%/12 = 0.375\%$). These values illustrate that the market value of fixed-rate mortgages, as fixed-income securities, varies inversely with market interest rates.

$$MP = MB \times \{i / [1 - (1+i)^{-n}]\} \quad (14.1)$$



EXPLANATION

Please see the explanation for **Application 14.2.1b**. Note that this application changes the computation of the mortgage's value during its life from the remaining principal to the market value based on a new market interest rate. Otherwise, the computation is the same.



CALCULATIONS

Step One: Press 2nd → CLR TVM

Step Two: Press 12 → x → 20 → = → N

Step Three: Press 4.5 → ÷ → 12 → = → I/Y

Step Four: Press 644.30 → PMT

Step Five: Press 0 → FV

Step Six: Press CPT → PV

Answer: 101841.56



WORKOUT AREA: *Here are sample problems – cover one of the values in the market value column and see if you can solve it using the others*

Loan Monthly Payment	Initial Loan Value	Annual Interest Rate	Month of Mortgage Life	Original Maturity	Market Value	New Rate
\$644.30	\$100,000.00	6.00%	61	25	\$97,627.97	5.00%
\$706.78	\$100,000.00	7.00%	30	25	\$125,984.98	4.00%
\$908.70	\$100,000.00	10.00%	40	25	\$78,841.64	13.00%
\$584.59	\$100,000.00	5.00%	50	25	\$83,483.12	6.00%
\$474.21	\$100,000.00	3.00%	10	25	\$69,369.36	6.50%
\$768.91	\$100,000.00	8.50%	15	30	\$133,284.24	5.50%
\$675.21	\$100,000.00	6.50%	20	25	\$93,170.65	7.00%

Application 14.2.2a (page 328): Consider a \$100,000 mortgage that is structured as a 10/15 interest-only mortgage, with an annual rate of 6%. What would the payments be for the first 10 and the last 15 years? For the first 10 years, the monthly payments, which are interest only, would be \$500 ($\$100,000 \times 6.0\%/12$). Between years 11 and 25, the monthly fixed payment necessary to fully amortize the mortgage for the remaining 15 years would be \$843.86 (using a financial calculator: $n = 12 \times 15 = 180$, $i = 6\%/12 = 0.5\%$, $PV = +/\$100,000$, $FV = \$0$, solve for PMT).

$$MP = MB \times \{i / [1 - (1 + i)^{-n}]\} \quad (14.1)$$



EXPLANATION

There are two separate problems in this application:

- 1) We need to determine the interest only payments for the first 10 years of the mortgage
- 2) We need to determine the fixed payment that will amortize the mortgage for the remaining 15 years.

For the first 10 years, since it is interest only all we need to do is calculate the monthly interest rate from the annual interest of 6% by dividing it by 12 for a monthly rate of 0.5%. Then take the monthly interest rate of 0.5% and multiply it by 100000, the value of the mortgage, for a monthly payment of \$500.

For an explanation on how to solve for the amortized payment, see **Application 14.2.1a**.



CALCULATIONS

Find payments for the first 10 years

Step One: Press .06 → ÷ → 12

Step Two: Press x → 100000

Step Three: Press =

Answer: 500

Find payments for the last 15 years

Step One: Press 2nd → CLR TVM

Step Two: Press 12 → x → 15 → = → N

Step Three: Press 6 → ÷ → 12 → = → I/Y

Step Four: Press 100000 → +/- → PV

Step Five: Press 0 → FV

Step Six: Press CPT → PMT

Answer: 843.86



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Loan Monthly Payment (First 10 Years)	Loan Monthly Payment (Last 15 Years)	Loan Value	Annual Interest Rate	25 Year (10/15 Interest Only Mortgage)		Amortization Balance
\$500.00	\$843.86	\$100,000.00	6.0%	10	15	\$0.00
\$812.50	\$1,306.66	\$150,000.00	6.5%	10	15	\$0.00
\$916.67	\$1,634.17	\$200,000.00	5.5%	10	15	\$0.00
\$1,562.50	\$2,317.53	\$250,000.00	7.5%	10	15	\$0.00
\$2,125.00	\$2,954.22	\$300,000.00	8.5%	10	15	\$0.00
\$333.33	\$477.83	\$50,000.00	8.0%	10	15	\$0.00
\$1,604.17	\$2,859.79	\$350,000.00	5.5%	10	15	\$0.00

Application 14.2.3a (page 330): What would the monthly payment be for the mortgage in Exhibit 14.2 in the second year, when the mortgage's rate climbs to 10.0%? Note that it is necessary to decrease the mortgage's original principal to reflect amortization and decrease the months remaining by 12, to 288. From Exhibit 14.2, the monthly mortgage payment that the borrower would have to make during the second year, for which a higher index rate of 8.5% applies, is equal to \$903.36 ($n = 12 \times 24 = 288$, $i = 10\%/12$, $PV = +/\text{--}\$98,470.30$, $FV = \$0$, solve for PMT). Notice that the increase in interest rates between the first year and the second year has caused a substantial increase (27.81%) in the monthly payment that the borrower is obligated to make.

$$MP = MB \times \{i / [1 - (1 + i)^{-n}]\} \quad (14.1)$$



EXPLANATION

Please see the explanation for **Application 14.2.1a**.



CALCULATIONS

Step One: Press 2nd → CLR TVM

Step Two: Press 12 → x → 24 → = → N

Step Three: Press 10 → ÷ → 12 → = → I/Y

Step Four: Press 98470.30 → +/- → PV

Step Five: Press 0 → FV

Step Six: Press CPT → PMT

Answer: 903.36



WORKOUT AREA: Here are sample problems – cover one of the values and see if you can solve it using the others. **NOTE:** The loan values in rows 2-7 are arbitrary. Also note that all rows assume an initial mortgage maturity of 25 years and that the number in the fourth column represents the year number: The 4 in row 4 requests the mortgage payment for the first month of the fourth year. The first month of the fourth year begins with 264 months remaining: $((25*12)-(3*12))$.

Loan Monthly Payment	Loan Value	Interest Rate Per Year	Time: Year # (start of Year)	Amortization Balance
\$903.36	\$98,470.30	10.00%	2	\$0.00
\$782.05	\$100,000.00	8.00%	2	\$0.00
\$882.77	\$100,000.00	9.50%	2	\$0.00
\$760.28	\$100,000.00	9.00%	4	\$0.00
\$917.39	\$100,000.00	10.00%	2	\$0.00
\$743.58	\$100,000.00	8.50%	3	\$0.00
\$642.76	\$100,000.00	7.50%	4	\$0.00

Application 14.2.4a (page 332): To illustrate balloon payments, assume that the borrower and the lender in the original example decide that the \$100,000 loan made at the fixed rate of 6% per year compounded monthly for 25 years will amortize to a \$70,000 balance on the 25-year maturity date rather than being fully amortized to \$0. This amount of \$70,000 is known as a balloon payment and will be due at the end of 25 years. In this case, the monthly payment would be equal to \$543.29 (using a financial calculator: $n = 12 \times 25 = 300$, $i = 6\%/12 = 0.5\%$, $PV = +/- \$100,000$, $FV = \$70,000$, solve for PMT). Notice that the \$543.29 monthly payment is less than the \$644.30 payment that was computed for the case of the fully amortizing loan, even though the interest rates in both mortgages are equal to 6%.

$$MP = MB \times \{i / [1 - (1+i)^{-n}]\} \quad (14.1)$$



EXPLANATION

Please see the explanation for **Application 14.2.1a**. The key is that the present value of the mortgage payments not only include the present value of the payments (entered as with the PMT key) but also the present value of the balloon payment (entered with the FV key). The PMT and FV must be of the same sign.



CALCULATIONS

Step One: Press 2nd → CLR TVM

Step Two: Press 12 → x → 25 → = → N

Step Three: Press 6 → ÷ → 12 → = → I/Y

Step Four: Press 100000 → +/- → PV

Step Five: Press 70000 → FV

Step Six: Press CPT → PMT

Answer: 543.29



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Loan Monthly Payment	Loan Value	Fixed Rate Per Year	Time Frame (Years, Compounded Monthly)	Amortization Balance (Balloon Payment)
\$543.29	\$100,000.00	6.00%	25	\$70,000.00
\$643.62	\$100,000.00	6.50%	20	\$50,000.00
\$603.83	\$100,000.00	7.00%	30	\$75,000.00
\$706.46	\$100,000.00	5.00%	10	\$55,000.00
\$605.13	\$100,000.00	5.50%	7	\$85,000.00
\$375.00	\$100,000.00	4.50%	25	\$100,000.00
\$892.19	\$100,000.00	7.50%	8	\$65,000.00

Application 14.4.2a (page 339): Mortgage B experiences a CPR of 2% in its 20th month. How would this prepayment rate be expressed using the PSA benchmark? Mortgage B has a PSA prepayment speed of 50% in month 20. Mortgage B's prepayment rate of 2% is 50% of the 4% benchmark. The 4% benchmark is $0.2\% \times 20$ months, since the month number is less than 30.



EXPLANATION

This application may seem slightly complicated, but it is actually quite easy. Let's take stock of what we know. Mortgage B has a CPR of 2% in month 20. We know enough to solve this problem. The PSA benchmark is 0.2% multiplied by the number of months into the life of the mortgage, in this case 20. (The benchmark hits its 6% maximum at month 30). The 20 months times the 0.2% per month is a product of 4%. Dividing 2% by 4% the PSA prepayment rate is 50%.



CALCULATIONS

Step One: Press $0.02 \rightarrow \div \rightarrow 0.04$

Step Two: Press =

Answer: 0.50



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Mortgage CPR	Month	PSA Benchmark	PSA Prepayment Rate
1.00%	2	0.40%	250.0%
1.00%	7	1.40%	71.4%
3.00%	4	0.80%	375.0%
2.00%	15	3.00%	66.7%
1.00%	19	3.80%	26.3%
6.00%	40	6.00%	100.0%
2.00%	20	4.00%	50.0%

Application 14.4.2b (page 339): Mortgage C experiences a PSA rate of 200% in each month and is now five years old. What is its CPR? The PSA standard is 6% at 30 months and beyond, and 200% of 6% is 12%. Since the mortgage is already at or beyond month 60, the CPR for the mortgage is now 12%.



EXPLANATION

At month 60 (5 years), the PSA benchmark is 6% (every month after 30 is 6%). The PSA rate is 200%. Therefore, the CPR rate is 200% multiplied by 6% or 12%. This problem is manipulating the equation utilized in Application 14.4.2a.



CALCULATIONS

Step One: Press 2 → x → 0.06

Step Two: Press =

Answer: 0.12



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Five Year old; Mortgage C CPR	Mortgage C	
	PSA Rate Each Month	PSA Standard at 30 Months
12.00%	200.00%	6.00%
15.00%	250.00%	6.00%
9.00%	150.00%	6.00%
6.00%	100.00%	6.00%
18.00%	300.00%	6.00%
21.00%	350.00%	6.00%
24.00%	400.00%	6.00%

Application 15.2.2a (page 354): Assume that U.S. Treasury notes with a seven-year maturity are currently yielding 5.8%, that the liquidity premium is 1% per year, and that the required or anticipated risk premium for the systematic risk of the real estate project is 2.2% per year. With these numbers, the required rate of return for this real estate project is 9%. The required return using Equation 15.3 is found as $(1.058 \times 1.01 \times 1.022) - 1$, or 9.21%. Using Equation 15.4, the three rates sum to 9% (i.e., $5.8\% + 1.0\% + 2.2\% = 9\%$).

$$r = [1 + R_f][1 + E(R_{LP})][1 + E(R_{RP})] - 1 \quad (15.3)$$

$$r \approx R_f + E(R_{LP}) + E(R_{RP}) \quad (15.4)$$



EXPLANATION

There are two ways to solve this application. Equation 15.3 is the *exact* required rate of return, while equation 15.4 is an approximate required rate of return. Let's start by calculating the required rate of return using 15.4:

$$r \approx R_f + E(R_{LP}) + E(R_{RP})$$

$$r \approx 0.058 + 0.01 + 0.022$$

$$r \approx 0.068 + 0.022$$

$$r \approx 0.09$$

The approximate required rate of return is 9%. Now, let's calculate the *exact* required rate of return using equation 15.3.

$$r = [1 + R_f][1 + E(R_{LP})][1 + E(R_{RP})] - 1$$

$$r = [1 + 0.058][1 + 0.022][1 + 0.01] - 1$$

$$r = [1.058][1.022][1.01] - 1$$

$$r = [1.081276][1.01] - 1$$

$$r = [1.09208876] - 1$$

$$r = 0.09208876$$

The *exact* required rate of return is 9.21%.



CALCULATIONS

Find the approximate required rate of return

Step One: Press 0.058 → +

Step Two: Press 0.01 → + → 0.022

Step Three: Press =

Answer: 0.09

Find the exact required rate of return

Step One: Press 1 → + → 0.058

Step Two: Press = “1.058”

Step Three: Press 1 → + → 0.022

Step Four: Press = “1.022”

Step Five: Press 1 → + → 0.01

Step Six: Press = “1.01”


Step Seven: Press 1.058 → x → 1.022

Step Eight: Press x → 1.01

Step Nine: Press - → 1


Answer: 0.0921

WORKOUT AREA: *Here are sample problems based on the approximation model– cover one of the values and see if you can solve it using the others*



Required Rate of Return for this Real Estate Project	Yield of 7-Year U.S. Treasury Notes	Liquidity Premium per year	Required or Anticipated Risk Premium for the Systematic Risk of the Real Estate Project
9.00%	5.80%	1.00%	2.20%
9.40%	5.60%	1.50%	2.30%
8.80%	5.30%	1.00%	2.50%
9.60%	4.60%	2.00%	3.00%
8.45%	5.10%	1.25%	2.10%
10.95%	6.70%	1.15%	3.10%
11.25%	7.30%	1.75%	2.20%

Application 15.2.3a (page 356): Investment A offers \$80 per year in taxable income and an additional final non-taxable cash flow in five years of \$1,000. An investor in a 40% tax bracket requires a pre-tax return of 8% and an after-tax return of 4.8% on investments. What is the value of Investment A on both a pre-tax basis and an after-tax basis? On a pre-tax basis, Investment A is worth \$1,000, found on a financial calculator as $PMT = \$80$, $FV = \$1,000$, $N = 5$, $I = 8\%$, solve for PV . On an after-tax basis, the \$80 annual income is worth \$48 [$\$80 \times (100\% - 40\%)$]. On an after-tax basis, Investment A is also worth \$1,000, found on a financial calculator as $PMT = \$48$, $FV = \$1,000$, $N = 5$, $I = 4.8\%$, solve for PV .

 EXPLANATION: In both cases the problem is a simple “bond” problem of discounting a combination of an annuity and a lump sum.

CALCULATIONS

Find the value of Investment A on a pre-tax basis

Step One: Press 2nd → CLR TVM

Step Two: Press 5 → N

Step Three: Press 8 → I/Y

Step Four: Press 80 → PMT

Step Five: Press 1000 → FV

Step Six: Press CPT → PV

Answer: 1000

Find the value of Investment A on a post-tax basis

Step One: Press 2nd → CLR TVM

Step Two: Press 5 → N

Step Three: Press 4.8 → I/Y

Step Four: Press 1 → - → 40

Step Five: x → 80 → = → PMT

Step Six: Press 1000 → FV

Step Seven: Press CPT → PV

Answer: 1000



WORKOUT AREA: *Here are sample problems – cover one of the values in the two leftmost columns and see if you can solve it using the others*

Value of Investment A on a Pre- Tax Basis	Value of Investment A on a After-Tax Basis	Taxable Income From Investment A Per Year	Non- Taxable Income From Investment A in 5- Years	Investor Tax Bracket	Required Pre-Tax Return	Required After Tax Return
\$1,000.00	\$1,000.00	\$80.00	\$1,000.00	40.00%	8.00%	4.80%
\$1,059.11	\$1,044.29	\$100.00	\$1,000.00	30.00%	8.50%	5.95%
\$1,110.54	\$1,140.91	\$85.00	\$1,200.00	40.00%	9.00%	5.40%
\$1,289.89	\$1,293.42	\$95.00	\$1,300.00	40.00%	7.50%	4.50%
\$1,918.00	\$1,931.86	\$120.00	\$2,000.00	20.00%	7.00%	5.60%
\$1,973.46	\$2,049.66	\$150.00	\$2,200.00	40.00%	9.50%	5.70%
\$2,240.47	\$2,261.42	\$135.00	\$2,500.00	10.00%	8.00%	7.20%

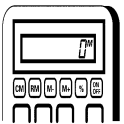
Application 15.3.5a (page 360): Private real estate fund A has \$100 million of assets and \$50 million of debt. Private real estate fund B has \$20 million of equity and \$30 million of debt. What is the LTV and debt-to-equity ratio of each of these geared funds? Fund A is 50% debt, and has an LTV of 50% and a debt-to-equity ratio of 1.0. Fund B is 60% debt, and has an LTV of 60% and a debt-to-equity ratio of 1.5.



EXPLANATION

In order to calculate debt to equity, we need to know the total debt of each fund and the equity of each fund. Fund A has \$50 million of debt and \$50 million of equity as determined by using the equations $\text{Assets} = \text{Debt} + \text{Equity}$ ($\$100 \text{ million} - \$50 \text{ million} = \$50 \text{ million}$). Therefore, the debt to equity ratio of Fund A is 1.0. Fund B's debt to equity ratio can be calculated the same way. Fund has \$20 million of equity and \$30 million of debt. Therefore the debt to equity ratio of Fund B is 1.5.

The Loan to Value (LTV) ratio for each fund can be calculated by dividing the amount of debt by the amount of assets. Fund A has a LTV ratio of 50% ($\$50 \text{ million divided by } \100 million). Fund B doesn't provide the value of assets, but we know that debt plus equity equals the amount of assets. In this case, we add \$20 million (Fund B's equity) plus \$30 million (Fund B's debt) for Fund B's assets of \$50 million. Therefore, the LTV ratio for Fund B is \$30 million divided by \$50 million for quotient of 60%.



CALCULATIONS

Find the LTV and Debt to Equity for Fund A

Step One: Press $50 \rightarrow \div \rightarrow 100$

Step Two: Press = "0.5" (LTV ratio for Fund A)

Step Three: Press $100 \rightarrow - \rightarrow 50$

Step Four: Press = "50"

Step Five: Press $50 \rightarrow \div \rightarrow 50$

Step Six: Press =

Answer: 1 (Debt to Equity for Fund A)

Find the LTV and Debt to Equity for Fund B

Step One: Press $20 \rightarrow + \rightarrow 30$

Step Two: Press = "50"

Step Three: Press $30 \rightarrow \div \rightarrow 50$

Step Four: Press $= 0.6$ (LTV ratio for Fund B)

Step Five: Press $30 \rightarrow \div \rightarrow 20$

Step Six: Press $=$

Answer: 1.5 (Debt to Equity for Fund B)



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Private Real Estate		Private Real Estate		Private Real Estate		Private Real Estate		Private Real Estate
Fund A Debt-to-Equity Ratio	Private Real Estate	Fund B Debt-to-Equity Ratio	Private Real Estate	Equity	Fund A Debt	Fund B Equity	Debt	Private Real Estate
	Fund A LTV		Fund B LTV	(millions)	(millions)	(millions)	(millions)	Fund B
0.50	33.33%	1.50	60.00%	\$100.00	\$50.00	\$20.00	\$30.00	
0.50	33.33%	2.33	70.00%	\$150.00	\$75.00	\$15.00	\$35.00	
0.50	33.33%	4.00	80.00%	\$200.00	\$100.00	\$10.00	\$40.00	
0.60	37.50%	9.00	90.00%	\$250.00	\$150.00	\$5.00	\$45.00	
0.58	36.84%	2.00	66.67%	\$300.00	\$175.00	\$25.00	\$50.00	
0.71	41.67%	1.83	64.71%	\$350.00	\$250.00	\$30.00	\$55.00	
0.69	40.74%	1.71	63.16%	\$400.00	\$275.00	\$35.00	\$60.00	

Application 15.4.6a (page 369): Consider four investments with otherwise equivalent characteristics. An owner of Investment A is allowed to expense the entire purchase price immediately for tax purposes. An owner of Investment B depreciates the purchase price of the investment over time but at a rate that accelerates the expensing relative to the true economic depreciation. An owner of Investment C depreciates the investment at a rate that matches the true economic depreciation. An owner of Investment D depreciates the investment at a rate that is slower than the true economic depreciation. The pre-tax rate of return on the cash flows is 12%. What can be said about the after-tax rates of return for each investment for a taxpayer in an income tax bracket of 25%?

The answer is that the after-tax rate of return for Investment A is 12%, for Investment B it is between 9% and 12%, for Investment C, when economic depreciation equals depreciation for tax purposes, the after-tax rate of return is 9% which equals the pre-tax rate of return (12%) times 1 minus the 25% tax rate, and for Investment D the after-tax rate of return is less than 9%.



EXPLANATION

The answer is that the after-tax rate of return for Investment A is 12% because the after tax and before tax IRRs of fully tax deductible/deferred investments are equal. For investment C, when economic depreciation equals the depreciation for tax purposes the after-tax rate of return equals the pre-tax return times one minus the 25% tax rate. In this case, $0.12 \times (1 - 0.25) = 0.09$ or 9%. For Investment B (accelerated depreciation) it is between 9% and 12% (the two previous answers). When depreciation for tax purposes occurs more slowly than economic depreciation, the after-tax return will be less than the pre-tax return reduced by the tax rate. Practice knowing how the four depreciation schemes place after-tax returns relative to the gross pre-tax return and the pre-tax return net of taxes at the stated tax rate.



CALCULATIONS

Step One: Press $1 \rightarrow - \rightarrow 0.25$

Step Two: Press $\times \rightarrow 0.12$

Step Three: Press $=$

Answer: 0.09

Application 16.2.1a (page 389): TTMAR Hedge Fund has a 1.5 and 30 fee arrangement, with no hurdle rate and a NAV of \$200 million at the start of the year. At the end of the year, before fees, the NAV is \$253 million. Assuming that management fees are computed on start-of-year NAVs and are distributed annually, find the annual management fee, the incentive fee, and the ending NAV after fees, assuming no redemptions or subscriptions. The annual management fee is simply 1.5% of \$200 million, or \$3 million. After the management fee of \$3 million, the fund earned a profit of \$50 million (\$253 – \$3 – \$200). The incentive fee on the profit is \$15 million (\$50 x 30% = \$15). Therefore, the ending NAV after distribution of fees to the fund manager is \$235 million (\$253 – \$3 – \$15).

$$\text{Annual Fee} = \text{Management Fee} + \{\text{Max}[0, \text{Incentive Fee} \times (\text{Gross Return above HWM} - \text{Management Fee-Hurdle Rate})]\} \quad (16.1)$$



EXPLANATION

In this application, we need to determine the management fee and the incentive fee for TTMAR Hedge Fund, which has a 1.5% management fee and a 30% incentive fee. To start let's calculate the management fee, which is .015 (management fee percentage) multiplied by \$200 million (beginning NAV) for a product of \$3 million, which is the management fee. To calculate the incentive fee, we need to solve for the fund's profit minus the management fee. To do that we subtract from \$253 million (ending NAV) the \$3 million management fee and the \$200 million (beginning NAV) for a difference of \$50 million, this is the fund's profit after management fees. Solving for the incentive fee, we multiply the 30% incentive fee percentage by the \$50 million profit after management fees for a \$15 million incentive fee. Therefore, the ending NAV after distribution of fees to the fund manager is the difference between \$253 million (ending NAV), \$3 million (management fee), and \$15 million (incentive fee), which is \$235 million.



CALCULATIONS

Management fee

Step One: Press 200 → x → 0.015

Step Two: Press =

Answer: 3

Incentive Fee

Step One: Press 253 → - → 3

Step Two: Press - → 200

Step Three: Press x → 0.30

Step Four: Press =

Answer: 15

Ending NAV

Step One: Press 253 → - → 3

Step Two: Press - → 15

Step Three: Press =

Answer: 235



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Annual Management Fee (millions)	Incentive Fee (millions)	Ending Nav After Fees (millions)	Fund Profit (millions)	Management Fee	Performance Fee	Hurdle Rate	Beginning NAV (millions)	Ending NAV (millions)
\$3.0	\$15.0	\$235.0	\$50.0	1.5%	30.0%	0.0%	\$200	\$253
\$4.0	\$9.2	\$236.8	\$46.0	2.0%	20.0%	0.0%	\$200	\$250
\$4.5	\$19.1	\$376.4	\$95.5	1.5%	20.0%	0.0%	\$300	\$400
\$3.8	\$29.4	\$416.8	\$196.3	1.5%	15.0%	0.0%	\$250	\$450
\$2.0	\$44.4	\$203.6	\$148.0	2.0%	30.0%	0.0%	\$100	\$250
\$1.0	\$0.0	\$100.0	\$0.0	1.0%	30.0%	0.0%	\$100	\$101
\$2.0	\$0.5	\$102.6	\$3.0	2.0%	15.0%	0.0%	\$100	\$105

Application 16.2.1b (page 389): VVMAR Hedge Fund has a 1.5 and 30 fee arrangement, with no hurdle rate and a NAV of \$200 million at the start of the year. At the end of the year, after fees, the NAV is \$270 million. Assuming that management fees are computed on start-of-year NAVs and are distributed annually, find the annual management fee, the incentive fee, and the ending NAV before fees, assuming no redemptions or subscriptions. The incentive fee represents 30% of the total profits and so represents the proportion 30%/70% to the net profits to limited partners. Since the profit to the limited partners is \$70 million, the incentive fee to the manager must be \$30 million (i.e., \$70 million x 30%/70%). Thus, the NAV after management fees but before incentive fees must be \$300 million. The management fees are 1.5% of the starting NAV: 1.5% x \$200 million = \$3 million, inferring an ending NAV of \$303 million before fees. To recap: \$303 million is reduced to \$300 million by the 1.5% management fee on the starting value of \$200 million. The fund therefore earned a profit of \$100 million after management fees (\$300 million – \$200 million). The incentive fee to the manager was 30% of \$100 million, or \$30 million. The profit after fees to the limited partners was \$70 million, leaving a NAV of \$270 million after all fees.

$$\text{Annual Fee} = \text{Management Fee} + \{\text{Max}[0, \text{Incentive Fee} \times (\text{Gross Return above HWM} - \text{Management Fee-Hurdle Rate})]\} \quad (16.1)$$

EXPLANATION

In this application, we face the challenge of being given the AFTER FEE end-of-year NAV. We need to back out the management fee and the incentive fee for TTMAR Hedge Fund, which has a 1.5% management fee and a 30% incentive fee. The management fee is easy to determine because it is based on beginning net asset value. But the incentive fee is based on profits.

To start let's calculate the management fee, which is .015 (management fee percentage) multiplied by \$200 million (beginning NAV) for a product of \$3 million, which is the management fee. In order to determine the incentive fee let's consider the split between limited partners (investors) and the general partners (fund manager), which is 30% and 70%. Since the limited partners are receiving 270 million (ending NAV after fees) - \$200 million (beginning NAV) or \$70 million. That implies that the incentive fee to the general partners is \$30 million, or 30% of the \$100 million profit after the management fee. Therefore the ending NAV before fees was \$200 million (beginning NAV) plus \$3 million (management fee) plus \$30 million (incentive fee), for a sum of \$303 million.



CALCULATIONS

Management fee

Step One: Press 200 → x → 0.015

Step Two: Press =

Answer: 3

Incentive Fee

Step One: Press 270 → - → 200

Step Two: Press x → 0.3

Step Three: Press = “21”

Step Four: Press 1 → - → 0.30

Step Five: Press = “0.70”

Step Six: Press 21 → ÷ → 0.70

Answer: 30

Ending NAV

Step One: Press 200 → + → 3

Step Two: Press + → 70 + → 30

Step Three: Press =

Answer: 303



WORKOUT AREA: *Here are sample problems – solve for columns 1, 2, 4 and 9 using the rest.*

Annual Management Fee (millions)	Incentive Fee (millions)	Ending Nav After Fees (millions)	Fund Profit (millions)	Management Fee	Performance Fee	Hurdle Rate	Beginning NAV (millions)	Ending NAV (millions)
\$3.00	\$30.00	\$270.00	\$300.00	1.50%	30.00%	0.00%	\$200.00	\$303.00
\$2.00	\$50.00	\$300.00	\$350.00	2.00%	20.00%	0.00%	\$100.00	\$352.00
\$2.25	\$100.00	\$450.00	\$550.00	1.50%	25.00%	0.00%	\$150.00	\$552.25
\$6.00	\$52.94	\$500.00	\$552.94	3.00%	15.00%	0.00%	\$200.00	\$558.94
\$1.00	\$25.00	\$150.00	\$175.00	2.00%	20.00%	0.00%	\$50.00	\$176.00
\$1.13	\$22.06	\$200.00	\$222.06	1.50%	15.00%	0.00%	\$75.00	\$223.18
\$1.00	\$26.47	\$250.00	\$276.47	1.00%	15.00%	0.00%	\$100.00	\$277.47

Application 16.2.5a (page 397): Consider a \$1 billion hedge fund with a 20% incentive fee at the start of a new incentive fee computation period. If the hedge fund computes incentive fees annually and begins the year very near its high-water mark, what would be the value of the incentive fee over the next year for annual asset volatilities of 10%, 20%, and 30% using the at-the-money incentive fee approximation formula? Inserting $i = 20\%$, $NAV = \$1$ billion, $T = 1$, and the three given volatilities generates approximations of \$8 million, \$16 million, and \$24 million.

$$\text{Payout on Incentive Fee Option} = \text{Max}[i(ENAV - BNAV), 0] \quad (16.2)$$

$$\text{Incentive Fee Call Option Value} \approx i \times 40\% \times NAV \times \sigma_1 \times \sqrt{T} \quad (16.3)$$

$$\text{Incentive Fee Call Option Value} \approx 8\% \times \$100 \text{ million} \times \sigma_1 \quad (16.4)$$

Note in the above form of the equation that the square root of T is 1



EXPLANATION

Utilizing equation 16.3, we can solve for the annual asset volatilities of 10%, 20%, and 30%. The parameters are $i = 20\%$, $T = 1$, and $NAV = \$1$ billion. Solving for 10% annual asset volatility:

$$\text{Incentive Fee Call Option Value} \approx 0.20 \times 0.40 \times \$1,000,000,000 \times 0.10 \times \sqrt{1}$$

$$\text{Incentive Fee Call Option Value} \approx 0.08 \times \$1,000,000,000 \times 0.10 \times \sqrt{1}$$

$$\text{Incentive Fee Call Option Value} \approx 0.08 \times \$1,000,000,000 \times 0.10$$

$$\text{Incentive Fee Call Option Value} \approx \$80,000,000 \times 0.10$$

$$\text{Incentive Fee Call Option Value} \approx \$8,000,000$$

Solving for 20% annual asset volatility:

$$\text{Incentive Fee Call Option Value} \approx 0.20 \times 0.40 \times \$1,000,000,000 \times 0.20 \times \sqrt{1}$$

$$\text{Incentive Fee Call Option Value} \approx 0.08 \times \$1,000,000,000 \times 0.20 \times \sqrt{1}$$

$$\text{Incentive Fee Call Option Value} \approx 0.08 \times \$1,000,000,000 \times 0.20$$

$$\text{Incentive Fee Call Option Value} \approx \$80,000,000 \times 0.20$$

$$\text{Incentive Fee Call Option Value} \approx \$16,000,000$$

Solving for 30% annual asset volatility:

$$\text{Incentive Fee Call Option Value} \approx 0.20 \times 0.40 \times \$1,000,000,000 \times 0.30 \times \sqrt{1}$$

$$\text{Incentive Fee Call Option Value} \approx 0.08 \times \$1,000,000,000 \times 0.30 \times \sqrt{1}$$

$$\text{Incentive Fee Call Option Value} \approx 0.08 \times \$1,000,000,000 \times 0.30$$

$$\text{Incentive Fee Call Option Value} \approx \$80,000,000 \times 0.30$$

$$\text{Incentive Fee Call Option Value} \approx \$24,000,000$$



CALCULATIONS

10% annual asset volatility:

Step One: Press $0.20 \rightarrow x \rightarrow 0.40$

Step Two: Press $x \rightarrow 0.10$

Step Three: Press $x \rightarrow 1 \rightarrow \sqrt{x}$

Step Four: Press $x \rightarrow 1,000,000,000$

Step Five: Press =

Answer: 8,000,000

20% annual asset volatility:

Step One: Press $0.20 \rightarrow x \rightarrow 0.40$

Step Two: Press $x \rightarrow 0.20$

Step Three: Press $x \rightarrow 1 \rightarrow \sqrt{x}$

Step Four: Press $x \rightarrow 1,000,000,000$

Step Five: Press =

Answer: 16,000,000

30% annual asset volatility:

Step One: Press $0.20 \rightarrow x \rightarrow 0.40$

Step Two: Press $x \rightarrow 0.30$

Step Three: Press $x \rightarrow 1 \rightarrow \sqrt{x}$

Step Four: Press $x \rightarrow 1,000,000,000$

Step Five: Press =

Answer: 24,000,000



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Option Value <i>(millions)</i>	Volatility	Incentive Fee (i)	NAV <i>(millions)</i>
\$8.00	10%	20.00%	\$1,000.00
\$8.00	20%	20.00%	\$500.00
\$6.00	30%	20.00%	\$250.00
\$24.00	40%	15.00%	\$1,000.00
\$7.00	35%	5.00%	\$1,000.00
\$7.50	25%	15.00%	\$500.00
\$5.00	50%	10.00%	\$250.00
\$6.00	40%	25.00%	\$150.00

Application 17.6.1a (page 439): A stock price experiences the following 10 consecutive daily prices corresponding to days -10 to -1 : 100, 102, 99, 97, 95, 100, 109, 103, 103, and 106. What are the simple (arithmetic) moving average prices on day 0 using 3-day and 10-day moving averages, as well as the 3-day moving average for days -2 and -1 ? Using the data, the three-day moving average on day 0 is $[(103 + 103 + 106)/3]$, or 104. For days -2 and -1 , the three-day moving averages are 104 and 105, respectively. The 10-day moving average for day 0 is 101.4. Because the price on day -1 moved above the recent three-day moving averages, a classic interpretation of a simple moving average trading system would be that a long position should have been established.

$$SMA_t(n) = \frac{1}{n}P_{t-1} + \frac{1}{n}P_{t-2} + \dots + \frac{1}{n}P_{t-n}$$



EXPLANATION

The simple moving average is a sum of the prices divided by the number of days in the moving average. The key is to make sure you are starting on the correct day. In this application we need to find the 3-day simple moving average on Day 0, so the prices on Day -1, Day -2, and Day -3 are the added together and then the sum is divided by 3 (number of days in the simple moving average).

Therefore, the 3-day simple moving average on Day 0 is $(106 + 103 + 103)/3 = 104$. The 3-day simple moving average on Day -1 is $(103 + 103 + 109)/3 = 105$. The 3-day simple moving average on Day -2 is $(103 + 109 + 100)/3 = 104$. Now, the 10-day simple moving average on Day 0 is $(100 + 102 + 99 + 97 + 95 + 100 + 109 + 103 + 103 + 106)/10$ or 101.4.



CALCULATIONS

Find the 3-day simple moving average on Day 0

Step One: Press $106 \rightarrow + \rightarrow 103$

Step Two: Press $+ \rightarrow 103$

Step Three: Press $\div \rightarrow 3$

Step Four: Press $=$

Answer: 104

Find the 3-day simple moving average on Day -1

Step One: Press 103 $\rightarrow + \rightarrow$ 103

Step Two: Press + \rightarrow 109

Step Three: Press $\div \rightarrow$ 3

Step Four: Press =

Answer: 105

Find the 3-day simple moving average on Day -2

Step One: Press 103 $\rightarrow + \rightarrow$ 109

Step Two: Press + \rightarrow 100

Step Three: Press $\div \rightarrow$ 3

Step Four: Press =

Answer: 104

Find the 10-day simple moving average on Day 0

Step One: Press 100 $\rightarrow + \rightarrow$ 102

Step Two: Press + \rightarrow 99

Step Three: Press + \rightarrow 97

Step Four: Press + \rightarrow 95

Step Five: Press + \rightarrow 100

Step Six: Press + \rightarrow 109

Step Seven: Press + \rightarrow 103

Step Eight: Press + \rightarrow 103

Step Nine: Press + \rightarrow 106

Step Ten: Press $\div \rightarrow$ 10

Step Eleven: Press =

Answer: 101.4



WORKOUT AREA: *Here are sample problems – cover one of the values in the four rightmost columns and see if you can solve it using the others*

											3- Day Moving Average	10- Day Moving Average	3- Day Moving Average	3- Day Moving Average
	Day -10	Day -9	Day -8	Day -7	Day -6	Day -5	Day -4	Day -3	Day -2	Day -1	Day 0	Day 0	Day -2	Day -1
Stock Prices	100	102	99	97	95	100	109	103	103	106	✓ 104.0	101.4	✓ 104.0	✓ 105.0
	50	51	52	50	49	47	55	53	51	52	✓ 52.0	51.0	✓ 51.7	✓ 53.0
	30	31	35	36	37	34	33	35	36	37	✓ 36.0	34.4	✓ 34.0	✓ 34.7
	20	21	23	19	18	17	20	21	22	23	✓ 22	20.4	✓ 19.3	✓ 21
	45	47	48	46	45	44	45	47	48	49	✓ 48	46.4	✓ 45.3	✓ 46.7
	35	33	32	31	30	29	28	27	30	21	✓ 26	29.6	✓ 28	✓ 28.3
	10	9	10	11	12	14	15	17	18	21	✓ 18.7	13.7	✓ 15.3	✓ 16.7

Application 17.6.2a (page 440): A stock price experiences the following 10 consecutive daily prices corresponding to days -10 to -1: 100, 102, 99, 97, 95, 100, 109, 103, 103, and 106. What are the five-day weighted moving average prices on days -1 and 0? The sum of the digits 1 through 5 is 15. The five-day weighted moving average on day 0 is as follows:

$$[(106 \times 5) + (103 \times 4) + (103 \times 3) + (109 \times 2) + (100 \times 1)] / 15, \text{ or } 104.6$$

The five-day moving average on day -1 is as follows:

$$[(103 \times 5) + (103 \times 4) + (109 \times 3) + (100 \times 2) + (95 \times 1)] / 15, \text{ or } 103.27$$

Define $N = 1 + 2 + 3 + \dots + n$

$$WMA_t(n) = \frac{n}{N} P_{t-1} + \frac{n-1}{N} P_{t-2} + \dots + \frac{1}{N} P_{t-n} \quad (17.2)$$



EXPLANATION

The weighted moving average for N days is calculated by multiplying the most recent daily price by N, and then the second most recent daily price in the series by the number N-1, and so on ending with the least recent daily price multiplied by 1. Then the products are summed and divided by the sum of the numbers 1 to N.

