



2016 FRM PART I

百题巅峰班

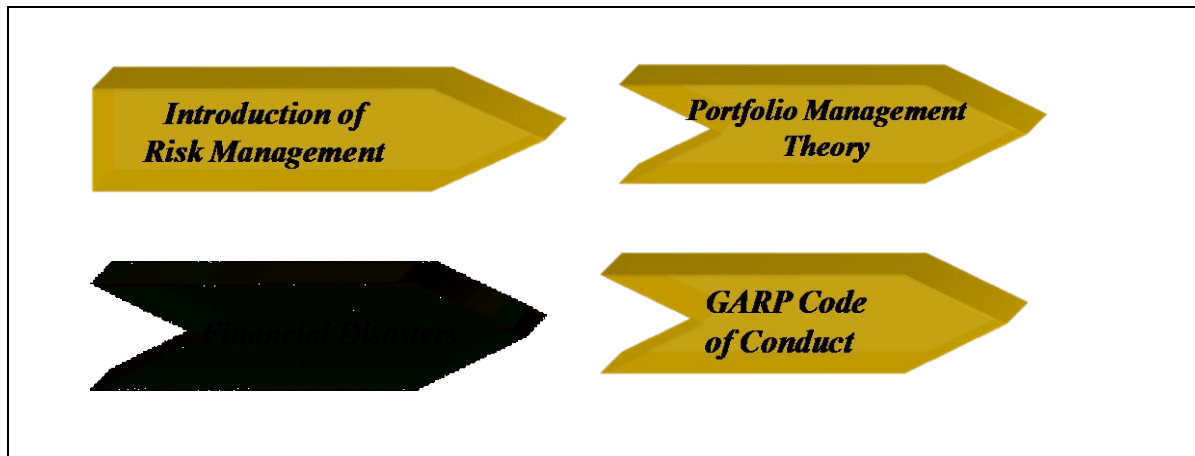
风险管理基础 & 定量分析

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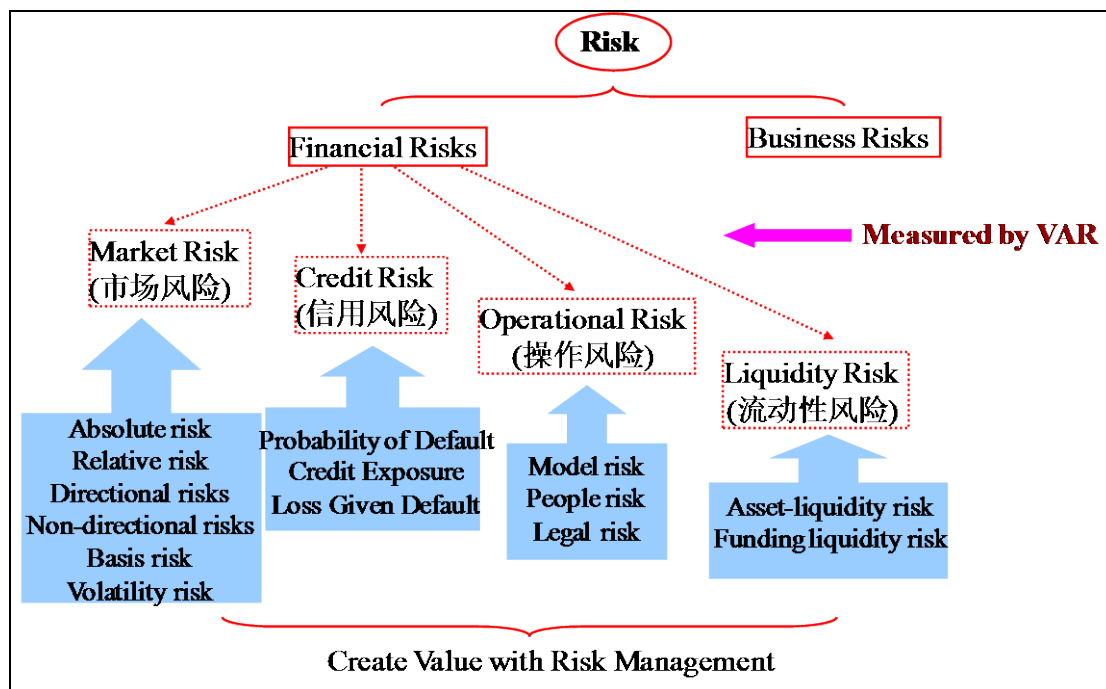
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Part 1 Fundamentals of Risk Management



● Key Point: Types of Risk



- There are both absolute risk (measured without reference to a benchmark) and relative risk (measured against a benchmark) measures of market risk. Which of the following is an absolute measure of market risk?
 - Tracking error
 - Volatility of total returns
 - Correlation with a benchmark portfolio
 - Deviations from a benchmark index

Answer: B

Market risk is the risk of losses from movements in market prices. Absolute risk measures these changes

in terms of the volatility of total returns. Tracking error is a relative measure of market risk defined as the deviation from a benchmark index. Correlation refers to a benchmark. Deviation from the benchmark index is a consideration in measuring relative risk.

2. Jennifer Durrant is evaluating the existing risk management system of Silverman Asset Management. She is asked to match the following events to the corresponding type of risk. Identify each numbered event as a market risk, credit risk, operational risk, or legal risk event.

1. Insufficient training leads to misuse of order management system.
 2. Credit spreads widen following recent bankruptcies.
 3. Option writer does not have the resources required to honor a contract.
 4. Credit swaps with counterparty cannot be netted because they originated in multiple jurisdictions.
- A. 1: legal risk. 2: credit risk. 3: operational risk. 4: credit risk
B. 1: operational risk. 2: credit risk. 3: operational risk. 4: legal risk
C. 1: operational risk. 2: market risk. 3: credit risk. 4: legal risk
D. 1: operational risk. 2: market risk. 3: operational risk. 4: legal risk

Answer: C

1. An insufficient training lead to misuse of order management system is an example of operational risk.
2. Widening of credit spreads represents an increase in market risk.
3. An option writer not honoring the obligation in a contract is a credit risk event.
4. When a contract is originated in multiple jurisdictions leading to problems with enforceability, there is legal risk.

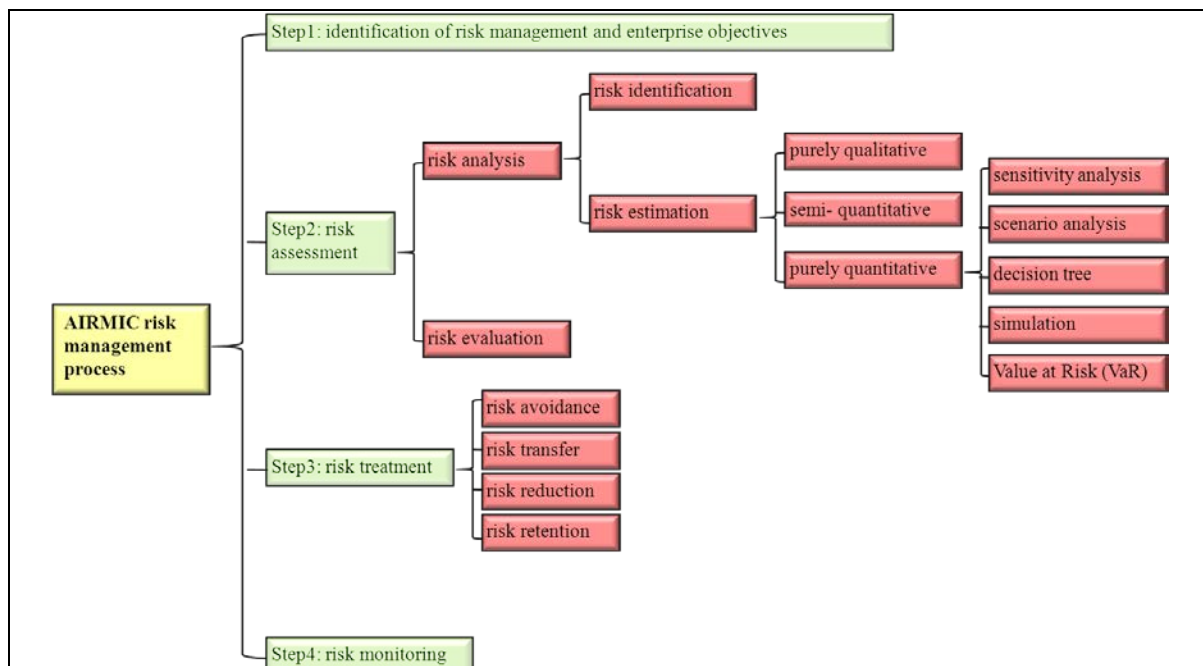
● Key Point: Systematic Risk and Unsystematic Risk

3. Which of the following statements about portfolio risk and diversification is least accurate?
 - A. Not all risk is diversifiable.
 - B. Unsystematic risk can be substantially reduced by diversification.
 - C. Systematic risk can be eliminated by holding securities in a well-diversified international stock portfolio.
 - D. None of above.

Answer: C

Systematic risk cannot be eliminated by diversification. Unsystematic risk can be reduced by diversification. Diversification benefits will occur any time security returns have less than perfect positive correlations.

● Key Point: Enterprise Risk Management



● Role and Responsibilities of CRO

1. Providing the overall leadership, vision, and direction for enterprise risk management;
2. Establishing an integrated risk management framework for all aspects of risks across the organization;
3. Developing risk management policies, including the quantification of the firm's risk appetite through specific risk limits;
4. Implementing a set of risk indicators and reports, including losses and incidents, key risk exposures, and early warning indicators;
5. Allocating economic capital to business activities based on risk, and optimizing the company's risk portfolio through business activities and risk transfer strategies;
6. Communicating the company's risk profile to key stakeholders such as the board of directors, regulators, stock analysts, rating agencies, and business partners; and
7. Developing the analytical, systems, and data management capabilities to support the risk management program.

● Role of the Board of Director:

1. The firm's risk management policies.
2. The firm's periodic risk management reports.
3. The firm's appetite and its impact on business strategy.
4. The firm's internal controls.
5. The firm's financial statements and disclosures.
6. The firm's related parties and related party transactions.
7. Any audit reports from internal or external audits.

8. Corporate governance best practices for the industry.
 9. Risk management practices of competitors and the industry.
 - Role of Audit Committee:
 1. Has traditionally been responsible for the reasonable accuracy of the firm's financial statements and its regulatory reporting requirements.
 2. In addition to the more visible verification duties, the audit committee monitors the underlying systems in place regarding financial reporting, regulatory compliance, internal controls, and risk management.
 3. The audit committee is largely meant to be independent of management but it should work with management and communicate frequently to ensure that any issues arising are addressed and resolved.
4. Each of the following is true except for:
 - A. Probabilistic approaches include sensitivity analysis, scenario analysis and simulations.
 - B. A simulation allows for the deepest assessment of uncertainty because it lets analysts specify distributions of values rather than a single expected value for each input.
 - C. Certainty-equivalent value is the value at risk (VaR) of a risk-adjusted value.
 - D. The output of a simulation can used to generate a value at risk (VaR).

Answer: C

This statement does not make sense.

In regard to A, B and D, each is true.

In regard to D, this is importantly true as it illustrates the compatibility of simulation and VaR: the output of a simulation is a distribution, which is an input into value at risk, VaR; or more specifically, VaR is a quantile of the distribution.

5. Which of the following statements regarding the responsibilities of the chief risk officer (CRO) is least accurate?
 - A. The CRO should provide the vision for the organization's risk management.
 - B. In addition to providing overall leadership for risk, the CRO should communicate the organization's risk profile to stakeholders.
 - C. Although the CRO is responsible for top-level risk management, he is not responsible for the analytical or systems capabilities for risk management.
 - D. The CRO may have a solid line reporting to the CEO or a dotted line reporting to the CEO and the board.

Answer: C

While it is accurate that the CRO is responsible for top-level risk management, he is also responsible for the analytical or systems capabilities for risk management.

● Key Point: Risk Appetite Frameworks

Risk appetite is the amount of risk, on a broad level, an entity is willing to accept in pursuit of value. It reflects the entity's risk management philosophy, and in turn influences the entity's culture and operating style.

A firm's risk appetite reflects its tolerance (especially willingness) to accept risk.

There must be a logical relationship between the firm's risk appetite and its business strategy. As a result, business strategy planning meetings require input from the risk management team right from the outset to ensure the consistency between risk appetite and business strategy.

6. Which of the following tasks regarding risk appetite would be reasonably performed by an organization's Board of Directors?
- I. Develop the organization's risk appetite statement.
 - II. Determine if the risk appetite may cause risks in other areas of the organization.
- A. I only
 - B. II only
 - C. Both I and II
 - D. Neither I nor II

Answer: B

Developing the organization's risk appetite statement is the responsibility of management. It is the Board's role to review and provide appropriate feedback on management's work with regard to the risk appetite statement. Determining if the risk appetite may cause risks in other areas of the organization is consistent with the Board's oversight role.

7. Which of the following statements regarding risk appetite and risk tolerance is correct?
- I. Risk appetite directly impacts the allocation of resources.
 - II. Risk tolerance is a measure of an organization's ability to take risk.
- A. I only
 - B. II only
 - C. Both I and II
 - D. Neither I nor II

Answer: A

Risk appetite directly impacts the allocation of resources. Risk tolerance is a measure of an organization's willingness to take risk.

8. A growing regional bank has added a risk committee to its board. One of the first recommendations of the risk committee is that the bank should develop a risk appetite statement. What best represents a primary function of a risk appetite statement?
- A. To quantify the level of variability for each risk metric that a firm is willing to accept.
 - B. To state specific new business opportunities that a firm is willing to pursue.
 - C. To assign risk management responsibilities to specific internal staff members.
 - D. To state a broad level of acceptable risk to guide the allocation of the firm's resources.

Answer: D

A risk appetite statement states a broad level of risk across the organization the firm is willing to accept in order to pursue value creation. The statement is typically broadly articulated and can be communicated across the organization, and helps to allocate resources to specific objectives at the firm.

● Key Point: Risk Treatment

There are four possibilities for managing risk:

1. **Risk avoidance:** risks that are not congruent with stated policy should be avoided.
2. **Risk transfer:** risk hedging
3. **Risk reduction:** diversification
4. **Risk retention:** the risk is acceptable

9. Krista Skujins, FRM, is the CFO of a manufacturing firm. She is currently in the process of diversifying the firm's investment portfolio by varying the correlations and asset classes among securities. Diversification is best characterized as which of the following risk treatments?
- A. Risk avoidance
 - B. Risk transfer
 - C. Risk retention
 - D. Risk reduction

Answer: D

Diversification is a risk reduction technique.

● Key Point: Data Quality

Key Dimensions of Data Quality:

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1) Accuracy

The degree to which data correctly reflects the real world object.

2) Completeness

Refers to the extent to which the expected attributes of data are provided.

3) Consistency

Refers to reasonable comparison of values between multiple data sets.

4) Reasonableness

Refers to conformity with consistency expectations.

5) Currency

Refers to the lifespan of data.

6) Uniqueness

Tied into the data error involving duplicate records.

Basel Principles for Effective Risk Data Aggregation:

1) Governance

2) Data Architecture and Infrastructure

3) Accuracy and Integrity

4) Completeness

5) Timeliness

6) Adaptability

7) Accuracy

8) Comprehensive-ness

9) Clarity and Usefulness

10) Frequency

11) Distribution

10. Which of the following data issues is least likely to increase risk for an organization?

- A. Duplicate records
- B. Data normalization
- C. Nonstandard formats
- D. Data transformations

Answer: B

Data normalization is a process to better organize data in order to minimize redundancy and dependency so it is least likely to increase risk. All of the other data issues are likely to increase risk, especially complex data transformations.

11. A risk analyst is reconciling customer account data held in two separate databases and wants to

ensure the account number for each customer is the same in each database. Which dimension of data quality would she be most concerned with in making this comparison?

- A. Completeness
- B. Accuracy
- C. Consistency
- D. Currency

Answer: C

Consistency refers to the comparison of one element of data across two or more different databases.

12. In characterizing various dimensions of a bank's data, the Basel Committee has suggested several principles to promote strong and effective risk data aggregation capabilities. Which statement correctly describes a recommendation that the bank should follow in accordance with the given principle?

- A. The integrity principle recommends that data aggregation should be completely automated without any manual intervention.
- B. The completeness principle recommends that a financial institution should capture data on its entire universe of material risk exposures.
- C. The adaptability principle recommends that a bank should frequently update its risk reporting systems to incorporate changes in best practices.
- D. The accuracy principle recommends that the risk data be reconciled with management's estimates of risk exposure prior to aggregation.

Answer: B

The completeness principle recommends that a bank be able to capture and aggregate all data on the material risks to which it is exposed across the organization. This will allow it to identify and report risk exposures, concentrations, and set exposure limits.

13. A bank's risk manager is considering different viewpoints for reporting data quality metrics within a data quality scorecard: a data quality issues viewpoint, a business process viewpoint, and a business impact viewpoint. For which of the following purposes would a business process viewpoint be most effective?

- A. Aggregating the business impacts of poor quality data across different business processes.
- B. Creating a high-level overview of risks associated with data issues on the trading desk.
- C. Isolating the point at which data issues begin to arise in a foreign exchange hedging procedure.
- D. Identifying organizational processes that require enhanced monitoring and control.

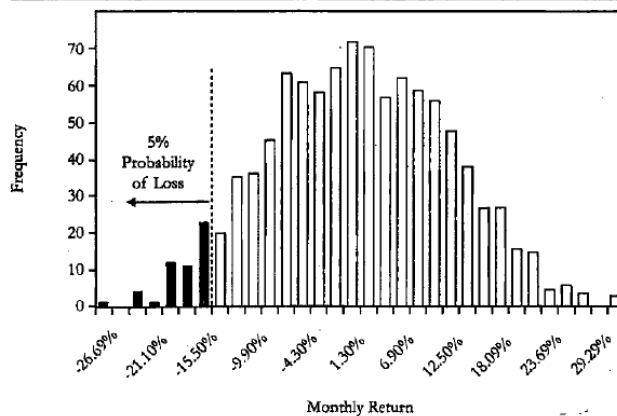
Answer: C

A business process view would be the best choice when the firm is looking to isolate the specific point within a business process where data quality issues are introduced, as in this example.

● Key Point: Risk Management Tools

1. Sensitivity Analysis
2. Scenario Analysis
3. Decision Trees
4. Simulation
5. Value at Risk (VaR)

Figure 3: Histogram of Monthly Returns



14. Danielle Marquis is a quantitative analyst who works for a company that experiences risks in a sequential manner in that information obtained in earlier steps helps to make better estimates of future outcomes. Which of the following risk management tools should Marquis consider in her analysis?

- A. Decision trees
- B. Scenario analysis
- C. Sensitivity analysis
- D. Simulation

Answer: A

Decision trees depend on a successful outcome in one step before moving on to the next step. Sensitivity analysis involves changing one variable at a time. It estimates outcomes and values under several possible fixture scenarios. Simulation is a complex tool that looks at distributions of values.

● Key Point: Corporate Risk Governance Practices

The risk policy committee within the Board of Director should have acceptable, desirable, and best practices surrounding the establishment of the committee.

Its purpose, composition, membership qualifications, committee chair, appointment, remuneration, meetings, attendance and notice, reporting to the Board and shareholders, evaluation, authority and resources, responsibilities involving policies and procedures, and responsibilities involving specific risk reviews.

Risk Management Failures:

- 1) Measure risks correctly.
- 2) Recognize some risk (taking known and unknown risk into account).
- 3) Communicate risks to top management.
- 4) Monitor and manage risks.
- 5) Use appropriate metrics.

15. Which of the following statements regarding corporate risk governance is correct?

- A. Management of the organization is ultimately responsible for risk oversight.
- B. A risk committee is useful for enforcing the firm's risk governance principles.
- C. Effective risk governance requires multiple levels of accountability and authority
- D. The point of risk governance is to minimize the amount of risk taken by the organization.

Answer: B

The Board of Directors is ultimately responsible for risk oversight. Effective risk governance simply requires clear accountability; authority; and methods of communication; it is not necessary to have multiple levels. The point of risk governance is to consider the methods in which risk-taking is permitted, optimized, and monitored; it is not necessarily to minimize the amount of risk taken. The real point of risk governance is to increase the value of the organization from the perspective of the shareholders and/or stakeholders.

16. Firms commonly incentivize their management to increase the firm's value by granting managers securities tied to the firm's stock. Some securities, however, can reduce managerial incentives to manage risk within the firm. Which is likely the best example of this type of security?

- A. Deep in-the-money call option on the firm's stock
- B. At-the-money call option on the firm's stock
- C. Deep out-of-the-money call option on the firm's stock
- D. Long position in the firm's stock

Answer: C

Deep out-of-the-money calls have no value unless the firm value increases substantially, so providing

deep out-of-the-money calls as an incentive could cause managers to take substantially higher risks and perform, less hedging. With an at-the-money call, managers could still be incentivized to take greater risks but they would not have to aim for as large of a stock price increase to recognize significant value from their options, so the danger of mismanaging risk is less. A deep in-the-money call would have a similar investment profile as a long equity position and both of the latter choices would provide the least managerial incentive to reduce risk management.

17. Which of the following is not necessarily considered a failure of risk management?

- A. Incorrect measurement of known risks
- B. Failure in communicating risk issues to top management
- C. Failure to minimize losses on credit portfolios
- D. Failure to use appropriate risk metrics

Answer: C

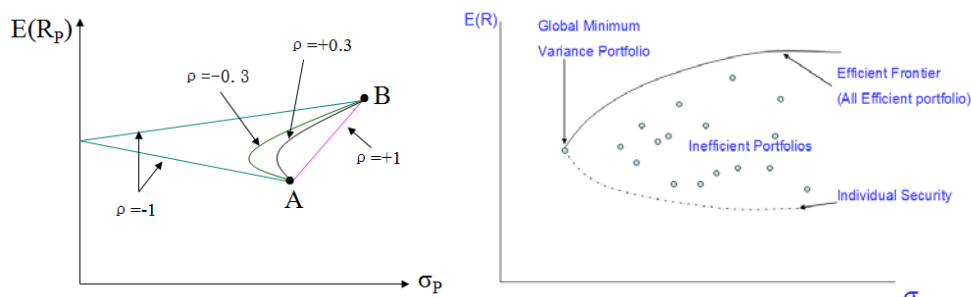
A failure to minimize losses on credit portfolios is not necessarily a failure of risk management. The firm may have used prudent risk management and decided that the potential rewards from entering into the credit agreements adequately compensated the firm for the risks taken. It could also have ignored the advice of its risk managers to attempt to minimize its credit losses. Either way, this is not necessarily a failure of risk management.