Let's find the 5-day weighted moving average on Day 0. Day -1, -2, -3, -4, and -5 prices are \$106.00, \$103.00, \$103.00, \$109.00, and \$100.00. With those prices we need to weight them so: $(106 \times 5) + (103 \times 4) + (103 \times 3) + (109 \times 2) + (100 \times 1) = 1569$. Now we need to divide that sum by the sum of the multiples: $5 + 4 + 3 + 2 + 1 = 15$. $1569/15 = 104.6$ is the 5-day weighted moving average on Day 0.

Let's find the 5-day weighted moving average on Day -1. Day -2, -3, -4, -5, and -6 prices are \$103.00, \$103.00, \$109.00, \$100.00, and \$95.00. With those prices we need to weight them so: $(103 \times 5) + (103 \times 4) + (109 \times 3) + (100 \times 2) + (95 \times 1) = 1549$. Now we need to divide that sum by the sum of the multiples: $5 + 4 + 3 + 2 + 1 = 15$. $1549/15 = 103.4$ is the 5-day weighted moving average on Day -1.



CALCULATIONS

Find the 5-day weighted moving average on Day 0

Step One: Press $106 \rightarrow \times \rightarrow 5$

Step Two: Press = "530"

Step Three: Press $103 \rightarrow \times \rightarrow 4$

Step Four: Press = "412"

Step Five: Press $103 \rightarrow \times \rightarrow 3$

Step Six: Press = "309"

Step Seven: Press $109 \rightarrow \times \rightarrow 2$

Step Eight: Press = "218"

Step Nine: Press $100 \rightarrow \times \rightarrow 1$

Step Ten: Press = "100"

Step Eleven: Press $5 \rightarrow + \rightarrow 4$

Step Twelve: Press $+ \rightarrow 3$

Step Thirteen: Press $+ \rightarrow 2$

Step Fourteen: Press $+ \rightarrow 1$

Step Fifteen: Press = "15"

Step Sixteen: Press $530 \rightarrow + \rightarrow 412$

Step Seventeen: Press $+ \rightarrow 309$

Step Eighteen: Press $+ \rightarrow 218$

Step Nineteen: Press $+ \rightarrow 100$

Step Twenty: Press = "1569"

Step Twenty-One: Press $1569 \rightarrow \div \rightarrow 15$

Answer: 104.6

Find the 5-day weighted moving average on Day -1

Step One: Press $103 \rightarrow x \rightarrow 5$

Step Two: Press = "515"

Step Three: Press $103 \rightarrow x \rightarrow 4$

Step Four: Press = "412"

Step Five: Press $109 \rightarrow x \rightarrow 3$

Step Six: Press = "327"

Step Seven: Press $100 \rightarrow x \rightarrow 2$

Step Eight: Press = "200"

Step Nine: Press $95 \rightarrow x \rightarrow 1$

Step Ten: Press = "95"

Step Eleven: Press $5 \rightarrow + \rightarrow 4$

Step Twelve: Press $+ \rightarrow 3$

Step Thirteen: Press $+ \rightarrow 2$

Step Fourteen: Press $+ \rightarrow 1$

Step Fifteen: Press = "15"

Step Sixteen: Press $515 \rightarrow + \rightarrow 412$

Step Seventeen: Press $+ \rightarrow 327$

Step Eighteen: Press $+ \rightarrow 200$

Step Nineteen: Press $+ \rightarrow 95$

Step Twenty: Press = "1549"

Step Twenty-One: Press $1549 \rightarrow \div \rightarrow 15$

Answer: 103.27



WORKOUT AREA: *Here are sample problems – cover one of the values in the two rightmost columns and see if you can solve it using the others*

	Day -10	Day -9	Day -8	Day -7	Day -6	Day -5	Day -4	Day -3	Day -2	Day -1	5-Day Weighte d Moving Average	5-Day Weighte d Moving Average
											Day 0	Day -1
Stock Prices	100	102	99	97	95	100	109	103	103	106	104.60	103.27
	50	51	52	50	49	47	55	53	51	52	52.00	51.67
	30	31	35	36	37	34	33	35	36	37	35.60	34.93
	20	21	23	19	18	17	20	21	22	23	21.53	20.40
	45	47	48	46	45	44	45	47	48	49	47.47	46.40
	35	33	32	31	30	29	28	27	30	21	26.07	28.67
	10	9	10	11	12	14	15	17	18	21	18.13	16.20

Application 17.6.2b (page 441): A stock price experiences the following five consecutive daily prices corresponding to days –5 to –1: 100, 109, 103, 103, and 106. What are the exponential moving average prices on days –1 and 0 using $\lambda = 0.25$? Assume that the exponential moving average up to and including the price on day –3 was 100. The exponential moving average on day –1 is found as 0.25×103 (the day –2 price) plus 0.75×100 (the previous exponential moving average), which equals 100.75. The exponential moving average on day 0 is found as 0.25×106 (the day –1 price) plus 0.75×100.75 (the previous exponential moving average), or 102.0625.

$$EMA_t(\lambda) = \lambda P_{t-1} + \lambda(1-\lambda)P_{t-2} + \lambda(1-\lambda)^2 P_{t-3} + \lambda(1-\lambda)^3 P_{t-4} + \dots \quad (17.3a)$$

$$EMA_t(\lambda) = (\lambda \times P_{t-1}) + [(1-\lambda) \times EMA_{t-1}(\lambda)] \quad (17.3b)$$



EXPLANATION

Let's find the 5-day exponential moving average on Day -1. Day -2 is \$103. It is also important to note that the exponential moving average up to and including the price on day –3 is 100. With those prices we need to weight them so: $103 \times (0.25) + 100 \times (1 - 0.25) = 100.75$. 100.75 is the 5-day exponential moving average on Day -1.

Let's find the 5-day exponential moving average on Day 0. Day -1 and -2 are \$106.00 and \$103.00. It is also important to note that the exponential moving average up to and including the price on day –3 is 100. With those prices we need to weight them so: $106 \times (0.25) + 100.75 \times (1 - 0.25) = 102.0625$. 102.0625 is the 5-day exponential moving average on Day 0. Note we used Day -1 exponential moving average to calculate the Day 0 exponential moving average.



CALCULATIONS

Find the 5-day exponential moving average on Day -1

Step One: Press $103 \rightarrow x \rightarrow 0.25$

Step Two: Press = "25.75"

Step Three: Press $1 \rightarrow - \rightarrow 0.25$

Step Four: Press $x \rightarrow 100$

Step Five: Press = "75"

Step Six: Press $25.75 \rightarrow + \rightarrow 75$

Step Seven: Press =

Answer: 100.75

Find the 5-day exponential moving average on Day 0

Step One: Press 106 \rightarrow x \rightarrow 0.25

Step Two: Press = "26.5"

Step Three: Press 1 \rightarrow - \rightarrow 0.25

Step Four: Press x \rightarrow 100.75 (Day -1 exponential moving average)

Step Five: Press = "75"

Step Six: Press 26.5 \rightarrow + \rightarrow 75.5625

Step Seven: Press =

Answer: 102.0625



WORKOUT AREA: *Here are sample problems – cover the EMA values and see if you can solve it using the others*

Day -5	Day -4	Day -3	Day -2	Day -1	λ	EMA Day -1	EMA Day 0	Previous Moving Average Day 0
\$100.00	\$109.00	\$103.00	\$103.00	\$106.00	0.25	\$100.75	\$101.50	100
\$47.00	\$55.00	\$53.00	\$51.00	\$52.00	0.30	\$50.30	\$50.60	50
\$34.00	\$33.00	\$35.00	\$36.00	\$37.00	0.35	\$34.05	\$34.40	33
\$17.00	\$20.00	\$21.00	\$22.00	\$23.00	0.15	\$20.30	\$20.45	20
\$44.00	\$45.00	\$47.00	\$48.00	\$49.00	0.10	\$43.50	\$43.60	43
\$29.00	\$28.00	\$27.00	\$30.00	\$21.00	0.40	\$27.00	\$23.40	25
\$14.00	\$15.00	\$17.00	\$18.00	\$21.00	0.25	\$15.75	\$16.50	15

Application 17.6.4a (page 444): A stock price experiences the following 10 consecutive daily high prices corresponding to days -10 to -1: 100, 102, 99, 98, 99, 104, 102, 103, 104, and 100. What is the day 0 price level that signals a breakout and possibly a long position, using these 10 days of data as representative of a trading range? A price of 105 exceeds the range of the past data and signals that a long position should be established. If the price series represented the low prices for each day, a current price of 97 would signal a breakout on the downside and would typically be interpreted as a sell signal.

UpperBound = HighestHigh(n)

LowerBound = LowestLow(n)

Most commonly, $n = 20$ days

EXPLANATION

The Upper Bound is determined by the highest daily price over the 10 consecutive day period, in this case \$104.00 is the highest daily price. Therefore a price of 105 would signal that a long position should be established. The Lower Bound is determined by the lowest daily price over the 10 consecutive day period, in this case \$98.00. Therefore a price of 97 would be interpreted as a sell signal.

WORKOUT AREA: Here are sample problems – cover the four rightmost columns of the values and see if you can solve it using the others

	Day -10	Day -9	Day -8	Day -7	Day -6	Day -5	Day -4	Day -3	Day -2	Day -1	Upper Bound	Lower Bound	Upper Bound Break Out	Lower Bound Break Out
Stock Prices	\$100.00	\$102.00	\$99.00	\$98.00	\$99.00	\$104.00	\$102.00	\$103.00	\$104.00	\$100.00	\$104.00	\$98.00	\$105.00	\$97.00
	\$50.00	\$51.00	\$52.00	\$50.00	\$49.00	\$47.00	\$55.00	\$53.00	\$51.00	\$52.00	\$55.00	\$47.00	\$56.00	\$46.00
	\$30.00	\$31.00	\$35.00	\$36.00	\$37.00	\$34.00	\$33.00	\$35.00	\$36.00	\$37.00	\$37.00	\$30.00	\$38.00	\$29.00
	\$20.00	\$21.00	\$23.00	\$19.00	\$18.00	\$17.00	\$20.00	\$21.00	\$22.00	\$23.00	\$23.00	\$17.00	\$24.00	\$16.00
	\$45.00	\$47.00	\$48.00	\$46.00	\$45.00	\$44.00	\$45.00	\$47.00	\$48.00	\$49.00	\$49.00	\$44.00	\$50.00	\$43.00
	\$35.00	\$33.00	\$32.00	\$31.00	\$30.00	\$29.00	\$28.00	\$27.00	\$30.00	\$21.00	\$35.00	\$21.00	\$36.00	\$20.00
	\$10.00	\$9.00	\$10.00	\$11.00	\$12.00	\$14.00	\$15.00	\$17.00	\$18.00	\$21.00	\$21.00	\$9.00	\$22.00	\$8.00

Application 18.1.2a (page 461): ABC Corp. has offered to purchase DEF Corp. for \$25 per share. Immediately before the merger proposal announcement, DEF was trading at \$18 per share. Immediately after the announcement, DEF is trading at \$23 per share. Assuming that the share price of DEF would fall to \$16 if the deal fails and that the riskless interest rate is 0%, describe a long position in DEF taken by an event-driven hedge fund both as a combination of positions in a risk-free bond and a binary call option and as a combination of positions including a binary put option. The hedge fund may be viewed as a long position in a riskless bond with a face value of \$16 and a long position in a binary call option with a potential payout of \$9 in case the merger is successful and shares of DEF rise to \$25 per share. The hedge fund may also be viewed as a long position in a riskless bond with a face value of \$25 and a short position in a binary put option with a potential payout of \$9 in case the merger is not successful and shares of DEF decline to \$16 per share.

EXPLANATION

This is a cash-for-stock merger. Essentially, if the ABC Corp. and DEF Corp. merger is successful, the payout to the hedge fund will be \$25 (DEF Corp. price per share if acquired) versus \$16 (DEF Corp. share price if merger fails). The hedge fund may be viewed as a long position in a riskless bond with a face value of \$16 and a long position in a binary call option with a potential payout of \$9 in case the merger is successful and shares of DEF rise to \$25 per share. The hedge fund may also be viewed as a long position in a riskless bond with a face value of \$25 and a short position in a binary put option with a potential payout of \$9 in case the merger is not successful and shares of DEF decline to \$16 per share.

WORKOUT AREA: *Here are sample problems cover the two leftmost columns and solve the others*

Share Price if Merger Fails	Share Price if Merger Occurs	Long Binary Call Max	Riskless Bond	Short Binary Put Min	Riskless Bond
\$16.00	\$25.00	\$9.00	\$16.00	-\$9.00	\$25.00
\$10.00	\$15.00	\$5.00	\$10.00	-\$5.00	\$15.00
\$57.00	\$24.00	-\$33.00	\$57.00	\$33.00	\$24.00
\$15.00	\$18.00	\$3.00	\$15.00	-\$3.00	\$18.00
\$17.00	\$27.00	\$10.00	\$17.00	-\$10.00	\$27.00
\$10.00	\$23.00	\$13.00	\$10.00	-\$13.00	\$23.00
\$12.00	\$22.00	\$10.00	\$12.00	-\$10.00	\$22.00

Application 18.3.1a (page 478): Prior to a merger announcement, MegaStock, trading at \$102, plans to offer one share of MegaStock for 3.5 shares of MiniStock, trading at \$20. After the announcement, MegaStock trades at \$100, MiniStock jumps to \$25, and an arbitrageur takes a traditional and hedged merger arbitrage position. Ignoring transaction costs, interest, and dividends, how much money would the arbitrageur earn per share of MegaStock if the merger consummates, and how much money would be lost if the deal fails and the prices revert to their preannouncement levels? The short position in one share of MegaStock generates proceeds of \$100. Buying 3.5 shares of MiniStock costs \$87.50. If the deal goes through, the arbitrageur pockets the \$12.50 net proceeds as profit and delivers the exchanged shares to cover the short. If the deal fails, the arbitrageur sells the 3.5 shares at \$20 for \$70 in proceeds, buys back MegaStock at \$102, and expends \$32, which is a \$19.50 loss relative to the proceeds of \$12.50.



EXPLANATION

This is a stock-for-stock deal. Standard merger arbitrage is to have a long position in the company being acquired and short position the acquirer (i.e., most merger arb deals try to earn a risk premium by insuring against a deal failure). First, we are to take a short position in the acquirer (MegaStock) that provides proceeds because we sold something we don't own (ignoring financing costs). Now, we need to buy 3.5 shares of MiniStock (the company being acquired) for \$87.50 (3.5 shares of MiniStock at \$25) because that is how many shares will be exchanged for 1 share of Megastock (which we are short).

If the deal goes through, the merger arbitrageurs will pocket \$12.50 or \$100.00 (MegaStock share price after merger announcement) minus \$87.50 or the product of 3.5 (number of shares of MiniStock for 1 share of MegaStock) and \$25.00 (MiniStock share Price after the merger announcement).

If the deal falls through, the merger arbitrageurs will lose \$19.50 or \$100.00 (MegaStock share price after merger announcement) minus \$87.50 or the product of 3.5 (number of shares of MiniStock for 1 share of MegaStock) and \$25.00 (MiniStock share Price after the merger announcement), plus 70 or the product of 3.5 and \$20.00 (MiniStock price before the merger announcement) minus \$102 (the share price before merger announcement).



CALCULATIONS

Find the payoff if the deal goes through

Step One: Press $3.5 \rightarrow x \rightarrow 25$

Step Two: Press = "87.50"

Step Three: Press $100 \rightarrow - \rightarrow 87.50$

Step Four: Press =

Answer: 12.50

Find the payoff if the deal falls through

Step One: Press $3.5 \rightarrow x \rightarrow 25$

Step Two: Press = "87.50"

Step Three: Press $3.5 \rightarrow x \rightarrow 20$

Step Four: Press = "70"

Step Five: Press $100 \rightarrow - \rightarrow 87.50$

Step Six: Press $+$ $\rightarrow 70$

Step Seven: Press $- \rightarrow 102$

Step Eight: Press =

Answer: -19.50



WORKOUT AREA: *Here are sample problems – cover values in the two rightmost columns and see if you can solve them using the others.*

Original Mega Share Price and if Merger fails	Original Mini Share Price and if Merger fails	MegaStock Share Price After Announced	# of Shares of Mini per Share of Mega	MiniStock Share Price After Announced	Proceeds of Trades and Profit if Occurs	Loss if Merger Fails
\$102.00	\$20.00	\$100.00	3.5	\$25.00	\$12.50	-\$19.50
\$50.00	\$40.00	\$48.00	1	\$42.00	\$6.00	-\$4.00
\$200.00	\$90.00	\$196.00	2	\$95.00	\$6.00	-\$14.00
\$100.00	\$10.00	\$102.00	5	\$19.00	\$7.00	-\$43.00
\$50.00	\$30.00	\$50.00	1	\$40.00	\$10.00	-\$10.00
\$120.00	\$20.00	\$123.00	6	\$24.00	-\$21.00	-\$21.00
\$50.00	\$80.00	\$50.00	0.5	\$85.00	\$7.50	-\$2.50

Application 18.4.3a (page 489): A bond is purchased at 40% of face value. After bankruptcy, 30% of the bond's face value is ultimately recovered. Express the rate of return as a non-annualized rate, as an annualized rate based on a four-month holding period, and as an annualized rate based on a four-year holding period, ignoring compounding and assuming no coupon income. The non-annualized rate is -25% , found as a 10% loss on a 40% investment. The annualized rate based on a four-month holding period is -75% , found as $-25\% \times (12 \text{ months}/4 \text{ months})$; and an annualized rate based on a four-year holding period is -6.25% , found as $-25\%/4$.



EXPLANATION

In order to calculate the bond's rate of return as a non-annualized rate we need to subtract the 30% (percentage of the bond's face value recovered after bankruptcy) by 40% (percentage of face value bond is purchased at) divided by 30% (percentage of the bond's face value recovered after bankruptcy) for a quotient of -25% . The annual rate based on a 4 year holding period is found by dividing -25% by 4 for a quotient of -6.25% . To find the annualized rate based on a four-month holding period multiply -25% by $12/4$ for a product of -75% .



CALCULATIONS

Find the rate of return as a non-annualized rate

Step One: Press $0.30 \rightarrow - \rightarrow 0.40$

Step Two: Press $\div \rightarrow 0.30$

Step Three: Press $=$

Answer: -0.25

Find the rate of return as an annualized rate based on a 4 month holding period

Step One: Press $12 \rightarrow \div \rightarrow 4$

Step Two: Press $\times \rightarrow -0.25$

Step Three: Press $=$

Answer: -0.75

Find the rate of return as an annualized rate based on a 4 year holding period

Step One: Press $-0.25 \rightarrow x \rightarrow 4$

Step Two: Press $=$

Answer: -0.0625



WORKOUT AREA: *Here are sample problems – cover one of the values in the three leftmost columns and see if you can solve it using the two rightmost columns*

Rate of Return as a Non-Annualized Rate	Rate of Return as an Annualized Rate based on a 4 Month Holding Period	Rate of Return as an Annualized Rate based on a 4 Year Holding Period	Percentage of Face Value Bond is Purchased At	Percentage of Bond's Face Value Recovered After Bankruptcy
-25.00%	-75.00%	-6.25%	40.00%	30.00%
-30.00%	-90.00%	-7.50%	50.00%	35.00%
22.22%	66.67%	5.56%	45.00%	55.00%
12.50%	37.50%	3.13%	40.00%	45.00%
11.11%	33.33%	2.78%	45.00%	50.00%
-14.29%	-42.86%	-3.57%	70.00%	60.00%
33.33%	100.00%	8.33%	75.00%	100.00%

Application 19.2.1a (page 501): Consider a firm with a borrowing cost of 8% on unsecured, subordinated straight debt and a current stock price of \$40. The firm may be able to issue three-year convertible bonds at an annual coupon rate of perhaps 4% by offering a conversion ratio such as 20. What is the bond's strike price, and what does the conversion option allow the bond investors to do? The conversion ratio of 20 is equivalent to a \$50 strike price using Equation 19.1c and assuming that the bond's face value is \$1,000. On or before maturity, bond investors can opt to convert each \$1,000 face value bond into 20 shares of the firm's equity rather than receive the remaining principal and coupon payments.

Convertible Bond Price = Value of Straight Corporate Debt + Value of the Implicit Equity Call Option
(19.1a)

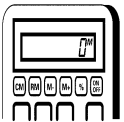
Conversion Ratio = Number of Shares Per Convertible Bond (19.1b)

Option Strike Price = Convertible Bond Face Value / Conversion Ratio (19.1c)



EXPLANATION

The bond's strike price is \$50 found by dividing the \$1,000.00 (convertible bond face value) by 20 (the conversion ratio). The conversion option allows the bond investor to convert each \$1,000 face value convertible bond into 20 shares of the firm's equity rather than receive the remaining principal and coupon.



CALCULATIONS

Step One: Press 1000 → ÷ → 20

Step Two: Press =

Answer: 50



WORKOUT AREA: *Here are sample problems – cover the leftmost column and see if you can solve it using the others*

Strike Price of the Three-Year Convertible Bonds	Borrowing Cost on Unsecured Subordinated Straight Debt	Current Stock Price	Annual Coupon of the Three-Year Convertible Bonds	Conversion Ratio of the Three-Year Convertible Bonds	Convertible Bond Face Value
\$50.00	8.0%	\$40.00	4.0%	20	\$1,000.00
\$66.67	7.5%	\$50.00	5.0%	15	\$1,000.00
\$100.00	8.5%	\$65.00	4.0%	10	\$1,000.00
\$40.00	9.0%	\$55.00	4.5%	25	\$1,000.00
\$33.33	5.5%	\$60.00	5.5%	30	\$1,000.00
\$28.57	6.0%	\$45.00	3.0%	35	\$1,000.00
\$200.00	6.5%	\$70.00	3.5%	5	\$1,000.00

Application 19.2.1b (page 501): Returning to the previous example of an 8% unsecured bond rate, a \$40 stock price, and a conversion ratio of 20, and assuming that a three-year European-style call option—given a current stock price of \$40, a strike price of \$50, and other parameters, such as volatility and dividends—is valued at \$5.14 per share according to the Black-Scholes option pricing model, what are the value of the convertible bond, the conversion value, and the conversion premium? Starting with the straight debt issue, the three-year bond in the example can be valued with a 4% coupon and an 8% discount rate, found from observing corporate bonds of similar credit risk, at \$896.92, using a financial calculator with annual coupons and compounding for simplicity. Using representative calculator inputs $n = 3$, $I = 8$, $PMT = 40$, and $FV = 1,000$ and computing PV yields 896.92. Adding the straight bond value of \$896.92 to the value of 20 options, \$102.80 (i.e., $\$5.14 \times 20$), yields a convertible bond valuation of \$999.72, a value that is very close to the bond's face value of \$1,000. The current stock price multiplied by the conversion ratio gives a conversion value of \$800 (i.e., $\$40 \times 20$). Therefore, this convertible bond is selling at a conversion premium of 24.97% [i.e., $(\$999.72 - \$800)/\$800$].

Convertible Bond Price = Value of Straight Corporate Debt + Value of the Implicit Equity Call Option
(19.1a)

Conversion Ratio = Number of Shares Per Convertible Bond (19.1b)

Conversion Value = Current Stock Price \times Conversion Ratio (19.1d)

Conversion Premium = (Convertible Bond Price - Conversion Value) / Conversion Value
(19.1e)



EXPLANATION

Let's first find the value of the convertible bond. This is the same as finding the present value in Application 14.2.1b by using the following parameters: $n = 3$, $I = 8$, $PMT = 40$, and $FV = 1,000$ for a present value of \$896.92. Now, we need to add the value of 20 options (conversion ratio of the three-year convertible bonds) to the present value. The value of 20 options is computed by multiplying 20 by \$5.14 (price of a three-year European-style call option) for a product of \$102.80. The sum of \$896.92 and \$102.80 of \$999.72 is the value of the convertible bond. The conversion value is \$800.00 found by multiplying 20 (conversion ratio of the three-year convertible bonds) and \$40 (current stock price). The conversion premium is 24.96 and is found by subtracting \$800 (the conversion value) from \$999.72 (value of the convertible bond) and dividing the difference by \$800 (the conversion value).



CALCULATIONS

Find the value of the convertible bond

Step One: Press 2nd → CLR TVM

Step Two: Press 5 → N

Step Three: Press 8 → I/Y

Step Four: Press 40 → PMT

Step Five: Press 1000 → FV

Step Six: Press CPT → PV

Step Seven: "892.92"

Step Eight: 20 → x → 5.14

Step Nine: = → + → 892.92

Step Ten: =

Answer: 999.72

Find the conversion value

Step One: 20 → x → 40

Step Two: =

Answer: 800

Find the conversion premium

Step One: 999.72 → - → 800

Step Two: Press ÷ → 800

Step Three: Press =

Answer: 0.2496



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Application 19.2.1b

Value of the Convertible Bond	The Conversion Value	The Conversion Premium	Price of a Three-year European-Style Call Option	Unsecured Subordinated Straight Debt	Borrowing Cost on Unsecured Subordinated Straight Debt	Current Stock Price	Annual Coupon of the Convertible Bonds	Conversion Ratio of the Three-Year Convertible Bonds	Convertible Bond Face Value
\$999.72	\$800.00	24.96%	\$5.14	\$896.92	8.00%	\$40.00	4.00%	20	\$1,000
\$890.78	\$675.00	31.97%	\$2.00	\$860.78	9.00%	\$45.00	3.50%	15	\$1,000
\$927.98	\$750.00	23.73%	\$3.00	\$882.98	7.50%	\$50.00	3.00%	15	\$1,000
\$954.39	\$550.00	73.53%	\$2.00	\$934.39	7.00%	\$55.00	4.50%	10	\$1,000
\$923.99	\$900.00	2.67%	\$6.00	\$833.99	8.50%	\$60.00	2.00%	15	\$1,000
\$936.44	\$650.00	44.07%	\$3.00	\$906.44	6.00%	\$65.00	2.50%	10	\$1,000
\$1,310.27	\$1,225.00	6.96%	\$10.00	\$960.27	6.50%	\$35.00	5.00%	35	\$1,000

Application 19.3.6a (page 524): Suppose that the realized volatility of an asset has exactly six equally likely outcomes: 1%, 2%, 3%, 4%, 5%, or 6%. The expected value of the volatility is 3.5%. Now consider the same dispersion expressed in term of variance: 0.01, 0.04, 0.09, 0.16, 0.25, and 0.36. The expected value of the variance is approximately 0.152. The volatility corresponding to this variance is approximately 3.9%. The square root of the expected variance differs substantially from the expected volatility (standard deviation). Special care should be taken in comparing volatility computations and variance computations.

EXPLANATION

Essentially the application is noting that the square root of the expected variance is not the same as expected volatility. They are in fact different and therefore care should be taken when computing and using the expected volatility or expected variance to ensure the computation is correct as well as the application. This exercise highlights a distinction that is important in contrasting a derivative with payoffs linearly based on variance with one based linearly on volatility.

WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Given the following five equally-likely volatilities, compute the expected variance and the expected volatility: 20%, 25%, 30%, 35% and 40%.

The expected (average) volatility is 30%. Now convert each to a variance (by squaring each volatility) to get the expected variance: .095

Application 19.4.3a (page 536): What would be the short position in a four-year zero-coupon bond that would form a duration-neutral hedge with a \$2 million long position in a bond with a duration of 2.5? The duration of the four-year zero-coupon bond is 4.0 (i.e., equal to its maturity). The size of the short position must be $\$2,000,000 \times (2.5/4.0)$, or \$1,250,000.

EXPLANATION

To find the short position in a four-year zero-coupon bond that would form a duration-neutral hedge with a \$2 million long position in a bond with a duration of 2.5, we need to divide the long bond position duration by the short bond position duration and multiply by the nominal amount of the position that needs to be hedged. In this application, we need to divide 2.5 (duration of long bond position) by 4.0 (duration of short bond position) and multiply the quotient by \$2,000,000 (size of long position, which is the position being hedged) for a short bond position of \$1,250,000.

CALCULATIONS

Step One: Press $2.5 \rightarrow \div \rightarrow 4$

Step Two: Press $\times \rightarrow 2000000$

Step Three: Press $=$

Answer: 1250000

WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Application 19.4.3a

Short Bond Position (millions)	Short Bond Duration	Long Bond Position (millions)	Long Bond Duration
\$1.25	4	\$2.00	2.5
\$2.40	5	\$4.00	3
\$2.86	3.5	\$5.00	2
\$2.00	4.5	\$6.00	1.5
\$1.27	5.5	\$7.00	1
\$2.49	6.5	\$4.50	3.6
\$5.50	2.5	\$5.50	2.5

Application 20.3.2a (page 560): Holding the information ratio constant at 1.0, consider what IC would be necessary to maintain this IR when the breadth of the portfolio is changed in various scenarios:

- One portfolio manager is a market timer who makes one major bet each quarter on the up-and-down movement of the stock market. Her breadth per year is 4. Therefore, to maintain an IR of 1.0, solve for the value of IC for $IR = 1.0$ using Equation 20.4: $1.0 = IC \times 2$. The result is that the $IC = 0.50$.
- Next, consider a commodities trader who makes nine forecasts per year on the movement of crude oil prices. Again, using Equation 20.4 and solving for IC when breadth = 9 and $IR = 1.0$, the result is that the $IC = 0.33$.

$$IR = IC \times \sqrt{Breadth} \quad (20.4)$$

- IR is the information ratio, and IC is the information coefficient.



EXPLANATION

The information coefficient is calculated using equation 20.4:

$$IR = IC \times \sqrt{Breadth}$$

Applying equation 20.4 to scenario 1 we solve for the information coefficient:

$$IR = IC \times \sqrt{Breadth}$$

$$1 = IC \times \sqrt{4}$$

$$1 = IC \times 2$$

$$0.5 = IC$$

The information coefficient is 0.5 for scenario 1.

Applying equation 20.4 to scenario 2 we solve for the information coefficient:

$$IR = IC \times \sqrt{Breadth}$$

$$1 = IC \times \sqrt{9}$$

$$1 = IC \times 3$$

$$0.33 = IC$$

The information coefficient is 0.33 for scenario 2.



CALCULATIONS

Find the information coefficient in scenario 1

Step One: Press $1 \rightarrow \div \rightarrow 4$

Step Two: Press \sqrt{x}

Step Three: Press $=$

Answer: 0.5

Find the information coefficient in scenario 2

Step One: Press $1 \rightarrow \div \rightarrow 9$

Step Two: Press \sqrt{x}

Step Three: Press $=$

Answer: 0.33



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Information Coefficient (IC)	Information Ratio (IR)	Breadth per Year
0.50	1	4
0.33	1	9
0.89	2	5
2.12	3	2
2.31	4	3
1.12	5	20
2.67	10	14

Application 20.5.1a (page 566): Suppose that a short seller establishes a short position in one share of XYZ Corporation at \$50 per share and that XYZ pays a dividend of \$0.30 per share each calendar quarter. The current rebate on XYZ share is 1% per year. What would be the dollar return to the short seller if XYZ rose to \$51 at the end of one year? First, the short position loses \$1 (a capital loss) when the stock rises from \$50 to \$51. When the stock pays four quarterly dividends of \$0.30, it is up to the short seller to make a cash payment to the securities lender in lieu of dividends, so the short seller loses another \$1.20. Finally, an institutional short seller typically receives a short stock rebate; in this case, the rebate would be \$0.50 ($1\% \times \50). The total loss is \$1.70 ($\$1.00 + \$1.20 - \0.50).



EXPLANATION

There are three components of profit/loss in this short position, capital gain/loss, dividend gain/loss, and rebate gain/loss. When the stock rises to \$51 from \$50, the short position loses \$1 of capital loss. The stock pays a dividend quarterly, which the short seller pays the securities lender, so \$0.30 (stock dividend) multiplied by 4 (number of quarters in a year) equals \$1.20 of dividends the short seller owes the securities lender. Lastly, the short seller earns a rebate equal to 0.01 multiplied by \$50 (the price the security was sold short) or \$0.50. Putting it all together, $-\$1$ (capital loss of as share price rises to \$51 from \$50) $- \$1.20$ (quarterly dividend owed to securities lender from short seller) $+ \$0.50$ (short stock rebate) equals $-\$1.70$ or the dollar return to short seller in one year.



CALCULATIONS

Step One: Press 50 \rightarrow - \rightarrow 51

Step Two: Press = “-1”

Step Three: Press 4 \rightarrow x \rightarrow 0.30

Step Four: Press = “1.20”

Step Five: Press 0.01 \rightarrow x \rightarrow 50

Step Six: Press = “0.50”

Step Seven: 1 \rightarrow +/-

Step Eight: - \rightarrow 1.20

Step Nine: + \rightarrow 0.50

Step Ten: =

Answer: -1.70

Answer: 0.33



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Dollar Return to Short Seller in One Year	Short Position Shares	Price of XYZ Corp. Per Share	Quarterly Dividend of XYZ Corp. Per Share	Rebate on XYZ Corp.	Price of XYZ Corp. Per Share in One- Year
(\$1.70)	1	\$50.00	\$0.30	1.00%	\$51.00
(\$19.50)	10	\$65.00	\$0.40	1.00%	\$66.00
(\$279.38)	25	\$55.00	\$0.50	1.50%	\$65.00
\$305.00	50	\$75.00	\$0.10	2.00%	\$70.00
\$450.00	100	\$10.00	\$0.15	1.00%	\$5.00
\$876.00	200	\$15.00	\$0.20	1.20%	\$10.00
(\$810.30)	300	\$13.00	\$0.25	2.30%	\$15.00

Application 22.4.2a (page 827): Shares of closed-end fund ABC were selling at a premium of 10% and then fell to \$44 per share while ABC's net asset value held constant at \$50 per share. What were the previous market price, subsequent discount, NAV-based return, and market-price return for ABC?

The previous market price was \$55 (solved using Equation 22.1, with 0.10 on the left-hand side and \$50 for the NAV). The subsequent discount (solved as -12% using Equation 22.1, with \$44/\$50 as the fraction inside the parentheses) was 12%. The NAV-based return was 0%, since the NAV was assumed unchanged, and the market-price return was -20% (-\$11/\$55), assuming no dividends or other distributions.

$$\text{Premium (or Discount)} = (\text{Market Price/Net Asset Value}) - 1 \quad (22.1)$$

Other Variations:

$$\text{Market Price} = (\text{Premium or Discount} + 1) \times \text{Net Asset Value}$$

$$\text{Net Asset Value} = \text{Market Price} / (\text{Premium or Discount} + 1)$$



EXPLANATION

The previous market price is equal to NAV multiplied by 1 + the premium. In this case, $\$50 \times (1 + 0.10) = \55 . The subsequent discount is calculated using the same formula, but arranged differently, in this case, $\$44 / \$50 - 1 = -12\%$. The NAV return is zero as the NAV is assumed to have stayed constant throughout the example. The market price return is calculated by $(\$44 - \$55) / \$55$ or -20%.