● Key Point: Portfolio Management Theory

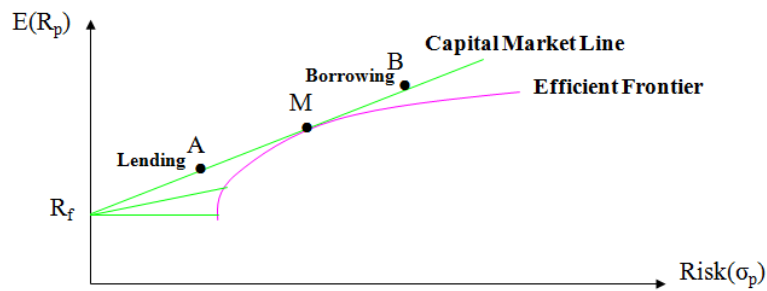
Expected return and volatility of a two-asset portfolio

$$E(R_p) = \omega_1 E(R_1) + \omega_2 E(R_2)$$

$$\sigma_p^2 = \omega_1^2 \sigma_1^2 + \omega_2^2 \sigma_2^2 + 2\omega_1 \omega_2 \text{Cov}_{1,2} = \omega_1^2 \sigma_1^2 + \omega_2^2 \sigma_2^2 + 2\omega_1 \omega_2 \sigma_1 \sigma_2 \rho_{1,2}$$



Capital Market Line (CML)



$$\text{CML: } E(R_p) = R_f + \left[\frac{E(R_M) - R_f}{\sigma_M} \right] \sigma_p$$

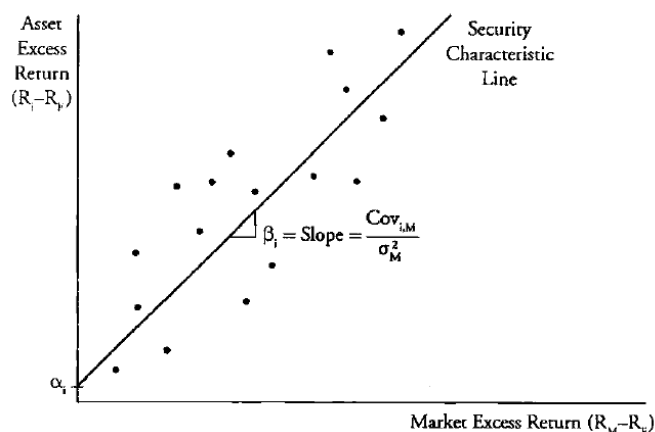
Capital Asset Pricing Model (CAPM) Assumptions

1. Investors face no transaction costs when trading assets.
2. Assets are infinitely divisible.
3. There are no taxes; therefore, investors are indifferent between capital gains and income or dividends.
4. Investors are price takers whose individual buy and sell decisions have no effect on asset prices.
5. Investor's utility functions are based solely on expected portfolio return and risk.
6. Unlimited short-selling is allowed.
7. Investors can borrow and lend unlimited amounts at the risk-free rate.
8. One-period horizon investment.
9. Homogeneous expectations about the expected returns, variances.
10. All assets are marketable, including human capital.

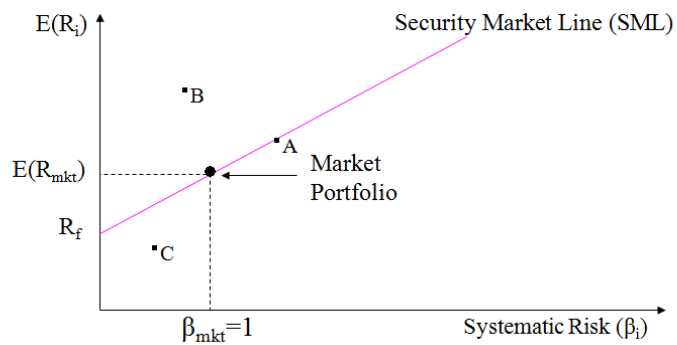
$$E(R_i) = R_f + \beta_i [E(R_M) - R_f], \quad (\beta_i = \frac{\text{Cov}_{i,M}}{\sigma_M^2} = \rho \frac{\sigma_i}{\sigma_M})$$

Calculating the beta:

Figure 1: Regression of Asset Excess Returns against Market Asset Returns



Security Market Line (SML)



Comparing the CML and the SML

Differences	SML	CML
Measure of Risk	Uses systematic risk	Uses standard deviation
Application	Tool used to determine the appropriate expected returns for securities	Tool used to determine the appropriate asset allocation (percentages allocated to the risk-free asset and to the market portfolio) for the investor
Definition	Graph of the CAPM	Graph of the efficient frontier
Slope	Market risk premium	Market portfolio Sharpe Ratio

18. According to the Capital Asset Pricing Model (CAPM), over a single time period, investors seek to maximize their:

- A. Wealth and are concerned about the tails of return distributions.
- B. Wealth and are not concerned about the tails of return distributions.
- C. Expected utility and are concerned about the tails of return distributions.
- D. Expected utility and are not concerned about the tails of return distributions.

Answer: D

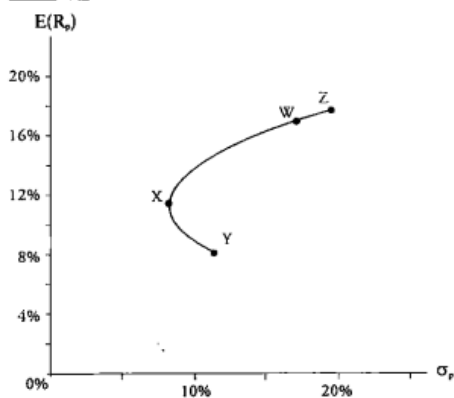
CAPM assumes investors seek to maximize the expected utility of their wealth at the end of the period, and that when choosing their portfolios, investors only consider the first two moments of return distribution: the expected return and the variance. Hence, investors are not concerned with the tails of the return distribution.

Use the following data to answer Questions 18 and 19.

Assume the expected return on stocks is 18% (represented by Z in the figure), and the expected return

on bonds is 8% (represented by point Y on the graph).

Portfolio Possibilities Curve: Stocks and Bonds



19. The graph shows the portfolio possibilities curve for stocks and bonds. The point on the graph that most likely represents a 90% allocation in stocks and a 10% allocation in bonds is Portfolio:

- A. W
- B. X
- C. Y
- D. Z

Answer: A

Since the return to W is the nearest to Z (stocks), it is logical to assume that point W represents an allocation of 90% stocks/10% bonds. The return for W is lower than Z, but it also represents a reduction in risk.

20. The efficient frontier consists of the portfolios between and including:

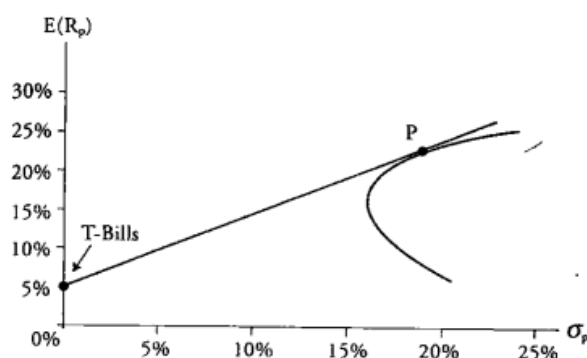
- A. X and W
- B. Y and Z
- C. X and Z
- D. Y and X

Answer: C

The efficient frontier consists of portfolios that have the maximum expected return for any given level of risk (standard deviation or variance). The efficient frontier starts at the global minimum-variance portfolio and continues above it. Any portfolio below the efficient frontier is dominated by a portfolio on the efficient frontier. This is because efficient portfolios have higher expected returns for the same level of risk.

Use the following graph to answer Question 20.

Mean-Variance Analysis



21. Portfolio P in the mean variance analysis represents the tangency point between the capital market line and the portfolio possibilities curve. In this analysis, the market price of risk would be the:
- standard deviation of Portfolio P
 - expected return on the minimum-variance portfolio
 - slope of the line connecting T-bills and Portfolio P
 - point at which the straight line intersects the expected return axis

Answer: C

The CML is the line connecting T-bills and Portfolio P. The market price of risk is the slope of the CML. Had risk been measured on the graph with beta, the graph would represent the SML. The market price of risk would still be the slope of the line.

22. Suppose that the correlation of the return of a portfolio with the return of its benchmark is 0.8, the volatility of the return of the portfolio is 5%, and the volatility of the return of the benchmark is 4%. What is the beta of the portfolio?
- 1.00
 - 0.80
 - 0.64
 - 1.00

Answer: A

The following equation is used to calculate beta:

$$\beta = \rho \times \frac{\sigma_P}{\sigma_B} = 0.8 \times \frac{0.05}{0.04} = 1.00$$

23. Patricia Franklin makes buy and sell stock recommendations using the capital asset pricing model. Franklin has derived the following information for the broad market and for the stock of the CostSave Company (CS):

- Expected market risk premium 8%
- Risk-free rate 5%
- Historical beta for CostSave 1.50

Franklin believes that historical betas do not provide good forecasts of future beta, and therefore uses the following formula to forecast beta:

$$\text{Forecasted beta} = 0.80 + 0.20 \times \text{historical beta}$$

After conducting a thorough examination of market trends and the CS financial statements, Franklin predicts that the CS return will equal 10%. Franklin should derive the following required return for CS along with the following valuation decision (undervalued or overvalued):

	Valuation	CAPM required return
A.	overvalued	8.3%
B.	overvalued	13.8%
C.	undervalued	8.3%
D.	undervalued	13.8%

Answer: B

The CAPM equation is: $E(R_i) = R_F + \beta_i [E(R_M) - R_F]$. Franklin forecasts the beta for CostSave as follows: $\text{beta forecast} = 0.80 + 0.20 (\text{historical beta}) = 0.80 + 0.20(1.50) = 1.10$

The CAPM required return for CostSave is: $0.05 + 1.1(0.08) = 13.8\%$

Note that the market premium, $E(R_M) - R_F$, is provided in the question (8%).

Franklin should decide that the stock is overvalued because she forecasts that the CostSave return will equal only 10%, whereas the required return (minimum acceptable return) is 13.8%.

24. The efficient frontier is defined by the set of portfolios that, for each volatility level, maximizes the expected return. According to the capital asset pricing model (CAPM), which of the following statements are correct with respect to the efficient frontier?

- i. The capital market line is the straight line connecting the risk-free asset with the zero beta minimum variance portfolio.
- ii. The capital market line always has a positive slope and its steepness depends on the market risk premium and the volatility of the market portfolio.
- iii. The complete efficient frontier without a risk-free asset can be obtained by combining the minimum variance portfolio and the market portfolio.
- iv. The efficient frontier allows different individuals to have different portfolios of risky assets based upon their own risk aversion and forecast for asset returns.
- v. The efficient frontier assumes no transaction costs, no taxes, a common investment horizon for all investors, and that the return distribution has no skewness.