CALCULATIONS

Previous market price

Step One: Press 1 → + → 0.10

Step Two: Press x → \$50

Step Three: Press =

Answer: 55

Subsequent discount

Step One: Press 44 → ÷ → 50

Step Two: Press - → 1

Step Three: Press =

Answer: -0.12 or -12%

Market price return

Step One: Press 44 → - → 55

Step Two: Press $\div \rightarrow 55$

Step Three: Press =

Answer: -0.20 or -20%



WORKOUT AREA: *Here are sample problems – cover the values in the rightmost column and see if you can solve it using the others*

Previous Market Price	Subsequent Discount	Premium	Subsequent Price Per Share	NAV	Market Price Return
\$55.00	12.00%	10.00%	\$44.00	\$50.00	-20.00%
\$44.80	0.00%	12.00%	\$40.00	\$40.00	-10.71%
\$22.40	0.00%	12.00%	\$20.00	\$20.00	-10.71%
\$21.00	20.00%	5.00%	\$16.00	\$20.00	-23.81%
\$30.30	0.00%	1.00%	\$30.00	\$30.00	-0.99%
\$20.60	10.00%	3.00%	\$18.00	\$20.00	-12.62%
\$25.50	12.00%	2.00%	\$22.00	\$25.00	-13.73%

Application 22.5.2a (page 632): A convertible preferred stock with a par or face value of \$100 per share is convertible into four shares of common stock. What is the conversion ratio, and what is the conversion price? What would be the conversion ratio if the conversion price were \$20?

The original example of the preferred stock has a conversion ratio of 4:1. The conversion option may be expressed as a conversion price of \$25 (using the face value of the preferred stock to make the purchase). In the second example of a \$20 conversion price, the conversion ratio would be 5:1.



EXPLANATION

The conversion ratio is 4:1. It is how many shares the preferred stock can be converted into. In this case, one share of preferred stock can be converted into 4 shares. The conversion price is \$100 (face value of the preferred stock) divided by 4 equals \$25, the conversion price. If the conversion price was \$20, then \$100 (face value of the preferred stock) divided by \$20 equals 5 (5:1), the conversion ratio.



CALCULATIONS

Conversion price

Step One: Press $100 \rightarrow \div \rightarrow 4$

Step Two: Press =

Answer: 25

Conversion ratio with conversion price of \$20

Step One: Press $100 \rightarrow \div \rightarrow 20$

Step Two: Press =

Answer: 5



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Conversion Price	Face value	Conversion ratio
\$25.00	\$100.00	4 :1
\$20.00	\$100.00	5 :1
\$50.00	\$100.00	2 :1
\$50.00	\$350.00	7 :1
\$83.33	\$250.00	3 :1
\$90.00	\$450.00	5 :1
\$187.50	\$750.00	4 :1

Application 23.3.2a (page 641): A VC fund manager raises \$100 million in committed capital for his VC fund. The management fee is 2.5%. To date, only \$50 million of the raised capital has been called and invested in start-ups. What would be the annual management fee? The annual management fee that the manager collects is \$2.5 million ($2.5\% \times \100 million), even though not all of the capital has been invested.



EXPLANATION

The key trait in most VC fund deals is that the management fee is collected on the total capital including the committed capital that has not even been funded (let alone invested in companies).



CALCULATIONS

Step One: Press $100000000 \rightarrow \times \rightarrow 0.025$

Step Two: Press =

Answer: 2,500,000



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using*

Committed Cap.	Called Capital	Invested Capital	Mgmt. Fee %	Mgmt. Fee \$
\$100 m	\$70 m	\$50 m	1%	\$1 m
\$500 m	\$400 m	\$100 m	2%	\$10 m

Application 23.7.7a (page 861): Returning to the previous example, suppose that all other facts remain the same except that the discount rate used at the end of seven years is 15%. The projected value of the company becomes \$120 million/ $(0.15 - 0.02) = \$0.923$ billion, and the seven-year rate of return becomes $(\$0.923 \text{ billion}/\$100 \text{ million})^{1/7} - 1 = 37.4\%$.



EXPLANATION

The key issues in this application are that the value of the company at the exit horizon is being changed by the change in the discount factor used in the valuation model. The new exit value generates a new rate of return

The old valuation was:

$$\$120 \text{ million} / (0.12 - 0.02) = \$1.2 \text{ billion}$$

The new valuation is:

$$\$120 \text{ million} / (0.15 - 0.02) = \$0.923 \text{ billion}$$

The old rate of return was:

$$(\$1.2 \text{ billion} / \$100 \text{ million})^{1/7} - 1 = 42.6\%$$

The new rate of return is:

$$(\$0.923 \text{ billion} / \$100 \text{ million})^{1/7} - 1 = 37.4\%$$



CALCULATIONS

Previous market price

Step One: Press $0.120 \rightarrow \div .13 =$

Step Two: Press $0.923 \div .1 = y^x .142857 =$

Step Three: Press $- 1 =$

Answer: .374 or 37.4%



WORKOUT AREA: *Here are sample problems – cover the values in the rightmost two columns and see if you can solve for them using the others*

Initial Invest.	Valuation Cash Flow	Discount Rate	Growth Rate	Ending Value	Rate of Return
\$100	\$120	15.00%	2.00%	\$923	37.37%
\$100	\$120	12.00%	5.00%	\$1,714	50.07%
\$100	\$120	12.00%	2.00%	\$1,200	42.62%
\$150	\$150	12.00%	7.00%	\$3,000	53.41%
\$150	\$120	14.00%	1.00%	\$923	29.64%

Application 23.7.7b (page 861): Returning to the original example, suppose that all other facts remain the same except that the growth rate used at the end of seven years is 5%. The projected value of the company becomes \$120 million/ $(0.12 - 0.05) = \$1.714$ billion, and the seven-year rate of return becomes $(\$1.714 \text{ billion}/\$100 \text{ million})^{1/7} - 1 = 50.1\%$.



EXPLANATION

The key issues in this application are that the value of the company at the exit horizon is being changed by the change in the growth rate used in the valuation model. The new exit value generates a new rate of return

The old valuation was:

$$\$120 \text{ million} / (0.12 - 0.02) = \$1.2 \text{ billion}$$

The new valuation is:

$$\$120 \text{ million} / (0.12 - 0.05) = \$1.714 \text{ billion}$$

The old rate of return was:

$$(\$1.2 \text{ billion} / \$100 \text{ million})^{1/7} - 1 = 42.6\%$$

The new rate of return is:

$$(\$1.714 \text{ billion} / \$100 \text{ million})^{1/7} - 1 = 50.1\%$$



CALCULATIONS

Previous market price

Step One: Press $0.120 \rightarrow \div .07 =$

Step Two: Press $1.714 \div 0.1 = y^x .142857 =$

Step Three: Press $- 1 =$

Answer: .501 or 50.1%



WORKOUT AREA: *Here are sample problems – cover the values in the two rightmost columns and see if you can solve for them using the others*

Initial Invest.	Valuation Cash Flow	Discount Rate	Growth Rate	Ending Value	Rate of Return
\$100	\$120	15.00%	2.00%	\$923	37.37%
\$100	\$120	12.00%	5.00%	\$1,714	50.07%
\$100	\$120	12.00%	2.00%	\$1,200	42.62%
\$50	\$120	13.00%	2.00%	\$1,091	55.33%
\$200	\$150	14.00%	4.00%	\$1,500	33.35%

Application 23.7.7c (page 862): Returning to the original example, suppose that all other facts remain the same except that the investment requires eight years to exit. The projected value of the company becomes \$120 million/ $(0.12 - 0.02) =$ \$1.2 billion, and the eight year rate of return becomes $(\$1.2 \text{ billion}/\$100 \text{ million})^{1/8} - 1 = 36.4\%$.



EXPLANATION

The key issues in this application is that the value of the company at the exit horizon is the same, but the time interval changes (from 7 years to 8 years) and the rate of return therefore changes:

The old valuation is still:

$$\$120 \text{ million} / (0.12 - 0.02) = \$1.2 \text{ billion}$$

The new rate of return is:

$$(\$1.2 \text{ billion} / \$100 \text{ million})^{1/8} - 1 = 36.4\%$$



CALCULATIONS

Previous market price

Step One: Press $0.120 \rightarrow \div .10 =$

Step Two: Press $1.2 \div 0.1 = y^x .125 =$

Step Three: Press $- 1 =$

Answer: .364 or 36.4%



WORKOUT AREA: *Here are sample problems – cover the values in the two rightmost columns and see if you can solve for them using the others*

Initial Invest.	Valuation Cash Flow	Discount Rate	Growth Rate	Ending Value	Rate of Return
\$100	\$120	15.00%	2.00%	\$923	32.02%
\$100	\$120	12.00%	5.00%	\$1,714	42.65%
\$100	\$120	12.00%	2.00%	\$1,200	36.43%
\$50	\$120	13.00%	2.00%	\$1,091	47.01%
\$200	\$150	14.00%	4.00%	\$1,500	28.64%

Application 23.7.7d (page 862): Returning to the original example, suppose that all other facts remain the same except that the \$120 million cash flow estimate given is a year 7 cash flow that is anticipated to grow by year 8. The \$120 million seven-year cash flow is therefore estimated to grow to an eight-year cash flow as $\$120 \text{ million} \times (1.02) = \122.4 million . The projected value of the company becomes $\$122.4 \text{ million} / (0.12 - 0.02) = \1.224 billion , and the seven-year rate of return becomes $(\$1.224 \text{ billion} / \$100 \text{ million})^{1/7} - 1 = 43.0\%$.



EXPLANATION

The key issue is that the cash flow being earned at exit is higher. The application attempts to emphasize that when using the perpetual growth model the proper cash flow to use in the numerator is the cash flow at the end of the year following the valuation date.

The old valuation was:

$$\$120 \text{ million} / (0.12 - 0.02) = \$1.2 \text{ billion}$$

The new valuation is:

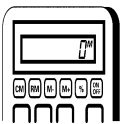
$$\$120 \text{ million} * (1.02) / (0.12 - 0.02) = \$1.224 \text{ billion}$$

The old rate of return was:

$$(\$1.2 \text{ billion} / \$100 \text{ million})^{1/7} - 1 = 42.6\%$$

The new rate of return is:

$$(\$1.224 \text{ billion} / \$100 \text{ million})^{1/7} - 1 = 43.0\%$$



CALCULATIONS

Previous market price

Step One: Press $0.120 \times 1.02 = \rightarrow \div .10 =$

Step Two: Press $\div .1 = y^x .142857 =$

Step Three: Press $- 1 =$

Answer: .430 or 43.0%



WORKOUT AREA: *Here are sample problems – cover the values in the two rightmost columns and see if you can solve for them using the others*

Initial Invest.	Valuation Cash Flow	Discount Rate	Growth Rate	Ending Value	Rate of Return
\$100	\$120.00	12.00%	2.00%	\$1,200	42.62%
\$100	\$122.40	12.00%	2.00%	\$1,224	43.02%
\$100	\$124.80	12.00%	2.00%	\$1,248	43.42%
\$100	\$120.00	15.00%	2.00%	\$923	37.37%
\$100	\$150.00	12.00%	5.00%	\$2,143	54.93%

Application 24.1.2 (page 670): Suppose that the structure on the right-hand side of Exhibit 24.1 is changed such that the mezzanine debt rises to being 30% of the capital structure, and the bank debt falls to being 50% of the capital structure. If the costs of bank debt and equity remain the same (8% and 32%, respectively), what must the new cost of mezzanine debt be such that the weighted average cost of capital would be 15.8%? The answer is found by solving for x : $15.8\% = (.20 \times 32\%) + (.30x) + (.50 \times 8\%)$. The solution is that the cost of mezzanine debt, x , is 18%.

The weighted average cost of capital for a firm is the sum of the products of the percentages of each type of capital used to finance a firm times its annual cost to the firm.

EXPLANATION

Let's manipulate the WACC equation to solve for the cost of mezzanine debt:

$$WACC = C_a \times P_a + C_b \times P_b + C_c \times P_c$$

$$WACC - C_b \times P_b = C_a \times P_a + C_c \times P_c$$

$$WACC - C_b \times P_b - C_c \times P_c = C_a \times P_a$$

$$\frac{WACC - C_b \times P_b - C_c \times P_c}{P_a} = C_a$$

After manipulating the equation, we can now solve for the cost of mezzanine debt:

$$\frac{0.158 - 0.32 \times 0.20 - 0.08 \times 0.50}{0.30} = C_a$$

$$\frac{0.158 - 0.064 - 0.08 \times 0.50}{0.30} = C_a$$

$$\frac{0.158 - 0.064 - 0.04}{0.30} = C_a$$

$$\frac{0.094 - 0.04}{0.30} = C_a$$

$$\frac{0.054}{0.30} = C_a$$

$$0.18 = C_a$$

The cost of mezzanine debt is 0.18 or 18%.



CALCULATIONS

Step One: Press 0.32 → +/-

Step Two: Press x → 0.20

Step Three: Press = “-0.064”

Step Four: Press 0.08 → +/-

Step Five: Press x → 0.50

Step Six: Press = “0.04”

Step Seven: Press 0.158 → - → 0.064

Step Eight: Press - → 0.04

Step Nine: Press ÷ → 0.30

Step Ten: Press =

Answer: 0.18



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

WACC	Cost of Bank Debt	Cost of Mezzanine Debt	Cost of Equity	Mezzanine Debt	Bank Debt	Equity
12.40%	8.00%	12.00%	20.00%	20.00%	50.00%	30.00%
12.50%	8.00%	12.00%	22.00%	25.00%	50.00%	25.00%
13.25%	8.00%	13.00%	23.00%	15.00%	55.00%	30.00%
13.00%	8.00%	13.00%	24.00%	20.00%	55.00%	25.00%
13.15%	8.00%	14.00%	25.00%	15.00%	60.00%	25.00%
13.20%	8.00%	14.00%	28.00%	20.00%	60.00%	20.00%
15.80%	8.00%	18.00%	32.00%	30.00%	50.00%	20.00%

Application 24.2.3a (page 678): If 20% of the bonds in a portfolio default each year and if 60% of the bonds' value is ultimately unrecovered (i.e., 40% of the bonds' cost is recovered), then the total loss due to default over that time period is 12% (20% x 60%). A minimum criterion for the success of a distressed debt investor is that the coupon rate exceeds the 12% loss rate.

$$\text{Coupon Rate} \geq \text{Annual Default Rate} \times \text{Loss Rate Given Default} \quad (24.2)$$



EXPLANATION

Total Loss due to Default is calculated by multiplying the annual default rate by the loss rate given default. In this application, 20% (annual default rate) is multiplied by 60% (loss rate given default) for a product of 12% (total loss due to default).



CALCULATIONS

Step One: Press 0.20 → x → 0.60

Step Two: Press =

Answer: 0.12



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Total Loss Due to Default	Annual Default Rate	Loss Rate Given Default
12.00%	20.00%	60.00%
24.00%	30.00%	80.00%
6.00%	20.00%	30.00%
0.75%	15.00%	5.00%
20.00%	25.00%	80.00%
21.00%	30.00%	70.00%
26.00%	40.00%	65.00%

Application 25.5.3a (page 700): Consider a firm with \$50 million in assets and \$25 million in equity value. The firm has one debt issue: a zero-coupon bond maturing in one year with a face value of \$30 million. A riskless zero-coupon bond of the same maturity sells for 90% of its face value. What is the value of the firm's debt? What is the value of a one-year put option on the firm's assets with a strike price of \$30 million? Since the assets are worth \$50 million and the call option is worth \$25 million, the firm's risky debt must be worth \$25 million, since $\text{assets} = \text{equity} + \text{risky debt}$. Since the riskless bond in the right-most bracket in Equation 25.3 is worth \$27 million, the put option must be worth \$2 million.

$$\text{Assets} = [\text{Call}] + [\text{Riskless Bond} - \text{Put}] \quad (25.3)$$



EXPLANATION

The easiest and most important step is recognizing that the value of the firm's debt is simply the difference between \$50 million (the firm's asset) and \$25 million (the firm's equity value or the value of the call option) for a difference of \$25 million. Next, we break the value of the firm's debt into its two components: the riskless portion and the short put position. So we rearrange equation 25.3 to solve for the value of the put.

$$\text{Assets} = [\text{Call}] + [\text{Riskless Bond} - \text{Put}]$$

$$\text{Assets} - \text{Call} = \text{Debt} = \text{Riskless Bond} - \text{Put}$$

-After rearranging the equation to solve for the value of the put, we can solve:

$$\$25 \text{ million} = \text{Riskless Bond} - \text{Put}$$

$$\$25 \text{ million} = \$27 \text{ million} - \text{Put}$$

$$\text{Put} = \$2 \text{ million}$$

The value of the put option is \$2 million.



CALCULATIONS

Step One: Press 0.90 → x → 30,000,000

Step Two: Press + → 25,000,000

Step Three: Press + → 50,000,000 → +/-

Step Four: Press =

Answer: 2,000,000



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others, especially the second column*

Value of the Firms Debt (millions)	Value of a One- Year Put Option on the Firm's Assets (millions)	Assets (millions)	Equity (millions)	Face Value (millions)	Percent of Face Value a One-Year Riskless Zero Coupon Bond Sell For
\$25.00	\$2.00	\$50.00	\$25.00	\$30.00	90.00%
\$20.00	\$1.25	\$25.00	\$5.00	\$25.00	85.00%
\$15.00	\$4.00	\$25.00	\$10.00	\$20.00	95.00%
\$25.00	\$3.00	\$50.00	\$25.00	\$35.00	80.00%
\$45.00	\$1.80	\$75.00	\$30.00	\$48.00	90.00%
\$5.00	\$0.25	\$55.00	\$50.00	\$7.00	75.00%
\$10.00	\$3.00	\$65.00	\$55.00	\$20.00	65.00%

Application 25.5.4a (page 701): Consider a firm with \$100 million in assets and \$60 million in equity value. The firm's debt has a face value of \$50 million and a maturity of one year. The volatility of the firm's equity is estimated at 40%. How would an analyst estimate the value of the firm's equity if the volatility of the firm's assets doubled? Step #2 is based on Equation 25.4 and unlevers the current equity volatility from 40% to an asset volatility of 24% through multiplying the equity volatility (40%) by the ratio of the value of the equity to the value of the assets (\$60 million/\$100 million, or 0.60). A doubling in the asset volatility increases the asset volatility to 48%. The value of the firm's equity can be found using an option pricing model for a call option, with an underlying asset value of \$100 million, an underlying asset volatility of 48%, a strike price of \$50 million, a time to expiration of one year, and the prevailing riskless rate.

$$\sigma_{\text{assets}} \approx \sigma_{\text{equity}} \times (\text{Equity/Assets}) \quad (25.4)$$



EXPLANATION

The idea behind this application is to understand three things: (1) how the Black-Scholes option pricing model can value a firm's equity as a call option on the firm's assets, (2) how the asset volatility required in that model can be inferred from the equity volatility, and (3) how changes in the equity volatility would be transmitted through the model into a high equity price.

Let's look closer at the second step. We need to unlever the current equity volatility from 40% into the corresponding asset volatility. This is done by multiplying the equity volatility by the equity-to-asset ratio (40% x 0.60 for a product of 24%, the asset volatility). The final step is to note that a doubling of the equity volatility transmits into a doubling of the asset volatility: Multiply 24% (the volatility of the firm's assets) by 2 to get the expected volatility of the firm's assets as 48%. The value of the firm's equity with the higher volatility would be solved using the Black-Scholes option pricing model (which is not required in this application).



CALCULATIONS

Find Volatility of Firms Assets

Step One: Press 60 \rightarrow \div \rightarrow 100

Step Two: Press x \rightarrow 0.40

Step Three: Press =

Answer: 0.24

Find the Approximate Equity with Expected Asset Volatility

Step One: Press 0.24 \rightarrow x \rightarrow 2 =

Answer: 0.48 (ready for use in option pricing model)



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Assets (millions)	Equity (millions)	Volatility of the Firm's Equity	Volatility of the Firm's Assets
\$100.00	\$60.00	40.00%	24.00%
\$75.00	\$45.00	35.00%	21.00%
\$50.00	\$20.00	30.00%	12.00%
\$150.00	\$75.00	25.00%	12.50%
\$200.00	\$125.00	45.00%	28.13%
\$250.00	\$200.00	50.00%	40.00%
\$300.00	\$275.00	60.00%	55.00%

Application 25.6.1a (page 704): Suppose that the CDO depicted in Exhibit 25.5 alters its portfolio such that the average coupon on the assets is 6%. Ignoring defaults, fees, and expenses, how much annual income should be available to the equity tranche? The answer is that \$3.3 million would go to the senior and mezzanine tranches, and \$2.7 million would be available for the equity tranche.

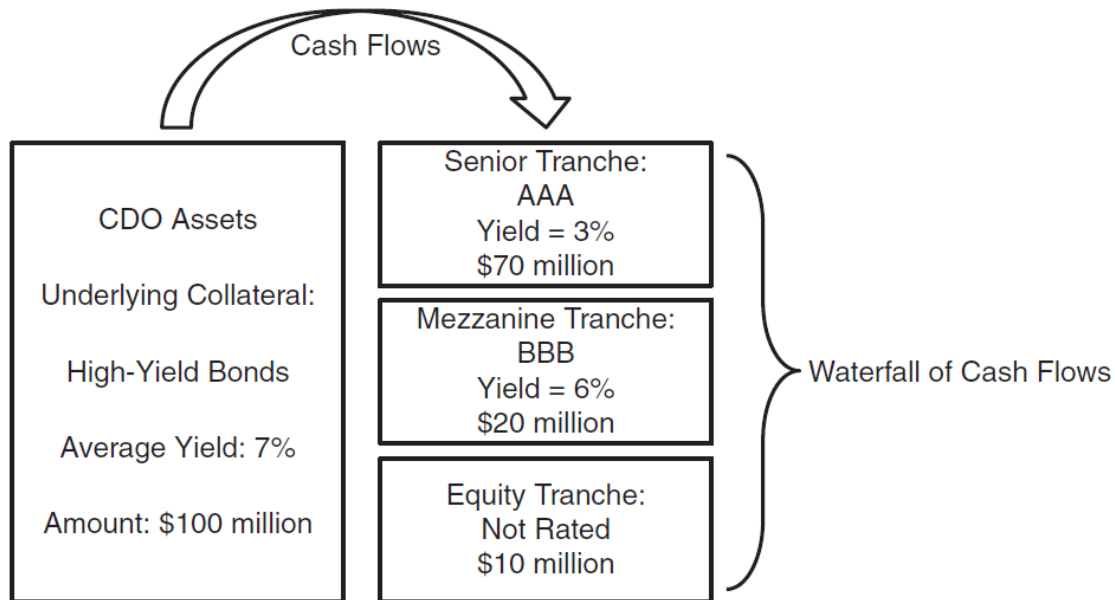


EXHIBIT 25.5 Simplified CDO Structure

EXPLANATION

The equity tranche receives all the income from the assets that is left over after paying funds due to all the other tranches. Therefore, we need to determine overall CDO income, income to the senior tranche, and income to the mezzanine tranche. To determine the overall income we need to multiple 6% (average yield on assets) by \$100 million (total value of assets) for a product of \$6 million (net income from the assets of the CDO). Now, the cash flow to the mezzanine and senior tranche is based on their coupons and principal amounts (because there is enough income for both of the tranches). The income to the senior tranche is 3% (yield on senior tranche) multiplied by \$70 million for a product of \$2.1 million (income to the senior tranche). Now there is \$3.9 million of income left for the mezzanine and equity tranches. The income to the mezzanine tranche is 6% (yield on mezzanine tranche) multiplied by \$20 million for a product of \$1.2 million (income to the mezzanine tranche). That leaves \$2.7 million of income for

the equity tranche, which is calculated by subtracting \$6 million (income to the CDO) by the sum of \$2.1 million (income to the senior tranche) and \$1.2 million (income to the mezzanine tranche).



CALCULATIONS

Find income to the Equity Tranche

Step One: Press 100 \rightarrow x \rightarrow 0.06

Step Two: Press = "6"

Step Three: Press 70 \rightarrow x \rightarrow 0.03

Step Four: Press = "2.1"

Step Five: Press 20 \rightarrow x \rightarrow 0.06

Step Six: Press = "1.2"

Step Seven: Press 6 \rightarrow - \rightarrow 2.1

Step Eight: Press - \rightarrow 1.2

Step Nine: Press =

Answer: 2.7



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others, especially the first column*

Cash to Equity Tranche	Cash to Sr. and Mezz. Tranches	Yield on Assets	Cash from Assets	Senior Tranche Coupon	Mezzanine Tranche Coupon	Value of Equity Tranche	Value of Senior Tranche	Mezz. Tranche Value	Total Value of Assets
\$2.70	\$3.30	6.00%	\$6.00	3.00%	6.00%	\$10.00	\$70.00	\$20.00	\$100.00
\$2.08	\$4.93	7.00%	\$7.00	2.50%	6.50%	\$15.00	\$15.00	\$70.00	\$100.00
\$6.13	\$1.88	8.00%	\$8.00	2.00%	7.50%	\$20.00	\$75.00	\$5.00	\$100.00
\$6.00	\$4.00	10.00%	\$10.00	3.50%	9.00%	\$25.00	\$50.00	\$25.00	\$100.00
\$4.96	\$4.04	9.00%	\$9.00	4.00%	8.00%	\$33.00	\$33.00	\$34.00	\$100.00
\$5.55	\$1.95	7.50%	\$7.50	1.50%	7.50%	\$10.00	\$80.00	\$10.00	\$100.00
\$0.00	\$5.50	5.50%	\$5.50	6.00%	8.00%	\$15.00	\$10.00	\$75.00	\$100.00

Application 25.6.1b (page 705): Suppose that the CDO depicted in Exhibit 25.5 experiences defaults in \$50 million of the assets with 30% recovery. What will happen to the tranches? First, note that the 30% recovery reduces the losses to 70% of \$50 million (\$35 million). After the equity tranche is eliminated due to the first \$10 million in defaults, the mezzanine tranche is eliminated due to the next \$20 million in defaults. The remaining \$5 million of defaults will bring down the notional value of the senior tranche from \$70 million to \$65 million. The senior tranche has first priority to the recovered value of the bonds (\$15 million), which may be distributed to the senior tranche, further reducing its notional value to \$50 million.



EXPLANATION

To calculate the recovered assets multiply \$50 million (the combined principal values of the bonds experiencing default) by 1 minus 30% (the 30% is the loss given default rate and the 70% is the recovery rate) for a product of \$35 million (the recovery on the defaulted assets). Now the equity tranche is the least protected from defaults (first to bear losses) and is currently valued at \$10 million. Therefore, the entire equity tranche is eliminated because \$35 million (defaulted assets) is greater than \$10 million (value of equity tranche). The next subordinated tranche is the mezzanine tranche, which is valued at \$20 million. There is \$25 million left of default losses to be covered, as we have allocated \$10 million to the equity tranche, which eliminated that tranche. Therefore, the mezzanine tranche is also eliminated because \$25 million (remaining defaulted assets after the equity tranche) is greater than \$20 million (value of mezzanine tranche). There is now \$5 million left of the defaults to be covered, which will impact the senior tranche. The senior tranche is valued at \$70 million. Thus, we will subtract the \$5 million remaining of the defaulted assets by the \$70 million value of the senior tranche reducing the value of the senior tranche to \$65 million.

CALCULATIONS

Find value after default of each tranche

Step One: Press 1 → - → 0.30

Step Two: Press x → 50

Step Three: Press = “35”

Step Four: Press 35 → - → 10 (eliminated the equity tranche)

Step Five: Press = “25”

Step Six: Press 25 → - → 20 (eliminated the mezzanine tranche)

Step Seven: Press = “5”

Step Eight: Press 70 → - → 5 (reducing the senior tranche)

Step Nine: Press =

Answer: 65 (remaining value in millions of the senior tranche)

WORKOUT AREA: *Here are sample problems– cover the values in the four leftmost columns and see if you can solve it using the other columns*

Value of Equity Tranche	Value of Senior Tranche After Default	Value of Mezzanine Tranche After Default	Total Value of Assets After Default	Start Value of Equity Tranche	Start Value of Senior Tranche	Start Value of Mezzanine Tranche	Total Value of Assets	Principal Value of Defaults	Recovery Rate	Default Losses
\$0.00	\$65.00	\$0.00	\$65.00	\$10.00	\$70.00	\$20.00	\$100.00	\$50.00	30.00%	\$35.00
\$0.00	\$15.00	\$66.25	\$81.25	\$15.00	\$15.00	\$70.00	\$100.00	\$25.00	25.00%	\$18.75
\$0.00	\$70.25	\$0.00	\$70.25	\$20.00	\$75.00	\$5.00	\$100.00	\$35.00	15.00%	\$29.75
\$0.00	\$50.00	\$9.50	\$59.50	\$25.00	\$50.00	\$25.00	\$100.00	\$45.00	10.00%	\$40.50
\$8.00	\$33.00	\$34.00	\$75.00	\$33.00	\$33.00	\$34.00	\$100.00	\$50.00	50.00%	\$25.00
\$0.00	\$64.25	\$0.00	\$64.25	\$10.00	\$80.00	\$10.00	\$100.00	\$55.00	35.00%	\$35.75
\$0.00	\$10.00	\$54.25	\$64.25	\$15.00	\$10.00	\$75.00	\$100.00	\$65.00	45.00%	\$35.75

Application 26.2.2a (page 711): A bank has extended a \$50 million one-year loan at an interest rate of 14% to a client with a BBB credit rating. Suppose that historical data indicate that the one-year probability of default for firms with a BBB rating is 5% and that investors are typically able to recover 40% of the notional value of an unsecured loan to such firms. What is the expected credit loss? The expected credit loss of the bank is as follows:

$$\text{PD} = 5\%$$

$$\text{EAD} = \$50 \text{ million} \times (1 + 0.14) = \$57 \text{ million}$$

$$\text{RR} = 0.40 \text{ so that } \text{LGD} = 0.60$$

$$\text{Expected Credit Loss} = 0.05 \times \$57 \text{ million} \times (1 - 0.40) = \$1.71 \text{ million}$$

Note that this calculation is an estimate of the average loss. If a default actually occurs, then the loss in this example is $60\% \times \$57 \text{ million} = \34.2 million .

$$\text{Expected Credit Loss} = \text{PD} \times \text{EAD} \times (1 - \text{RR}) \quad (26.1)$$



EXPLANATION

The expected credit loss is found by implementing equation 26.1. PD is 5%. Estimated amount of default is \$50 million \times (1+0.14) or \$57 million. The recovery rate is 40%, so the amount not recovered is 1 minus 40% (the recovery rate). Now we can utilize equation 26.1 and solve for the expected credit loss:

$$\text{Expected Credit Loss} = \text{Probability of Default} \times \text{Estimated Amount of Default} \times (1 - \text{Recovery Rate})$$

$$\text{Expected Credit Loss} = 0.05 \times \$57 \text{ million} \times (1 - 0.40)$$

$$\text{Expected Credit Loss} = 0.05 \times \$57 \text{ million} \times 0.60$$

$$\text{Expected Credit Loss} = \$2.85 \text{ million} \times 0.60$$

$$\text{Expected Credit Loss} = \$1.71 \text{ million}$$

The expected credit loss is \$1.71 million.



CALCULATIONS

Find the Expected Credit Loss

Step One: Press 1 \rightarrow - \rightarrow 0.40

Step Two: Press x \rightarrow 57

Step Three: Press x \rightarrow 0.05

Step Four: Press =

Answer: 1.71



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Expected Credit Loss (millions)	Interest Rate	One-Year Loan Value (millions)	Probability of Default	Recovery Rate
\$1.71	14.00%	\$50.00	5.00%	40.00%
\$4.03	12.00%	\$100.00	6.00%	40.00%
\$2.37	13.00%	\$50.00	7.00%	40.00%
\$3.43	10.00%	\$65.00	8.00%	40.00%
\$3.50	11.00%	\$75.00	7.00%	40.00%
\$3.64	19.00%	\$85.00	6.00%	40.00%
\$3.24	20.00%	\$90.00	5.00%	40.00%

Application 26.2.5a (page 714): Suppose that the risk-free rate is 5% per year and that a one-year, zero-coupon corporate bond yields 6% per year. What are the precise and approximate risk-neutral probabilities of default? Assuming a recovery rate of 80% on the corporate bond, the precise risk-neutral probability of default can be estimated as shown in Equation 26.4:

$$\lambda = \frac{1}{1-0.80} \left(\frac{0.01}{1+0.05+0.01} \right) = 4.7\%$$

If the approximation formula (the approximation in Equation 26.5) is used, the risk-neutral probability of default would be 5%, found as .01/0.20.



EXPLANATION

The approximate risk neutral probability of default found by subtracting 0.05 (the risk-free rate) from 0.06 (the corporate bond yield) and then divide the result (1%) by the loss given default (1.00 minus the recovery rate of 0.80) for an answer of 5%. This is very intuitive. Ignoring a risk premium, a bond with default risk with a 1% higher yield that will lose 20% if default occurs must have a probability of default of only 5% so that on average the bond will pay the same return as the riskless rate.

The precise risk-neutral probability of default is calculated using equation 26.4.

$$\lambda = \frac{1}{1-RR} \left(\frac{s}{1+r+s} \right)$$

In this equation, RR is the recovery rate (or 80% in this application). s is the credit spread which is the corporate bond yield (6%) minus the risk free rate (5%). r is the risk free rate (5%). Let's solve for λ , the precise risk-neutral probability of default.

$$\lambda = \frac{1}{1-0.80} \left(\frac{0.06-0.05}{1+0.05+(0.06-0.05)} \right)$$

$$\lambda = \frac{1}{1-0.80} \left(\frac{0.01}{1+0.05+(0.06-0.05)} \right)$$

$$\lambda = \frac{1}{1-0.80} \left(\frac{0.01}{1+0.05+0.01} \right)$$

$$\lambda = \frac{1}{1-0.80} \left(\frac{0.01}{1.06} \right)$$

$$\lambda = \frac{1}{0.20} \left(\frac{0.01}{1.06} \right)$$

$$\lambda = 5 \left(\frac{0.01}{1.06} \right)$$

$$\lambda = 5 \left(\frac{0.01}{1.06} \right)$$

$$\lambda = 0.04716$$

The precise risk-neutral probability of default is 4.72%.



CALCULATIONS

Find the approximate risk neutral probability of default

Step One: Press 0.06 → - → 0.05

Step Two: Press = “0.01”

Step Three: Press 1 → - → 0.80

Step Four: Press = “0.20”

Step Five: Press 0.01 → ÷ → 0.20

Step Six: Press =

Answer: 0.05

Find the precise risk-neutral probability of default

Step One: Press 0.06 → - → 0.05

Step Two: Press = “0.01”

Step Three: Press 1 → + → 0.05

Step Four: Press + → 0.01

Step Five: Press = “1.06”

Step Six: Press 1 → - → 0.80

Step Seven: Press = "0.20"

Step Eight: Press $1 \rightarrow \div \rightarrow 0.20$

Step Nine: Press = "5"

Step Ten: Press $0.01 \rightarrow \div \rightarrow 1.06$

Step Eleven: Press $\times \rightarrow 5$

Step Twelve: Press =

Answer: 0.04716



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Approximate Risk-Neutral Probability of Default	Precise Risk-Neutral Probability of Default	Riskless Interest Rate	1 Year Corporate Bond Yield	Recovery Rate
5.00%	4.72%	5.00%	6.00%	80.00%
20.00%	18.18%	8.00%	10.00%	90.00%
18.00%	16.82%	2.50%	7.00%	75.00%
13.33%	12.40%	5.50%	7.50%	85.00%
50.00%	47.39%	3.00%	5.50%	95.00%
4.29%	4.08%	3.50%	5.00%	65.00%
10.00%	9.26%	4.00%	8.00%	60.00%

Application 26.2.5b (page 714): Suppose that the risk-neutral probability of default for a bond is 5% per year and that the recovery rate of the bond is 70%. What is the approximate spread by which the bond should trade relative to the yield of a riskless bond? The approximate credit spread (from Equation 26.6) is $5\% \times (1 - 0.70)$, or 1.5%.

$$s \approx \lambda \times (1 - RR) \quad (26.6)$$

EXPLANATION

Equation 26.6 addresses this mathematical relationship. To solve for the approximate credit spread subtract 70% from 1 (1-0.70) and multiply that difference of 30% by 5% for a product of 1.5%. 1.5% is the approximate credit spread.

CALCULATIONS

Find the approximate credit spread

Step One: Press 1 → - → 0.70 = 0.03

Step Two: Press x → 0.05

Step Three: Press =

Answer: 0.015

WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Approximate Spread by which the Bond Should Trade Relative to the Riskless Bond	Precise Risk- Neutral Probability of Default	Recovery Rate
1.50%	5.00%	70.00%
0.55%	5.50%	90.00%
1.63%	6.50%	75.00%
0.90%	6.00%	85.00%
0.35%	7.00%	95.00%
1.40%	4.00%	65.00%
1.80%	4.50%	60.00%

Application 26.2.6a (page 715): Suppose that the junior debt of XYZ Corporation is frequently traded and currently trades at a credit spread of 2.50% over riskless bonds of comparable maturity. The senior debt of the firm has not been regularly traded because it was primarily held by a few institutions, and a new issue of debt that is subordinated to all other debt has been rated as speculative. The expected recovery rate of the senior debt is 80%, the old junior debt is 50%, and the recently issued speculative debt is 20%. Using approximation formulas, what arbitrage-free credit spreads should be expected on the senior and speculative debt issues? The 2.50% credit spread and 50% recovery rate of the junior debt implies a risk-neutral default probability of 5.0% using Equation 26.5. The same risk-neutral default probability is then used with recovery rates of 80% and 20% to find credit spreads on the other debt using Equation 26.6. That process generates a credit spread of 1.0% on the senior debt and 4.0% on the speculative debt.

$$\lambda \approx \frac{s}{(1 - RR)} \quad (26.5)$$

$$s \approx \lambda \times (1 - RR) \quad (26.6)$$



EXPLANATION

To solve for the arbitrage-free credit spreads for the senior and speculative debt issues we need to use equation 26.6. We know that the junior debt with its 2.50% spread and 50% recovery rate implies a risk-neutral probability of default (λ) of 5%. The default rate of both bonds must be equal because they are in the same corporate structure. Because we know the recovery rate for the senior debt is 80%, we can solve for the arbitrage-free credit spreads using 26.6

Arbitrage-Free Credit Spread for Senior Debt

$$s \approx 0.05 \times (1 - 0.80)$$

$$s \approx 0.05 \times 0.20$$

$$s \approx 0.01$$

The arbitrage-free credit spread for the senior debt is 1%.

Arbitrage-Free Credit Spread for Speculative Debt

$$s \approx 0.05 \times (1 - 0.20)$$

$$s \approx 0.05 \times 0.80$$

$$s \approx 0.04$$

The arbitrage-free credit spread for the speculative debt is 4%.



CALCULATIONS

Find the approximate credit spread for the Senior debt

Step One: Press 1 → - → 0.80

Step Two: Press x → 0.05

Step Three: Press =

Answer: 0.01

Find the approximate credit spread for the Speculative debt

Step One: Press 1 → - → 0.2

Step Two: Press x → 0.05

Step Three: Press =

Answer: 0.043



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Senior Debt Credit Spread	Speculative Debt Credit Spread	Junior Debt Credit Spread	Approx. Risk-Neutral Probability of Default	Junior Debt Recovery Rate	Senior Debt Recovery Rate	Speculative Debt Recovery Rate
1.00%	4.00%	2.50%	5.00%	50.00%	80.00%	20.00%
2.19%	7.44%	3.50%	8.75%	60.00%	75.00%	15.00%
1.09%	2.73%	2.00%	3.64%	45.00%	70.00%	25.00%
2.33%	4.67%	3.00%	6.67%	55.00%	65.00%	30.00%
2.91%	4.73%	4.00%	7.27%	45.00%	60.00%	35.00%
1.13%	5.25%	4.50%	7.50%	40.00%	85.00%	30.00%
0.50%	2.75%	1.50%	5.00%	70.00%	90.00%	45.00%

Application 26.4.2a (page 723): In this example, a hypothetical transaction takes place between a hedge fund (the Fund) as a credit protection seller and a commercial bank (the Bank) as a credit protection buyer. The reference entity is an airline company (the Firm). The referenced asset is \$20 million of face value debt. The term of the transaction is seven years. In exchange for the protection provided over the next seven years, the Fund receives 2% of the notional amount per year, payable quarterly. The contract will be settled physically. This means that if a credit event takes place, the Bank will deliver \$20 million in face value of any qualifying senior unsecured paper issued by the Firm in return for a \$20 million payment by the Fund. Further, the contract will be terminated, and no further payments will be made by the Bank. Let's assume that default takes place after exactly three years. What cash flows and exchanges take place? Each quarter for 12 quarters, the Bank pays the Fund \$100,000. This value is found by multiplying the notional amount (\$20 million) by the quarterly rate of 0.5% (i.e., $2\%/4$). When the default occurs, the Bank delivers \$20 million in face value of the referenced bond to the Fund in exchange for \$20 million in cash. The CDS terminates immediately after these exchanges.



EXPLANATION

The bank pays the Fund \$20 million multiplied by 2% (notional amount per year). The value is paid quarterly, so in such an instance we must divide \$400,000 (the amount per year) by 4 (number of quarters in a year) for a result of \$100,000 per quarter. In this particular scenario since the default takes place in exactly three years after a total of \$1.2 million in payments. Now since there was a default in year three, the bank delivers the defaulted debt to the fund and receives a lump sum payment of \$20 million. In total, by year three the fund will have received \$1.2 million plus the defaulted debt from the bank. The bank will have paid \$1.2 million for protection, will have received a high interest rate while holding the risky debt before it defaulted and then will be able to get rid of the defaulted bond at its face value by delivering the bond to the fund as the provider of the credit protection.



CALCULATIONS

Find the total bank payments over three years

Step One: Press 20 → x → 0.02

Step Two: Press x → 3 (years)

Step Three: Press =

Answer: 1.2



WORKOUT AREA: *Here are sample problems– cover one of the values and see if you can solve it using the others*

Cash Flow From the Bank in First 3 Years Assuming no Default	Face Value of Debt (millions)	Annual Premium for Protection (payable quarterly)
\$1.20	\$20.00	2.00%
\$1.88	\$25.00	2.50%
\$2.70	\$30.00	3.00%
\$4.73	\$45.00	3.50%
\$6.00	\$50.00	4.00%
\$8.78	\$65.00	4.50%
\$3.38	\$75.00	1.50%

Application 27.4.1a (page 745): Consider a bank with a \$500 million loan portfolio that it wishes to sell. It must hold risk-based capital equal to 8% to support these loans. If the bank sponsors a CDO trust in which the trust purchases the \$500 million loan portfolio from the bank for cash, how much reduction in risk-based capital will the bank receive if it finds outside investors to purchase all of the CDO securities? Since the bank no longer has any exposure to the basket of commercial loans, it has now freed \$40 million of regulatory capital ($8\% \times \$500 \text{ million} = \40 million) from needing to be held to support these loans.



EXPLANATION

Since the bank sold the entire \$500 million loan portfolio to the CDO trust, which is a separate entity, the bank can make available all of the 8% of the risk capital set aside. In that case, we need to multiply 8% by \$500 million for a \$40 million reduction in risk-based capital.



CALCULATIONS

Find the reduction of risk-based capital

Step One: Press $0.08 \rightarrow \times \rightarrow 500$

Step Two: Press $=$

Answer: 40



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Reduction in Risk-Based Capital (millions)	Value of Loan Portfolio (millions)	Percent of Risk Based Capital
\$40.00	\$500.00	8.00%
\$337.50	\$450.00	75.00%
\$36.00	\$400.00	9.00%
\$60.00	\$600.00	10.00%
\$71.50	\$650.00	11.00%
\$42.00	\$350.00	12.00%
\$60.00	\$300.00	20.00%

Application 27.4.1b (page 746): Consider a bank with a \$400 million loan portfolio that it wishes to sell. It must hold risk-based capital equal to 8% to support these loans. If the sponsoring bank has to retain a \$10 million equity piece in the CDO trust to attract other investors, how much reduction in regulatory capital will result? Since the bank must take a one-for-one regulatory capital charge (\$10 million) for this first-loss position, only \$22 million (\$32 million – \$10 million) of regulatory capital is freed by the CDO trust.



EXPLANATION

The sponsoring bank needs to hold \$10 million in equity in order to sell the loan portfolio. Therefore the bank will be able to free \$400 million (loan portfolio) multiplied by 8% (required risk-based capital) minus the \$10 million (the required equity piece to sell the loan portfolio), which is equal to \$22 million (risk-based capital freed by sale of loan portfolio).



CALCULATIONS

Find the reduction of risk-based capital

Step One: Press 400 → x → 0.08

Step Two: Press - → 10

Step Three: Press =

Answer: 22



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Reduction in Regulatory Capital (millions)	Value of Loan Portfolio (millions)	Percent of Risk Based Capital	Equity in CDO (millions)
\$22.00	\$400.00	8.00%	\$10.00
\$14.75	\$350.00	8.50%	\$15.00
\$20.50	\$450.00	9.00%	\$20.00
\$22.50	\$500.00	9.50%	\$25.00
\$46.00	\$600.00	10.00%	\$14.00
\$35.75	\$650.00	7.50%	\$13.00
\$32.00	\$700.00	7.00%	\$17.00

Application 28.2a (page 761): An investor in a 40% tax bracket earns an after-tax return of 9%. What must be the investor's pre-tax return? Rearranging Equation 28.1 generates an answer of 15%, found as 9% divided by 0.6.

$$r^* = r(1 - T) \quad (28.1)$$



EXPLANATION

Let's use equation 28.1 to solve for the investor's pre-tax return. First we need to rearrange the formula, since we know the after-tax return, but not the pre-tax return.

$$r^* = r(1 - T)$$
$$\frac{r^*}{(1 - T)} = r$$

Now, we need to plug in the variables: $T = 0.40$ and $r^* = 0.09$.

$$\frac{0.09}{(1 - 0.4)} = r$$

$$\frac{0.09}{(0.6)} = r$$

$$0.15 = r$$

The pre-tax return for the investor is 15%.



CALCULATIONS

Find the pre-tax return to the investor

Step One: Press 1 → - → 0.4

Step Two: Press = "0.6"

Step Three: Press 0.09 → ÷ → 0.6

Step Four: Press =

Answer: 0.15



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Pre-Tax Return	Tax Bracket	After-Tax Return
12.40%	40.00%	7.44%
15.83%	45.00%	8.71%
18.86%	38.00%	11.69%
6.21%	35.00%	4.04%
33.69%	42.00%	19.54%
27.69%	43.00%	15.79%
39.90%	50.00%	19.95%

Application 28.2b (page 761): An investor in a 40% tax bracket on ordinary income invests in a product that earns a pre-tax return of 10%. Sixty percent of the income is distributed as a capital gain that is taxed at 40% of the ordinary income tax rate. What is the investor's total after-tax return? The investor's total after-tax return is the weighted average of the after-tax returns of the return components. Sixty percent of the total return (i.e., 6%) is taxed at a capital gains rate of 16% (found as 40% x 40%), leaving an after-tax capital gain return of 5.04%. Forty percent of the total return (i.e., 4%) is taxed at the ordinary rate of 40%, leaving an after-tax ordinary income return of 2.40%. The total weighted average is 7.44%, found as the sum of the two components (5.04% + 2.40%). This can also be found as the pre-tax return of 10% reduced by the weighted average tax rate of 25.6%. The average tax rate of 25.6% reflects the weighted average of 60% of the income being taxed as capital gains at 16%, and 40% of the income being taxed at the ordinary rate of 40%.

$$r^* = r(1 - T) \quad (28.1)$$



EXPLANATION

We need to find the investor's total after tax return. We are provided with the tax rates, pre-tax returns, and the capital gains proportion. Let's begin with the capital gains return 60% (pre-tax return proportion of capital gains) of the 10% pre-tax return is from capital gains that needs to be taxed at 16%. Therefore, 60% multiplied by 10% multiplied by 1 minus 16% equals 5.04% of after-tax gains. Now, let's tackle the non-capital gains portion. Now, 1 minus 60% (pre-tax return proportion of capital gains) or 40% is the proportion of pre-tax returns that is taxed as regular income. Therefore, we need to multiply 40% by 10% (pre-tax return) for a product of 4% multiplied by 1 minus 40% equals 2.4% of after-tax gains. The sum of 2.4% and 5.04% is the total after-tax gains of 7.44%



CALCULATIONS

Find the investor's total after tax return

Step One: Press 1 → - → 0.16

Step Two: Press x → 0.6

Step Three: Press x → 0.1

Step Four: Press = "0.0504"

Step Five: Press 1 → - → 0.60

Step Six: Press x → 0.1

Step Seven: Press = "0.04"

Step Eight: Press 1 → - → 0.40

Step Nine: Press = "0.60"

Step Ten: Press 0.04 → x → 0.60

Step Eleven: Press = "0.024"

Step Twelve: Press + → 0.0504

Step Thirteen: Press =

Answer: 0.0744



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

After-Tax Return	Pre-Tax Return	Ordinary Tax Bracket	Capital Gains Tax	Capital Gains Proportion of Return
7.44%	10.00%	40.00%	16.00%	60.00%
8.71%	12.00%	45.00%	18.00%	65.00%
11.69%	15.00%	38.00%	15.20%	70.00%
4.04%	5.00%	35.00%	14.00%	75.00%
19.54%	25.00%	42.00%	16.80%	80.00%
15.79%	20.00%	43.00%	17.20%	85.00%
19.95%	30.00%	50.00%	20.00%	55.00%

Application 28.2c (page 762): Consider an investor in a current tax rate of 30% who anticipates withdrawing funds in 20 years. If the investor places money into a wrapper that offers tax deferment, how much will the after-tax annual rate of return improve through use of the wrapper if the pre-tax rate is 8% and the time horizon is 20 years? The answer is found as follows: $(1 + r)^N$ is the pre-tax future value, 4.661, which generates a taxable income of $4.661 - 1 \Rightarrow 3.661$. The 3.661 is taxed at 30%, leaving 2.563. Re-adding the principal (1.0) gives an after-tax future value of 3.563 (the value inside the outermost brackets). The 20th root of 3.563 generates 1.0656, from which 1 is subtracted to yield 0.0656. The answer (6.56% interest) improves by 0.96% the 5.60% after-tax return found using the same inputted values in Equation 28.1.

$$r^* = \{1 + [(1 + r)^N - 1](1 - T)\}^{1/N} - 1 \quad (28.2)$$



EXPLANATION

There are two components we need to calculate in order to determine the rate of return improvement achieved by using the tax deferment wrapper. First, let's calculate the simple after-tax rate of return without using the tax deferment wrapper, which uses equation 28.1.

$$r^* = r(1 - T)$$

$$r^* = 0.08(1 - 0.30)$$

$$r^* = 0.08(0.70)$$

$$r^* = 0.056$$

The after-tax rate of return without using the tax deferment wrapper is 5.6%. To calculate the after-tax rate of return with the tax wrapper, we need to turn to equation 28.2.

$$\begin{aligned}
r^* &= \left\{ 1 + \left[(1+r)^N - 1 \right] (1-T) \right\}^{1/N} - 1 \\
r^* &= \left\{ 1 + \left[(1+0.08)^{20} - 1 \right] (1-0.30) \right\}^{1/20} - 1 \\
r^* &= \left\{ 1 + \left[(1+0.08)^{20} - 1 \right] (0.70) \right\}^{1/20} - 1 \\
r^* &= \left\{ 1 + \left[(1.08)^{20} - 1 \right] (0.70) \right\}^{1/20} - 1 \\
r^* &= \left\{ 1 + [4.661 - 1] (0.70) \right\}^{1/20} - 1 \\
r^* &= \left\{ 1 + 3.661 (0.70) \right\}^{1/20} - 1 \\
r^* &= \left\{ 1 + 2.563 \right\}^{1/20} - 1 \\
r^* &= \left\{ 3.563 \right\}^{1/20} - 1 \\
r^* &= 1.0656 - 1 \\
r^* &= 0.0656
\end{aligned}$$

The after-tax return with the tax wrapper is 6.56%. The improvement is 6.56% minus 5.60% which is a difference of 0.96%.



CALCULATIONS

Find the investor's after tax return improvement using a tax deferment wrapper

Step One: Press 1 → - → 0.30

Step Two: Press = "0.70"

Step Three: Press 1 → + → 0.0.08

Step Four: Press y^x → 20

Step Five: Press - → 1

Step Six: Press x → 0.70

Step Seven: Press + → 1

Step Eight: Press = "3.563"

Step Nine: Press 1 → ÷ → 20

Step Ten: Press = "0.05"

Step Eleven: Press 3.563 → y^x → 0.05

Step Twelve: Press - → 1

Step Thirteen: Press =

Answer: 0.0656



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

After Tax Rate of Return		After-tax Rate of Return with Tax Wrapper	After-Tax Future Value	Pre-Tax Rate	Tax Bracket	Term (years)
Improvement	After Tax Return					
0.96%	5.60%	6.56%	3.56	8.00%	30.00%	20
0.81%	6.75%	7.56%	2.98	9.00%	25.00%	15
2.09%	9.75%	11.84%	3.83	15.00%	35.00%	12
3.91%	12.00%	15.91%	6.82	20.00%	40.00%	13
8.31%	13.75%	22.06%	146.03	25.00%	45.00%	25
0.57%	8.00%	8.57%	2.27	10.00%	20.00%	10
5.86%	8.50%	14.36%	56.03	17.00%	50.00%	30

Application 28.2d (page 763): Consider an investor in a current tax rate of 35% who anticipates a reduced tax rate of 20% in 10 years (after retirement). If the investor places money into a wrapper that offers tax deduction and tax deferment, what will the investor's after-tax rate of annual return be if the pre-tax rate is 6% and the time horizon is 10 years? The future value (1.791) is multiplied by the after-tax ratio $(1.00 - 0.20)/(1.00 - 0.35) \Rightarrow 1.231$ to generate 2.2041. The 10th root of 2.2041 followed with subtraction of 1 generates the answer that the after-tax rate is 8.22%. Note the dramatic magnitude of the after-tax yield (8.22%), which exceeds the pre-tax yield (6%).

$$r^* = \{(1 + r)^N [(1 - T_N)/(1 - T_0)]\}^{1/N} - 1 \quad (28.3)$$

EXPLANATION

We need to solve equation 28.3 to solve for the after-tax rate of annual return with the tax deferment wrapper.

$$r^* = \left\{ (1 + r)^N \left[\frac{(1 - T_N)}{(1 - T_0)} \right] \right\}^{1/N} - 1$$

$$r^* = \left\{ (1 + 0.06)^{10} \left[\frac{(1 - 0.20)}{(1 - 0.35)} \right] \right\}^{1/10} - 1$$

$$r^* = \left\{ (1 + 0.06)^{10} \left[\frac{0.80}{0.65} \right] \right\}^{1/10} - 1$$

$$r^* = \left\{ (1.06)^{10} \left[\frac{0.80}{0.65} \right] \right\}^{1/10} - 1$$

$$r^* = \left\{ (1.791) \left[\frac{0.80}{0.65} \right] \right\}^{1/10} - 1$$

$$r^* = \{(1.791)[1.231]\}^{1/10} - 1$$

$$r^* = \{2.2041\}^{1/10} - 1$$

$$r^* = 1.0822 - 1$$

$$r^* = 0.0822$$

The after-tax rate of return with the tax deferment wrapper is 8.22%

CALCULATIONS

Find the investor's after tax rate of annual return with the tax deferment wrapper

Step One: Press $1 \rightarrow + \rightarrow 0.06$

Step Two: Press $y^x \rightarrow 10$

Step Three: Press = "1.791"

Step Four: Press $y^x \rightarrow 20$

Step Five: Press $1 \rightarrow - \rightarrow 0.20$

Step Six: Press = "0.80"

Step Seven: Press $+ \rightarrow 1$

Step Eight: Press $1 \rightarrow - \rightarrow 0.35$

Step Nine: Press = "0.65"

Step Ten: Press $0.80 \rightarrow \div \rightarrow 0.65$

Step Eleven: Press = "1.231"

Step Twelve: Press $1.231 \rightarrow \times \rightarrow 1.791$

Step Thirteen: Press = "2.2041"


Step Fourteen: Press $1 \rightarrow \div \rightarrow 10$

Step Fifteen: Press = "0.10"

Step Sixteen: Press $2.2041 \rightarrow y^x \rightarrow 0.10$

Step Seventeen: Press $- \rightarrow 1$

Answer: 0.0822



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

After-Tax Rate of Annual Return	Pre-Tax Future Value	Pre-Tax Rate	Tax Bracket	Term (years)	Reduced Tax Rate
8.22%	1.791	6.00%	35.00%	10	20.00%
9.40%	2.518	8.00%	40.00%	12	30.00%
7.03%	2.415	6.50%	30.00%	14	25.00%
4.87%	2.191	4.00%	45.00%	20	35.00%
4.07%	3.386	5.00%	25.00%	25	40.00%
10.31%	1.307	5.50%	32.00%	5	15.00%
9.41%	1.783	5.40%	37.00%	11	5.00%

Application 28.3.1a (page 766): Consider a five-year zero-coupon cash-and-call position on the S&P 500 Index that has an initial cost of \$1,000 and offers \$1,000 principal protection (ignoring counterparty risk). The product's payout will be the greater of \$1,000 and $\$1,000 \cdot (1 + r)$, where r is the total return (non-annualized) of the underlying index over the five-year life of the product. If the riskless market interest rate is 5% (compounded annually), what is the value of the call option and the cash that replicates this product as a cash-and-call strategy (ignoring dividends)? If the riskless market interest rate is 5% (compounded annually), the present value of the minimum \$1,000 payout is \$783.53. Thus, the cash position at the start of the investment is \$783.53. The remaining value of the structured product (\$216.47) is attributable to the call option with a strike price of \$1,000.



EXPLANATION

To solve this application, we need to calculate the present value of \$1,000 the minimum payout of this strategy. 1 plus 0.05 to the fifth power will be the divisor to the \$1,000 numerator for a quotient of \$783.53, which is the cash position at the start of the investment or the present value of \$1,000 (the minimum pay out of this strategy). The remaining value, that is \$1,000 minus \$783.53 or \$216.47, is the value of the call option with a strike price of \$1,000.



CALCULATIONS

Step One: Press $1 \rightarrow + \rightarrow 0.05$

Step Two: Press $y^x \rightarrow 5$

Step Three: Press $=$ “1.2763”

Step Four: Press $1000 \rightarrow \div \rightarrow 1.2763$

Step Five: Press $=$ “783.53” (the cash position at the start of the investment)

Step Six: Press $1000 \rightarrow - \rightarrow 783.53$

Step Seven: Press $=$

Step Eight: Press “216.47” (the value of the call option with a strike price of \$1,000)



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Value of the Call			Risk-Less		Principal
Option	Value of the Cash		Interest Rate	Initial Cost	Protection
\$216.47	\$783.53		5.0%	\$1,000.00	\$1,000.00
\$469.73	\$1,530.27		5.5%	\$2,000.00	\$2,000.00
\$758.23	\$2,241.77		6.0%	\$3,000.00	\$3,000.00
\$135.06	\$364.94		6.5%	\$500.00	\$500.00
\$256.81	\$1,043.19		4.5%	\$1,300.00	\$1,300.00
\$169.17	\$780.83		4.0%	\$950.00	\$950.00
\$241.67	\$600.33		7.0%	\$842.00	\$842.00

Application 28.3.5a (page 790): An asset sells for \$100. A European knock-in call option on that asset has a strike price of \$110 and a barrier of \$90. Describe the option using the terms in Exhibit 28.2 and describe the payoff under each of the following scenarios: (a) the asset moves monotonically to \$120; (b) the asset declines monotonically to \$89 before rising monotonically to \$110 at expiration. Answer: The option is a down-and-in call option. It pays nothing under scenario (a) because the option never knocks in; it pays nothing under scenario (b) because although the option becomes active, it does not finish in-the-money.

EXPLANATION

For a barrier call option to work it must first reach the barrier and then reach the strike price, then the difference between the current price and the strike price is the payoff. In scenario A, the call option surpassed the strike price, but never declined to \$90 to hit the barrier. In scenario B, the option reached the barrier, but expired at-the-money, which implies a \$0 payoff.

WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Assume asset starts at \$100

Option Type	Maximum Asset Price	Minimum Asset Price	Final Asset Price	Strike Price	Barrier	Option Payoff
Knock-In call	\$120.00	\$100.00	\$120.00	\$110.00	\$90.00	\$0.00
Knock-Out call	\$120.00	\$100.00	\$120.00	\$110.00	\$115.00	\$0.00
Knock-In put	\$120.00	\$100.00	\$80.00	\$95.00	\$90.00	\$15.00
Knock-Out put	\$120.00	\$100.00	\$80.00	\$95.00	\$85.00	\$0.00
Knock-In call	\$120.00	\$100.00	\$120.00	\$110.00	\$115.00	\$10.00
Knock-Out call	\$105.00	\$85.00	\$80.00	\$110.00	\$75.00	\$0.00
Knock-In put	\$105.00	\$70.00	\$70.00	\$95.00	\$85.00	\$25.00
Knock-Out put	\$110.00	\$70.00	\$70.00	\$95.00	\$105.00	\$0.00

Application 28.3.6a (page 769): Consider two indices: a gold index and a copper index. Consider a European option that pays 0% if the gold index has performance equal to or better than -2% relative to the copper index. For each percentage point that the gold index return is worse than 2% below the copper index, the option pays 1% of its notional value. Describe the type of option and its strike price in terms of both calls and puts. Answer: The option is a spread option. In the case of a spread put, the strike price of the put is -2% , and the spread is defined as the performance of the gold index less the performance of the copper index. In the case of a spread call, the strike price of the call is $+2\%$, and the spread is defined as the performance of the copper index less the performance of the gold index.



EXPLANATION

This is a spread option because it is based on the relative performance between the copper and gold indices. In the case of a spread put, the strike price of the put is -2% , and the spread is defined as the performance of the gold index less the performance of the copper index. In the case of a spread call, the strike price of the call is $+2\%$, and the spread is defined as the performance of the copper index less the performance of the gold index.

Application 31.7.2a (page 837): Assume an unleveraged fund and an otherwise identical fund that is leveraged 3:1 ($L = 3$). To simplify the math, assume that the expected return of each fund is 0% and that the returns of the assets have a daily standard deviation of 2%. When markets decline, the equity of the unleveraged fund experiences the same percentage loss as the assets of the fund because in the case of an unleveraged fund, assets = equity. For example, a three-sigma loss causes the assets of each fund to decline by 6% in one day ($3 \times 2\% = 6\%$). The three-sigma event causes the unleveraged fund to lose 6% in assets and 6% in equity. What is the probability that a fund leveraged 3:1 will experience a 6% drop in equity? For the leveraged fund to suffer the same loss in equity (6%), it needs to experience only a 2% loss in assets, which is only a one-sigma event. Assuming the normal distribution for simplicity, the probability of a one-sigma loss (15.9%) is over 100 times the probability of a three-sigma loss (0.135%). Thus, with only 3:1 leverage, the leveraged fund in this example is more than 100 times more likely to lose 6% than an unleveraged fund with the same assets.

($L = \text{Assets/Equity}$)



EXPLANATION

Let's take a look at the example in the application. For an unleveraged fund it takes a 3 sigma event to cause a loss of 6%. So, 3 (# of sigma for the event) multiplied by 2% (standard deviation) equals 6% (asset loss). For the leveraged fund the equation is similar. X (number of sigma event) multiplied by 3 (amount of leverage) multiplied by 2% (standard deviation) equals 6% (the asset loss). Solving for x find that it is 1, as 3 multiplied by 2% equals 6%. Therefore, for the leveraged fund only a 1 standard deviation will cause a 6% loss in asset value.



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Assume that the underlying fund assets have a standard deviation of 3%

Asset Movement	L	Unleveraged Fund Return	Unleveraged Fund	Leveraged Fund Return	Leveraged Fund
			Standard Deviations		Standard Deviations
6.00%	3	6.00%	2.00	18.00%	6.00
12.00%	2	12.00%	4.00	24.00%	8.00
9.00%	3	9.00%	3.00	27.00%	9.00
-3.00%	2	-3.00%	1.00	-6.00%	2.00
3.00%	4	3.00%	1.00	12.00%	4.00
6.00%	3	6.00%	2.00	18.00%	6.00
-6.00%	2	-6.00%	2.00	-12.00%	4.00

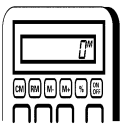
Application 32.4.1a (page 849): What notional value in futures contracts would a \$10 million long position with a beta of 0.7 need to form a hedge against systematic risk? A \$10 million long position with a beta of 0.7 would require a short position with \$7 million of notional value in futures contracts with a beta of 1.0 to hedge the risk. A futures position with a notional value of \$7 million, an index value of \$2,000, and a multiplier of 500 would require $[\$7,000,000/(\$2,000 \times 500)] = 7$ contracts.

$$\text{Notional Value for Hedging} = \text{Value of Position to Be Hedged} \times \text{Beta} \quad (32.1)$$



EXPLANATION

The equation is value of position to be hedged multiplied by the ratio of the beta (position beta divided by hedge position beta) equals the notional value of the hedge position. In this case, \$10 million multiplied by 0.7 divided by 1 equals \$7 million the notional value of the hedge position.



CALCULATIONS

Find the notional value of hedge position

Step One: Press 0.7 → ÷ → 1

Step Two: Press x → 10

Step Three: Press =

Step Four: Press 7



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Notional Value of Hedge Position (millions)	Hedge Position Beta	Long Position (millions)	Beta of Positon
\$7.00	1	\$10.00	0.7
\$19.50	1	\$15.00	1.3
\$24.00	1	\$20.00	1.2
\$40.00	1	\$25.00	1.6
\$28.90	1	\$17.00	1.7
\$46.00	1	\$23.00	2
\$30.00	1.4	\$30.00	1.4
\$15.50	2	\$31.00	1

Application 32.4.3a (page 851): Consider an investor with a benchmark of U.S. value stocks when the expected return of U.S. value stocks is 8%. Assume that the expected return of growth stocks is 9%. What is the expected return to this investor from a position with \$50 million in a hedge fund with an estimated alpha of 2% and a long exposure to growth stocks (beta equals 1) after the strategy is ported from growth stocks to value stocks? The expected return is found as 10%, the sum of the expected return of value stocks (8%) and the estimated alpha (2%). The expected return of the growth stocks is irrelevant, since the risk is hedged in the process of porting the return from growth stocks to value stocks.

EXPLANATION

The expected return of the position is provided to you in pieces, the expected return of value stocks and the estimated alpha. To find the expected return of the position, which is benchmarked to U.S. value stocks, add 8% (the expected return of value stocks, the benchmark) and 2% (the estimated alpha) for a sum of 10% (the expected return of the position).

CALCULATIONS

Find the expected return of the position

Step One: Press 0.08 → + → 0.02

Step Two: Press =

Step Three: Press 0.10

WORKOUT AREA: Assume the same problem discussed in the application (benchmark is value stocks and fund with estimate alpha is successfully ported to the benchmark).

Here are sample problems – cover one of the following three columns: 1, 2 and 5 and see if you can solve for it using the other two columns.

Expected Return After Strategy is Ported from Growth Stock to Value Stocks	Expected Return of U.S. Value Stocks	Expected Return of U.S. Growth Stocks	U.S. Growth Stock Beta	Estimated Alpha	Position Size (millions)
10.00%	8.00%	9.00%	1	2.00%	\$50.00
8.50%	7.50%	10.00%	1.2	1.00%	\$50.00
8.70%	7.20%	17.00%	1.3	1.50%	\$50.00
11.30%	8.30%	20.00%	1.5	3.00%	\$50.00
11.60%	7.60%	15.00%	1.9	4.00%	\$50.00
12.60%	8.10%	12.00%	2	4.50%	\$50.00
14.00%	9.00%	11.00%	2.5	5.00%	\$50.00

Application 32.4.3b (page 852): The manager of a €400 million portfolio benchmarked to the equity index of Country A has decided to allocate €360 million to the equity index of Country A and €40 million to a hedge fund with an ex ante alpha of 150 basis points per year and a beta of 0.60 to the stocks of Country B. Futures contracts trade on the equity indices of Countries A and B. Country A's equity futures contract trades at 200 times the index, with a current index value of €125. Country B's equity futures contract trades at 500 times the index, with a current index value of €40. Assume riskless interest rates are zero and dividend rates are zero, and ignore transaction costs. With respect to the €40 million allocation to the hedge fund, what position should be established in the futures contracts of the equity index of Country A, what position should be established in the futures contracts of the equity index of Country B, and how much ex ante alpha should the asset allocator expect expressed on the basis of the entire €400 million portfolio? The position in Country A's equity index futures contracts should be a long position of $\text{€40 million} / (200 \times \text{€125}) = 1,600$ contracts. Country B's equity index futures contracts should be a short position of $(0.60 \times \text{€40 million}) / (500 \times \text{€40}) = 1,200$ contracts. The ex ante alpha of the entire portfolio would be 15 basis points per year, found as the weighted average of the ex ante alphas of the positions comprising the portfolio: 90% with an ex ante alpha of 0, and 10% with an ex ante alpha of 150 basis points.

$$\text{Number of Contracts} = \text{Future Contract Notional Value} / (\text{Index Value} \times \text{Multiplier}) \quad (32.2)$$



EXPLANATION

We need to find out how much of the €40 million hedge fund to allocate to the equity index of country A and country B as well as the expected ex ante alpha. To determine the allocation, we need to use equation 32.2. For the allocation to equity index of country A (the long position), multiply €125 (country A index value) by 200 (country A multiplier) and divide €40 million by the product of 25,000 for a quotient of 1,600 country A equity index long futures contracts. For the allocation to equity index of country B (the short position), multiply €40 million by 0.60 (beta of hedge fund C to country B equity index) for a product of €24 million. Now, multiply €40 (country B index value) by 500 (country B multiplier) for a product of 20,000. Divide the two products, €24 million by 20,000 for a result of 1,200 country B equity index short futures contracts. In order to calculate the expected ex ante alpha, we need to multiply the portfolio positions by the alpha. In this case, we divide €360 million by €400 million for a quotient of 0.90 multiplied by 0 (no alpha on an index position) plus €40 million by €400 million for a quotient of 0.10 multiplied by 1.50% for a total expected ex ante alpha based on the entire portfolio of 0.15%.



CALCULATIONS

Find Futures Contract Position in Equity Index of Country A (long position)

Step One: Press $125 \rightarrow \times \rightarrow 200$

Step Two: Press = “25000”

Step Three: Press $40000000 \rightarrow \div \rightarrow 25000$

Step Four: Press =

Answer: 1600

Find Futures Contract Position in Equity Index of Country B (short position)

Step One: Press $40000000 \rightarrow \times \rightarrow 0.60$

Step Two: Press = “24000000”

Step Three: Press $500 \rightarrow \times \rightarrow 40$

Step Four: Press = “20000”

Step Five: Press $24000000 \rightarrow \div \rightarrow 20000$

Step Six: Press =

Answer: 1200

Find Expected Ex Ante Alpha Expressed on the Basis of the Entire Portfolio

Step One: Press $360 \rightarrow \div \rightarrow 400$

Step Two: Press $\times \rightarrow 0$

Step Three: Press = “0”

Step Four: Press $40 \rightarrow \div \rightarrow 400$

Step Five: Press $\times \rightarrow 0.015$

Step Six: Press = “0.0015”

Step Seven: Press $0 \rightarrow + \rightarrow 0.0015$

Step Eight: Press =

Answer: 0.0015



WORKOUT AREA: *Here are sample problems – cover one of the values and see if you can solve it using the others*

Futures Contract	Position in	Futures Contract	Position in	Expected Ex	Ante Alpha	Portfolio B that	Amount of	Amount of	Beta of				
Equity Index of Country A	Country B	Equity Index of	Country B	Expressed on	the Basis of	to the Equity	Portfolio B	Portfolio B	Hedge Fund	Country A	Country A	Country B	Country B
<i>(long position)</i>	<i>(short position)</i>	<i>Portfolio</i>	<i>A (millions)</i>	<i>(millions)</i>	<i>(millions)</i>	<i>C</i>	<i>Country B</i>	<i>Index Value</i>	<i>Multiplier</i>	<i>Value</i>	<i>Multiplier</i>	<i>Value</i>	<i>Multiplier</i>
1,600	1,200	0.15%	✓	€ 400.00	€ 360.00	€ 40.00	1.50%	0.60	€ 125.00	200	€ 40.00	500	
833	1,786	0.31%	✓	€ 400.00	€ 350.00	€ 50.00	2.50%	0.50	€ 200.00	300	€ 35.00	400	
1,714	4,333	0.17%	✓	€ 450.00	€ 375.00	€ 75.00	1.00%	0.65	€ 175.00	250	€ 25.00	450	
1,238	1,300	0.62%	✓	€ 315.00	€ 250.00	€ 65.00	3.00%	0.55	€ 150.00	350	€ 50.00	550	
3,333	2,143	0.44%	✓	€ 425.00	€ 300.00	€ 125.00	1.50%	0.45	€ 250.00	150	€ 75.00	350	
1,111	1,458	0.14%	✓	€ 175.00	€ 150.00	€ 25.00	1.00%	0.35	€ 225.00	100	€ 20.00	300	
476	2,000	0.31%	✓	€ 236.00	€ 200.00	€ 36.00	2.00%	0.75	€ 275.00	275	€ 30.00	450	

GLOSSARY

Page	Section	Keywords	Definitions
13	1.4.1	absolute return products	Absolute return products are investment products viewed as having little or no return correlation with traditional assets, and have investment performance that is often analyzed on an absolute basis rather than relative to the performance of traditional investments.
19	1.7.2	absolute return standard	An absolute return standard means that returns are to be evaluated relative to zero, a fixed rate, or relative to the riskless rate, and therefore independently of performance in equity markets, debt markets, or any other markets.
18	1.7.1	active management	Active management refers to efforts of buying and selling securities in pursuit of superior combinations of risk and return.
19	1.7.1	active return	Active return is the difference between the return of a portfolio and its benchmark that is due to active management.
19	1.7.1	active risk	Active risk is that risk that causes a portfolio's return to deviate from the return of a benchmark due to active management.
3	1.1	alternative investments	Alternative investments are sometimes viewed as including any investment that is not simply a long position in traditional investments.
19	1.7.1	benchmark	A benchmark is a performance standard for a portfolio that reflects the preferences of an investor with regard to risk and return.