A. ii, iii and v

- B. i, ii and iii
- C. i, iv and v
- D. ii, iii and iv

Answer: A

Within modern portfolio theory (MPT), the efficient frontier is a combination of assets that has the best possible expected level of return for its level of risk. The efficient frontier is the positively sloped portion of the opportunity set that offers the highest expected return for a given risk level. The efficient frontier is at the top of the feasible set of portfolio combinations. ii, iii and v are correct statements.

The capital market line connects the risk-free asset and the market portfolio. The efficient frontier does allow investors to have different risk aversions, but assumes that they all have the same forecast for asset returns.

25. An investment advisor is analyzing the range of potential expected returns of a new fund designed to replicate the directional moves of the BSE Sensex Index but with twice the volatility of the index. The Sensex has an expected annual return of 12.3% and volatility of 19.0%, and the risk free rate is 2.5% per year. Assuming the correlation between the fund's returns and that of the index is 1, what is the expected return of the fund using the capital asset pricing model?
- A. 18.5%
 - B. 19.0%
 - C. 22.1%
 - D. 24.6%

Answer: C

If the CAPM holds, then $R_i = R_f + \beta_i \times (R_m - R_f)$, which is maximized at the greatest possible beta value which implies a correlation of 1 between the fund's return and the index return. Since the volatility of the fund is twice that of the index, a correlation of 1 implies a maximum beta β_i of 2. Therefore: $R_i(\text{max}) = 2.5\% + 2 * (12.3\% - 2.5\%) = 22.1\%$.

26. Suppose the S&P 500 has an expected annual return of 7.6% and volatility of 10.8%. Suppose the Atlantis Fund has an expected annual return of 8.3% and volatility of 8.8% and is benchmarked against the S&P 500. If the risk free rate is 2.0% per year, what is the beta of the Atlantis Fund according to the Capital Asset Pricing Model?
- A. 0.81
 - B. 0.89
 - C. 1.13
 - D. 1.23

Answer: C

Since the correlation or covariance between the Atlantis Fund and the S&P 500 is not known, CAPM must be used to back out the beta: $\overline{R}_i = R_F + \beta_i \times (\overline{R}_M - R_F)$.

Therefore:

$$8.3\% = 2.0\% + \beta_i \times (7.6\% - 2.0\%); \text{ hence } \beta_i = \frac{8.3\% - 2.0\%}{7.6\% - 2.0\%} = 1.13$$

● Key Point: Measures of Performance

Applying the CAPM to Performance Measurement ★★★ 性质、计算		
Types	Formula	Application
Sharpe Ratio	$S_p = \frac{E(R_p) - R_F}{\sigma_p}$	Applied to <u>all portfolios</u> and is a better method for measuring <u>historical performance</u> .
Treynor Ratio	$TR = \frac{E(R_p) - R_F}{\beta_p}$	For <u>well-diversified</u> portfolios.
Sortino Ratio	$SOR = \frac{E(R_p) - R_{min}}{\sqrt{MSD_{min}}}$	Return distribution is <u>skewed to the left</u> (for example hedge fund), but <u>Sortino</u> ratio is much less widely used.
Information Ratio	$IR = \frac{E(R_p) - E(R_B)}{\sigma_{e_p}}$	A measure of how well the manager has acquired and used information compared to the average manager.
Jensen Alpha	$\alpha_p = E(R_p) - \{R_F + \beta_p[E(R_M) - R_F]\}$	The Jensen measure is the asset's <u>excess return</u> over the return predicted by the CAPM.

27. The market portfolio (M) contains the optimal allocation of only risky asset and no risky assets. Let the S_1 be the Sharpe ratio of this market portfolio. There exists a risk-free asset. Initially, an investor is fully (100%) invested in M with a portfolio Sharpe ratio of S_1 . Subsequently, the investor borrows 30% at the risk-free rate, such that she is 130% invested in the market portfolio (M) where this leverage portfolio has a Sharpe ratio of S_2 . After the leverage (i.e., borrowing at the risk-free rate to invest +30% in M, is the investor still on the efficient frontier and how do the Sharpe ratios?
- A. No (no longer efficient), and $S_2 < S_1$.
- B. No, but $S_2 = S_1$.
- C. Yes (still efficient), but $S_2 < S_1$.
- D. Yes and $S_2 = S_1$.

Answer: D

The ability to borrowing or lend morphs the concave/convex efficient frontier into the linear CML; i.e.,

the leveraged portfolio is efficient with higher risk and higher return.

All portfolios on the CML have the same Sharpe ratio: the slope of the CML.

28. Assume that you are only concerned with systematic risk. Which of the following would be the best measure to use to rank order funds with different betas based on their risk-return relationship with the market portfolio?
- A. Treynor ratio
 - B. Sharpe ratio
 - C. Jensen's alpha
 - D. Sortino ratio

Answer: A

Systematic risk of a portfolio is that risk which is inherent in the market and thus cannot be diversified away. In this situation you should seek a measure which ranks funds based on systematic risk only, which is reflected in the beta as defined below: $\beta_p = (\rho_{PM} * \sigma_p * \sigma_M) / \sigma_M^2$

where ρ_{PM} is the correlation coefficient between the portfolio and the market, σ_p represents the standard deviation of the portfolio and σ_M represents the standard deviation of the market. In a well-diversified portfolio (where one is normally only concerned with systematic risk), it can be assumed that the correlation coefficient is close to 1, therefore beta can be approximated to an even simpler equation: $\beta_p = \sigma_p / \sigma_M$

In either case, beta explains the volatility of the portfolio compared to the volatility of the market, which captures only systematic risk.

The Treynor ratio is the correct ratio to use in this case. The formula is: $T_p = [E(R_p) - R_f] / \beta_p$ which describes the difference between the expected return of the portfolio, $E(R_p)$ and the risk free rate R_f divided by the portfolio beta β . Therefore, it plots excess return over systematic risk.

29. Donaldson Capital Management, a regional money management firm, manages nearly \$400 million allocated among three investment managers. All portfolios have the same objective, which is to produce superior risk-adjusted returns (by beating the market) for their clients. You have been hired as a consultant to measure the performance of the portfolio managers. You have collected the following information based on the last ten years of returns.

Portfolio Manager	Mean Annualized Rate of Return	Beta	Standard Deviation of Return
a	0.18	1.35	0.24
b	0.21	1.95	0.25
c	0.24	2.10	0.22

During the same time period the average annual rate of return on the market portfolio was 13% with a standard deviation of 19%. In order to assess the portfolio performance of the above

managers, you should use:

- A. The Treynor measure of performance
- B. The Sharpe measure of performance
- C. The Jensen measure of performance
- D. The Sortino measure of performance

Answer: B

The Treynor measure is most appropriate for comparing well-diversified portfolios. That is the Treynor measure is the best to compare the excess returns per unit of systematic risk earned by portfolio managers, provided all portfolios are well-diversified.

All three portfolios managed by Donaldson Capital Management are clearly less diversified than the market portfolio. Standard deviation of returns for each of the three portfolios is higher than the standard deviation of the market portfolio, reflecting a low level of diversification.

Jensen's alpha is the most appropriate measure for comparing portfolios that have the same beta. The Sharpe measure can be applied to all portfolios because it uses total risk and it is more widely used than the other two measures. Also, the Sharpe ratio evaluates the portfolio performance based on realized returns and diversification. A less-diversified portfolio will have higher total risk and vice versa.

30. A high net worth investor is monitoring the performance of an index tracking fund in which she has invested. The performance figures of the fund and the benchmark portfolio are summarized in the table below:

Year	Benchmark Return	Fund Return
2005	9.00%	1.00%
2006	7.00%	3.00%
2007	7.00%	5.00%
2008	5.00%	4.00%
2009	2.00%	1.50%

What is the tracking error volatility of the fund over this period?

- A. 0.09%
- B. 1.10%
- C. 3.05%
- D. 4.09%

Answer: C

Relative risk measures risk relative to a benchmark index, and measures it in terms of tracking error or deviation from the index.

We need to calculate the standard deviation (square root of the variance) of the series:

{0.08, 0.04, 0.02, 0.01, 0.005}

Perform the calculation by computing the difference of each data point from the mean, square the result of each, take the average of those values, and then take the square root. This is equal to 3.04%.

31. Gregory is analyzing the historical performance of two commodity funds tracking the Reuters/Jefferies-CRB Index (CRB) as benchmark. He collated the data on the monthly returns and decided to use the information ratio (IR) to assess which fund achieved higher returns more efficiently and presented his findings.

	Fund I	Fund II	Benchmark returns
Average monthly returns	1.488%	1.468%	1.415%
Average excess return	0.073%	0.053%	0.000%
Standard deviation of returns	0.294%	0.237%	0.238%
Tracking error	0.344%	0.341%	0.000%

What is the information ratio for each fund and what conclusion can be drawn?

- A. IR for Fund I = 0.212, IR for Fund II = 0.155; Fund II performed better as it has a lower IR.
- B. IR for Fund I = 0.212, IR for Fund II = 0.155; Fund I performed better as it has a higher IR.
- C. IR for Fund I = 0.248, IR for Fund II = 0.224; Fund I performed better as it has a higher IR.
- D. IR for Fund I = 0.248, IR for Fund II = 0.224; Fund II performed better as it has a lower IR.

Answer: B

The information ratio may be calculated by either a comparison of the residual return to residual risk, or the excess return to tracking error. The higher the IR, the better 'informed' the manager is at picking assets to invest in. Since neither residual return nor risk is given, only the latter is an option.

$$IR = E(R_p - R_b) / \text{Tracking Error}$$

$$\text{For Fund I: } IR = 0.00073 / 0.00344 = 0.212$$

$$\text{For Fund II: } IR = 0.00053 / 0.00341 = 0.155$$

32. Portfolio A has an expected return of 8%, volatility of 20%, and beta of 0.5. Assume that the market has an expected return of 10% and volatility of 25%. Also assume a risk-free rate of 5%. What is Jensen's alpha for portfolio A?

- A. 0.5%
- B. 1.0%
- C. 10%
- D. 15%

Answer: A

The Jensen measure of a portfolio, or Jensen's alpha, is computed as follows:

$$\alpha_p = E(R_p) - R_F - \beta \times [E(R_M) - R_F] = 8\% - 5\% - 0.5 \times (10\% - 5\%) = 0.5\%$$

33. An analyst is evaluating the performance of a portfolio of Mexican equities that is benchmarked to the IPC Index. The analyst collects the information about the portfolio and the benchmark index shown in the table below:

Expected return on the portfolio	6.6%
Volatility of returns on the portfolio	13.1%
Expected return on the IPC Index	4.0%
Volatility of returns on the IPC Index	8.7%
Risk-free rate of return	1.5%
Beta of portfolio relative to IPC Index	1.4

What is the Sharpe ratio for this portfolio?

- A. 0.036
- B. 0.047
- C. 0.389
- D. 0.504

Answer: C

The Sharpe ratio for the portfolio is $(6.6\% - 1.5\%) / 13.1\% = 0.389$.