19	1.7.1	benchmark return	A benchmark return is the return of the benchmark index or benchmark portfolio.
5	1.2.1	commodities	Commodities are homogeneous goods available in large quantities, such as energy products, agricultural products, metals, and building materials.
11	1.3.1	compensation structure	Compensation structure refers to the ways that organizational issues, especially compensation schemes, influence particular investments.
7	1.2.3	distressed debt	Distressed debt refers to the debt of companies that have filed or are likely to file in the near future for bankruptcy protection.
13	1.4.1	diversifier	A diversifier is an investment with a primary purpose of contributing diversification benefits to its owner.
14	1.4.3	efficiency	Efficiency refers to the tendency of market prices to reflect all available information.
6	1.2.1	farmland	Farmland consists of land cultivated for row crops (e.g., vegetables and grains) and permanent crops (e.g., orchards and vineyards).
6	1.2.1	financial asset	A financial asset is not a real asset—it is a claim on cash flows, such as a share of stock or a bond.
6	1.2.2	hedge fund	A hedge fund as a privately organized investment vehicle that uses its less regulated nature to generate investment opportunities that are substantially distinct from those offered by traditional investment vehicles, which are subject to regulations such as those restricting their use of derivatives and leverage.

13	1.4.2	illiquidity	Illiquidity means that the investment trades infrequently or with low volume (i.e., thinly).
18	1.6	incomplete markets	Incomplete markets refer to markets with insufficient distinct investment opportunities.
14	1.4.3	inefficiency	Inefficiency refers to the deviation of actual prices from valuations that would be anticipated in an efficient market.
18	1.6	information asymmetries	Information asymmetries refer to the extent to which market participants possess different data and knowledge.
6	1.2.1	infrastructure investments	Infrastructure investments are claims on the income of toll roads, regulated utilities, ports, airports, and other real assets that are traditionally held and controlled by the public sector (i.e., various levels of government).
11	1.3.1	institutional structure	Institutional structure refers to the financial markets and financial institutions related to a particular investment, such as whether the investment is publicly traded.
3	1.1	institutional-quality investment	An institutional-quality investment is the type of investment that financial institutions such as pension funds or endowments might include in their holdings because they are expected to deliver reasonable returns at an acceptable level of risk.
3	1.1	investment	An investment is that it is deferred consumption. Any net outlay of cash made with the prospect of receiving future benefits might be considered an investment.
6	1.2.1	land	Land comprises a variety of forms, including undeveloped land, timberland, and farmland.

13	1.4.2	lumpy assets	Lumpy assets are assets that can be bought and sold only in specific quantities, such as a large real estate project.
7	1.2.3	mezzanine debt	Mezzanine debt derives its name from its position in the capital structure of a firm: between the ceilings of senior secured debt and the floor of equity.
18	1.6	moral hazard	Moral hazard is that risk that the behavior of one or more parties will change after entering into a contract.
5	1.2.1	operationally focused real assets	Operationally focused real assets include real estate, land, infrastructure, and intellectual property.
18	1.7.1	passive investing	Passive investing tends to focus on buying and holding securities in an effort to match the risk and return of a target, such as a highly diversified index.
6	1.2.3	private equity	The term private equity is used in the CAIA curriculum to include both equity and debt positions that, among other things, are not publicly traded.
19	1.7.3	pure arbitrage	Pure arbitrage is the attempt to earn risk-free profits through the simultaneous purchase and sale of identical positions trading at different prices in different markets.
4	1.2.1	real assets	Real assets are investments in which the underlying assets involve direct ownership of nonfinancial assets rather than ownership through financial assets, such as the securities of manufacturing or service enterprises.
5	1.2.1	real estate	Real estate focuses on land and improvements that are permanently affixed, like buildings.
10	1.3.1	regulatory structure	Regulatory structure refers to the role of government, including both regulation and taxation, in influencing the nature of an investment.
19	1.7.2	relative return standard	A relative return standard means that returns are to be evaluated relative to a benchmark.

20	1.7.3	return diversifier	If the primary objective of including the product is the reduction in the portfolio's risk that it is believed to offer through its lack of correlation with the portfolio's other assets, then that product is often referred to as a return diversifier .
20	1.7.3	return enhancer	If the primary objective of including an investment product in a portfolio is the superior average returns that it is believed to offer, then that product is often referred to as a return enhancer .
11	1.3.1	securities structure	Securities structure refers to the structuring of cash flows through leverage and securitization.
7	1.2.4	structured products	Structured products are instruments created to exhibit particular return, risk, taxation, or other attributes.
6	1.2.1	timberland	Timberland includes both the land and the timber of forests of tree species typically used in the forest products industry.
11	1.3.1	trading structure	Trading structure refers to the role of an investment vehicle's investment managers in developing and implementing trading strategies.
3	1.1	traditional investments	Traditional investments include publicly traded equities, fixed-income securities, and cash.
25	2.1.1	40 Act funds	Mutual funds , or ' 40 Act funds ', are registered investment pools offering their shareholders pro rata claims on the fund's portfolio of assets.
27	2.1.2	back office operations	Back office operations play a supportive role in the maintenance of accounts and information systems used to transmit important market and trader information in all trading transactions, as well as in the clearance and settlement of the trades.
31	2.2.2	bid-ask spread	The price difference between the highest bid price (the best bid price) and the lowest offer (the best ask price) is the bid-ask spread .
23	2.1.1	buy side	Buy side refers to the institutions and entities that buy large quantities of securities for the portfolios they manage.
39	2.4.3	closed-end mutual fund	Closed-end mutual fund structures provide investors with relatively liquid access to the returns of underlying assets even when the underlying assets are illiquid.
29	2.1.3	commercial bank	A commercial bank focuses on the business of accepting deposits and making loans, with modest investment-related services.

29	2.1.3	custodians	Depositories and custodians are very similar entities that are responsible for holding their clients' cash and securities and settling clients' trades, both of which maintain the integrity of clients' assets while ensuring that trades are settled quickly.
35	2.3.3	dark pool	A dark pool refers to non-exchange trading by large market participants that is hidden from the view of most market participants.
29	2.1.3	depositories	Depositories and custodians are very similar entities that are responsible for holding their clients' cash and securities and settling clients' trades, both of which maintain the integrity of clients' assets while ensuring that trades are settled quickly.
29	2.1.3	Depository Trust Company (DTC)	The Depository Trust Company (DTC) is the principal holding body of securities for traders all over the world and is part of the Depository Trust and Clearing Corporation (DTCC), which provides clearing, settlement, and information services.
24	2.1.1	endowment	An endowment is a fund bestowed on an individual or institution (e.g., a museum, university, hospital, or foundation) to be used by that entity for specific purposes and with principal preservation in mind.
24	2.1.1	family office	A family office is a group of investors joined by familial or other ties who manage their personal investments as a single entity, usually hiring professionals to manage money for members of the office.
28	2.1.3	financial data providers	Financial data providers supply funds primarily with raw financial market data, including security prices, trading information, and indices.
28	2.1.3	financial platforms	Financial platforms are systems that provide access to financial markets, portfolio management systems, accounting and reporting systems, and risk management systems.
28	2.1.3	financial software	Financial software may consist of prepackaged software programs and computer languages tailored to the needs of financial organizations. Some funds use open-source software, and others pay licensing fees for proprietary software.
24	2.1.1	foundation	A foundation is a not-for-profit organization that donates funds and support to other organizations for its own charitable purposes.
32	2.2.3	fourth markets	Fourth markets are electronic exchanges that allow traders to quickly buy and sell exchange-listed stocks via the electronic

communications systems offered by these markets.

27	2.1.2	front office operations	Front office operations involve investment decision-making and, in the case of brokerage firms, contact with clients.
28	2.1.3	fund administrator	The fund administrator maintains a general ledger account, marks the fund's books, maintains its records, carries out monthly accounting, supplies its monthly profit and loss (P&L) statements, calculates its returns, verifies asset existence, independently calculates fees, and provides an unbiased, third-party resource for price confirmation on security positions.
39	2.4.3	hedge fund replication	Hedge fund replication is the attempt to mimic the returns of an illiquid or highly sophisticated hedge fund strategy using liquid assets and simplified trading rules.
29	2.1.3	investment bank	An investment bank focuses on providing sophisticated investment services, including underwriting and raising capital, as well as other activities such as brokerage services, mergers, and acquisitions.
26	2.1.2	large dealer banks	Large dealer banks are major financial institutions, such as Goldman Sachs, Deutsche Bank, and the Barclays Group, that deal in securities and derivatives.
37	2.4	liquid alternatives	Liquid alternatives are investment vehicles that offer alternative strategies in a form that provides investors with liquidity through opportunities to sell their positions in a market.
28	2.1.3	management company operating agreement	A management company operating agreement is an agreement between members related to a limited liability company and the conduct of its business as it pertains to the law.
31	2.2.2	market making	Market making is a practice whereby an investment bank or another market participant deals securities by regularly offering to buy securities and sell securities.
31	2.2.2	market orders	Market participants that wish to have transactions executed without delay may place market orders , which cause immediate execution at the best available price.
31	2.2.2	market takers	Participants that place market orders are market takers , which buy at ask prices and sell at bid prices, generally paying the bid-ask spread for taking liquidity.

35	2.3.3	Markets in Financial Instruments Directive (MiFID)	The Markets in Financial Instruments Directive (MiFID) is an EU law that establishes uniform regulation for investment managers in the European Economic Area (the EU plus Iceland, Norway, and Liechtenstein).
25	2.1.1	master limited partnerships (MLPs)	Master limited partnerships (MLPs) are publicly traded investment pools that are structured as limited partnerships and that offer their owners pro rata claims.
27	2.1.2	middle office operations	Middle office operations form the interface between the front office and the back office, with a focus on risk management.
25	2.1.1	mutual funds	Mutual funds , or '40 Act funds , are registered investment pools offering their shareholders pro rata claims on the fund's portfolio of assets.
28	2.1.3	partnership agreement	A partnership agreement is a formal written contract creating a partnership.
23	2.1.1	plan sponsor	A plan sponsor is a designated party, such as a company or an employer, that establishes a health care or retirement plan (pension) that has special legal or taxation status, such as a 401(k) retirement plan in the United States for employees.
30	2.2	primary market	A primary market refers to the methods, institutions, and mechanisms involved in the placement of new securities to investors.
27	2.1.3	prime broker	The prime broker has the following primary functions: clearing and financing trades for its client, providing research, arranging financing, and producing portfolio accounting.
24	2.1.1	private limited partnerships	Private limited partnerships are a form of business organization that potentially offers the benefit of limited liability to the organization's limited partners (similar to that enjoyed by shareholders of corporations) but not to its general partner.
28	2.1.3	private-placement memoranda	Private-placement memoranda (a.k.a. offering documents) are formal descriptions of an investment opportunity that comply with federal securities regulations.
41	2.5.1	progressive taxation	Progressive taxation places higher-percentage taxation on individuals and corporations with higher incomes.
26	2.1.2	proprietary trading	Proprietary trading occurs when a firm trades securities with its own money in order to make a profit.

34	2.3.2	Regulation T margin rule	Federal Reserve Board leverage rules include the Regulation T margin rule , which currently requires a deposit of at least 50% of the purchase cost or short sale proceeds of a trade (margin).
30	2.2	secondary market	A secondary market facilitates trading among investors of previously existing securities.
42	2.5.1	Section 1256 contracts	Section 1256 contracts include many futures and options contracts; have potentially enormous tax advantages in the United States. including having their income treated as 60% long-term capital gain and 40% short-term capital gain regardless of holding period.
31	2.2.1	securitization	Securitization involves bundling assets, especially unlisted assets, and issuing claims on the bundled assets.
25	2.1.2	sell side	Sell-side institutions, such as large dealer banks, act as agents for investors when they trade securities.
25	2.1.1	separately managed accounts	Separately managed accounts (SMAs) are individual investment accounts offered by a brokerage firm and managed by independent investment management firms.
33	2.3.2	soft dollar arrangement	A soft dollar arrangement generally refers to an agreement or an understanding by which an investment adviser receives research services from a broker-dealer in exchange for a fee (such as a commission) paid out of the fund or client account.
24	2.1.1	sovereign wealth funds	Sovereign wealth funds are state-owned investment funds held by that state's central bank for the purpose of future generations and/or to stabilize the state currency.
28	2.1.3	subscription agreement	A subscription agreement is an application submitted by an investor who desires to join a limited partnership.
32	2.3	systemic risk	Systemic risk is the potential for economy-wide losses attributable to failures or concerns over potential failures in financial markets, financial institutions, or major participants.
31	2.2.3	third markets	Third markets are regional exchanges where stocks listed in primary secondary markets can also be traded. In the United States, third markets allow brokers and dealers to set up trades away from an exchange by listing their prices on the NASDAQ Intermarket.

34	2.3.3	Undertakings for Collective Investment in Transferable Securities (UCITS)	Regulation of hedge funds in Europe centers on the concept of Undertakings for Collective Investment in Transferable Securities (UCITS) . UCITS are carefully regulated European fund vehicles that allow retail access and marketing of hedge-fund-like investment pools.
30	2.1.3	universal banking	Germany uses universal banking , which means that German banks can engage in both commercial and investment banking.
57	3.4.3	aggregation of IRRs	Aggregation of IRRs refers to the relationship between the IRRs of individual investments and the IRR of the combined cash flows of the investments.
54	3.4.1	borrowing type cash flow pattern	A borrowing type cash flow pattern begins with one or more cash inflows and is followed only by cash outflows.
61	3.5.1	carried interest	Carried interest is synonymous with an incentive fee or a performance-based fee and is the portion of the profit paid to the GPs as compensation for their services, above and beyond management fees.
61	3.5.1	catch-up provision	A catch-up provision permits the fund manager to receive a large share of profits once the hurdle rate of return has been achieved and passed.
61	3.5.1	catch-up rate	A catch-up provision contains a catch-up rate , which is the percentage of the profits used to catch up the incentive fee once the hurdle is met.
62	3.5.1	claw back	A claw back clause, claw back provision, or claw back option is designed to return incentive fees to LPs when early profits are followed by subsequent losses.
62	3.5.2	compensation scheme	The compensation scheme is the set of provisions and procedures governing management fees, general partner investment in the fund, carried-interest allocations, vesting, and distribution.
54	3.4.1	complex cash flow pattern	A complex cash flow pattern is an investment involving either borrowing or multiple sign changes.
45	3.1.1	continuous compounding	Continuous compounding assumes that earnings can be instantaneously reinvested to generate additional earnings.
64	3.5.4	deal-by-deal carried interest	Deal-by-deal carried interest is when incentive fees are awarded separately based on the performance of each individual investment.

45	3.1.1	discrete compounding	Discrete compounding includes any compounding interval other than continuous compounding such as daily, monthly, or annual.
59	3.4.5	dollar-weighted returns	Dollar-weighted returns are averaged returns that are adjusted for and therefore reflect when cash has been contributed or withdrawn during the averaging period.
49	3.2.2	fully collateralized	Fully collateralized means that a position (such as a forward contract) is assumed to be paired with a quantity of capital equal in value to the notional principal of the contract.
64	3.5.4	fund-as-a-whole carried interest	Carried interest can be fund-as-a-whole carried interest , which is carried interest based on aggregated profits and losses across all the investments, or can be structured as deal-by-deal carried interest.
66	3.5.6	hard hurdle rate	A hard hurdle rate limits incentive fees to profits in excess of the hurdle rate.
61	3.5.1	hurdle rate	A hurdle rate specifies a return level that LPs must receive before GPs begin to receive incentive fees.
61	3.5.1	incentive fee	Carried interest is synonymous with an incentive fee or a performance-based fee and is the portion of the profit paid to the GPs as compensation for their services, above and beyond management fees.
53	3.3.3	interim IRR	The interim IRR is a computation of IRR based on realized cash flows from an investment and its current estimated residual value.
51	3.3.1	internal rate of return (IRR)	The internal rate of return (IRR) can be defined as the discount rate that equates the present value of the costs (cash outflows) of an investment with the present value of the benefits (cash inflows) from the investment.
53	3.3.3	lifetime IRR	A lifetime IRR contains all of the cash flows, realized or anticipated, occurring over the investment's entire life, from period 0 to period T.
46	3.1.2	log return	A log return is a continuously compounded return that can be formed by taking the natural logarithm of a wealth ratio: $R_{m=\infty} = \ln(1 + R)$ where $\ln()$ is the natural logarithm function, $R_{m=\infty}$ is the log return, or continuously compounded return, and m is the number of compounding intervals per year.

62	3.5.2	management fees	Management fees are regular fees that are paid from the fund to the fund managers based on the size of the fund rather than the profitability of the fund.
59	3.4.4	modified IRR	The modified IRR approach discounts all cash outflows into a present value using a financing rate, compounds all cash inflows into a future value using an assumed reinvestment rate, and calculates the modified IRR as the discount rate that sets the absolute values of the future value and the present value equal to each other.
54	3.4.1	multiple sign change cash flow pattern	A multiple sign change cash flow pattern is an investment where the cash flows switch over time from inflows to outflows, or from outflows to inflows, more than once.
48	3.2.2	notional principal	Notional principal or notional value of a contract is the value of the asset underlying, or used as a reference to, the contract or derivative position.
49	3.2.3	partially collateralized	A partially collateralized position has collateral lower in value than the notional value.
61	3.5.1	performance-based fee	Carried interest is synonymous with an incentive fee or a performance-based fee and is the portion of the profit paid to the GPs as compensation for their services, above and beyond management fees.
53	3.3.3	point-to-point IRR	A point-to-point IRR is a calculation of performance over part of an investment's life.
61	3.5.1	preferred return	The term preferred return is often used synonymously with hurdle rate—a return level that LPs must receive before GPs begin to receive incentive fees.
59	3.4.4	reinvestment rate assumption	The reinvestment rate assumption refers to the assumption of the rate at which any cash flows not invested in a particular investment or received during the investment's life can be reinvested during the investment's lifetime.
46	3.1.3	return computation interval	The return computation interval for a particular analysis is the smallest time interval for which returns are calculated, such as daily, monthly, or even annually.
48	3.2.2	return on notional principal	The return on notional principal divides economic gain or loss by the notional principal of the contract.
57	3.4.2	scale differences	Scale differences are when investments have unequal sizes and/or timing of their cash flows.

45	3.1.1	simple interest	Simple interest is an interest rate computation approach that does not incorporate compounding.
53	3.3.3	since-inception IRR	A since-inception IRR is commonly used as a measure of fund performance rather than the performance of an individual investment.
67	3.5.7	soft hurdle rate	A soft hurdle rate allows fund managers to earn an incentive fee on all profits, given that the hurdle rate has been achieved.
59	3.4.5	time-weighted returns	Time-weighted returns are averaged returns that assume that no cash was contributed or withdrawn during the averaging period, meaning after the initial investment.
61	3.5.1	vesting	Vesting is the process of granting full ownership of conferred rights, such as incentive fees.
61	3.5	waterfall	The waterfall is a provision of the limited partnership agreement that specifies how distributions from a fund will be split and how the payouts will be prioritized.
99	4.6	ARCH	ARCH (autoregressive conditional heteroscedasticity) is a special case of GARCH that allows future variances to rely only on past disturbances, whereas GARCH allows future variances to depend on past variances as well.
85	4.3.6	autocorrelation	The autocorrelation of a time series of returns from an investment refers to the possible correlation of the returns with one another through time.
99	4.6	autoregressive	Autoregressive refers to when subsequent values to a variable are explained by past values of the same variable.
84	4.3.5	beta	The beta of an asset is defined as the covariance between the asset's returns and a return such as the market index, divided by the variance of the index's return, or, equivalently, as the correlation coefficient multiplied by the ratio of the asset volatility to market volatility: $\beta_i = \text{Cov}(R_m, R_i) / \text{Var}(R_m) = \sigma_{im} / \sigma_m^2$ where β_i is the beta of the returns of asset i (R_i) with respect to a market index of returns, R_m .
99	4.6	conditionally heteroskedastic	Conditionally heteroskedastic financial market prices have different levels of return variation even when specified conditions are similar (e.g., when they are viewed at similar price levels).
81	4.3.2	correlation coefficient	The correlation coefficient (also called the Pearson correlation coefficient) measures the degree of association between two variables, but unlike the covariance, the correlation coefficient can be easily interpreted.

79	4.3.1	covariance	The covariance of the return of two assets is a measure of the degree or tendency of two variables to move in relationship with each other.
71	4.1.1	ex ante returns	Future possible returns and their probabilities are referred to as expectational or ex ante returns .
71	4.1.1	ex post returns	Ex post returns are realized outcomes rather than anticipated outcomes.
78	4.2.4	excess kurtosis	Excess kurtosis provides a more intuitive measure of kurtosis relative to the normal distribution because it has a value of zero in the case of the normal distribution: $\text{Excess Kurtosis} = \{E[(R - \mu)^4] / \sigma^4\} - 3$
86	4.3.6	first-order autocorrelation	First-order autocorrelation refers to the correlation between the return in time period t and the return in the immediately previous time period, $t - 1$.
98	4.6	GARCH	GARCH (generalized autoregressive conditional heteroskedasticity) is an example of a time-series method that adjusts for varying volatility.
98	4.6	heteroskedasticity	Heteroskedasticity is when the variance of a variable changes with respect to a variable, such as itself or time.
98	4.6	homoskedasticity	Homoskedasticity is when the variance of a variable is constant.
97	4.5.3	Jarque-Bera test	The Jarque-Bera test involves a statistic that is a function of the skewness and excess kurtosis of the sample: $JB = (n/6)[S^2 + (K^2/4)]$ where JB is the Jarque-Bera test statistic, n is the number of observations, S is the skewness of the sample, and K is the excess kurtosis of the sample.
77	4.2.4	kurtosis	Kurtosis serves as an indicator of the peaks and tails of a distribution. $\text{Kurtosis} = E[(R - \mu)^4] / \sigma^4$
78	4.2.5	leptokurtosis	If a return distribution has positive excess kurtosis, meaning it has more kurtosis than the normal distribution, it is said to be leptokurtic, leptokurtotic, or fat tailed, and to exhibit leptokurtosis .
73	4.1.3	lognormal distribution	A variable has a lognormal distribution if the distribution of the logarithm of the variable is normally distributed.
74	4.2.1	mean	The most common raw moment is the first raw moment and is known as the mean , or expected value, and is an indication of the central tendency of the variable.

78	4.2.5	mesokurtosis	If a return distribution has no excess kurtosis, meaning it has the same kurtosis as the normal distribution, it is said to be mesokurtic, mesokurtotic, or normal tailed, and to exhibit mesokurtosis .
72	4.1.2	normal distribution	The normal distribution is the familiar bell-shaped distribution, also known as the Gaussian distribution.
81	4.3.2	perfect linear negative correlation	A correlation coefficient of -1 indicates that the two assets move in the exact opposite direction and in the same proportion, a result known as perfect linear negative correlation .
81	4.3.2	perfect linear positive correlation	A correlation coefficient of $+1$ indicates that the two assets move in the exact same direction and in the same proportion, a result known as perfect linear positive correlation .
78	4.2.5	platykurtosis	If a return distribution has negative excess kurtosis, meaning less kurtosis than the normal distribution, it is said to be platykurtic, platykurtotic, or thin tailed, and to exhibit platykurtosis .
76	4.2.3	skewness	The skewness is equal to the third central moment divided by the standard deviation of the variable cubed and serves as a measure of asymmetry: $\text{Skewness} = E[(R - \mu)^3] / \sigma^3$
81	4.3.2	Spearman rank correlation	The Spearman rank correlation is a correlation designed to adjust for outliers by measuring the relationship between variable ranks rather than variable values.
76	4.2.2	standard deviation	The square root of the variance is an extremely popular and useful measure of dispersion known as the standard deviation : $\text{Standard Deviation} = \sqrt{\sigma^2} = \sigma$
75	4.2.2	variance	The variance is the second central moment and is the expected value of the deviations squared,
76	4.2.2	volatility	In investment terminology, volatility is a popular term that is used synonymously with the standard deviation of returns.
120	5.4.3	average tracking error	Average tracking error refers to the excess of an investment's return relative to its benchmark. In other words, it is the numerator of the information ratio.
105	5.1.6	conditional value-at-risk	Conditional value-at-risk (CVaR) , also known as expected tail loss, is the expected loss of the investor given that the VaR has been equaled or exceeded.

103	5.1.5	drawdown	Drawdown is defined as the maximum loss in the value of an asset over a specified time interval and is usually expressed in percentage-return form rather than currency.
116	5.3.6	information ratio	The information ratio has a numerator formed by the difference between the average return of a portfolio (or other asset) and its benchmark, and a denominator equal to its tracking error: $\text{Information Ratio} = [E(R_p) - R_{\text{Benchmark}}]/TE$ where $E(R_p)$ is the expected or mean return for portfolio p, $R_{\text{Benchmark}}$ is the expected or mean return of the benchmark, and TE is the tracking error of the portfolio relative to its benchmark return.
117	5.4.1	Jensen's alpha	Jensen's alpha may be expressed as the difference between its expected return and the expected return of efficiently priced assets of similar risk.
118	5.4.2	M2 approach	The M2 approach , or M-squared approach, expresses the excess return of an investment after its risk has been normalized to equal the risk of the market portfolio.
103	5.1.5	maximum drawdown	Maximum drawdown is defined as the largest decline over <i>any</i> time interval within the entire observation period.
109	5.2.6	Monte Carlo analysis	Monte Carlo analysis is a type of simulation in which many potential paths of the future are projected using an assumed model, the results of which are analyzed as an approximation to the future probability distributions.
106	5.2.1	parametric VaR	A VaR computation assuming normality and using the statistics of the normal distribution is known as parametric VaR .
117	5.3.7	return on VaR (RoVaR)	Return on VaR (RoVaR) is simply the expected or average return of an asset divided by a specified VaR (expressing VaR as a positive number): $\text{RoVaR} = E(R_p)/\text{VaR}$.
102	5.1.2	semistandard deviation	Semistandard deviation , sometimes called semideviation, is the square root of semivariance.
101	5.1.1	semivariance	The semivariance uses a formula otherwise identical to the variance formula except that it considers only the negative deviations. Semivariance is therefore expressed as: $\text{Semivariance} = \frac{1}{T^*} \sum [R_t - E(R)]^2$ For all $R_t < E(R)$ where T^* is the number of negative deviations.

111	5.3.1	Sharpe ratio	The Sharpe ratio has excess return as its numerator and volatility as its denominator: $SR = [E(R_p) - R_f] / \sigma_p$ where SR is the Sharpe ratio for portfolio p, $E(R_p)$ is the expected return for portfolio p, R_f is the riskless rate, and σ_p is the standard deviation of the returns of portfolio p.
102	5.1.3	shortfall risk	Shortfall risk is simply the probability that the return will be less than the investor's target rate of return.
115	5.3.5	Sortino ratio	The Sortino ratio subtracts a benchmark return, rather than the riskless rate, from the asset's return in its numerator and uses downside standard deviation as the measure of risk in its denominator: Sortino Ratio = $[E(R_p) - R_{Target}] / TSSD$ where $E(R_p)$ is the expected return, or mean return in practice, for portfolio p; R_{Target} is the user's target rate of return; and TSSD is the target semistandard deviation (or downside deviation).
102	5.1.3	target semistandard deviation	Target semistandard deviation (TSSD) is simply the square root of the target semivariance.
102	5.1.3	target semivariance	Target semivariance is similar to semivariance except that target semivariance substitutes the investor's target rate of return in place of the mean return.
103	5.1.4	tracking error	Tracking error indicates the dispersion of the returns of an investment relative to a benchmark return, where a benchmark return is the contemporaneous realized return on an index or peer group of comparable risk.
114	5.3.3	Treynor ratio	The Treynor ratio has excess return as its numerator and beta as the measure of risk as its denominator: $TR = [E(R_p) - R_f] / \beta_p$ where TR is the Treynor ratio for portfolio p; $E(R_p)$ is the expected return, or mean return, for portfolio p; R_f is the riskless rate; and β_p is the beta of the returns of portfolio p.
104	5.1.6	value at risk	Value at risk (VaR) is the loss figure associated with a particular percentile of a cumulative loss function.
113	5.3.1	well-diversified portfolio	In the field of investments, the term well-diversified portfolio is traditionally interpreted as any portfolio containing only trivial amounts of diversifiable risk.
136	6.4.2	absolute pricing model	An absolute pricing model attempts to describe a price level based on its underlying economic factors.
135	6.4	arbitrage	Arbitrage is the attempt to earn riskless profits (in excess of the risk-free rate) by identifying and trading relatively mispriced assets.

135	6.4.1	arbitrage-free model	An arbitrage-free model is a financial model with relationships derived by the assumption that arbitrage opportunities do not exist, or at least do not persist.
124	6.2	asset pricing model	An asset pricing model is a framework for specifying the return or price of an asset based on its risk, as well as future cash flows and payoffs.
150	6.6.5	bear spread	An option combination in which the long option position is at the higher of two strike prices is a bear spread , which offers bearish exposure to the underlying asset that begins at the higher strike price and ends at the lower strike price.
140	6.4.7	binomial tree model	A binomial tree model projects possible outcomes in a variable by modeling uncertainty as two movements: an upward movement and a downward movement.
154	6.7.2	Black-Scholes call option formula	Black-Scholes call option formula expresses the price of a call option as a function of five variables: the price of the underlying asset, the strike price, the return volatility of the underlying asset, the time to the option's expiration, and the riskless rate.
150	6.6.5	bull spread	An option combination in which the long option position is at the lower of two strike prices is a bull spread , which offers bullish exposure to the underlying asset that begins at the lower strike price and ends at the higher strike price.
125	6.2.1	capital asset pricing model (CAPM)	The capital asset pricing model (CAPM) provides one of the easiest and most widely understood examples of single-factor asset pricing by demonstrating that the risk of the overall market index is the only risk that offers a risk premium.
140	6.4.6	carrying cost	The carrying cost is the cost of maintaining a position through time and includes direct costs, such as storage or custody costs, as well as opportunity costs, such as forgone cash flows.
136	6.4.3	cash market	The spot market or cash market is any market in which transactions involve immediate payment and delivery: The buyer immediately pays the price, and the seller immediately delivers the product.
152	6.6.6	collar	A collar generally refers to a long position in an asset combined with a short call option and a long put option on that asset, in which the call option has a higher strike price than the put option.

140	6.4.6	cost-of-carry model	A cost-of-carry model specifies a relationship between two positions that must exist if the only difference between the positions involves the expense of maintaining the positions.
148	6.6.4	covered call	A covered call combines being long an asset with being short a call option on the same asset.
156	6.8.2	elasticity	An elasticity is the percentage change in a value with respect to a percentage change in another value.
131	6.3.2	empirical model	An empirical model is derived from observation. An example would be a model that recognizes that the returns of some traditional assets are correlated with their market-to-book ratios.
126	6.2.2	ex ante models	Ex ante models , such as ex ante asset pricing models, explain expected relationships, such as expected returns. Ex ante means “from before.”
128	6.2.3	ex post model	An ex post model describes realized returns and provides an understanding of risk and how it relates to the deviations of realized returns from expected returns.
128	6.2.3	excess return	The excess return of an asset refers to the excess or deficiency of the asset’s return relative to the periodic risk-free rate.
131	6.3.4	Fama-French model	The Fama-French model links the returns of assets to three factors: (1) the market portfolio, (2) a factor representing a value versus growth effect, and (3) a factor representing a small-cap versus large-cap effect.
132	6.3.4	Fama-French-Carhart model	The Fama-French-Carhart model adds a fourth factor to the Fama-French model: momentum.
139	6.4.6	financed positions	Financed positions enable economic ownership of an asset without the posting of the purchase price.
137	6.4.5	forward contract	A forward contract is simply an agreement calling for deferred delivery of an asset or a payoff.
128	6.2.3	idiosyncratic return	Idiosyncratic return is the portion of an asset’s return that is unique to an investment and not driven by a common association.
128	6.2.3	idiosyncratic risk	Idiosyncratic risk is the dispersion in economic outcomes caused by investment-specific effects. This section focuses on realized returns and the modeling of risk.
121	6.1	informational market efficiency	Informational market efficiency refers to the extent to which asset prices reflect available information.

157	6.8.2	lambda	Lambda or omega for a call option is the elasticity of an option price with respect to the price of the underlying asset and is equal to delta multiplied times the quantity (S/c).
125	6.2.1	market portfolio	The market portfolio is a hypothetical portfolio containing all tradable assets in the world.
125	6.2.1	market weight	The market weight of an asset is the proportion of the total value of that asset to the total value of all assets in the market portfolio.
129	6.3.1	multifactor models	Multifactor models of asset pricing express systematic risk using multiple factors and are extremely popular throughout traditional and alternative investing.
148	6.6.3	naked option	A short option position that is unhedged is often referred to as a naked option .
157	6.8.2	omega	Lambda or omega for a call option is the elasticity of an option price with respect to the price of the underlying asset and is equal to delta multiplied times the quantity (S/c).
156	6.8.2	omicron	Omicron is the partial derivative of an option or a position containing an option to a change in the credit spread and is useful for analyzing option positions on credit-risky assets.
152	6.6.6	option collar	An option collar generally refers only to the long position in a put and a short position in a call.
152	6.6.6	option combination	An option combination contains both calls and puts on the same underlying asset.
150	6.6.5	option spread	An option spread (1) contains either call options or put options (not both), and (2) contains both long and short positions in options with the same underlying asset.
152	6.6.6	option straddle	An option straddle is a position in a call and put with the same sign (i.e., long or short), the same underlying asset, the same expiration date, and the same strike price.
152	6.6.6	option strangle	An option strangle is a position in a call and put with the same sign, the same underlying asset, the same expiration date, but <i>different strike prices</i> .
148	6.6.4	protective put	A protective put combines being long an asset with a long position in a put option on the same asset.
153	6.6.7	put-call parity	Put-call parity is an arbitrage-free relationship among the values of an asset, a riskless bond, a call option, and a put option.

136	6.4.2	relative pricing model	A relative pricing model prescribes the relationship between two prices.
156	6.8.1	rho	Rho is the sensitivity of an option price with respect to changes in the riskless interest rate.
152	6.6.6	risk reversal	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 date is termed a risk reversal .
122	6.1.2	semistrong form informational market efficiency	The concept of semistrong form informational market efficiency (or semistrong level) refers to market prices reflecting all publicly available information (including not only past prices and volumes but also any publicly available information such as financial statements and other underlying economic data).
125	6.2.1	single-factor asset pricing model	A single-factor asset pricing model explains returns and systematic risk using a single risk factor.
136	6.4.3	spot market	The spot market or cash market is any market in which transactions involve immediate payment and delivery: The buyer immediately pays the price, and the seller immediately delivers the product.
122	6.1.2	strong form informational market efficiency	The concept of strong form informational market efficiency (or strong level) refers to market prices reflecting all publicly and privately available information.
128	6.2.3	systematic return	Systematic return is the portion of an asset's return driven by a common association.
128	6.2.3	systematic risk	Systematic risk is the dispersion in economic outcomes caused by variation in systematic return.
142	6.5	term structure of forward contracts	The term structure of forward contracts is the relationship between forward prices (or forward rates) and the time to delivery of the forward contract.
130	6.3.2	theoretical model	In a theoretical model , the factors are derived from reasoning based on known facts and relationships.
131	6.3.3	tradable asset	A tradable asset is a position that can be readily established and liquidated in the financial market, such as a stock position, a bond position, or a portfolio of liquid positions.
122	6.1.2	weak form informational market efficiency	Weak form informational market efficiency (or weak level) refers to market prices reflecting available data on past prices and volumes.

163	7.2.3	abstract models	Abstract models , also called basic models, tend to have applicability only in solving real-world challenges of the future.
163	7.2.3	applied models	Applied models are designed to address immediate real-world challenges and opportunities.
159	7.1	benchmarking	Benchmarking , often referred to as performance benchmarking, is the process of selecting an investment index, an investment portfolio, or any other source of return as a standard (or benchmark) for comparison during performance analysis.
164	7.2.4	cross-sectional models	Cross-sectional models analyze behavior at a single point in time across various subjects, such as investors or investments.
162	7.2.1	normative model	A normative model attempts to describe how people and prices ought to behave.
164	7.2.4	panel data sets	Panel data sets combine the two approaches by tracking multiple subjects through time and can also be referred to as longitudinal data sets and cross-sectional time-series data sets.
160	7.1.1	peer group	The peer group is typically a group of funds with similar objectives, strategies, or portfolio holdings.
165	7.3	performance attribution	Performance attribution , also known as return attribution , is the process of identifying the components of an asset's return or performance.
162	7.2.1	positive model	A positive model attempts to describe how people and prices <i>actually</i> behave.
165	7.3	return attribution	Performance attribution , also known as return attribution , is the process of identifying the components of an asset's return or performance.
164	7.2.4	time-series models	Time-series models analyze behavior of a single subject or a set of subjects through time.
185	8.5	abnormal return persistence	Abnormal return persistence is the tendency of idiosyncratic performance in one time period to be correlated with idiosyncratic performance in a subsequent time period.
176	8.1.2	alpha	Alpha refers to any excess or deficient investment return after the return has been adjusted for the time value of money (the risk-free rate) and for the effects of bearing systematic risk (beta).
186	8.6	alpha driver	An investment that seeks high returns independent of the market is an alpha driver .

189	8.7.1	alternative hypothesis	The alternative hypothesis is the behavior that the analyst assumes would be true if the null hypothesis were rejected.
187	8.6.2	asset gatherers	Asset gatherers are managers striving to deliver beta as cheaply and efficiently as possible, and include the large-scale index trackers that produce passive products tied to well-recognized financial market benchmarks.
195	8.8.3	backfill bias	Backfill bias fun , or instant history bias, is when the funds, returns, and strategies being added to a data set are not representative of the universe of fund managers, fund returns, and fund strategies.
195	8.8.3	backfilling	Backfilling typically refers to the insertion of an actual trading record of an investment into a database when that trading record predates the entry of the investment into the database.
195	8.8.3	backtesting	Backtesting is the use of historical data to test a strategy that was developed subsequent to the observation of the data.
184	8.4.3	beta creep	Beta creep is when hedge fund strategies pick up more systematic market risk over time.
186	8.6	beta driver	An investment that moves in tandem with the overall market or a particular risk factor is a beta driver .
184	8.4.3	beta expansion	Beta expansion is the perceived tendency of the systematic risk exposures of a fund or asset to increase due to changes in general economic conditions.
184	8.4.3	beta nonstationarity	Beta nonstationarity is a general term that refers to the tendency of the systematic risk of a security, strategy, or fund to shift through time.
199	8.9.4	causality	The difference between true correlation and causality is that causality reflects when one variable's correlation with another variable is determined by or due to the value or change in value of the other variable.
196	8.8.4	cherry-picking	Cherry-picking is the concept of extracting or publicizing only those results that support a particular viewpoint.
196	8.8.4	chumming	Chumming is a fishing term used to describe scattering pieces of cheap fish into the water as bait to attract larger fish to catch.
190	8.7.1	confidence interval	A confidence interval is a range of values within which a parameter estimate is expected to lie with a given probability.
194	8.8.2	data dredging	Data dredging , or data snooping, refers to the overuse and misuse of statistical tests to identify historical patterns.

194	8.8.2	data mining	Data mining typically refers to the vigorous use of data to uncover valid relationships.
191	8.7.2	economic significance	Economic significance describes the extent to which a variable in an economic model has a meaningful impact on another variable in a practical sense.
187	8.6.1	equity risk premium	The equity risk premium (ERP) is the expected return of the equity market in excess of the risk-free rate.
187	8.6.1	equity risk premium puzzle	The equity risk premium puzzle is the enigma that equities have historically performed much better than can be explained purely by risk aversion, yet many investors continue to invest heavily in low-risk assets.
177	8.2.1	ex ante alpha	Ex ante alpha is the expected superior return if positive (or inferior return if negative) offered by an investment on a forward-looking basis after adjusting for the riskless rate and for the effects of systematic risks (beta) on expected returns.
178	8.2.2	ex post alpha	Ex post alpha is the return, observed or estimated in retrospect, of an investment above or below the risk-free rate and after adjusting for the effects of beta (systematic risks).
185	8.4.3	full market cycle	A full market cycle is a period of time containing a large representation of market conditions, especially up (bull) markets and down (bear) markets.
189	8.7.1	hypotheses	Hypotheses are propositions that underlie the analysis of an issue.
187	8.6.2	linear risk exposure	A linear risk exposure means that when the returns to such a strategy are graphed against the returns of the market index or another appropriate standard, the result tends to be a straight line.
181	8.3.2	model misspecification	Model misspecification is any error in the identification of the variables in a model or any error in identification of the relationships between the variables.
189	8.7.1	null hypothesis	The null hypothesis is usually a statement that the analyst is attempting to reject, typically that a particular variable has no effect or that a parameter's true value is equal to zero.
197	8.9.2	outlier	An outlier is an observation that is markedly further from the mean than almost all other observations.
195	8.8.3	overfitting	Overfitting is using too many parameters to fit a model very closely to data over some past time frame.

187	8.6.2	passive beta driver	A passive beta driver strategy generates returns that follow the up-and-down movement of the market on a one-to-one basis.
188	8.6.4	process drivers	Process drivers are beta drivers that focus on providing beta that is fine-tuned or differentiated.
188	8.6.4	product innovators	At one end of the spectrum are product innovators , which are alpha drivers that seek new investment strategies offering superior rates of risk-adjusted return.
190	8.7.1	<i>p</i> -value	The <i>p</i>-value is a result generated by the statistical test that indicates the probability of obtaining a test statistic by chance that is equal to or more extreme than the one that was actually observed (under the condition that the null hypothesis is true).
186	8.6	return driver	The term return driver represents the investments, the investment products, the investment strategies, or the underlying factors that generate the risk and return of a portfolio.
194	8.8.1	selection bias	Selection bias is a distortion in relevant sample characteristics from the characteristics of the population, caused by the sampling method of selection or inclusion.
194	8.8.1	self-selection bias	If the selection bias originates from the decision of fund managers to report or not to report their returns, then the bias is referred to as a self-selection bias .
190	8.7.1	significance level	The term significance level is used in hypothesis testing to denote a small number, such as 1%, 5%, or 10%, that reflects the probability that a researcher will tolerate of the null hypothesis being rejected when in fact it is true.
199	8.9.4	spurious correlation	The difference between spurious correlation and true correlation is that spurious correlation is idiosyncratic in nature, coincidental, and limited to a specific set of observations.
194	8.8.1	survivorship bias	Survivorship bias is a common problem in investment databases in which the sample is limited to those observations that continue to exist through the end of the period of study.
190	8.7.1	test statistic	The test statistic is the variable that is analyzed to make an inference with regard to rejecting or failing to reject a null hypothesis.

192	8.7.3	type I error	A type I error , also known as a false positive, is when an analyst makes the mistake of falsely rejecting a true null hypothesis.
192	8.7.3	type II error	A type II error , also known as a false negative, is failing to reject the null hypothesis when it is false.
212	9.4.1	conditional correlation	A conditional correlation is a correlation between two variables under specified circumstances.
203	9.1.1	dependent variable	The dependent variable is the variable supplied by the researcher that is the focus of the analysis and is determined at least in part by other (independent or explanatory) variables.
211	9.3.1	down market beta	The down market beta , bi,d , is the responsiveness of the fund's return to the market return when the market return is less than the riskless rate (i.e., when the market's excess return is negative, or down).
206	9.1.6	goodness of fit	The goodness of fit of a regression is the extent to which the model appears to explain the variation in the dependent variable.
203	9.1.1	independent variable	Independent variables are those explanatory variables that are inputs to the regression and are viewed as causing the observed values of the dependent variable.
204	9.1.1	intercept	The intercept is the value of the dependent variable when all independent variables are zero.
218	9.5.3	look-back option	A look-back option has a payoff that is based on the value of the underlying asset over a reference period rather than simply the value of the underlying asset at the option's expiration date.
209	9.2.2	multicollinearity	Multicollinearity is when two or more independent variables in a regression model have high correlation to each other.
208	9.2	multiple regression model	A multiple regression model is a regression model with more than one independent variable.
213	9.4.1	negative conditional correlation	When the correlation in the down sample is higher than the correlation in the up sample, it is termed negative conditional correlation .
210	9.3	nonlinear exposure	A nonlinear exposure of a position to a market factor is when the sensitivity of the position's value varies based on the magnitude of the level of change in the market factor's value.

212	9.4	nonstationary	The return distributions of hedge funds and hedge fund indices are nonstationary , meaning that return volatilities and correlations vary through time.
213	9.4.1	positive conditional correlation	Positive conditional correlation of investment returns to market returns is when the correlation in the up sample is higher than the correlation in the down sample. Investors prefer investment strategies with positive conditional correlation, since the strategies offer higher participation in profits during bull markets and lower participation in losses during bear markets.
217	9.5.2	principal components analysis	Principal components analysis is a statistical technique that groups the observations in a large data set into smaller sets of similar types based on commonalities in the data.
	9.1.1	regression	A regression is a statistical analysis of the relationship that explains the values of a dependent variable as a function of the values of one or more independent variables based on a specified model.
204	9.1.1	residuals	The residuals of the regression, <i>eit</i> , reflect the regression's estimate of the idiosyncratic portion of asset <i>i</i> 's realized returns above or below its mean idiosyncratic return (i.e., the regression's estimates of the error term).
214	9.4.2	rolling window analysis	Rolling window analysis is a relatively advanced technique for analyzing statistical behavior over time, using overlapping subsamples that move evenly through time.
206	9.1.6	<i>r</i> -squared	The r-squared value of the regression, which is also called the coefficient of determination, is often used to assess goodness of fit, especially when comparing models. In a simple linear regression, the <i>r</i> -squared is simply the squared value of the estimated correlation coefficient between the dependent variable and the independent variable.
220	9.6	serial correlation	Serial correlation is the same as autocorrelation: It is the correlation of a variable, such as return, in one time period (e.g., year) to the same variable in another time period.
203	9.1.1	simple linear regression	A simple linear regression is a linear regression in which the model has only one independent variable.
204	9.1.1	slope coefficient	The slope coefficient is a measure of the change in a dependent variable with respect to a change in an independent variable.

209	9.2.3	stepwise regression	Stepwise regression is an iterative technique in which variables are added or deleted from the regression equation based on their statistical significance.
216	9.5.1	style analysis	Style analysis is the process of understanding an investment strategy, especially using a statistical approach, based on grouping funds by their investment strategies or styles.
207	9.1.7	<i>t</i> -statistic	The <i>t</i>-statistic of a parameter is formed by taking the estimated absolute value of the parameter and dividing by its standard error.
207	9.1.7	<i>t</i> -test	A <i>t</i>-test is a statistical test that rejects or fails to reject a hypothesis by comparing a <i>t</i> -statistic to a critical value.
211	9.3.1	up market beta	The up market beta , bi,u , is the responsiveness of the fund's return to the market return when the excess market return is positive, and is estimated as the sum of bi,d and $bi,diff$.
238	10.4	agency risk	Agency risk is the economic dispersion resulting from the consequences of having another party (the agent) making decisions contrary to the preferences of the owner (the principal).
232	10.2.3	binomial option pricing	Binomial option pricing is a technique for pricing options that assumes that the price of the underlying asset can experience only a specified upward movement or downward movement during each period.
231	10.2.1	blue top lots	Blue top lots are at an interim stage of lot completion. In this case, the owner has completed the rough grading of the property and the lots, including the undercutting of the street section, interim drainage, and erosion control facilities, and has paid all applicable fees required.
239	10.4.1	cap rate	In real estate, the cap rate (capitalization rate) or yield is a common term for the return on assets (7.33% in this example).
245	10.5.4	contagion	Contagion is the general term used in finance to indicate any tendency of major market movements—especially declines in prices or increases in volatility—to be transmitted from one financial market to other financial markets.
226	10.1.2	exchange option	An exchange option is an option to exchange one risky asset for another rather than to buy or sell one asset at a fixed exercise or strike price.
243	10.5.2	favorable mark	A favorable mark is a biased indication of the value of a position that is intentionally provided by a subjective source.

231	10.2.1	finished lots	Finished lots are fully completed and ready for home construction and occupancy.
229	10.1.5	intrinsic option value	An intrinsic option value is the greater of \$0 and the value of an option if exercised immediately.
230	10.2.1	land banking	Land banking is the practice of buying vacant lots for the purpose of development or disposition at a future date.
229	10.1.4	low-hanging-fruit principle	The low-hanging-fruit principle states that the first action that should be taken is the one that reaps the highest benefits over costs.
243	10.5.2	managed returns	Managed returns are returns based on values that are reported with an element of managerial discretion.
244	10.5.2	market manipulation	Market manipulation refers to engaging in trading activity designed to cause the markets to produce favorable prices for thinly traded listed securities.
243	10.5.2	model manipulation	Model manipulation is the process of altering model assumptions and inputs to generate desired values and returns.
225	10	natural resources	Natural resources are real assets that have received no or almost no human alteration.
235	10.2.4	negative survivorship bias	A negative survivorship bias is a downward bias caused by excluding the positive returns of the properties or other assets that successfully left the database.
231	10.2.1	paper lots	Paper lots refers to sites that are vacant and approved for development by the local zoning authority but for which construction on streets, utilities, and other infrastructure has not yet commenced.
227	10.1.3	perpetual option	A perpetual option is an option with no expiration date.
238	10.4	political risk	Political risk is economic uncertainty caused by changes in government policy that may affect returns, perhaps dramatically.
225	10.1.1	pure play	A pure play on an investment is an investment vehicle that offers direct exposure to the risks and returns of a specific type of investment without the inclusion of other exposures.
233	10.2.3	risk-neutral probability	A risk-neutral probability is a probability that values assets correctly if, everything else being equal, all market participants were risk neutral.
237	10.3.1	rotation	Rotation is the length of time from the start of the timber (typically the planting) until the harvest of the timber.

243	10.5.2	selective appraisals	Selective appraisals refers to the opportunity for investment managers to choose how many, and which, illiquid assets should have their values appraised during a given quarter or some other reporting period.
242	10.5	smoothing	Smoothing is reduction in the reported dispersion in a price or return series.
225	10.1.1	split estate	A split estate is when surface rights and mineral rights are separately owned.
236	10.3	timberland investment management organizations (TIMOs)	Timberland investment management organizations (TIMOs) provide management services to timberland owned by institutional investors, such as pension plans, endowments, foundations, and insurance companies.
229	10.1.5	time value of an option	The time value of an option is the excess of an option's price above its intrinsic value.
267	11.4.1	backwardation	When the slope of the term structure of forward prices is negative, the market is in backwardation , or is backwardated.
271	11.5.3	basis	The basis in a forward contract is the difference between the spot (or cash) price of the referenced asset, S, and the price (F) of a forward contract with delivery T.
272	11.5.4	calendar spread	A calendar spread can be viewed as the difference between futures or forward prices on the same underlying asset but with different settlement dates.
267	11.4.1	contango	When the term structure of forward prices is upward sloping (i.e., when more distant forward contracts have higher prices than contracts that are nearby), the market is said to be in contango .
262	11.3.1	convenience yield	Convenience yield , y , is the economic benefit that the holder of an inventory in the commodity receives from directly holding the inventory rather than having a long position in a forward contract on the commodity.
261	11.3.1	cost of carry	In the context of futures and forward contracts, a cost of carry (or carrying cost) is any financial difference between maintaining a position in the cash market and maintaining a position in the forward market.
254	11.1.3	crisis at maturity	A crisis at maturity is when the party owing a payment is forced at the last moment to reveal that it cannot afford to make the payment or when the party obligated to deliver the asset at the original price is forced to reveal that it cannot deliver the asset.

259	11.2.1	distant contracts	Contracts with longer times to settlement are often called distant contracts , deferred contracts, or back contracts.
259	11.2.1	front month contract	On an exchange, the futures contract with the shortest time to settlement is often referred to as the front month contract .
266	11.3.4	inelastic supply	Inelastic supply is when supplies change slowly in response to market prices or when large changes in market prices are necessary to effect supply changes.
271	11.5.2	informationally inefficient term structure	An informationally inefficient term structure has pricing relationships that do not properly reflect available information.
257	11.1.6	initial margin	The collateral deposit made at the initiation of a long or short futures position is called the initial margin .
270	11.5.1	law of one price	The law of one price states that in the absence of trading restrictions, two identical assets will not persist in trading at different prices in different markets because arbitrageurs will buy the relatively underpriced asset and sell the relatively overpriced asset until the discrepancy disappears.
257	11.1.7	maintenance margin requirement	A maintenance margin requirement is a minimum collateral requirement imposed on an ongoing basis until a position is closed.
257	11.1.7	margin call	A margin call is a demand for the posting of additional collateral to meet the <i>initial</i> margin requirement.
264	11.3.2	marginal market participant	The marginal market participant to a derivative contract is any entity with individual costs and benefits that make the entity indifferent between physical positions and synthetic positions.
253	11.1.2	marked-to-market	The term marked-to-market means that the side of a futures contract that benefits from a price change receives cash from the other side of the contract (and vice versa) throughout the contract's life.
268	11.4.3	normal backwardation	In normal backwardation , the forward price is believed to be below the expected spot price.
268	11.4.3	normal contango	In normal contango , the forward price is believed to be above the expected spot price.
252	11.1.1	open interest	The outstanding quantity of unclosed contracts is known as open interest .

265	11.3.4	perfectly elastic supply	With regard to supply, on one end of the spectrum is a perfectly elastic supply , in which any quantity demanded of a commodity can be instantaneously and limitlessly supplied without changes in the market price.
259	11.2	rolling contracts	Rolling contracts refers to the process of closing positions in short-term futures contracts and simultaneously replacing the exposure by establishing similar positions with longer terms.
262	11.3.1	storage costs	Storage costs of physical commodities involve such expenditures as warehouse fees, insurance, transportation, and spoilage.
252	11.1.1	swap	A swap is a string of forward contracts grouped together that vary by time to settlement.
287	12.4.1	basis risk	Basis risk is the dispersion in economic returns associated with changes in the relationship between spot prices and futures prices.
295	12.5.2	Bloomberg Commodity Index (BCOM)	The Bloomberg Commodity Index (BCOM) , formerly the Dow Jones-UBS Commodity Index, is a long-only index composed of futures contracts on 22 physical commodities.
289	12.4.3	collateral yield	Collateral yield , is the interest earned from the riskless bonds or other money market assets used to collateralize the futures contract.
285	12.3.4	commodity-linked note	A commodity-linked note (CLN) is an intermediate-term debt instrument whose value at maturity is a function of the value of an underlying commodity or basket of commodities.
291	12.4.6	convergence at settlement	Convergence at settlement is the process of the futures price nearing the spot price as settlement approaches, and the two prices matching each other at settlement.
287	12.4	excess return of a futures contract	The return generated exclusively from changes in futures prices is known as the excess return of a futures contract .
287	12.4.1	fully collateralized position	A fully collateralized position is a position in which the cash necessary to settle the contract has been posted in the form of short-term, riskless bonds.
292	12.4.7	heterogeneous	A heterogeneous value differs across one or more dimensions.
277	12.1.1	inflation	Inflation is the decline in the value of money relative to the value of a general bundle of goods and services.
280	12.1.4	inflation risk	Inflation risk is the dispersion in economic outcomes caused by uncertainty regarding the value of a currency.

294	12.5	investable index	An investable index has returns that an investor can match in practice by maintaining the same positions that constitute the index.
277	12.1.1	nominal price	A nominal price refers to the stated price of an asset measured using the contemporaneous values of a currency.
295	12.5.2	production-weighted index	A production-weighted index weights each underlying commodity using estimates of the quantity of each commodity produced.
277	12.1.1	real price	A real price refers to the price of an asset that is adjusted for inflation through being expressed in the value of currency from a different time period.
296	12.5.2	Reuters/Jefferies Commodity Research Bureau (CRB) Index	The Reuters/Jefferies Commodity Research Bureau (CRB) Index is the oldest major commodity index and is currently made up of 19 commodities traded on various exchanges.
289	12.4.3	roll return	Roll yield or roll return is properly defined as the portion of the return of a futures position from the change in the contract's basis through time.
289	12.4.3	roll yield	Roll yield or roll return is properly defined as the portion of the return of a futures position from the change in the contract's basis through time.
289	12.4.3	spot return	Spot return is the return on the underlying asset in the spot market.
295	12.5.2	Standard & Poor's Goldman Sachs Commodity Index (S&P GSCI)	The Standard & Poor's Goldman Sachs Commodity Index (S&P GSCI) is a longonly index of physical commodity futures.
310	13.3.1	brownfield project	Investable infrastructure can also be an existing project, or brownfield project , that has a history of operations and may have converted from a government asset into something privately investable.
307	13.2.2	double taxation	Double taxation is the application of income taxes twice: taxation of profits at the corporate income tax level and taxation of distributions at the individual income tax level.
306	13.2.1	downstream operations	Downstream operations focus on refining, distributing, and marketing the oil and gas.
313	13.3.4	evergreen funds	Unlisted open-end funds, also called evergreen funds , allow investors to subscribe to or redeem from these funds on a regular basis.

315	13.4	excludable good	An excludable good is a good others can be prevented from enjoying.
313	13.3.4	gates	Gates are fund restrictions on investor withdrawals.
310	13.3.1	greenfield project	Investable infrastructure can originate as a new, yet-to-be-constructed project, referred to as a greenfield project , which was designed to be investable.
315	13.4	intangible assets	Intangible assets are economic resources that do not have a physical form.
315	13.4	intellectual property	Intellectual property (IP) is an intangible asset that can be owned, such as copyrighted artwork.
309	13.3.1	investable infrastructure	Investable infrastructure is typically differentiated from other assets with seven primary characteristics: (1) public use, (2) monopolistic power, (3) government related, (4) essential, (5) cash generating, (6) conducive to privatization of control, and (7) capital intensive with long-term horizons.
307	13.2.1	midstream operations	Midstream operations and midstream MLPs—the largest of the three segments—process, store, and transport energy and tend to have little or no commodity price risk.
317	13.4.2	negative costs	Negative costs refer not to the sign of the values but to the fact that these are costs required to produce what was, in the predigital era, the film’s negative image.
308	13.2.3	present value of growth opportunities (PVGO)	In corporate finance, present value of growth opportunities (PVGO) describes a high value assigned to an investment based on the idea that the underlying assets offer exceptional future income.
312	13.3.3	privatization	When a governmental entity sells a public asset to a private operator, this is termed privatization .
312	13.3.3	public-private partnership	A public-private partnership (PPP) occurs when a private sector party is retained to design, build, operate, or maintain a public building (e.g., a hospital), often for a lease payment for a prespecified period of time.
312	13.3.3	regulatory risk	Regulatory risk is the economic dispersion to an investor from uncertainty regarding governmental regulatory actions.
315	13.4	unbundling	In recent years, there has been an increased interest in unbundling IP from corporations and permitting it to be purchased as a stand-alone investment.

306	13.2.1	upstream operations	Upstream operations focus on exploration and production; midstream operations focus on storing and transporting the oil and gas.
325	14.2.1	amortization	. Reduction in principal due to payments is known as amortization .
331	14.2.4	balloon payment	A balloon payment is a large scheduled future payment.
336	14.4	collateralized mortgage obligations (CMOs)	Collateralized mortgage obligations (CMOs) extend this MBS mechanism to create different security classes, called tranches, which have different priorities to receiving cash flows and therefore different risks.
333	14.3	commercial mortgage loans	Commercial mortgage loans are loans backed by commercial real estate (multifamily apartments, hotels, offices, retail and industrial properties) rather than owner-occupied residential properties.
340	14.4.4	commercial mortgage-backed securities	Commercial mortgage-backed securities (CMBS) are mortgage-backed securities with underlying collateral pools of commercial property loans.
338	14.4.2	conditional prepayment rate	The annualized percentage of a mortgage's remaining principal value that is prepaid in a particular month is known as the conditional prepayment rate (CPR) .
322	14.1.3	core real estate	Core real estate includes assets that achieve a relatively high percentage of their returns from income and are expected to have low volatility.
333	14.3.2	covenants	Covenants are promises made by the borrower to the lender, such as requirements that the borrower maintain the property in good repair and continue to meet specified financial conditions.
334	14.3.2	cross-collateral provision	In order to mitigate the risk to which they are exposed, lenders commonly use a cross-collateral provision , wherein the collateral for one loan is used as collateral for another loan.
335	14.3.3	debt service coverage ratio	A related measure is the debt service coverage ratio (DSCR) , which is the ratio of the property's net operating income to all loan payments, including the amortization of the loan.
341	14.5	equity REITs	Equity REITs invest predominantly in equity ownership within the private real estate market.

335	14.3.3	fixed charges ratio	The fixed charges ratio is the ratio of the property's net operating income to all fixed charges that the borrower pays annually.
324	14.2	fixed-rate mortgage	A fixed-rate mortgage has interest charges and interest payments based on a single rate established at the initiation of the mortgage.
325	14.2.1	fully amortized	An asset is fully amortized when its principal is reduced to zero.
339	14.4.3	idiosyncratic prepayment factors	Factors affecting prepayment decisions other than interest rates or other systematic factors are known as idiosyncratic prepayment factors .
329	14.2.3	index rate	An index rate is a variable interest rate used in the determination of the mortgage's stated interest rate.
335	14.3.3	interest coverage ratio	Lenders typically examine the interest coverage ratio , which can be defined as the property's net operating income divided by the loan's interest payments.
330	14.2.3	interest rate cap	An interest rate cap is a limit on interest rate adjustments used in mortgages and derivatives with variable interest rates.
333	14.2.5	loan-to-value ratio (LTV ratio)	The loan-to-value ratio (LTV ratio) is the ratio of the amount of the loan to the value (either market or appraised) of the property.
322	14.1.2	lumpiness	Lumpiness describes when assets cannot be easily and inexpensively bought and sold in sizes or quantities that meet the preferences of the buyers and sellers.
330	14.2.3	margin rate	A margin rate is the spread by which the stated mortgage rate is set above the index rate. (This should not be confused with the same term used to describe a rate associated with margin debt in a brokerage account.)
323	14.2	mortgage	A mortgage loan can be simply defined as a loan secured by property.
341	14.5	mortgage REITs	Mortgage REITs invest predominantly in real estate-based debt.
335	14.4	mortgage-backed securities (MBS)	Mortgage-backed securities (MBS) are a type of asset-backed security that is secured by a mortgage or pool of mortgages.

331	14.2.4	negative amortization	Negative amortization occurs when the interest owed is greater than the payments being made such that the deficit is added to the principal balance on the loan, causing the principal balance to increase through time.
323	14.1.3	opportunistic real estate	Opportunistic real estate properties are expected to derive most or all of their returns from property appreciation and may exhibit substantial volatility in value and returns.
331	14.2.4	option adjustable-rate mortgage (option ARM)	An option adjustable-rate mortgage (option ARM) is an adjustable-rate mortgage that provides borrowers with the flexibility to make one of several possible payments on their mortgage every month.
336	14.4	pass-through MBS	A pass-through MBS is perhaps the simplest MBS and consists of the issuance of a homogeneous class of securities with pro rata rights to the cash flows of the underlying pool of mortgage loans.
327	14.2.1	prepayment option	The ability of the borrower to make or not make unscheduled principal payments is an option to the borrower: the borrower's prepayment option .
338	14.4.2	PSA benchmark	The Public Securities Association (PSA) established the PSA benchmark , a benchmark of prepayment speed that is based on the CPR and that has become the standard approach used by market participants.
341	14.5	real estate investment trust (REIT)	A real estate investment trust (REIT) is an entity structured much like a traditional operating corporation, except that the assets of the entity are almost entirely real estate.
334	14.3.2	recourse	Recourse is the set of rights or means that an entity such as a lender has in order to protect its investment.
340	14.4.3	refinancing burnout	Reduced refinancing speeds due to high levels of previous refinancing activity is known as refinancing burnout .
324	14.2	residential mortgage loans	Residential mortgage loans are typically taken out by individual households on properties that generate no explicit rental income, since the houses are usually owner occupied.
336	14.4	residential mortgage-backed securities	The residential mortgage-backed securities (RMBS) market is backed by residential mortgage loans.
322	14.1.3	styles of real estate investing	Styles of real estate investing refer to the categorization of real estate property characteristics into core, value added, and opportunistic.

332	14.2.5	subprime mortgages	Uninsured mortgages with borrowers of relatively high credit risk are generally known as subprime mortgages .
326	14.2.1	unscheduled principal payments	If the borrower makes unscheduled principal payments , which are payments above and beyond the scheduled mortgage payments, the mortgage's balance will decline more quickly than illustrated in Exhibit 14.1, and the mortgage will terminate early. In traditional mortgages, payments that exceed the required payment reduce the principal payment but do not lower required subsequent payments until the mortgage is paid off.
323	14.1.3	value-added real estate	Value-added real estate includes assets that exhibit one or more of the following characteristics: (1) achieving a substantial portion of their anticipated returns from appreciation in value, (2) exhibiting moderate volatility, and (3) not having the financial reliability of core properties.
324	14.2	variable-rate mortgage	A variable-rate mortgage has interest charges and interest payments based on a rate that is allowed to vary over the life of the mortgage based on terms established at the initiation of the mortgage.
356	15.2.3	after-tax discounting approach	In an after-tax discounting approach , the estimated after-tax cash flows (e.g., after-tax bond payments) are discounted using a rate that has been reduced to reflect the net rate received by an investor with a specified marginal tax rate.
370	15.5.1	appraisals	Appraisals are professional opinions with regard to the value of an asset, such as a real estate property.
350	15.1.4	backward induction	Backward induction is the process of solving a decision tree by working from the final nodes toward the first node, based on valuation analysis at each node.
362	15.3.9	closed-end real estate mutual fund	A closed-end real estate mutual fund is an investment pool that has real estate as its underlying asset and a relatively fixed number of outstanding shares.
359	15.3.2	commingled real state funds	Commingled real estate funds (CREFs) are a type of private equity real estate fund that is a pool of investment capital raised from private placements that are commingled to purchase commercial properties.
352	15.2	comparable sale prices approach	The comparable sale prices approach values real estate based on transaction values of similar real estate, with adjustments made for differences in characteristics.

371	15.5.2	data smoothing	Data smoothing occurs in a return series when the prices used in computing the return series have been dampened relative to the volatility of the true but unobservable underlying prices.
360	15.1.3	decision node	A decision node is a point in a decision tree at which the holder of the option must make a decision.
349	15.1.3	decision tree	A decision tree shows the various pathways that a decision maker can select as well as the points at which uncertainty is resolved.
356	15.2.2	depreciation	Depreciation is a noncash expense that is deducted from revenues in computing accounting income to indicate the decline of an asset's value.
369	15.4.5	depreciation tax shield	A depreciation tax shield is a taxable entity's ability to reduce taxes by deducting depreciation in the computation of taxable income.
352	15.2.1	discounted cash flow (DCF) method	The income approach is also known as the discounted cash flow (DCF) method when cash flows are discounted rather than accounting estimates of income.
353	15.2.1	effective gross income	The effective gross income is the potential gross income reduced for the vacancy loss rate.
365	15.4.2	effective tax rate	The effective tax rate is the actual reduction in value that occurs in practice when other aspects of taxation are included in the analysis, such as exemptions, penalties, and timing of cash flows.
357	15.2.3	equity residual approach	An alternative approach, often termed the equity residual approach , focuses on the perspective of the equity investor by subtracting the interest expense and other cash outflows due to mortgage holders (in the numerator) and by discounting the remaining cash flows using an interest rate reflective of the required rate of return on the equity of a leveraged real estate investment (in the denominator).
362	15.3.8	exchange-traded funds (ETFs)	Exchange-traded funds (ETFs) represent a tradable investment vehicle that tracks a particular index or portfolio by holding its constituent assets or a subsample of them.
353	15.2.1	fixed expenses	Fixed expenses , examples of which are property taxes and property insurance, do not change directly with the level of occupancy of the property.

374	15.5.4	FTSE NAREIT US Real Estate Index Series	The FTSE NAREIT US Real Estate Index Series is a family of REIT-based performance indices that covers the different sectors of the U.S. commercial real estate space.
360	15.3.5	gearing	Gearing is the use of leverage.
373	15.5.3	hedonic price index	A hedonic price index estimates value changes based on an analysis of observed transaction prices that have been adjusted to reflect the differing characteristics of the assets underlying each transaction.
352	15.2	income approach	The income approach values real estate by projecting expected income or cash flows, discounting for time and risk, and summing them to form the total value.
350	15.1.3	information node	An information node denotes a point in a decision tree at which new information arrives.
370	15.5.1	NCREIF Property Index (NPI)	The NCREIF Property Index (NPI) is the primary example of an appraisal-based real estate index in the United States and is published by the National Council of Real Estate Investment Fiduciaries (NCREIF), a not-for-profit industry association that collects data regarding property values from its members.
355	15.2.2	net lease	In a net lease , the tenant is responsible for almost all of the operating expenses.
352	15.2.1	net operating income (NOI)	Net operating income (NOI) is a measure of periodic earnings that is calculated as the property's rental income minus all expenses associated with maintaining and operating the property.
352	15.2.1	net sale proceeds	The net sale proceeds (NSP) is the expected selling price minus any expected selling expenses arising from the sale of the property at time T.
360	15.3.6	open-end real estate mutual funds	Open-end real estate mutual funds are public investments that offer a non-exchange traded means of obtaining access to the private real estate market.
353	15.2.1	operating expenses	Operating expenses are non-capital outlays that support rental of the property and can be classified as fixed or variable.
353	15.2.1	potential gross income	The potential gross income is the gross income that could potentially be received if all offices in the building were occupied.

356	15.2.3	pre-tax discounting approach	The pre-tax discounting approach is commonly used in finance, where pre-tax cash flows are used in the numerator of the present value analysis (as the cash flows to be received), and the pre-tax discount rate is used in the denominator.
358	15.3.1	private equity real estate funds	Private equity real estate funds are privately organized funds that are similar to other alternative investment funds, such as private equity funds and hedge funds, yet have real estate as their underlying asset.
352	15.2	profit approach	The profit approach to real estate valuation is typically used for properties with a value driven by the actual business use of the premises; it is effectively a valuation of the business rather than a valuation of the property itself.
347	15.1	real estate development projects	Real estate development projects can include one or more stages of creating or improving a real estate project, including the acquisition of raw land, the construction of improvements, and the renovation of existing facilities.
359	15.3.4	real estate joint ventures	Real estate joint ventures are private equity real estate funds that consist of the combination of two or more parties, typically represented by a small number of individual or institutional investors, embarking on a business enterprise such as the development of real estate properties.
351	15.2	real estate valuation	Real estate valuation is the process of estimating the market value of a property and should be reflective of the price at which informed investors would be willing to both buy and sell that property.
347	15.1.1	real option	A real option is an option on a real asset rather than a financial security.
354	15.2.2	risk premium approach	The risk premium approach to estimation of a discount rate for an investment uses the sum of a riskless interest rate and one or more expected rewards—expressed as rates—for bearing the risks of the investment.
361	15.3.6	stale pricing	The use of prices that lag changes in true market prices is known as stale pricing .
359	15.3.3	syndications	Syndications are private equity real estate funds formed by a group of investors who retain a real estate expert with the intention of undertaking a particular real estate project.
353	15.2.1	vacancy loss rate	The vacancy loss rate is the observed or anticipated rate at which potential gross income is reduced for space that is not generating rental income.

353	15.2.1	variable expenses	Variable expenses , examples of which are maintenance, repairs, utilities, garbage removal, and supplies, change as the level of occupancy of the property varies.
402	16.4.1	absolute return strategies	Absolute return strategies are hedge fund strategies that seek to minimize market risk and total risk.
393	16.2.4	annuity view of hedge fund fees	The annuity view of hedge fund fees represents the prospective stream of cash flows from fees available to a hedge fund manager.
392	16.2.3	asymmetric incentive fees	Asymmetric incentive fees , in which managers earn a portion of investment gains without compensating investors for investment losses, are generally prohibited for stock and bond funds offered as '40 Act mutual funds in the United States.
396	16.2.5	at-the-money incentive fee approximation	The at-the-money incentive fee approximation expresses the value of a managerial incentive fee as the product of 40%, the fund's NAV, the incentive fee percentage, and the volatility of the assets (σ_1) over the option's life.
419	16.7.7	capacity	Capacity is the limit on the quantity of capital that can be deployed without substantially diminished performance.
400	16.3	classification of hedge fund strategies	A classification of hedge fund strategies is an organized grouping and labeling of hedge fund strategies.
397	16.2.5	closet indexer	A closet indexer is a manager who attempts to generate returns that mimic an index while claiming to be an active manager.
384	16.1.4	consolidation	Consolidation is an increase in the proportion of a market represented by a relatively small number of participants (i.e., the industry concentration).
405	16.4.3	convergent strategies	Convergent strategies profit when relative value spreads move tighter, meaning that two securities move toward relative values that are perceived to be more appropriate.
402	16.4.1	diversified strategies	Diversified strategies are hedge fund strategies that seek to diversify across a number of different investment themes.
402	16.4.1	equity strategies	Equity strategies are hedge fund strategies that exhibit substantial market risk.
402	16.4.1	event-driven strategies	Event-driven strategies are hedge fund strategies that seek to earn returns by taking on event risk, such as failed mergers, that other investors are not willing or prepared to take.

393	16.2.3	excessive conservatism	Excessive conservatism is inappropriately high risk aversion by the manager, since the manager's total income and total wealth may be highly sensitive to fund performance.
413	16.7.1	fee bias	Fee bias is when index returns overstate what a new investor can obtain in the hedge fund marketplace because the fees used to estimate index returns are lower than the typical fees that a new investor would pay.
401	16.3	fund mortality	Fund mortality , the liquidation or cessation of operations of funds, illustrates the risk of individual hedge funds and is an important issue in hedge fund analysis.
401	16.3	fund of funds	A fund of funds in this context is a hedge fund with underlying investments that are predominantly investments in other hedge funds.
410	16.6	headline risk	Headline risk is dispersion in economic value from events so important, unexpected, or controversial that they are the center of major news stories.
402	16.4	hedge fund program	A hedge fund program refers to the processes and procedures for the construction, monitoring, and maintenance of a portfolio of hedge funds.
390	16.2.2	high-water mark	The high-water mark (HWM) is the highest NAV of the fund on which an incentive fee has been paid.
396	16.2.5	incentive fee option value	The incentive fee option value is the risk-adjusted present value of the incentive fees to a manager that have been adjusted for its optionality.
416	16.7.5	instant history bias	Instant history bias or backfill bias occurs when an index contains histories of returns that predate the entry date of the corresponding funds into a database and thereby cause the index to disproportionately reflect the characteristics of funds that are added to a database.
419	16.7.7	investability	The investability of an index is the extent to which market participants can invest to actually achieve the returns of the index.
416	16.7.5	liquidation bias	Liquidation bias occurs when an index disproportionately reflects the characteristics of funds that are not near liquidation.
398	16.2.6	lock-in effect	The lock-in effect in this context refers to the pressure exerted on managers to avoid further risks once high profitability and a high incentive fee have been achieved.