34. Consider two stocks, A and B. Assume their annual returns are jointly normally distributed, the marginal distribution of each stock has mean 2% and standard deviation 10%, and the correlation is 0.9. What is the expected annual return of stock A if the annual return of stock B is 3%?
- A. 2%
 - B. 2.9%
 - C. 4.7%
 - D. 1.1%

Answer: B

$$E(R_A) = R_F + \beta \times [E(R_B) - R_F]$$

$$2\% = R_F + 0.9 \times (2\% - R_F) \Rightarrow R_F = 2\%$$

$$E(R_A) = 2\% + 0.9 \times (3\% - 2\%) = 2.9\%$$

35. A portfolio has an average return over the last year of 13.2%. Its benchmark has provided an average return over the same period of 12.3%. The portfolio's standard deviation is 15.3%, its beta is 1.15, its tracking error volatility is 6.5% and its semi-standard deviation is 9.4%. Lastly, the risk-free rate is 4.5%. Calculate the portfolio's information Ratio (IR).

- A. 0.569
- B. 0.076
- C. 0.139
- D. 0.096

Answer: C

$$IR = \frac{E(R_p) - E(R_B)}{\sigma_{e_p}} = \frac{13.2\% - 12.3\%}{6.5\%} = 0.139$$

36. Market portfolio's sharp ratio is 40%, the correlation between the market portfolio and the stock is 0.7, the stock's sharp ratio is:

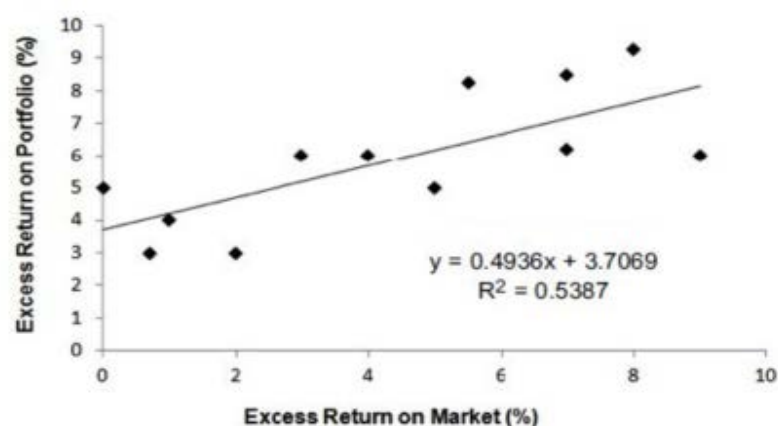
- A. 12%
- B. 28%
- C. 32%
- D. 30%

Answer: B

$$E(R_i) - R_f = \beta_i \times [E(R_m) - R_f]$$

$$\frac{E(R_i) - R_f}{\sigma_i} = \frac{\beta_i \times [E(R_m) - R_f]}{\sigma_i} = \frac{\beta_i}{\sigma_i} \sigma_m \times \frac{[E(R_m) - R_f]}{\sigma_m} = \rho_i \times \frac{[E(R_m) - R_f]}{\sigma_m} = 0.7 \times 40\% = 28\%$$

37. A risk manager is evaluating a portfolio of equities with an annual volatility of 12.1% per year that is benchmarked to the Straits Times Index. If the risk-free rate is 2.5% per year, based on the regression results given in the chart below, what is the Jensen's alpha of the portfolio?



- A. 0.4936%
- B. 0.5387%
- C. 1.2069%
- D. 3.7069%

Answer: D

Excess Return on Portfolio = $0.4936 \times \text{Excess Return on Market} + 3.7069$

$$E(R_p) - R_f = 0.4936 \times [E(R_M) - R_f] + 3.7069$$

$$\begin{aligned} \text{Jensen's alpha} &= E(R_p) - \{R_f + \beta[E(R_M) - R_f]\} \\ &= E(R_p) - R_f - \beta[E(R_M) - R_f] \\ &= 3.7069 \end{aligned}$$

The Jensen's alpha is equal to the y-intercept, or the excess return of the portfolio when the excess market return is zero. Therefore it is 3.7069%.

● Key Point: APT Model and Multi-factor Model

1. **APT** is a general theory of asset pricing that holds that the expected return of a financial asset can be modeled as a linear function of various macro-economic factors or theoretical market indices, where sensitivity to changes in each factor is represented by a factor-specific beta coefficient.

2. Multi-Factor Model

Inputs:

- 1) Expected return for the stock.
- 2) Factor betas, also known as factor sensitivities or factor loadings.
- 3) Deviation of macroeconomic factors from their expected values.
- 4) Firm-specific return.

$$E(r_j) = r_f + \beta_{j1}RP_1 + \beta_{j2}RP_2 + \dots + \beta_{jn}RP_n$$

r_f = risk-free rate

RP_k = risk premium of the factor

3. APT vs. CAPM

- 1) The APT differs from the CAPM in that it is less restrictive in its assumptions.
- 2) The CAPM can be considered a "special case" of the APT in that the securities market line represents a single-factor model of the asset price, where beta is exposed to changes in value of the market.
- 3) While they demonstrate how exposure to systematic risk factors should influence expected returns, they do not provide much guidance regarding with risk factors, or sources of risk, should result in risk premiums.
- 4) APT: no arbitrage chance. CAPM: risk-return dominance arguments.

38. Which of the following is least likely to be one of the inputs to a multifactor model?

- A. The mean-variance efficient market portfolio
- B. Factor betas

- C. Deviation of factor values from their expected values
- D. Firm-specific returns

Answer: A

The mean-variance efficient market portfolio is essential to the capital asset pricing model, but is not required in multifactor models.

39. Suppose an analyst examines expected return for the Broad Band Company (BBC) base on a 2-factor model. Initially, the expected return for BBC equals 10%. The analyst identifies GDP and 10-year interest rates as the two factors for the factor model. Assume the following data is used:

GDP growth consensus forecast = 6%

Interest rate consensus forecast = 3%

GDP factor beta for BBC = 1.5

Interest rate factor beta for BBC = -1.00

Suppose GDP ends up growing 5% and the 10-year interest rate ends up equaling 4%. Also assume that during the period, the Broad Band Company unexpectedly experiences shortage of key inputs, causing its revenues to be less than originally expected. Consequently, the firm-specific return is -2% during the period. Using the 2-factor model with the revised data, which of the following expected returns for BBC is correct?

- A. 1.5%
- B. 3.5%
- C. 5.5%
- D. 6.5%

Answer: C

$$R_{BBC} = E(R_{BBC}) + \beta_{BBC,GDP} F_{GDP} + \beta_{BBC,IR} F_{IR} + e_{BBC}$$

$$R_{BBC} = 0.10 + 1.5(-0.01) - 1(0.01) - 0.02 = 0.055 = 5.5\%$$

40. Which of the following statements is least likely a requirement for an arbitrage opportunity? The arbitrage situation leads to a:
- A. Risk-free opportunity
 - B. Zero net investment opportunity
 - C. Profitable opportunity
 - D. Return in excess of the risk-free rate opportunity

Answer: D

An arbitrage situation exists if a risk-free, zero net investment can be created that produces a positive

profit. The arbitrage return need not exceed the risk-free rate.

41. Which of the following assumptions is not made when forming a single-factor security market line?

- A. Security returns are described by a factor model.
- B. A mean-variance efficient market portfolio exists.
- C. Well-diversified portfolio can be formed.
- D. No arbitrage opportunities exist.

Answer: B

The derivation of the single-factor security market line does not rely on the assumption that a mean-variance efficient market portfolio exists. This is in contrast with the capital asset pricing model, which relies on the existence of the mean-variance efficient market portfolio.

42. Suppose Portfolio P has factor betas of 0.40 and 0.50 on two risk factors (risk factors 1 and 2, respectively). Assume a portfolio manager wishes to hedge away all of the exposure to the two risk factors, yet does not want to sell the portfolio. Which of the following strategies is expected to achieve the desired result?

- A. Short sell a hedge portfolio that allocates 40% to the first factor portfolio, 50% to the second factor portfolio, and 10% to the risk-free asset.
- B. Short sell a hedge portfolio that allocates 90% to the market portfolio and 10% to the risk-free asset.
- C. Buy a hedge portfolio that allocates 40% to the first factor portfolio, 50% to the second factor portfolio, and 10% to the risk-free asset.
- D. Buy a hedge portfolio that allocates 90% to the market portfolio and 10% to the risk-free asset.

Answer: A

A factor portfolio is a well-diversified portfolio that has a factor beta equal to one for a single risk factor, and factor betas equal to zero on the remaining factors. By shorting the hedge portfolio, the investor will offset the factor risks of the original portfolio. In this case, the 0.40 and 0.50 exposures to the two risk factors are offset by the short position in the hedge portfolio that also has 0.40 and 0.50 exposures to the two risk factors.

43. An analyst is estimating the sensitivity of the return of stock A to different macroeconomic factors.

He prepares the following estimates for the factor betas:

$$\beta_{\text{Industrial production}} = 1.3 \quad \beta_{\text{Interest rate}} = -0.75$$

Under baseline expectations, with industrial production growth of 3% and an interest rate of 1.5%, the expected return for Stock A is estimated to be 5%.

The economic research department is forecasting an acceleration of economic activity for the following year, with GDP forecast to grow 4.2% and interest rates increasing 25 basis points to 1.75%.

What return of Stock A can be expected for next year according to this forecast?

- A. 4.8%
- B. 6.4%
- C. 6.8%
- D. 7.8%

Answer: B

The expected return for Stock A equals the expected return for the stock under the baseline scenario, plus the impact of "shocks", or excess returns of, both factors. Since the baseline scenario incorporates 3% industrial production growth and a 1.5% interest rate, the "shocks" are 1.2% for the GDP factor and 0.25% for the interest rate factor.

Therefore the expected return for the new scenario

$$\begin{aligned} &= \text{Baseline scenario expected return} + \beta_{\text{Industrial production}} \times \text{Industrial production shock} + \beta_{\text{Interest rate}} \times \text{Interest rate shock} \\ &= 5\% + (1.3 \times 1.2\%) + (-0.75 \times 0.25\%) = 6.37\% \end{aligned}$$

● Key Point: Financial Disasters

Metallgesellschaft:

- Stack-and-roll hedging strategy (Long futures)
- ✓ Basis risk, Liquidity risk

LTCM:

- **Relative value strategies:** arbitraging price difference among similar securities and profiting when the prices converged.
- **Credit spread:** betting that the credit spread tended to revert to average historical levels.
- **Equity volatility:** betting that the volatility on equity options tended to revert to long-term average levels.
- ✓ Reasons for failure: Extreme leverage, a lack of diversification, inadequate risk models, liquidity risk.

Sumitomo (Yasuo Hamanaka)

- Long position in futures contracts

- Purchased large quantities of physical copper
- Short put options on copper
- ✓ Operational risk

Barings (Nick Leeson)

- Selling straddles on the Nikkei 225: selling calls and puts.
- Arbitrating price differences on Nikkei 225 futures contracts that were trading on different exchanges: long-long futures position on both exchanges in hope of profiting from an increase in the Nikkei 225.
- ✓ Operational risk, dual roles

Kinder Peabody (Orlando Joseph Jett 交易员吉特)

- Artificially inflating reported profits.
- When ultimately corrected in April 1994, \$350 million in previously reported gains had to be reversed.
- ✓ Operational risk, not account for a forward contract's present value.

Société Générale

- To hide the size and riskiness of unauthorized positions in futures contracts and equity securities, Kerviel created fake transactions that offset the price movements of the actual positions.
- Created close to 1,000 fictitious trades before the fraud was finally discovered.
- ✓ Operational risk, the inability of the bank's trading system to consider gross positions.

44. The collapse of Long Term Capital Management (LTCM) is a classic risk management case study. Which of the following statements about risk management at LTCM is correct?

- A. LTCM had no active risk reporting.
- B. At LTCM, stress testing became a risk management department exercise that had little influence on the firm's strategy.
- C. LTCM's use of high leverage is evidence of poor risk management.
- D. LTCM failed to account properly for the illiquidity of its largest positions in its risk calculations.

Answer: D

A major contributing factor to the collapse of LTCM is that it did not account properly for the illiquidity of its largest positions in its risk calculations. LTCM received valuation reports from dealers who only knew a small portion of LTCM's total position in particular securities, therefore understating LTCM's true liquidity risk. When the markets became unsettled due to the Russian debt crisis in August 1998

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and a separate firm decided to liquidate large positions which were similar to many at LTCM, the illiquidity of LTCM's positions forced it into a situation where it was reluctant to sell and create an even more dramatic adverse market impact even as its equity was rapidly deteriorating. To avert a full collapse, LTCM's creditors finally stepped in to provide \$3.65 billion in additional liquidity to allow LTCM to continue holding its positions through the turbulent market conditions in the fall of 1998. However, as a result, investors and managers in LTCM other than the creditors themselves lost almost all their investment in the fund.

45. Which of the following is a common attribute of the collapse at both Metallgesellschaft and Long-Term Capital Management (LTCM)?
- A. Cash flow problems caused by large mark to market losses.
 - B. High leverage.
 - C. Fraud.
 - D. There are no similarities between the causes of the collapse at Metallgesellschaft and LTCM.

Answer: A

Metallgesellschaft and Long Term Capital Management (LTCM) dealt in the derivatives market in huge quantities and both experienced a cash flow crisis due to the change in economic conditions. This led to huge mark-to-market losses and margin calls.

46. In late 1993, Metallgesellschaft reported losses of approximately USD 1.5 billion in connection with the implementation of a hedging strategy in the oil futures market. In 1992, the company had begun a new strategy to sell petroleum to independent retailers, on a monthly basis, at fixed prices above the prevailing market price for periods of up to 5 and even 10 years. At the same time, Metallgesellschaft implemented a hedging strategy using a large number of short-term derivative contracts such as swaps and futures on crude oil, heating oil, and gasoline on several exchanges and markets. Its approach was to buy on the derivatives market exposure to one barrel of oil for each barrel it had committed to deliver. Because of its choice of a hedge ratio, the company suffered significant losses with its hedging strategy when oil market conditions abruptly changed to:
- A. Contango, which occurs when the futures price is above the spot price.
 - B. Contango, which occurs when the futures price is below the spot price.
 - C. Normal backwardation, which occurs when the futures price is above the spot price.
 - D. Normal backwardation, which occurs when the futures price is below the spot price.

Answer: A

Oil prices fell in the fall of 1993 because of OPEC's problems adhering to its production quotas, so the

market changed into one of contango, so C and D are incorrect. In contango, the futures price is above the spot price and as a result Metallgesellschaft incurred losses on its short-dated long futures contracts, so B is incorrect and A is correct.

47. Metallgesellschaft Refining and Marketing offered customers long-term contracts with fixed prices for petroleum contracts. Their strategy to hedge this exposure:
- A. Did not account for funding risk created by a mismatch between the timing of the hedge cash flows and the contract cash flows.
 - B. Failed because of improper internal controls.
 - C. Was based on fraudulent reporting.
 - D. Suffered from poor diversification.

Answer: A

Metallgesellschaft implemented a stack-and-roll hedge strategy, which uses short-term futures contracts to hedge long-term risk exposure. The stack-and-roll hedge strategy proved ineffective due to interim funding cash outflows created by margin calls, a shift in the market from backwardation to contango, and other factors. No offsetting interim cash inflows were available on their long-term customer contracts, creating a liquidity crisis that was exacerbated by their size of their futures positions in relation to the liquidity of the market. Central themes were not diversification, fraud, or operational controls.

48. The high degree of operational risk in the Sumitomo case was illustrated by which of the following?
- I. Model risk.
 - II. Lack of informed supervisors to approve large trades.
 - III. High degree of autonomy, allowing the trader to execute highly levered positions.
 - IV. The trader's ability to keep two sets of books trading books and hide trading losses.
- A. II, III, and IV
 - B. I only
 - C. I and IV only
 - D. II and III only

Answer: A

The lack of operational oversight gave Sumitomo's copper trader the autonomy to execute large highly-levered transactions in the spot market. The large trades in the both the spot and futures market should have required the approval of a supervisor who was informed about the trader's strategies and competent to understand them. The trader's broad authority allowed him to manipulate the reporting

system and thereby hide his huge losses. Model risk is the risk that a hedging or pricing model is flawed, which is not pertinent in this case.

49. Which of the following are examples of model risk illustrated in the Long-Term Capital Management case?

- I. Poor management oversight.
 - II. Financial reporting standards.
 - III. Ignoring autocorrelation of economic shocks.
 - IV. Underestimating correlations among asset classes during economic crises.
- A. II, III, and IV only
 - B. III and IV only
 - C. I, II, III, and IV
 - D. I only

Answer: B

LTCM's models underestimated the extent to which securities prices would move together in times of economic crisis. The models also failed to anticipate that multiple economic shocks might occur in clusters through time (i.e., be positively auto-correlated) as economic history suggests. Poor management oversight and financial reporting standards are not issues in the LTCM case.

50. All of the following are reasons that Nick Lesson engaged in aggressive speculative trading in the Barings Bank collapse except:

- A. He was attempting to recover previous trading losses.
- B. Barings' lack of risk management oversight.
- C. Barings' risk management models were flawed.
- D. His authority over settlement operations allowed him to hide trading losses.

Answer: C

The collapse of Barings Bank was not an instance of flawed hedging models, but one of poor operational control. Lesson had previously incurred huge trading losses that, if revealed, would have cost him his job. In an effort to recover those losses, he abandoned his hedging strategies and speculated to recoup these losses. His influence and authority in back office operations allowed him to hide his speculative losses and report phantom profits. Lesson ignored and exceeded risk control limits, and senior management's lack of understanding about Lesson's role and oversight allowed his schemes to go undetected.

51. Barings was forced to declare bankruptcy after reporting over USD 1 billion in unauthorized

trading losses by a single trader, Nick Leeson. Which of the following statements concerning the collapse of Barings is correct?

- A. Leeson avoided reporting the unauthorized trades by convincing the head of his back office that they did not need to be reported.
- B. Management failed to investigate high levels of reported profits even though they were associated with a low-risk trading strategy.
- C. Leeson traded primarily in OTC foreign currency swaps which allowed Barings to delay cash payments on losing trades until the first payment was due.
- D. The loss at Barings was detected when several customers complained of losses on trades that were booked to their accounts.

Answer: B

Leeson was supposed to be running a low-risk, limited return arbitrage business out of his Singapore office, but in actuality he was investing in large speculative positions in Japanese stocks and interest rate futures and options. When Leeson fraudulently declared very substantial reported profits on his positions, management did not investigate the stream of large profits even though it was supposed to be associated with a low-risk strategy.

52. In October 1994, General Electric sold Kidder Peabody to Paine Webber, which eventually dismantled the firm. Which of the following led up to the sale?

- A. Kidder Peabody had its primary dealer status revoked by the Federal Reserve after it was found to have submitted fraudulent bids at US Treasury auctions.
- B. Kidder Peabody reported a large quarterly loss from highly leveraged positions, which left the company insolvent and on the verge of bankruptcy.
- C. Kidder Peabody suffered a large loss when counterparties to its CDS portfolio could not honor their contracts, which left the company with little equity.
- D. Kidder Peabody reported a sudden large accounting loss to correct an error in the firm's accounting system, which called into question the management team's competence.

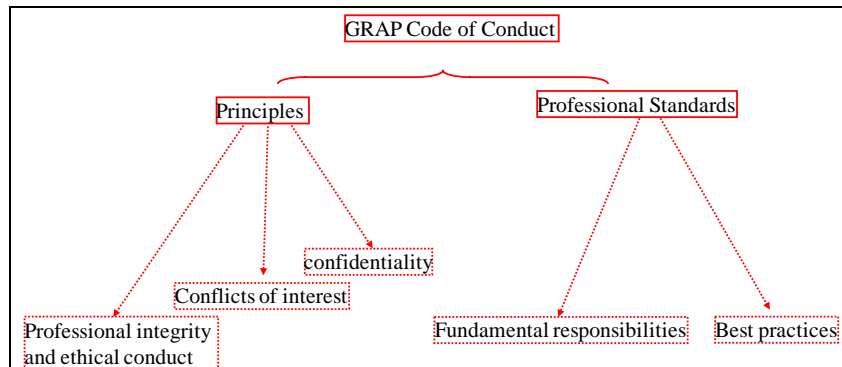
Answer: D

Kidder Peabody's accounting system failed to account for the present value of forward trades, which allowed trader Joseph Jett to book an instant, but fraudulent, accounting profit by purchasing cash bonds to be delivered at a later date. These profits would dissipate as the bonds approached their delivery date, but Jett covered this up by rolling the positions forward with increasingly greater positions and longer lengths to delivery, which created a higher stream of hypothetical profits due to the accounting flaw.

Finally this stream of large profits was investigated and Kidder Peabody was forced to take a USD 350 million accounting loss to reverse the reported gains, which resulted in a loss of confidence in the firm

and General Electric's subsequent sale.

● Key Point: GARP Code of Conduct



53. Which of the following is a potential consequence of violating the GARP Code of Conduct once a formal determination is made that such a violation has occurred?
- A. Formal notification to the GARP Member's employer of such a violation
 - B. Suspension of the GARP Member's right to work in the risk management profession
 - C. Removal of the GARP Member's right to use the FRM designation
 - D. Required participation in ethical training

Answer: C

According to the GARP Code of Conduct, violation(s) of this Code may result in, among other things, the temporary suspension or permanent removal of the GARP Member from GARP's Membership roles, and may also include temporarily or permanently removing from the violator the right to use or refer to having earned the FRM designation or any other GARP granted designation, following a formal determination that such a violation has occurred.

54. Junaid Manzoor has been hired as head of risk management by KDB Asset Management, a small investment firm in Pakistan. Manzoor implements a risk measurement framework to gauge portfolio risk for the firm. Unfortunately, the methodology he implements for risk measurement has changed considerably in recent years and is no longer used internationally. Neither Manzoor nor anyone else at the firm is aware of the changes to risk measurement approaches. As a GARP member, has Junaid violated the GARP Code of Conduct?
- A. No, this is not a violation of the GARP Code of Conduct because neither Manzoor nor the firm is aware of the changes to risk measurement approaches.
 - B. No, this is not a violation as the methodology worked when Manzoor took his FRM exams.
 - C. This is only a violation of the GARP Code of Conduct if investment decisions are made based on Manzoor's risk reports.