392	16.2.3	managerial coinvesting	Managerial coinvesting in this context is an agreement between fund managers and fund investors that the managers will invest their own money in the fund.
399	16.2.6	managing returns	The terms managing returns and massaging returns refer to efforts by managers to alter reported investment returns toward preferred targets through accounting decisions or investment changes.
399	16.2.6	massaging returns	The terms managing returns and massaging returns refer to efforts by managers to alter reported investment returns toward preferred targets through accounting decisions or investment changes.
401	16.3	multistrategy fund	A multistrategy fund deploys its underlying investments with a variety of strategies and sub-managers, much as a corporation would use its divisions.
404	16.4.3	off-balance-sheet risk	Event risk is effectively an off-balance-sheet risk —that is, a risk exposure that is not explicitly reflected in the statement of financial positions.
408	16.5.1	opportunistic	An investment strategy is referred to as opportunistic when a major goal is to seek attractive returns through locating superior underlying investments.
392	16.2.3	optimal contracting	Optimal contracting between investors and hedge fund managers attempts to align the interests of both parties to the extent that the interests can be aligned cost-effectively, with marginal benefits that exceed marginal costs.
395	16.2.5	option view of incentive fees	The option view of incentive fees uses option theory to demonstrate the ability of managers to increase the present value of their fees by increasing the volatility of the fund's assets.
417	16.7.5	participation bias	Participation bias may occur for a successful hedge fund manager who closes a fund and stops reporting results because the fund no longer needs to attract new capital.
393	16.2.3	perverse incentive	A perverse incentive is an incentive that motivates the receiver of the incentive to work in opposition to the interests of the provider of the incentive.
397	16.2.5	pure asset gatherer	A pure asset gatherer is a manager focused primarily on increasing the AUM of the fund. A pure asset gatherer is likely to take very little risk in a portfolio and, like mutual fund managers, become a closet indexer.

406	16.4.4	relative return product	A relative return product is an investment with returns that are substantially driven by broad market returns and that should therefore be evaluated on the basis of how the investment's return compares with broad market returns.
402	16.4.1	relative value strategies	Relative value strategies are hedge fund strategies that seek to earn returns by taking risks regarding the convergence of values between securities.
415	16.7.5	representativeness	The representativeness of a sample is the extent to which the characteristics of that sample are similar to the characteristics of the universe.
382	16.1.1	safe harbor	In investments, a safe harbor denotes an area that is explicitly protected by one set of regulations from another set of regulations.
404	16.4.3	short volatility exposure	Short volatility exposure is any risk exposure that causes losses when underlying asset return volatilities increase.
401	16.3	single-manager hedge fund	A single-manager hedge fund , or single hedge fund, has underlying investments that are not allocations to other hedge funds.
417	16.7.6	strategy definitions	Strategy definitions , the method of grouping similar funds, raise two problems: (1) definitions of strategies can be very difficult for index providers to establish and specify, and (2) some funds can be difficult to classify in the process of applying the definition.
419	16.7.6	synthetic hedge funds	Synthetic hedge funds attempt to mimic hedge fund returns using listed securities and mathematical models.
423	17.1.1	black-box model trading	Systematic fund trading, often referred to as black-box model trading because the details are hidden in complex software, occurs when the ongoing trading decisions of the investment process are automatically generated by computer programs.
443	17.6.4	breakout strategies	Breakout strategies focus on identifying the commencement of a new trend by observing the range of recent market prices (e.g., looking back at the range of prices over a specific time period).
453	17.7.4	capacity risk	Capacity risk arises when a managed futures trader concentrates trades in a market that lacks sufficient depth (i.e., liquidity).
434	17.4.2	commodity pools	Commodity pools are investment funds that combine the money of several investors for the purpose of investing in the futures markets.

435	17.4.2	commodity trading advisers (CTAs)	Commodity trading advisers (CTAs) are professional money managers who specialize in the futures markets.
448	17.7.2	conditional correlation coefficient	A conditional correlation coefficient is a correlation coefficient calculated on a subset of observations that is selected using a condition.
423	17.1	counterparty risk	Counterparty risk is the uncertainty associated with the economic outcomes of one party to a contract due to potential failure of the other side of the contract to fulfill its obligations, presumably due to insolvency or illiquidity.
445	17.6.6	countertrend strategies	Countertrend strategies use various statistical measures, such as price oscillation or a relative strength index, to identify range-trading opportunities rather than price-trending opportunities.
438	17.5.3	degradation	Degradation is the tendency and process through time by which a trading rule or trading system declines in effectiveness.
423	17.1.1	discretionary fund trading	Discretionary fund trading occurs when the decisions of the investment process are made according to the judgment of human traders.
429	17.2.2	event risk	Event risk refers to sudden and unexpected changes in market conditions resulting from a specific event (e.g., Lehman Brothers bankruptcy).
441	17.6.2	exponential moving average	The exponential moving average is a geometrically declining moving average based on a weighted parameter, λ , with $0 < \lambda < 1$.
424	17.1.2	fundamental analysis	Fundamental analysis uses underlying financial and economic information to ascertain intrinsic values based on economic modeling.
425	17.2	global macro funds	Global macro funds have the broadest investment universe: They are not limited by market segment, industry sector, geographic region, financial market, or currency, and therefore tend to offer high diversification.
437	17.5.3	in-sample data	In-sample data are those observations directly used in the backtesting process.
455	17.7.4	lack of trends risk	Lack of trends risk , which comes into play when the trader continues allocating capital to trendless markets, leading to substantial losses.

429	17.2.2	leverage	Leverage refers to the use of financing to acquire and maintain market positions larger than the assets under management (AUM) of the fund.
455	17.7.4	liquidity risk	Liquidity risk , is somewhat related to capacity risk in that it refers to how a large fund that is trading in a thinly traded market will affect the price should it decide to increase or decrease its allocation.
435	17.4.2	managed account	A managed account (or separately managed account) is created when money is placed directly with a CTA in an individual account rather than being pooled with other investors.
431	17.4	managed futures	The term managed futures refers to the active trading of futures and forward contracts on physical commodities, financial assets, and exchange rates.
428	17.2.1	market microstructure	Market microstructure is the study of how transactions take place, including the costs involved and the behavior of bid and ask prices.
429	17.2.2	market risk	Market risk refers to exposure to directional moves in general market price levels.
438	17.6.1	mean-reverting	Mean-reverting refers to the situation in which returns show negative autocorrelation—the opposite tendency of momentum or trending.
453	17.7.4	model risk	Model risk is economic dispersion caused by the failure of models to perform as intended.
438	17.6.1	momentum	Momentum is the extent to which a movement in a security price tends to be followed by subsequent movements of the same security price in the same direction.
451	17.7.2	Mount Lucas Management (MLM) Index	The Mount Lucas Management (MLM) Index is a passive, transparent, and investable index designed to capture the returns to active futures investing.
438	17.6.1	moving average	A moving average is a series of averages that is recalculated through time based on a window of observations.
452	17.7.3	natural hedger	A natural hedger is a market participant who seeks to hedge a risk that springs from its fundamental business activities.
437	17.5.3	out-of-sample data	Out-of-sample data are observations that were not directly used to develop a trading rule or even indirectly used as a basis for knowledge in the research.

445	17.6.6	pattern recognition system	A pattern recognition system looks to capture non-trend-based predictable abnormal market behavior in prices or volatilities.
434	17.4.2	private commodity pools	Private commodity pools are funds that invest in the futures markets and are sold privately to high-net-worth investors and institutional investors.
434	17.4.2	public commodity pools	Public commodity pools are open to the general public for investing in much the same way that a mutual fund sells its shares to the public.
438	17.6.1	random walk	A price series with changes in its prices that are independent from current and past prices is a random walk .
445	17.6.6	relative strength index (RSI)	The relative strength index (RSI) , sometimes called the relative strength indicator, is a signal that examines average up and down price changes and is designed to identify trading signals such as the price level at which a trend reverses.
437	17.5.3	robustness	Robustness refers to the reliability with which a model or system developed for a particular application or with a particular data set can be successfully extended into other applications or data sets.
443	17.6.3	sideways market	A sideways market exhibits volatility without a persistent direction.
438	17.6.1	simple moving average	The most basic approach uses a simple moving average , a simple arithmetic average of previous prices.
436	17.5.1	slippage	Slippage is the unfavorable difference between assumed entry and exit prices and the entry and exit prices experienced in practice.
423	17.1.1	systematic fund trading	Systematic fund trading , often referred to as black-box model trading because the details are hidden in complex software, occurs when the ongoing trading decisions of the investment process are automatically generated by computer programs.
424	17.1.2	technical analysis	Technical analysis relies on data from trading activity, including past prices and volume data.
428	17.2.1	thematic investing	Thematic investing is a trading strategy that is not based on a particular instrument or market; rather, it is based on secular and long-term changes in some fundamental economic variables or relationships—for example, trends in population, the need for alternative sources of energy, or changes in a particular region of the world economy.

453	17.7.4	transparency	Transparency is the ability to understand the detail within an investment strategy or portfolio.
453	17.7.4	transparency risk	Transparency risk is dispersion in economic outcomes caused by the lack of detailed information regarding an investment portfolio or strategy.
438	17.6.1	trend-following strategies	Trend-following strategies are designed to identify and take advantage of momentum in price direction (i.e., trends in prices).
437	17.5.3	validation	Validation of a trading rule refers to the use of new data or new methodologies to test a trading rule developed on another set of data or with another methodology.
440	17.6.2	weighted moving average	A weighted moving average is usually formed as an unequal average, with weights arithmetically declining from most recent to most distant prices.
442	17.6.3	whipsawing	Whipsawing is when a trader alternates between establishing long positions immediately before price declines and establishing short positions immediately before price increases and, in so doing, experiences a sequence of losses. In trend following strategies, whipsawing results from a sideways market.
462	18.2	activist investment strategy	The activist investment strategy involves efforts by shareholders to use their rights, such as voting power or the threat of such power, to influence corporate governance to their financial benefit as shareholders.
466	18.2.3	agency costs	Agency costs are any costs, explicit (e.g., monitoring and auditing costs) or implicit (e.g., excessive corporate perks), resulting from inherent conflicts of interest between shareholders as principals and managers as agents.
466	18.2.3	agency theory	Agency theory studies the relationship between principals and agents.
466	18.2.3	agent compensation scheme	An agent compensation scheme is all agreements and procedures specifying payments to an agent for services, or any other treatment of an agent with regard to employment.
479	18.3.2	antitrust review	An antitrust review is a government analysis of whether a corporate merger or some other action is in violation of regulations through its potential to reduce competition.
484	18.4.1	bankruptcy process	The bankruptcy process is the series of actions taken from the filing for bankruptcy through its resolution.

479	18.3.2	bidding contest	A bidding contest or bidding war is when two or more firms compete to acquire the same target.
490	18.4.5	capital structure arbitrage	Capital structure arbitrage involves offsetting positions within a company's capital structure with the goal of being long relatively underpriced securities, being short overpriced securities, and being hedged against risk.
459	18.1	corporate event risk	Corporate event risk is dispersion in economic outcomes due to uncertainty regarding corporate events.
462	18.2	corporate governance	Corporate governance describes the processes and people that control the decisions of a corporation.
482	18.4	distressed debt hedge funds	Distressed debt hedge funds invest in the securities of a corporation that is in bankruptcy or is likely to fall into bankruptcy.
459	18	event-driven	The event-driven category of hedge funds includes activist hedge funds, merger arbitrage funds, and distressed securities funds, as well as special situation funds and multistrategy funds that combine a variety of event-driven strategies.
495	18.5	event-driven multistrategy funds	Event-driven multistrategy funds diversify across a wide variety of event-driven strategies, participating in opportunities in both corporate debt and equity securities.
491	18.4.5	financial market segmentation	Financial market segmentation occurs when two or more markets use different valuations for similar assets due to the lack of participants who trade in both markets or who perform arbitrage between the markets.
481	18.3.5	financing risk	Financing risk is the economic dispersion caused by failure or potential failure of an entity, such as an acquiring firm, to secure the funding necessary to consummate a plan.
468	18.2.4	Form 13D	In the United States, Form 13D is required to be filed with the Securities and Exchange Commission (SEC) within 10 days, publicizing an activist's stake in a firm once the activist owns more than 5% of the firm and has a strategic plan for the firm.
468	18.2.4	Form 13F	In the United States, Form 13F is a required quarterly filing of all long positions by all U.S. asset managers with over \$100 million in assets under management, including hedge funds and mutual funds, among other investors.

468	18.2.4	Form 13G	In the United States, Form 13G is required of passive shareholders who buy a 5% stake in a firm, but this filing may be delayed until 45 days after year-end.
465	18.2.2	free rider	A free rider is a person or entity that allows others to pay initial costs and then benefits from those expenditures.
469	18.2.5	interlocking boards	Interlocking boards occur when board members from multiple firms—especially managers—simultaneously serve on each other’s boards and may lead to a reduced responsiveness to the interests of shareholders.
484	18.4.1	liquidation process	In a liquidation process (chapter 7 in U.S. bankruptcy laws), all of the assets of the firm are sold, and the cash proceeds are distributed to creditors.
460	18.1.2	long binary call option	A long binary call option makes one payout when the referenced price exceeds the strike price at expiration and a lower payout or no payout in all other cases.
461	18.1.2	long binary put option	A long binary put option makes one payout when the referenced price is lower than the strike price at expiration and a lower payout or no payout in all other cases.
473	18.3	merger arbitrage	Merger arbitrage attempts to benefit from merger activity with minimal risk and is perhaps the best-known event-driven strategy.
486	18.4.1	one-off transaction	A one-off transaction has one or more unique characteristics that cause the transaction to require specialized skill, knowledge, or effort.
466	18.2.3	principal-agent relationship	A principal-agent relationship is any relationship in which one person or group, the principal(s), hires another person or group, the agent(s), to perform decision-making tasks.
463	18.2.1	proxy battle	A proxy battle is a fight between the firm’s current management and one or more shareholder activists to obtain proxies (i.e., favorable votes) from shareholders.
488	18.4.3	recovery value	The recovery value of the firm and its securities is the value of each security in the firm and is based on the time it will take the firm to emerge from the bankruptcy process and the condition in which it will emerge.
484	18.4.1	reorganization process	In a reorganization process (chapter 11 in U.S. bankruptcy laws), the firm’s activities are preserved.

460	18.1.1	selling insurance	Selling insurance in this context refers to the economic process of earning relatively small returns for providing protection against risks, not the literal process of offering traditional insurance policies.
463	18.2.1	shareholder activism	Shareholder activism refers to efforts by one or more shareholders to influence the decisions of a firm in a direction contrary to the initial recommendations of the firm's senior management.
495	18.5	special situation funds	Special situation funds also invest across a number of event styles are typically focused on equity securities, especially those with a spin-off or recent emergence from bankruptcy.
472	18.2.7	spin-off	A spin-off occurs when a publicly traded firm splits into two publicly traded firms, with shareholders in the original firm becoming shareholders in both firms.
472	18.2.7	split-off	A split-off occurs when investors have a choice to own Company A or B, as they are required to exchange their shares in the parent firm if they would like to own shares in the newly created firm.
469	18.2.4	staggered board seats	Staggered board seats exist when instead of having all members of a board elected at a single point in time, portions of the board are elected at regular intervals.
475	18.3	stock-for-stock mergers	Stock-for-stock mergers acquire stock in the target firm using the stock of the acquirer and typically generate large initial increases in the share price of the target firm.
468	18.2.4	toehold	A toehold is a stake in a potential merger target that is accumulated by a potential acquirer prior to the news of the merger attempt becoming widely known.
475	18.3	traditional merger arbitrage	Traditional merger arbitrage generally uses leverage to buy the stock of the firm that is to be acquired and to sell short the stock of the firm that is the acquirer.
468	18.2.4	wolf pack	A wolf pack is a group of investors who may take similar positions to benefit from an activists' engagement with corporate management.
518	19.3.1	anticipated volatility	Anticipated volatility is the future level of volatility expected by a market participant.

537	19.4.4	asset-backed securities	Still another subset of fixed-income arbitrage trades is asset-backed securities (ABS), which are securitized products created from pools of underlying loans or other assets.
502	19.2.2	busted convertibles	Bonds with very high conversion premiums are often called busted convertibles , as the embedded stock options are far out-of-the-money.
534	19.4.2	carry trades	Carry trades attempt to earn profits from carrying or maintaining long positions in higher-yielding assets and short positions in lower-yielding assets without suffering from adverse price movements.
500	19.2	classic convertible bond arbitrage trade	The classic convertible bond arbitrage trade is to purchase a convertible bond that is believed to be undervalued and to hedge its risk using a short position in the underlying equity.
526	19.3.8	classic dispersion trade	The classic dispersion trade is a market-neutral short correlation trade, popular among volatility arbitrage practitioners, that typically takes long positions in options listed on the equities of single companies and short positions in a related index option.
499	19.1	classic relative value strategy trade	The classic relative value strategy trade is based on the premise that a particular relationship or spread between two prices or rates has reached an abnormal level and will therefore tend to return to its normal level.
507	19.2.6	complexity premium	A complexity premium is a higher expected return offered by a security to an investor to compensate for analyzing and managing a position that requires added time and expertise.
509	19.2.8	components of convertible arbitrage returns	The components of convertible arbitrage returns include interest, dividends, rebates, and capital gains and losses.
499	19.1	convergence	Convergence is the return of prices or rates to relative values that are deemed normal.
500	19.2.1	convertible bonds	Convertible bonds are hybrid corporate securities, mixing fixed-income and equity characteristics into one security.
523	19.3.4	correlation risk	Correlation risk is dispersion in economic outcomes attributable to changes in realized or anticipated levels of correlation between market prices or rates.
526	19.3.7	correlations go to one	The term correlations go to one means that during periods of enormous stress, stocks and bonds with credit risk decline simultaneously and with somewhat similar magnitudes.

502	19.2.3	delta	Delta is the change in the value of an option (or a security with an implicit option) with respect to a change in the value of the underlying asset (i.e., it measures the sensitivity of the option price to small changes in the price of its underlying asset).
504	19.2.4	delta-neutral	A delta-neutral position is a position in which the value-weighted sum of all deltas of all positions equals zero.
508	19.2.7	dilution	Dilution takes place when additional equity is issued at below-market values, and the per-share value of the holdings of existing shareholders is diminished.
533	19.4.1	duration	Duration is a measure of the sensitivity of a fixed-income security to a change in the general level of interest rates.
535	19.4.3	duration-neutral	A duration-neutral position is a portfolio in which the aggregated durations of the short positions equal the aggregated durations of the long positions weighted by value.
512	19.2.9	dynamic delta hedging	Dynamic delta hedging is the process of frequently adjusting positions in order to maintain a target exposure to delta, often delta neutrality.
537	19.4.5	effective duration	Effective duration is a measure of the interest rate sensitivity of a position that includes the effects of embedded option characteristics.
502	19.2.2	equity-like convertible	An equity-like convertible is a convertible bond that is far in-the-money and therefore has a price that tracks its underlying equity very closely.
532	19.4	fixed-income arbitrage	Fixed-income arbitrage involves simultaneous long and short positions in fixed income securities with the expectation that over the investment holding period, the security prices will converge toward a similar valuation standard.
503	19.2.3	gamma	Gamma is the second derivative of an option's price with respect to the price of the underlying asset—or, equivalently, the first derivative of delta with respect to the price of the underlying asset.
506	19.2.5	general collateral stocks	General collateral stocks , which are stocks not facing heavy borrowing demand, may earn a 2% rebate when Treasury bill rates are at 2%, whereas stocks on special may earn zero rebates or even negative rebates, wherein borrowers must pay the lenders money in addition to the interest that the lender is earning on the collateral.

502	19.2.2	hybrid convertibles	Convertible bonds with moderately sized conversion ratios have stock options closer to being at-the-money and are called hybrid convertibles .
505	19.2.4	implied volatility	The implied volatility of an option or an option-like position—in this case, the implied volatility of a convertible bond—is the standard deviation of returns that is viewed as being consistent with an observed market price for the option.
534	19.4.2	intercurve arbitrage positions	There are also intercurve arbitrage positions , which means arbitrage (hedged positions) using securities related to different yield curves.
535	19.4.3	interest rate immunization	Interest rate immunization is the process of eliminating all interest rate risk exposures.
533	19.4.2	intracurve arbitrage positions	These are examples of intracurve arbitrage positions because they are based on hedged positions within the same yield curve.
522	19.3.3	marking-to-market	Marking-to-market refers to the use of current market prices to value instruments, positions, portfolios, and even the balance sheets of firms.
522	19.3.3	marking-to-model	Marking-to-model refers to valuation based on prices generated by pricing models. The pricing models generally involve two components.
536	19.4.3	modified duration	Modified duration is equal to traditional duration divided by the quantity $[1 + (y/m)]$, where y is the stated annual yield, m is the number of compounding periods per year, and y/m is the periodic yield.
502	19.2.2	moneyness	Moneyness is the extent to which an option is in-the-money, at-the-money, or out-of-the-money.
538	19.4.5	mortgage-backed securities arbitrage	Mortgage-backed securities arbitrage attempts to generate low-risk profits through the relative mispricing among MBS or between MBS and other fixed-income securities.
512	19.2.9	net delta	The net delta of a position is the delta of long positions minus the delta of short positions.

538	19.4.5	option-adjusted spread	A key concept in pricing fixed income securities with embedded prepayment options is the option-adjusted spread (OAS) , which is a measure of the excess of the return of a fixed-income security containing an option over the yield of an otherwise comparable fixed-income security without an option after the return of the fixed-income security containing the option has been adjusted to remove the effects of the option.
535	19.4.3	parallel shift	A parallel shift in the yield curve happens when yields of all maturities shift up or down by equal (additive) amounts.
525	19.3.7	portfolio insurance	Portfolio insurance is any financial method, arrangement, or program for limiting losses from large adverse price movements.
522	19.3.3	price transparency	Price transparency is information on the prices and quantities at which participants are offering to buy (bid) and sell (offer) an instrument.
522	19.3.3	pricing risk	Pricing risk is the economic uncertainty caused by actual or potential mispricing of positions.
505	19.2.4	realized volatility	Realized volatility is the actual observed volatility (i.e., the standard deviation of returns) experienced by an asset—in this case, the underlying stock.
506	19.2.5	rebate	A rebate is a payment of interest to the securities' borrower on the collateral posted.
535	19.4.3	riding the yield curve	The process of holding a bond as its yield moves up or down the yield curve due to the passage of time is known as riding the yield curve .
535	19.4.3	rolling down	Rolling down the yield curve is the process of experiencing decreasing yields to maturity as an asset's maturity declines through time in an upward-sloping yield curve environment.
527	19.3.8	short correlation	The classic dispersion trade is referred to as a short correlation trade because the trade generates profits from low levels of realized correlation and losses from high levels of realized correlation.
507	19.2.5	short squeeze	A short squeeze occurs when holders of short positions are compelled to purchase shares at increasing prices to cover their positions due to limited liquidity.
534	19.4.3	sovereign debt	Sovereign debt is debt issued by national governments.

506	19.2.5	special stock	A special stock is a stock for which higher net fees are demanded when it is borrowed.
524	19.3.7	tail risk	Tail risk is the potential for very large loss exposures due to very unusual events, especially those associated with widespread market price declines.
533	19.4.2	term structure of interest rates	Sometimes the term structure of interest rates is distinguished from the yield curve because the yield curve plots yields to maturity of coupon bonds, whereas the term structure of interest rates plots actual or hypothetical yields of zero-coupon bonds.
503	19.2.3	theta	Theta is the first derivative of an option's price with respect to the time to expiration of the option.
520	19.3.2	variance notional value	The variance notional value of the contract simply scales the size of the cash flows in a variance swap.
520	19.3.2	variance swaps	Variance swaps are forward contracts in which one party agrees to make a cash payment to the other party based on the realized variance of a price or rate in exchange for receiving a predetermined cash flow.
518	19.3.1	vega	Vega is a measure of the risk of a position or an asset due to changes in the volatility of a price or rate that helps determine the value of that position or asset.
520	19.3.2	vega notional value	The vega notional value of a contract serves to scale the contract and determine the size of the payoff in a volatility swap.
518	19.3.1	vega risk	Vega risk is the economic dispersion caused by changes in the volatility of a price, return, or rate.
518	19.3	volatility arbitrage	Volatility arbitrage is any strategy that attempts to earn a superior and riskless profit based on prices that explicitly depend on volatility.
523	19.3.4	volatility risk	Volatility risk is dispersion in economic outcomes attributable to changes in realized or anticipated levels of volatility in a market price or rate.
520	19.3.2	volatility swap	A volatility swap mirrors a variance swap except that the payoff of the contract is linearly based on the standard deviation of a return series rather than the variance.
533	19.4.2	yield curve	A yield curve is the relationship between the yields of various securities, usually depicted on the vertical axis, and the term to maturity, usually depicted on the horizontal axis.

553	20.2.3	accounting accrual	An accounting accrual is the recognition of a value based on anticipation of a transaction.
550	20.1.2	asynchronous trading	Asynchronous trading is an example of market inefficiency in which news affecting more than one stock may be assimilated into the price of the stocks at different speeds.
558	20.3.1	breadth	The breadth of a strategy is the number of independent active bets placed into an active portfolio.
555	20.2.5	earnings momentum	Earnings momentum is the tendency of earnings changes to be positively correlated.
555	20.2.5	earnings surprise	Earnings surprise is the concept and measure of the unexpectedness of an earnings announcement.
547	20	equity long/short funds	Equity long/short funds tend to have net positive systematic risk exposure from taking a net long position, with the long positions being larger than the short positions.
547	20	equity market-neutral funds	Equity market-neutral funds attempt to balance short and long positions, ideally matching the beta exposure of the long and short positions and leaving the fund relatively insensitive to changes in the underlying stock market index.
558	20.3	Fundamental Law of Active Management (FLOAM)	Richard Grinold in 1989 proposed the Fundamental Law of Active Management (FLOAM) , which identifies two key components of actively managed investment strategies: breadth and skill.
557	20.2.7	illegal insider trading	Illegal insider trading varies by jurisdiction but may involve using material nonpublic information, such as an impending merger, for trading without required disclosure.
558	20.3.1	information coefficient	The information coefficient (IC) measures managerial skill as the correlation between managerial return predictions and realized returns.
550	20.1.2	informationally efficient	Markets are said to be informationally efficient when security prices reflect available information.
557	20.2.6	issuance of new stock	Issuance of new stock is a firm's creation of new shares of common stock in that firm and may occur as a result of a stock-for-stock merger transaction or through a secondary offering.
557	20.2.7	legal insider trading	Trading by insiders can be legal insider trading when it is performed subject to legal restrictions.

564	20.4.4	limits to arbitrage	The limits to arbitrage refer to the potential inability or unwillingness of speculators, such as equity hedge fund managers, to hold their positions without time constraints or to increase their positions without size constraints.
548	20.1.1	liquidity	Liquidity in this context is the extent to which transactions can be executed with minimal disruption to prices.
552	20.2	market anomalies	Investment strategies that can be identified based on available information and that offer higher expected returns after adjustment for risk are known as market anomalies , and they are violations of informational market efficiency.
564	20.4.4	market impact	Market impact is the degree of the short-term effect of trades on the sizes and levels of bid prices and offer prices.
549	20.1.1	market maker	A market maker is a market participant that offers liquidity, typically both on the buy side by placing bid orders and on the sell side by placing offer orders.
574	20.5.6	mean neutrality	Mean neutrality is when a fund is shown to have zero beta exposure or correlation to the underlying market index.
561	20.4.1	multiple-factor scoring models	Multiple-factor scoring models combine the factor scores of a number of independent anomaly signals into a single trading signal.
557	20.2.6	net stock issuance	Net stock issuance is issuance of new stock minus share repurchases.
560	20.3.3	nonactive bets	Nonactive bets are positions held to reduce tracking error rather than to serve as return-enhancing active bets.
550	20.1.2	overreacting	Another potential source of abnormal profits for hedge funds is overreacting in which short-term price changes are too large relative to the value changes that should occur in a market with perfect informational efficiency.
562	20.4.2	pairs trading	Pairs trading is a strategy of constructing a portfolio with matching stocks in terms of systematic risks but with a long position in the stock perceived to be relatively underpriced and a short position in the stock perceived to be relatively overpriced.

556	20.2.5	post-earnings-announcement drift	A post-earnings-announcement drift anomaly has been documented, in which investors can profit from positive surprises by buying immediately after the earnings announcement or selling short immediately after a negative earnings surprise.
554	20.2.4	price momentum	Price momentum is trending in prices such that an upward price movement indicates a higher expected price and a downward price movement indicates a lower expected price.
548	20.1.1	providing liquidity	Providing liquidity refers to the placement of limit orders or other actions that increase the number of shares available to be bought or sold near the current best bid and offer prices.
556	20.2.6	share buyback program	When a company chooses to reduce its shares outstanding, a share buyback program is initiated, and the company purchases its own shares from investors in the open market or through a tender offer.
550	20.1.2	short interest	Short interest is the percentage of outstanding shares that are currently held short.
547	20	short-bias funds	Short-bias funds have larger short positions than long positions, leaving a persistent net short position relative to the market index that allows these funds to profit during times of declining equity prices.
551	20.1.3	speculation	Speculation is defined as bearing abnormal risk in anticipation of abnormally high expected returns.
556	20.2.5	standardized unexpected earnings	Standardized unexpected earnings (SUE) is a measure of earnings surprise.
548	20.1.1	taking liquidity	More generally, taking liquidity refers to the execution of market orders by a market participant to meet portfolio preferences that cause a decrease in the supply of limit orders immediately near the current best bid and offer prices.
552	20.2.1	test of joint hypotheses	An empirical test of market efficiency is a test of joint hypotheses , because the test assumes the validity of a model of the risk-return relationship to test whether a given trading strategy earns consistent risk-adjusted profits.
550	20.1.2	underreacting	Another potential source of abnormal profits for hedge funds is underreacting in which short-term price changes are too small relative to the value changes that should occur in a market with perfect informational efficiency.

567	20.5.2	uptick rule	An uptick rule permits short sellers to enter a short sale only at a price that is equal to or higher than the previous transaction price of the stock.
574	20.5.6	variance neutrality	Variance neutrality is when fund returns are uncorrelated to changes in market risk, including extreme risks in crisis market scenarios.
594	21.3	access	Access is an investor's ability to place new or increased money in a particular fund.
604	21.6	conservative funds of funds	Conservative funds of funds have underlying hedged positions.
604	21.6	diversified funds of funds	Diversified funds of funds represent a broad mix of funds.
592	21.2.1	fee netting	Fee netting in the case of a multistrategy fund is when the investor pays incentive fees based only on net profits of the combined strategies, rather than on all profitable strategies.
595	21.3	liquidity facility	A liquidity facility is a standby agreement with a major bank to provide temporary cash for specified needs with pre-specified conditions.
604	21.6	market-defensive funds of funds	Market-defensive funds of funds tend to have underlying and unhedged short positions.
602	21.5.5	nontraditional bond funds	Nontraditional or unconstrained bond funds do not simply take long positions in investment-grade sovereign and credit securities, but may also invest in high-yield or emerging markets debt, often including leverage and short positions.
586	21.1.2	operational due diligence	Operational due diligence is the process of evaluating the policies, procedures, and internal controls of an asset management organization.
597	21.3.3	seeding funds	Seeding funds , or seeders, are funds of funds that invest in newly created individual hedge funds, often taking an equity stake in the management companies of the newly minted hedge funds.
604	21.6	strategic funds of funds	Strategic funds of funds tend to have underlying directional bets.
602	21.5.5	unconstrained bond funds	Nontraditional or unconstrained bond funds do not simply take long positions in investment-grade sovereign and credit securities, but may also invest in high-yield or emerging markets debt, often including leverage and short positions.

616	22.2.1	burn rate	The burn rate of young businesses describes the speed with which cash is being depleted through time and can be used to project when the organization will again require outside funding.
625	22.4.1	business development companies (BDCs)	Business development companies (BDCs) are publicly traded funds with underlying assets typically consisting of equity or equity-like positions in small, private companies. BDCs use a closed-end structure and trade on major stock exchanges, especially the NASDAQ.
618	22.2.3	buyouts	In the context of private equity, buyouts are the purchase of a public company by an entity that has a private ownership structure.
613	22	call option view of private equity	This call option view of private equity from the perspective of the investor reflects the frequent total losses and occasional huge gains of private equity investments, especially venture capital.
622	22.3.3	charge-off loans	Charge-off loans are the loans of a financial institution or other lender that have been sold to investors and written off the books of the lender at a loss.
632	22.5.2	conversion price	The conversion price is the price per share at which the convertible security can be exchanged into shares of common stock, expressed in terms of the principal value of the convertible security.
632	22.5.2	conversion ratio	The conversion ratio is the number of shares of common stock into which each convertible security can be exchanged.
623	22.3.3	covenant-lite loans	Covenant-lite loans are loans that place minimal restrictions on the debtor in terms of loan covenants.
621	22.3.2	distressed debt investing	Distressed debt investing is the practice of purchasing the debt of troubled companies, requiring special expertise and subjecting the investor to substantial risk.
620	22.3.1	equity kicker	An equity kicker is an option for some type of equity participation in the firm (e.g., options to buy shares of common stock) that is packaged with a debt financing transaction.
632	22.5.2	equity line of credit	An equity line of credit (ELC) is a contractual agreement between an issuer and an investor that enables the issuer to sell a formula-based quantity of stock at set intervals of time.
624	22.3.3	haircut	In finance, the term haircut usually refers to a percentage reduction applied to the value of securities in determining their value as collateral.

623	22.3.3	incurrence covenants	Incurrence covenants typically require a borrower to take or not take a specific action once a specified event occurs.
618	22.2.4	junk bond	Junk bonds are debt instruments with high credit risk, also referred to as high-yield, noninvestment-grade, or speculative-grade debt.
624	22.3.4	leveraged loans	Leveraged loans are syndicated bank loans to non-investment grade borrowers.
623	22.3.3	maintenance covenants	Maintenance covenants are stricter than incurrence covenants in that they require that a standard be regularly met to avoid default.
619	22.2.5	merchant banking	Merchant banking is the practice whereby financial institutions purchase nonfinancial companies as opposed to merging with or acquiring other financial institutions.
621	22.3.1	middle market	The middle market refers to companies that are not as large as those companies that have ready access to the financial markets but are larger than companies seeking venture capital.
623	22.3.3	negative covenants	Negative covenants are promises by the debtor <i>not</i> to engage in particular activities, such as paying dividends or issuing new debt.
623	22.3.3	positive covenants	Positive covenants are promises to do particular things, such as maintain a specified cash level.
614	22.1	private equity firms	Private equity firms invest in private equity and serve as managers to private equity funds.
614	22.1	private equity funds	Private equity funds are investment pools created to hold portfolios of private equity securities.
631	22.5.2	private investments in public equity (PIPE)	Private investments in public equity (PIPE) transactions are privately issued equity or equity-linked securities that are placed outside of a public offering and are exempt from registration.
617	22.2.2	prudent person standard	The prudent person standard is a requirement that specifies levels of care that should be exercised in particular decision-making roles, such as investment decisions made by a fiduciary.
619	22.2.4	segmentation	Segmentation in this context denotes the grouping of market participants into clienteles that focus their activities within specific areas of the market, rather than varying their range of activities more broadly throughout all available opportunities.

621	22.3.1	story credit	A story credit is a debt issue with credit risk based on unusual circumstances, and may involve special aspects, such as corporate reorganizations, that distinguish their analysis from more traditional circumstances and as such involve a story.
633	22.5.2	structured PIPEs	Structured PIPEs include more exotic securities, like floating-rate convertible preferred stock, convertible resets, and common stock resets.
624	22.3.4	syndicated	The term syndicated refers to the use of a group of entities, often investment banks, in underwriting a security offering or, more generally, jointly engaging in other financial activities.
633	22.5.2	toxic PIPE	A toxic PIPE is a PIPE with adjustable conversion terms that can generate high levels of shareholder dilution in the event of deteriorating prices in the firm's common stock.
632	22.5.2	traditional PIPEs	The large majority of PIPE transactions are traditional PIPEs , in which investors can buy common stock at a fixed price.
615	22.1	underlying business enterprises	Underlying business enterprises in private equity are the unlisted, typically small businesses seeking to grow through investment from private equity funds or private equity firms.
616	22.2.1	venture capital (VC)	Venture capital (VC) , the best known of the private equity categories, is early-stage financing for young firms with high potential growth that do not have a sufficient track record to attract investment capital from traditional sources, like public markets or lending institutions.
616	22.2.1	venture capital securities	Venture capital securities are the privately held stock, or equity-linked securities, that venture capitalists obtain when investing in business ventures that are striving to become larger and to go public.
614	22.1	vintage year	The year a particular private equity fund commences operations is known as its vintage year .
639	23.2.2	20-bagger	The terminology 20-bagger indicates a company that appreciates in value 20-fold compared to the cost of the VC investment.
644	23.4.2	angel investing	Angel investing refers to the earliest stage of venture capital, in which investors fund the first cash needs of an entrepreneurial idea.
664	23.7.10	auction process	An auction process involves bidding among several private equity firms, with the deal going to the highest bidder.