D. Yes, this is a violation of the GARP Code of Conduct.

Answer: D

The GARP Code of Conduct states that GARP members should be familiar with current generally accepted risk management practices.

55. Which of the following are potential consequences of violating the GARP Code of Conduct once a formal determination that such a violation has occurred is made?

- I. Suspension of the GARP Member from GARP's Membership roles.
 - II. Suspension of the GARP Member's right to work in the risk management profession.
 - III. Removal of the GARP Member's right to use the FRM designation or any other GARP granted designation.
 - IV. Required participation in ethical training.
- A. I and II only
 - B. I and III only
 - C. II and IV only
 - D. III and IV only

Answer: B

According to the GARP Code of Conduct, violation(s) of the Code may result in the temporary suspension or permanent removal of the GARP Member from GARP's Membership roles, and may also include temporarily or permanently removing from the violator the right to use or refer to having earned the FRM designation or any other GARP granted designation, following a formal determination that such a violation has occurred.

56. Isabelle Burns, FRM, is an investment advisor for a firm whose client base is composed of high net worth individuals, in her personal portfolio, Burns has an investment in Torex, a company that has developed software to speed up Internet browsing. Burns has thoroughly researched Torex and believes the company is financially strong yet currently significantly undervalued. According to the GARP Code of Conduct, Burns may:

- A. Not recommend Torex as long as she has a personal investment in the stock.
- B. Not recommend Torex to a client unless her employer gives written consent to do so.
- C. Recommend Torex to a client, but she must disclose her investment in Torex to the client.
- D. Recommend Torex to a client without disclosure as long as it is a suitable investment for the client.

Answer: C

Standards 2.1 and 2.2 - Conflicts of Interest. Members and candidates must act fairly in all situations and must fully disclose any actual or potential conflict to all affected parties. Sell-side members and candidates should disclose to their clients any ownership in a security that they are recommending.

57. Beth Anderson, FRM, is a portfolio manager for several wealthy clients including Reuben Carlyle. Anderson manages Carlyle's personal portfolio of stock and bond investments. Carlyle recently told Anderson that he is under investigation by the IRS for tax evasion related to his business, Carlyle Concrete (CC). After learning about the investigation, Anderson proceeds to inform a friend at a local investment bank so that they may withdraw their proposal to take CC public. Which of the following is most likely correct? Anderson:

- A. Violated the Code by failing to immediately terminate the client relationship with Carlyle.
- B. Violated the Code by failing to maintain the confidentiality of her client's information.
- C. Violated the Code by failing to detect and report the tax evasion to the proper authorities.
- D. Did not violate the Code since the information she conveyed pertained to illegal activities on the part of her client.

Answer: B

Anderson must maintain the confidentiality of client information according to Standard 3.1. Confidentiality may be broken in instances involving illegal activities on the part of the client, but the client's information may only be relayed to proper authorities. Anderson did not have the right to inform the investment bank of her client's investigation.

58. Over the past two days, Lorraine Quigley, FRM, manager of a hedge fund, has been purchasing large quantities of Craeger Industrial Products' common stock while at the same time shorting put options on the same stock. Quigley did not notify her clients of the trades although they are aware of the fund's general strategy to generate returns. Which of the following statements is most likely correct? Quigley:

- A. Did not violate the Code.
- B. Violated the Code by manipulating the prices of publicly traded securities.
- C. Violated the Code by failing to disclose the transactions to clients before they occurred.
- D. Violated the Code by failing to establish a reasonable and adequate basis before making the trades.

Answer: A

A Quigley's trades are most likely an attempt to take advantage of an arbitrage opportunity that exists between Craeger's common stock and its put options. She is not manipulating the prices of securities in an attempt to mislead market participants. She is pursuing a legitimate investment strategy. Participants

in her hedge fund are aware of the fund's investment strategy, and thus Quigley did not violate the Code by not disclosing this specific set of trades in advance of trading (Standards 2.1 and 5.1).

59. Jack Schleifer, FRM, is an analyst for Brown Investment Managers (BIM). Schleifer has recently accepted an invitation to visit the facilities of ChemCo, a producer of chemical compounds used in a variety of industries. ChemCo offers to pay for Schleifer's accommodations in a penthouse suite at a luxury hotel and allow Schleifer to use the firm's private jet to travel to its three facilities located in New York, Hong Kong, and London. In addition, ChemCo offers two tickets to a formal high-society dinner in New York. Schleifer declines to use ChemCo's corporate jet or to allow the firm to pay for his accommodations but accepts the tickets to the dinner (which he discloses to his employer) since he will be able to market his firm's mutual funds to other guests at the dinner. Has Schleifer violated the CFP Code of Conduct?
- A. Yes.
 - B. No, since he is using the gifts accepted to benefit his employer's interests.
 - C. No, since the gifts he accepted were fully disclosed in writing to his employer.
 - D. No, since the gift he accepted is of nominal value and he declined to accept the hotel accommodations and the use of ChemCo's jet.

Answer: A

CFP Members must not offer, solicit, or accept any gift, benefit, compensation, or consideration that could be reasonably expected to compromise their own or another's independence and objectivity. Schleifer has appropriately rejected the offer of the hotel accommodations and the use of ChemCo's jet. However, Schleifer cannot accept the tickets to the dinner. Since it is a formal high-society dinner, the tickets are most likely expensive or hard to come by. Even though he has disclosed the gift to his employer and he plans to use the dinner as a marketing opportunity for his firm, the gift itself may influence Schleifer's future research in favor of ChemCo. Allowing such potential influence is a violation of Professional Integrity and Ethical Conduct (Standard 1.2).

60. Beth Bixby, FRM, oversees a mid-cap fund that is required to invest in a minimum of 40 and a maximum of 60 different issues. Bixby uses a quantitative approach to actively manage the assets. In promotional materials, she states that "through our complex quantitative approach, securities are selected that have similar exposures to a number of risk factors that are found in the S&P 500 Index. Thus the fund is designed to track the performance of the S&P 500 Index but will receive a return premium of between 2% and 4% according to our model's risk-return measures." This statement is:
- A. Permissible since the assertion is supported by modern portfolio theory and estimates from the firm's model.

- B. Not permissible since Bixby is misrepresenting the services that she and/or her firm are capable of performing.
- C. Not permissible since Bixby is misrepresenting the investment performance she and/or her firm can reasonably expect to achieve.
- D. Permissible since the statement describes the basic characteristics of the fund's risk and return objectives.

Answer: C

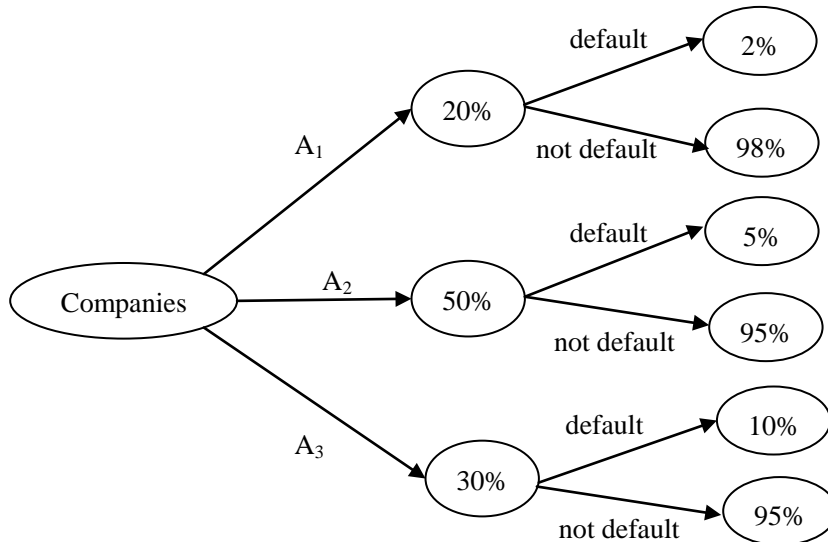
It is not reasonable for Bixby to expect a 40-to-60 stock mid-cap portfolio to track the entire S&P 500 Index, which is a large-cap index. She should know that there will be periods of wide variance between the performance of the portfolio and the S&P 500 index. There is no assurance that a premium of 2% to 4% will consistently be obtained. Biaby is in violation of Standard 1.4: "GARP Members shall not knowingly misrepresent details relating to analysis, recommendations, actions, or other professional activities," since she has made an implicit guarantee of the fund's expected performance.

Part 2 Quantitative Analysis

● Key Point: Total Probability Formula and Bayes' formula

$$P(B) = P(A_1)P(B|A_1) + P(A_2)P(B|A_2) + \dots + P(A_n)P(B|A_n)$$

$$P(A_1|B) = \frac{P(B|A_1)}{P(B)} \times P(A_1)$$



61. Half of the mortgages in a portfolio are considered subprime. The principal balance of half of the subprime mortgages and one-quarter of the non-subprime mortgages exceeds the value of the property used as collateral. If you randomly select a mortgage from the portfolio for review and its principal balance exceeds the value of the collateral, what is the probability that it is a subprime mortgage?

- A. 1/4
- B. 1/3
- C. 1/2
- D. 2/3

Answer: D

Assume: A = event that the loan is subprime

B = event that the face value of the loan exceeds that the property

$$P(A) = 1/2$$

$$P(A') = 1/2$$

$$P(B|A) = 1/2$$

$$P(B|A') = 1/4$$

$$P(A|B) = P(B|A) \cdot P(A) / [P(B|A) \cdot P(A) + P(B|A') \cdot P(A')]$$

$$P(A|B) = (1/2 \cdot 1/2) / (1/2 \cdot 1/2 + 1/4 \cdot 1/2) = (1/4) / (1/4 + 1/8) = (1/4) / (3/8) = 8/12 = 2/3$$

62. Suppose there are two events A and B. The probability of A occurrence equals that of B. $P(AB) = 4\%$. If event A occurred, the probability of B occurs is 80%. What is the probability of neither occurs?
- A. 86%
B. 90%
C. 94%
D. 96%

Answer: C

$$P(AB) = P(A)P(B|A) = 4\% = P(A) \times 80\% \Rightarrow P(A) = 5\% = P(B)$$

$$1 - [P(A) + P(B) - P(AB)] = 94\%$$

63. An analyst develops the following probability distribution about the state of the economy and the market.

Initial Probability P(A)	Conditional Probability P(B A)
Good economy 60%	Bull market 50%
	Normal market 30%
	Bear market 20%
Poor economy 40%	Bull market 20%
	Normal market 30%
	Bear market 50%

Which of the following statements about this probability distribution is least likely accurate?

- A. The probability of a normal market is 0.30.
B. The probability of having a good economy and a bear market is 0.12.
C. Given that the economy is good, the chance of a poor economy and a bull market is 0.15.
D. Given that the economy is poor, the combined probability of a normal or a bull market is 0.50.