639	23.2.3	business plan	The business plan should clearly state the business strategy, identify the niche that the new company will fill, and describe the resources needed to fill that niche, including the expenses, personnel, and assets.
659	23.7.4	buy-and-build strategy	A buy-and-build strategy is an LBO value-creation strategy involving the synergistic combination of several operating companies or divisions through additional buyouts.
654	23.6.3	buy-in management buyout	A buy-in management buyout is a hybrid between an MBI and an MBO in which the new management team is a combination of new managers and incumbent managers.
663	23.7.8	buyout-to-buyout deal	A buyout-to-buyout deal takes place when a private equity firm sells one of its portfolio companies to another buyout firm.
641	23.3.2	capital calls	Capital calls are options for the manager to demand, according to the subscription agreement, that investors contribute additional capital.
664	23.7.10	club deal	In a club deal , two or more LBO firms work together to share costs, present a business plan, and contribute capital to the deal.
641	23.3.2	committed capital	Committed capital is the cash investment that has been promised by an investor but not yet delivered to the fund.
646	23.4.3	compound option	A compound option is an option on an option. In other words, a compound option allows its owner the right but not the obligation to pay additional money at some point in the future to obtain an option.
658	23.7.4	conglomerates	Conglomerates have many different divisions or subsidiaries, often operating in completely different industries.
645	23.4.2	early-stage venture capital	First or early-stage venture capital denotes the funding after seed capital but before commercial viability has been established.
658	23.7.4	efficiency buyouts	Efficiency buyouts are LBOs that improve operating efficiency.
658	23.7.4	entrepreneurship stimulators	Entrepreneurship stimulators are LBOs that create value by helping to free management to concentrate on innovations.
641	23.3.2	escrow agreement	There is often an escrow agreement , in which a portion of the manager's incentive fees are held in a segregated account until the entire fund is liquidated.

639	23.2.3	exit plan	The exit plan describes how venture capitalists can liquidate their investment in the start-up company to realize a gain for themselves and their investors.
645	23.4.2	expansion stage venture capital	Expansion stage (i.e., Second or late-stage) venture capital fills the cash flow deficiency once commercial viability is established.
645	23.4.2	first stage venture capital	First or early-stage venture capital denotes the funding after seed capital but before commercial viability has been established.
655	23.6.4	golden parachute	A generous compensation scheme, known as a golden parachute , is often given to top managers whose careers are being negatively affected by a corporate reorganization.
643	23.4.1	J-curve	The J-curve is the classic illustration of the early losses and later likely profitability of venture capital.
652	23.6.1	leveraged buyout (LBO)	A leveraged buyout (LBO) is distinguished from a traditional investment by three primary aspects: (1) an LBO buys out control of the assets, (2) an LBO uses leverage, and (3) an LBO itself is not publicly traded.
640	23.3.1	limited liability	Limited liability is the protection of investors from losses that exceed their investment.
654	23.6.3	management buy-in (MBI)	A management buy-in (MBI) is a type of LBO in which the buyout is led by an outside management team.
652	23.6.2	management buyout (MBO)	A management buyout (MBO) is a buyout that is led by the target firm's current management.
646	23.4.2	mezzanine venture capital	Mezzanine venture capital , or pre-IPO financing, is the last funding stage before a start-up company goes public or is sold to a strategic buyer.
647	23.4.3	milestone	A milestone is a set of goals that must be met to complete a phase and usually denotes when the entrepreneur will be eligible for the next round of financing.
645	23.4.2	second or late-stage venture capital	Second or late-stage (i.e., expansion stage) venture capital fills the cash flow deficiency once commercial viability is established.
654	23.6.3	secondary buyout	In a secondary buyout , one private equity firm typically sells a private company to another private equity firm.
644	23.4.2	seed capital stage	The seed capital stage is the first stage where VC firms invest their capital into a venture and is typically prior to having established the viability of the product.

642	23.4.1	sourcing investments	Sourcing investments is the process of locating possible investments (i.e., generating deal flow), reading business plans, preparing intense due diligence on start-up companies, and determining the attractiveness of each start-up company.
659	23.7.4	turnaround strategy	A turnaround strategy is an approach used by LBO funds that look for underperforming companies with excessive leverage or poor management.
639	23.3	venture capital fund	A venture capital fund is a private equity fund that pools the capital of large sophisticated investors to fund new and start-up companies.
680	24.2.5	absolute priority rule	An absolute priority rule is a specification of which claims in a liquidation process are satisfied first, second, third, and so forth in receiving distributions.
675	24.1.6	acceleration	Acceleration is a requirement that debt be repaid sooner than originally scheduled, such as when the senior lender can declare the senior debt due and payable immediately.
675	24.1.6	blanket subordination	A blanket subordination prevents any payment of principal or interest to the mezzanine investor until after the senior debt has been fully repaid.
672	24.1.4	bridge financing	Bridge financing is a form of gap financing—a method of debt financing that is used to maintain liquidity while waiting for an anticipated and reasonably expected inflow of cash.
679	24.2.5	Chapter 11 bankruptcy	Chapter 11 bankruptcy attempts to maintain operations of a distressed corporation that may be viable as a going concern.
679	24.2.5	Chapter 7 bankruptcy	Chapter 7 bankruptcy is entered into when a company is no longer viewed as a viable business and the assets of the firm are liquidated. Essentially, the firm shuts down its operations and parcels out its assets to various claimants and creditors.
680	24.2.5	cramdown	A cramdown is when a bankruptcy court judge implements a plan of reorganization over the objections of an impaired class of security holders.
681	24.2.5	debtor-in-possession financing	When secured lenders extend additional credit to the debtor company, it is commonly known as debtor-in-possession financing (DIP financing).
678	24.2.4	fulcrum securities	Fulcrum securities are the more junior debt securities that are most likely to be converted into the equity of the reorganized company.

674	24.1.6	intercreditor agreement	An intercreditor agreement is an agreement with the company's existing creditors that places restrictions on both the senior creditor and the mezzanine investor.
671	24.1.3	PIK toggle	A PIK toggle allows the underlying company to choose whether it will make required coupon payments in the form of cash or in kind, meaning with more mezzanine bonds.
679	24.2.5	plan of reorganization	A plan of reorganization is a business plan for emerging from bankruptcy protection as a viable concern, including operational changes.
675	24.1.6	springing subordination	A springing subordination allows the mezzanine investor to receive interest payments while the senior debt is still outstanding.
673	24.1.5	stretch financing	In stretch financing , a bank lends more money than it believes would be prudent with traditional lending standards and traditional lending terms.
675	24.1.6	takeout provision	A takeout provision allows the mezzanine investor to purchase the senior debt once it has been repaid to a specified level.
669	24.1.2	weighted average cost of capital	The weighted average cost of capital for a firm is the sum of the products of the percentages of each type of capital used to finance a firm times its annual cost to the firm.
705	25.6.2	attachment point	The first percentage loss in the collateral pool that begins to cause reduction in a tranche is known as the lower attachment point , or simply the attachment point .
706	25.6.3	bull call spread	A bull call spread has two calls that differ only by strike price, in which the long position is in the lower strike price and the short position is in the higher strike price.
706	25.6.3	bull put spread	A bull put spread has two puts that differ only by strike price, in which the long position is in the lower strike price and the short position is in the higher strike price.
698	25.5.1	call option view of capital structure	The call option view of capital structure views the equity of a levered firm as a call option on the assets of the firm.
703	25.6	collateralized debt obligation (CDO)	A collateralized debt obligation (CDO) applies the concept of structuring to cash flows from a portfolio of debt securities into multiple claims; these claims are securities and are referred to as tranches.

687	25.3.1	complete market	A complete market is a financial market in which enough different types of distinct securities exist to meet the needs and preferences of all participants.
691	25.4.3	contraction risk	Contraction risk is dispersion in economic outcomes caused by uncertainty in the longevity—especially decreased longevity—of cash flow streams.
705	25.6.2	detachment point	The higher percentage loss point at which the given tranche is completely wiped out is known as the upper attachment point , or the detachment point .
704	25.6.1	equity tranche	The equity tranche has lowest priority and serves as the residual claimant.
691	25.4.3	extension risk	Extension risk is dispersion in economic outcomes caused by uncertainty in the longevity—especially increased longevity—of cash flow streams.
694	25.4.4	floating-rate tranches	Floating-rate tranches earn interest rates that are linked to an interest rate index, such as the London Interbank Offered Rate (LIBOR), and are usually used to finance collateral pools of adjustable-rate mortgages.
693	25.4.4	interest-only (IO)	Interest-only (IO) tranches receive only interest payments from the collateral pool.
694	25.4.4	inverse floater tranche	An inverse floater tranche offers a coupon that increases when interest rates fall and decreases when interest rates rise.
705	25.6.2	lower attachment point	The first percentage loss in the collateral pool that begins to cause reduction in a tranche is known as the lower attachment point , or simply the attachment point .
704	25.6.1	mezzanine tranche	A mezzanine tranche is a tranche with a moderate priority to cash flows in the structured product and with lower priority than the senior tranche.
693	25.4.4	planned amortization class (PAC) tranches	Planned amortization class (PAC) tranches receive principal payments in a more complex manner than do sequential pay CMOs.
693	25.4.4	principal-only (PO)	Principal-only (PO) tranches receive only principal payments from the collateral pool.
698	25.5.1	put option view of capital structure	The put option view of capital structure views the equity holders of a levered firm as owning the firm's assets through riskless financing and having a put option to deliver those assets to the debt holders.

704	25.6.1	senior tranche	The senior tranche is a tranche with the first or highest priority to cash flows in the structured product.
691	25.4.2	sequential-pay collateralized mortgage obligation	The sequential-pay collateralized mortgage obligation is the simplest form of CMO.
688	25.3.2	state of the world	A state of the world , or state of nature (or state), is a precisely defined and comprehensive description of an outcome of the economy that specifies the realized values of all economically important variables.
697	25.5	structural credit risk models	Structural credit risk models use option theory to explicitly take into account credit risk and the various underlying factors that drive the default process, such as (1) the behavior of the underlying assets, and (2) the structuring of the cash flows (i.e., debt levels).
685	25	structuring	In the context of alternative investments, structuring is the process of engineering unique financial opportunities from existing asset exposures.
693	25.4.4	targeted amortization class (TAC) tranches	Targeted amortization class (TAC) tranches receive principal payments in a manner similar to PAC tranches but generally with an even narrower and more complex set of ranges.
690	25.4.1	tranche	A tranche is a distinct claim on assets that differs substantially from other claims in such aspects as seniority, risk, and maturity.
705	25.6.2	upper attachment point	The higher percentage loss point at which the given tranche is completely wiped out is known as the upper attachment point , or the detachment point .
729	26.5.1	American credit options	American credit options are credit options that can be exercised prior to or at expiration.
725	26.4.4	assignment	A novation or an assignment is when one party to a contract reaches an agreement with a third party to take over all rights and obligations to a contract.
729	26.5.1	binary options	Binary options (sometimes termed digital options) offer only two possible payouts, usually zero and some other fixed value.
715	26.2.6	calibrate a model	To calibrate a model means to establish values for the key parameters in a model, such as a default probability or an asset volatility, typically using an analysis of market prices of highly liquid assets.

723	26.4.2	cash settlement	In a cash settlement , the credit protection seller makes the credit protection buyer whole by transferring to the buyer an amount of cash based on the contract.
731	26.6	CDS indices	CDS indices are indices or portfolios of single-name CDSs.
722	26.4.2	CDS premium	The CDS spread or CDS premium is paid by the credit protection buyer to the credit protection seller and is quoted in basis points per annum on the notional value of the CDS.
722	26.4.2	CDS spread	The CDS spread or CDS premium is paid by the credit protection buyer to the credit protection seller and is quoted in basis points per annum on the notional value of the CDS.
720	26.4	credit default swap (CDS)	A credit default swap (CDS) is an insurance-like bilateral contract in which the buyer pays a periodic fee (analogous to an insurance premium) to the seller in exchange for a contingent payment from the seller if a credit event occurs with respect to an underlying credit-risky asset.
717	26.3	credit derivatives	Credit derivatives transfer credit risk from one party to another such that both parties view themselves as having an improved position as a result of the derivative.
720	26.4.1	credit protection buyer	In a CDS, the credit protection buyer pays a periodic premium on a predetermined amount (the notional amount) in exchange for a contingent payment from the credit protection seller if a specified credit event occurs.
720	26.4.1	credit protection seller	The credit protection seller receives a periodic premium in exchange for delivering a contingent payment to the credit protection buyer if a specified credit event occurs.
709	26	credit risk	Credit risk is dispersion in financial outcomes associated with the failure or potential failure of a counterparty to fulfill its financial obligations.
730	26.5.3	credit-linked notes (CLNs)	Credit-linked notes (CLNs) are bonds issued by one entity with an embedded credit option on one or more other entities.
709	26.1	default risk	Default risk is the risk that the issuer of a bond or the debtor on a loan will not repay the interest and principal payments of the outstanding debt in full.
717	26.3	derivatives	Derivatives are cost-effective vehicles for the transfer of risk, with values driven by an underlying asset.
729	26.5.1	European credit options	European credit options are credit options exercisable only at expiration.

711	26.2.2	exposure at default	Exposure at default (EAD) specifies the nominal value of the position that is exposed to default at the time of default.
719	26.3.2	funded credit derivatives	Funded credit derivatives require cash outlays and create exposures similar to those gained from traditional investing in corporate bonds through the cash market.
717	26.2.7	hazard rate	Hazard rate is a term often used in the context of reduced-form models to denote the default rate.
711	26.2.2	loss given default	Loss given default (LGD) specifies the economic loss in case of default.
725	26.4.3	mark-to-market adjustment	The process of altering the value of a CDS in the accounting and financial systems of the CDS parties is known as a mark-to-market adjustment.
718	26.3.2	multiname instruments	Multiname instruments , in contrast to single-name instruments, make payoffs that are contingent on one or more credit events (e.g., defaults) affecting two or more reference entities.
725	26.4.4	novation	A novation or an assignment is when one party to a contract reaches an agreement with a third party to take over all rights and obligations to a contract.
723	26.4.2	physical settlement	Under physical settlement , the credit protection seller purchases the impaired loan or bond from the credit protection buyer at par value.
718	26.3.1	price revelation	Price revelation , or price discovery, is the process of providing observable prices being used or offered by informed buyers and sellers.
711	26.2.2	probability of default	Probability of default (PD) specifies the probability that the counterparty fails to meet its obligations.
711	26.2.2	recovery rate	The recovery rate is the percentage of the credit exposure that the lender ultimately receives through the bankruptcy process and all available remedies.
710	26.2.1	reduced-form credit models	Reduced-form credit models focus on default probabilities based on observations of market data of similar-risk securities.
724	26.4.2	referenced asset	The referenced asset (also called the <i>referenced bond</i> , <i>referenced obligation</i> , or <i>referenced credit</i>) is the underlying security on which the credit protection is provided.
712	26.2.3	risk-neutral approach	A risk-neutral approach models financial characteristics, such as asset prices, within a framework that assumes that investors are risk neutral.

712	26.2.4	risk-neutral investor	A risk-neutral investor is an investor that requires the same rate of return on all investments, regardless of levels and types of risk, because the investor is indifferent with regard to how much risk is borne.
718	26.3.2	single-name credit derivatives	Single-name credit derivatives transfer the credit risk associated with a single entity. This is the most common type of credit derivative and can be used to build more complex credit derivatives.
722	26.4.2	standard ISDA agreement	The standard ISDA agreement serves as a template to negotiated credit agreements that contains commonly used provisions used by market participants.
720	26.4.1	total return swap	In a total return swap , the credit protection buyer, typically the owner of the credit risky asset, passes on the total return of the asset to the credit protection seller in return for a certain payment.
718	26.3.2	unfunded credit derivatives	Unfunded credit derivatives involve exchanges of payments that are tied to a notional amount, but the notional amount does not change hands until a default occurs.
740	27.2	arbitrage CDOs	Arbitrage CDOs are created to attempt to exploit perceived opportunities to earn superior profits through money management.
740	27.2	balance sheet CDOs	Balance sheet CDOs are created to assist a financial institution in divesting assets from its balance sheet.
739	27.1.2	bankruptcy remote	Bankruptcy remote means that if the sponsoring bank or money manager goes bankrupt, the CDO trust is not affected.
748	27.5	cash flow CDO	In a cash flow CDO , the proceeds of the issuance and sale of securities (tranches) are used to purchase a portfolio of underlying credit-risky assets, with attention paid to matching the maturities of the assets and liabilities.
745	27.4.1	cash-funded CDO	A cash-funded CDO involves the actual purchase of the portfolio of securities serving as the collateral for the trust and to be held in the trust.
752	27.7.2	collateralized fund obligation (CFO)	A collateralized fund obligation (CFO) applies the CDO structure concept to the ownership of hedge funds as the collateral pool.
756	27.8.7	copula approach	A copula approach to analyzing the credit risk of a CDO may be viewed like a simulation analysis of the effects of possible default rates on the cash flows to the CDO's tranches and the values of the CDO's tranches.

751	27.7.1	distressed debt CDO	A distressed debt CDO uses the CDO structure to securitize and structure the risks and returns of a portfolio of distressed debt securities, in which the primary collateral component is distressed debt.
740	27.1.3	diversity score	A diversity score is a numerical estimation of the extent to which a portfolio is diversified.
751	27.6.5	external credit enhancement	An external credit enhancement is a protection to tranche investors that is provided by an outside third party, such as a form of insurance against defaults in the loan portfolio.
753	27.8.2	financial engineering risk	Financial engineering risk is potential loss attributable to securitization, structuring of cash flows, option exposures, and other applications of innovative financing devices.
749	27.6	internal credit enhancement	An internal credit enhancement is a mechanism that protects tranche investors and is made or exists within the CDO structure, such as a large cash position.
748	27.5	market value CDO	In a market value CDO , the underlying portfolio is actively traded without a focus on cash flow matching of assets and liabilities.
750	27.6.2	overcollateralization	Overcollateralization refers to the excess of assets over a given liability or group of liabilities.
739	27.1.2	ramp-up period	The ramp-up period , is the first period in a CDO life cycle, during which the CDO trust issues securities (tranches) and uses the proceeds from the CDO note sale to acquire the initial collateral pool (the assets).
739	27.1.3	reference portfolio	The underlying portfolio or pool of assets (and/or derivatives) held in the SPV within the CDO structure is also known as the collateral or reference portfolio .
750	27.6.4	reserve account	A reserve account holds excess cash in highly rated instruments, such as U.S. Treasury securities or high-grade commercial paper, to provide security to the debt holders of the CDO trust.
739	27.1.2	revolving period	The second phase in the CDO life cycle is normally called the revolving period , during which the manager of the CDO trust may actively manage the collateral pool for the CDO, potentially buying and selling securities and reinvesting the excess cash flows received from the CDO collateral pool.

754	27.8.4	risk shifting	Risk shifting is the process of altering the risk of an asset or a portfolio in a manner that differentially affects the risks and values of related securities and the investors who own those securities.
752	27.7.3	single-tranche CDO	In a single-tranche CDO , the CDO may have multiple tranches, but the sponsor issues (sells) only one tranche from the capital structure to an outside investor.
739	27.1.2	special purpose vehicle (SPV)	A special purpose vehicle (SPV) is a legal entity at the heart of a CDO structure that is established to accomplish a specific transaction, such as holding the collateral portfolio.
739	27.1.2	sponsor of the trust	The sponsor of the trust establishes the trust and bears the associated administrative and legal costs.
749	27.6.1	subordination	Subordination is the most common form of credit enhancement in a CDO transaction, and it flows from the structure of the CDO trust.
746	27.4.2	synthetic CDO	In a synthetic CDO , the CDO obtains risk exposure for the collateral pool through the use of a credit derivative, such as a total return swap or a CDS.
740	27.1.3	tranche width	The tranche width is the percentage of the CDO's capital structure that is attributable to a particular tranche.
740	27.1.3	weighted average rating factor (WARF)	The weighted average rating factor (WARF) , as described by Moody's Investors Service, is a numerical scale ranging from 1 (for AAA-rated credit risks) to 10,000 (for the worst credit risks) that reflects the estimated probability of default.
740	27.1.3	weighted average spread (WAS)	The weighted average spread (WAS) of a portfolio is a weighted average of the return spreads of the portfolio's securities in which the weights are based on market values.
773	28.4.4	absolute return structured product	An absolute return structured product offers payouts over some or all underlying asset returns that are equal to the absolute value of the underlying asset's returns.
767	28.3.4	active option	An active option in a barrier option is an option for which the underlying asset has reached the barrier.
776	28.5.1	analytical	The solution is analytical because the model can be exactly solved using a finite set of common mathematical operations.
766	28.3.2	Asian option	An Asian option is an option with a payoff that depends on the average price of an underlying asset through time.

767	28.3.4	barrier option	A barrier option is an option in which a change in the payoff is triggered if the underlying asset reaches a prespecified level during a prespecified time period.
775	28.5.1	boundary condition	A boundary condition of a derivative is a known relationship regarding the value of that derivative at some future point in time that can be used to generate a solution to the derivative's current price.
776	28.5.3	building blocks approach	The building blocks approach (i.e., portfolio approach) models a structured product or other derivative by replicating the investment as the sum of two or more simplified assets, such as underlying cash-market securities and simple options.
765	28.3.1	cash-and-call strategy	A cash-and-call strategy is a long position in cash, or a zero-coupon bond, combined with a long position in a call option.
777	28.5.3	dynamic hedging	Dynamic hedging is when the portfolio weights must be altered through time to maintain a desired risk exposure, such as zero risk.
759	28.1	equity-linked structured products	Equity-linked structured products are distinguished from structured products by one or more of the following three aspects: (1) They are tailored to meet the preferences of the investors and to generate fee revenue for the issuer; (2) they are not usually collateralized with risky assets; and (3) they rarely serve as a pass-through or simple tranching of the risks of a long-only exposure to an asset, such as a risky bond or a loan portfolio.
764	28.3	exotic option	Although there is no universally accepted definition of an exotic option, a useful definition is that an exotic option is an option that has one or more features that prevent it from being classified as a simple option, including payoffs based on values prior to the expiration date, and/or payoffs that are nonlinear or discontinuous functions of the underlying asset.
767	28.3.4	knock-in option	A knock-in option is an option that becomes active if and only if the underlying asset reaches a prespecified barrier.
768	28.3.5	knock-out option	A knock-out option is an option that becomes inactive (i.e., terminates) if and only if the underlying asset reaches a prespecified barrier.
776	28.5.1	numerical methods	Numerical methods for derivative pricing are potentially complex sets of procedures to approximate derivative values when analytical solutions are unavailable.

778	28.5.4	overconfidence bias	An overconfidence bias is a tendency to overestimate the true accuracy of one's beliefs and predictions.
775	28.5.1	partial differential equation approach (PDE approach)	The partial differential equation approach (PDE approach) finds the value to a financial derivative based on the assumption that the underlying asset follows a specified stochastic process and that a hedged portfolio can be constructed using a combination of the derivative and its underlying asset(s).
764	28.3.1	participation rate	The participation rate indicates the ratio of the product's payout to the value of the underlying asset.
766	28.3.2	path-dependent option	A path-dependent option is any option with a payoff that depends on the value of the underlying asset at points prior to the option's expiration date.
777	28.5.4	payoff diagram level	The payoff diagram level determines the amount of money or the percentage return that an investor can anticipate in exchange for paying the price of the product.
777	28.5.4	payoff diagram shape	The payoff diagram shape indicates the risk exposure of a product relative to an underlier.
774	28.4.6	power reverse dual-currency note	At its core, in a power reverse dual-currency note (PRDC) , an investor pays a fixed interest rate in one currency in exchange for receiving a payment based on a fixed interest rate in another currency.
773	28.4.4	principal protected absolute return barrier note	A principal protected absolute return barrier note offers to pay absolute returns to the investor if the underlying asset stays within both an upper barrier and a lower barrier over the life of the product.
764	28.3.1	principal-protected structured product	A principal-protected structured product is an investment that is engineered to provide a minimum payout guaranteed by the product's issuer (counterparty).
770	28.3.8	quanto option	A quanto option is an option with a payoff based in one currency using the numerical value of the underlying asset expressed in a different currency.
764	28.3	simple option	A simple option has (1) payoffs based only on the value of a single underlying asset observed at the expiration date, and (2) linear payoffs to the long position of the calls and puts based on the distance between the option's strike price and the value of the underlying asset.
769	28.3.6	spread option	A spread option has a payoff that depends on the difference between two prices or two rates.

777	28.5.3	static hedge	A static hedge is when the positions in the portfolio do not need to be adjusted through time in response to stochastic price changes to maintain a hedge.
762	28.2	tax deduction	Tax deduction of an item is the ability of a taxpayer to reduce taxable income by the value of the item.
762	28.2	tax deferral	Tax deferral refers to the delay between when income or gains on an investment occur and when they are taxed.
760	28.1	wrapper	A wrapper is the legal vehicle or construct within which an investment product is offered.
796	29.3.2	affinity fraud	Affinity fraud is the commission of fraud against people or entities with which the perpetrator of the fraud shares a common bond, such as race, ethnicity, or religious affiliation.
789	29.1.5	anchoring	Anchoring may be viewed in this context as a tendency to rely too heavily on previous beliefs.
790	29.1.5	behavioral biases	Behavioral biases are tendencies or patterns exhibited by humans that conflict with prescriptions based on rationality and empiricism.
789	29.1.5	behavioral finance	Behavioral finance studies the potential impacts of cognitive, emotional, and social factors on financing decision-making.
791	28.2.2	circuit breaker	A circuit breaker is a decision rule and procedure wherein exchange authorities invoke trading restrictions (even exchange closures) in an attempt to mute market fluctuations and to give market participants time to digest information and formulate their trading responses.
789	29.1.5	confirmation bias	Confirmation bias is the tendency to disproportionately interpret results that confirm a previously held opinion as being true.
791	29.2.1	crowded trade	When large investors hold substantial positions in the same asset or similar assets, it is known as a crowded trade .
792	29.3	fraud	Fraud is intentional deception typically for the purpose of financial gain.
798	29.3.3	painting the tape	Placing transactions to record high or low prices on the transaction records of public markets is a fraudulent activity often termed painting the tape , in reference to the historical use of ticker tape to broadcast prices.

795	29.3.2	Ponzi scheme	A Ponzi scheme is a fraudulent program that returns deposits to investors and identifies the returned capital as a distribution of profit in order to overstate the profitability of the enterprise and to attract additional and larger deposits.
796	29.3.2	restitution	Restitution is the restoration of lost funds.
788	29.1.4	return on assets (ROA)	Return on assets (ROA) is profit before financing costs (and taxes), expressed as a percentage of assets. ROE can be expressed as a function of ROA, leverage (L, which is defined here as the ratio of assets to equity), and interest costs on the financing (r): $ROE = (ROA \times L) - [r \times (L - 1)]$
788	29.1.4	return on equity (ROE)	Return on equity (ROE) is profit after financing costs, expressed as a percentage of equity.
791	28.2.2	spoofing	Spoofing is the placing of large orders to influence market prices with no intention of honoring the orders if executed.
790	29.2.1	unwind hypothesis	The unwind hypothesis suggests that hedge fund losses began with the forced liquidation of one or more large equity market-neutral portfolios, primarily to raise cash or reduce leverage.
797	29.3.3	window dressing	Window dressing is a term used in the investment industry to denote a variety of legal and illegal strategies to improve the outward appearance of an investment vehicle.
801	30.1.1	actual investment strategy	The actual investment strategy of a fund at a particular point in time is the investment strategy being implemented by the fund.
806	30.3	business activities	Business activities include the indirect support of the investment activities of the fund, including all of the normal activities of running any similarly sized organization, such as human resources management, technology, infrastructure, and facility maintenance.
806	30.3	business risk	Business risk is the added economic dispersion caused by unexpected performance of the business team and business activities.
811	30.5.4	custody	Custody refers to the safekeeping of the cash and securities of a fund.
811	30.5.5	fund culture	A fund culture is a generally shared set of priorities and values within the fund's organization.
808	30.4.2	gaming	Gaming refers to strategic behavior to gain benefits from circumventing the intention of the rules of a particular system.

805	30.3	investment activities	Investment activities span the investment process, involving all aspects of determining and implementing investment decisions.
802	30.1.3	investment management governance process	The investment process in discretionary cases centers on the investment management governance process , which is the explicit or implicit set of procedures through which investment decisions are made.
801	30.1.1	investment mandate	An investment mandate is an explicit or implicit statement of the allowable and intended strategy, goals, and/or risks of an investment program.
802	30.1.3	investment process	The investment process includes the methods a manager uses to formulate, execute, and monitor investment decisions, and spans the range of investment activities, from the design of the investment strategy, through the implementation of the ideas into decisions, and ultimately to the placing and execution of trading orders.
803	30.2.1	investment process risk	Investment process risk is economic dispersion caused by imperfect application of the stated investment strategy by the investment team.
801	30.1	investment strategy	A fund's investment strategy refers to the sets of objectives, principles, techniques, and procedures used to construct and modify the fund's portfolio.
803	30.2	market risk in the investment process	In discussions of investment process, the market risk in the investment process describes any systematic or idiosyncratic dispersion in economic outcomes attributable to changes in market prices and rates.
806	30.3	operational activities	Operational activities include the direct support of investment activities, often described as middle office and back office operations.
807	30.4.1	operational errors	Operational errors are inadvertent mistakes made in the process of executing a fund's investment strategy.
808	30.4.3	operational fraud	Operational fraud from the perspective of an investor is any intentional, self-serving, deceptive behavior in the operational activities of a fund that is generally harmful to the investor.
806	30.4	operational risk	A broad interpretation of operational risk is that it is any economic dispersion caused by investment, operational, or business activities.

801	30.1.1	permitted investment strategies	The permitted investment strategies of a fund delineate the range of investment strategies that the fund's managers have communicated and are mandated as allowable for the fund to implement.
809	30.5.2	position limit	A position limit is a specific restriction on the size of the holdings of a particular security or combination of securities.
809	30.5.2	risk limits	Risk limits are the maximum levels of measured risk that are allowed in a portfolio, in terms of both individual risks and aggregated risks.
808	30.4.2	rogue trader	A rogue trader intentionally establishes substantial positions well outside the investment mandate.
814	30.6.3	slack variable	A slack variable is the variable in an optimization problem that takes on whatever value is necessary to allow an optimum to be feasible but, while doing so, does not directly alter the value of the objective function.
801	30.1.1	stated investment strategy	The stated investment strategy of a fund is the investment strategy that a diligent investor would expect the fund to pursue, based on a reasonable analysis of information made available by the fund.
802	30.1.2	style drift	Style drift (or strategy drift) is the change through time of a fund's investment strategy based on purposeful decisions by the fund manager in an attempt to improve risk-adjusted performance in light of changing market conditions.
806	30.3	synergistic risk effect	A synergistic risk effect is the potential for the combination of two or more risks to have a greater total risk than the sum of the individual risks.
832	31.6.4	annual volatility	Thus, annual volatility is only about 16 times larger than daily volatility based on 256 trading days per year and zero autocorrelation.
829	31.6	bias blind spot	The bias blind spot is people's tendency to underestimate the extent to which they possess biases.
838	31.7.3	chief risk officer	The chief risk officer (CRO) oversees the fund manager's program for identifying, measuring, monitoring, and managing risk.
832	31.6.4	daily volatility	Annual volatility is only about 16 times larger than daily volatility based on 256 trading days per year and zero autocorrelation.

815	31	due diligence	Due diligence is the process of performing a review of an investment with an appropriate level of competence, care, and thoroughness.
831	31.6.3	expectation bias	Expectation bias is synonymous with confirmation bias and is a tendency to overweight those findings that most agree with one's prior beliefs.
820	31.3.1	feeder fund	A feeder fund is a legal structure through which investors have access to the investment performance of the master trust.
838	31.8.1	financial firewall	A limited liability shield or financial firewall is a legal construct that prevents creditors from pursuing restitution from investors or other participants involved in an economic activity beyond the amount of capital that they have contributed.
825	31.4.2	fund style index	A fund style index is a collection of fund managers operating with a similar strategy to the fund manager in question that can be used as a benchmark.
839	31.8.3	hard lockup period	In a hard lockup period , withdrawals are contractually not allowed for the entire duration of the lockup period.
829	31.6	herd behavior	Herd behavior is the extent to which people are overly eager to adopt beliefs that conform to those of their peers.
819	31.2.2	information filtering	Information filtering is the fund manager's ability to use data available to others but to be better able to glean tradable insights from it.
819	31.2.2	information gathering	Information gathering indicates the ability of the manager to create access to information or to have access to better information than do other managers.
816	31.2.1	investment objective	The investment objective of a fund specifies the goals, nature, and strategies of the fund's investment program.
818	31.2.1	key personnel clause	A key personnel clause is a provision that allows investors to withdraw their assets from the fund, immediately and without penalty, when the identified key personnel are no longer making investment decisions for the fund.
823	31.3.4	league table	Common in many industries, a league table is a listing of organizations, generated by a research or media firm, that ranks organizations by size, volume, or other indicators of activity.

834	31.6.6	level 1 assets	Level 1 assets are those assets that can be valued based on an unadjusted market price quote from an actively traded market of identical assets.
834	31.6.6	level 2 assets	Level 2 assets are best valued based on nonactive market price quotes, active market price quotes for similar assets, or non-quoted values based on observable inputs that can be corroborated.
835	31.6.6	level 3 assets	Level 3 assets must be valued substantially on the basis of unobservable inputs, critical assumptions, and/or imprecise valuation techniques.
838	31.8.1	limited liability shield	A limited liability shield or financial firewall is a legal construct that prevents creditors from pursuing restitution from investors or other participants involved in an economic activity beyond the amount of capital that they have contributed.
839	31.8.3	lockup period	A lockup period is a provision preventing, or providing financial disincentives for, redemption or withdrawal of an investor's funds for a designated period, typically one to three years for hedge funds, and up to ten years or more for real estate and private equity funds.
820	31.3.1	master trust	The master trust is the legal structure used to invest the assets of both onshore investors and offshore investors in a consistent if not identical manner, so that both funds share the benefit of the fund manager's insights.
820	31.3.1	master-feeder structure	Together, the master trust and feeder funds are referred to as a master-feeder structure .
836	31.7.2	N-sigma event	An N-sigma event is an event that is N standard deviations from the mean.
842	31.10.2	omega-score	The omega-score is a measure of future risk that is computed as a function of a fund's age, size, past performance, volatility, and fee structure.
824	31.4.1	shorting volatility	Shorting volatility is a strategy whereby a fund manager sells call or put options, especially out-of-the-money options, without an offsetting position.
821	31.3.1	side pocket arrangement	In a side pocket arrangement , illiquid investments held by a hedge fund are segregated from the rest of the portfolio.

839	31.8.3	soft lockup period	In a soft lockup period , investors may be allowed to withdraw capital from the fund before the expiration of the lockup period but only after the payment of a redemption fee, which is frequently 1% to 5% of the withdrawal amount.
830	31.6.1	trade allocation	Trade allocation , in this context, refers to the process by which—and priorities with which—an attractive investment opportunity is distributed among the manager’s various funds and accounts.
855	32.5.3	actively managed portfolio	An actively managed portfolio involves trading with the intent of generating improved performance.
847	32.3	distinguishing alpha and beta	Distinguishing alpha and beta involves measurement and attribution and the process of identifying how much of an asset’s return is generated by alpha and how much is generated by beta.
855	32.5.3	enhanced index products	Enhanced index products are designed to take slightly more risk than the index within tightly controlled parameters and offer a little extra return, usually on a large pool of capital.
855	32.5.3	index products	Index products take little or no active risk, extract no added value, and are not expected to generate active return.
854	32.5.2	new investment model	In the new investment model , investments are allocated with flexibility and in the explicit context of alpha and beta management.
855	32.5.3	passively managed portfolio	A passively managed portfolio , such as an indexed buy-and-hold portfolio, seeks to match the return of an index or a benchmark without engaging in active trading that attempts to generate improved performance.
848	32.4	portable alpha	Portable alpha is the ability of a particular investment product or strategy to be used in the separation of alpha and beta.
847	32.3	separating alpha and beta	Separating alpha and beta involves portfolio management and refers to attempts to independently manage a portfolio’s alpha and its exposure to beta, each toward desired levels.
845	32.1	smart beta	Smart beta is the strategy of implementing a rules-based portfolio weighting scheme based on one or more characteristics in the underlying assets that generates portfolio weights that differ from a market-capitalization weighting scheme.
853	32.5.1	strategic asset allocation decision	The strategic asset allocation decision is the long-term target asset allocation based on investor objectives and long-term expectations of returns and risk.

853	32.5.1	tactical asset allocation	Tactical asset allocation is the process of making portfolio decisions to alter the systematic risks of the portfolio through time in an attempt to earn superior risk adjusted returns.
853	32.5.1	traditional approach to portfolio allocation	In the traditional approach to portfolio allocation , the top-level decision is a long-term target allocation decision, known as the strategic asset allocation decision.
856	32.5.4	zero-sum game	A zero-sum game is a market, environment, or situation in which any gains to one party must be equally offset by losses to one or more other parties.

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