Answer: C

Given that the economy is good, the probability of a poor economy and a bull market is zero. The other statements are true. The $P(\text{normal market}) = (0.60 \times 0.30) + (0.40 \times 0.30) = 0.30$. $P(\text{good economy and bear market}) = 0.60 \times 0.20 = 0.12$. Given that the economy is poor, the probability of a normal or bull market $= 0.30 + 0.20 = 0.50$.

64. In country X, the probability that a letter sent through the postal system reaches its destination is

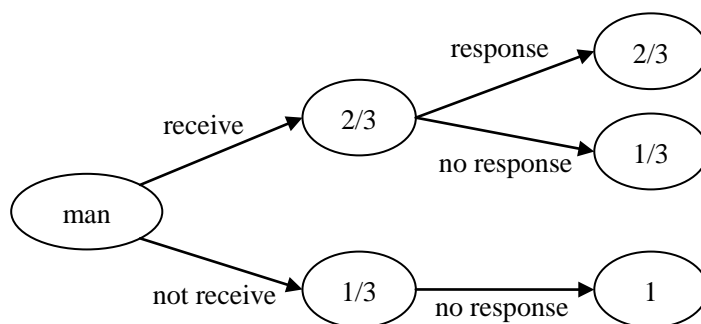
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2/3. Assume that each postal delivery is independent of every other postal delivery, and assume that if a wife receives a letter from her husband, she will certainly mail a response to her husband. Suppose a man in country X mails a letter to his wife (also in country X) through the postal system. If the man does not receive a response letter from his wife, what is the probability that his wife received his letter?

- A. 1/3
- B. 3/5
- C. 2/3
- D. 2/5

Answer: D



(Notices: if the wife did not receive the letter, she would not sent response to the man.)

Note:

A: the wife received the letter;

\bar{A} : the wife did not received the letter;

B: the man received a response letter from his wife;

\bar{B} : the man did not receive a response letter from his wife

The question “If the man does not receive a response letter from his wife, what is the probability that his wife received his letter?” is equal to figure out $P(A|\bar{B})$.

$$\begin{aligned}
 P(A|\bar{B}) &= \frac{P(A\bar{B})}{P(\bar{B})} = \frac{P(\bar{B}) \times P(\bar{B}|A)}{P(\bar{B}) \times P(\bar{B}|A) + P(B) \times P(\bar{B}|\bar{A})} \\
 &= \frac{\frac{2}{3} \times \frac{1}{3}}{\frac{2}{3} \times \frac{1}{3} + \frac{1}{3} \times 1} = \frac{2}{5}
 \end{aligned}$$

65. An insurance company estimates that 40% of policyholders who have only an auto policy will renew next year, and 60% of policyholders who have only a homeowner policy will renew next year. The company estimates that 80% of policyholders who have both an auto and a homeowner policy will renew at least one of those policies next year. Company records show that 65% of policyholders have an auto policy, 50% of policyholders have a homeowner policy, and 15% of

policyholders have both an auto and a homeowner policy. Using the company's estimates, what is the percentage of policyholders that will renew at least one policy next year?

- A. 20%
- B. 29%
- C. 41%
- D. 53%

Answer: D

Let:

A = event that a policyholder has an auto policy

H = event that a policyholder has a homeowners policy

Then, base on the information given:

$$P(A \text{ and } H) = 0.15$$

$$P(A \text{ and } H^c) = P(A) - P(A \text{ and } H) = 0.65 - 0.15 = 0.5$$

$$P(A^c \text{ and } H) = P(H) - P(A \text{ and } H) = 0.5 - 0.15 = 0.35$$

Therefore, the proportion of policyholders that will renew at least one policy is shown below:

$$\begin{aligned} &0.4 * P(A \text{ and } H^c) + 0.6 * P(A^c \text{ and } H) + 0.8 * P(A \text{ and } H) \\ &= 0.4 * 0.5 + 0.6 * 0.35 + 0.8 * 0.15 = 0.53 \end{aligned}$$

66. An analyst is examining a portfolio that consists of 600 subprime mortgages and 400 prime mortgages. Of the subprime mortgages, 120 are late on their payments. Of the prime mortgages, 40 are late on their payments. If the analyst randomly selects a mortgage from the portfolio and it is currently late on its payments, what is the probability that it is a subprime mortgage?

- A. 60%
- B. 67%
- C. 75%
- D. 80%

Answer: C

In order to solve this conditional probability question, first calculate the probability that any one mortgage in the portfolio is late. This is: $P(\text{Mortgage is late}) = (120 + 40)/1000 = 16\%$.

Next use the conditional probability relationship as follows:

$$P(\text{Mortgage subprime} | \text{Mortgage is late}) = P(\text{Mortgage subprime and late}) / P(\text{Mortgage is late})$$

$$\text{Since } P(\text{Mortgage subprime and late}) = 120/1000 = 12\%;$$

$$\text{therefore } P(\text{Mortgage subprime} | \text{Mortgage is late}) = 12\% / 16\% = 0.75 = 75\%.$$

Hence the probability that a random late mortgage selected from this portfolio turns out to be subprime is 75%.

● Key Point: Variance and Covariance

$$\text{var}(X) = \sigma^2 = E(X - \mu)^2$$

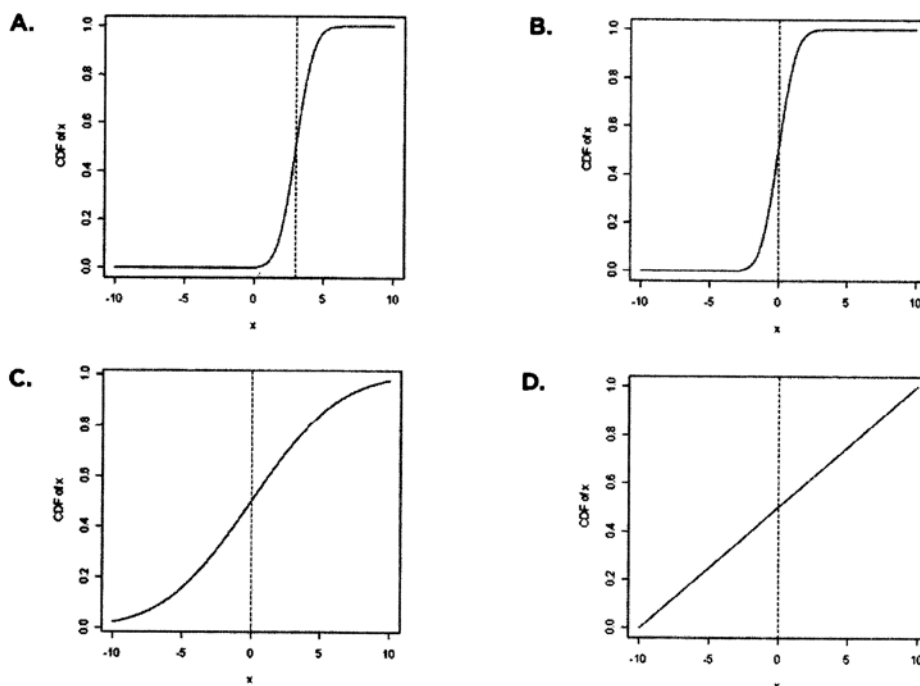
$$\text{var}(X) = E(X^2) - [E(X)]^2$$

$$\text{var}(X \pm Y) = \text{var}(X) + \text{var}(Y) \pm 2\text{cov}(X, Y)$$

$$\text{Cov}(X, Y) = E[(X - E(X))(Y - E(Y))] = E(XY) - E(X)E(Y)$$

$$\text{Cov}(ax + by, cx + dy) = ac\sigma_x^2 + bd\sigma_y^2 + (ad + bc)\text{Cov}(x, y)$$

67. The following graphs show the cumulative distribution function (CDF) of four different random variables. The dotted vertical line indicates the mean of the distribution. Assuming each random variable can only be values between -10 and 10, which distribution has the highest variance?



Answer: D

Variance is a measure of the mean deviation. In the above four graphs, it can be seen that D has the highest proportion of the distribution that deviates from the mean, and it also has a relatively higher density in both tails. Hence, D has the highest variance.

68. Roy Thomson, a global investment risk manager of FBN Bank, is assessing Markets A and B using

a two-factor model:

$$R_i = \alpha_i + \beta_{i,1}F_1 + \beta_{i,2}F_2 + \varepsilon_i$$

where R_i is the return for asset i ; β is the factor sensitivity; And F is the factor. The random error ε_i , has a mean of zero and is uncorrelated with the factors and with the random error of the other asset returns. In order to determine the covariance between Markets A and B, Thomson developed the following factor covariance matrix for global assets:

Factor Covariance Matrix for Global Assets		
	Global Equity Factor	Global Bond Factor
Global Equity Factor	0.3424	0.0122
Global Bond Factor	0.0122	0.0079

Suppose the factor sensitivities to the global equity factor are 0.70 for market A and 0.85 for Market B, and the factor sensitivities to the global bond factors are 0.30 for market A and 0.55 for Market B. The covariance between Market A and Market B is closest to:

- A. 0.213
- B. 0.461
- C. 0.205
- D. 0.453

Answer: A

Covariance is a measure of how the variables move together.

$$\begin{aligned} \text{Cov}(A, B) &= \beta_{A,1}\beta_{B,1}\sigma_{F1}^2 + \beta_{A,2}\beta_{B,2}\sigma_{F2}^2 + (\beta_{A,1}\beta_{B,2} + \beta_{A,2}\beta_{B,1})\text{Cov}(F_1, F_2) \\ &= (0.70)(0.85)(0.3424) + (0.30)(0.55)(0.0079) + [(0.70)(0.55) + (0.30)(0.85)](0.0122) \\ &= 0.213 \end{aligned}$$

69. Let X and Y be two random variables representing the annual returns of two different portfolios. If $E[X] = 3$, $E[Y] = 4$ and $E[XY] = 11$, then what is $\text{Cov}[X, Y]$?

- A. -1
- B. 0
- C. 11
- D. 12

Answer: A

$$\text{Cov}(X, Y) = E(XY) - E(X)E(Y) = 11 - 3 \times 4 = -1$$

Use the following data to answer Questions 64 and 65.

Probability Matrix			
Returns	$R_B = 50\%$	$R_B = 20\%$	$R_B = -30\%$
$R_A = -10\%$	40%	0%	0%

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$R_A = 10\%$	0%	30%	0%
$R_A = 30\%$	0%	0%	30%

70. Given the probability matrix above, the standard deviation of Stock B is closest to:

- A. 0.11
- B. 0.22
- C. 0.33
- D. 0.15

Answer: C

Expected return of Stock B = $(0.4)(0.5) + (0.3)(0.2) + (0.3)(-0.3) = 0.17$

Standard deviation (R_B) = $\sqrt{0.4(0.5 - 0.17)^2 + 0.3(0.2 - 0.17)^2 + 0.3(-0.3 - 0.17)^2} = 0.3318$

71. Given the probability matrix above, the covariance between Stock A and B is closest to:

- A. -0.160
- B. -0.055
- C. 0.004
- D. 0.020

Answer: B

$\text{Cov}(R_A, R_B) = 0.4(-0.1 - 0.08)(0.5 - 0.17) + 0.3(0.1 - 0.08)(0.2 - 0.17) + 0.3(0.3 - 0.08)(-0.3 - 0.17) = -0.0546$

72. A risk manager is calculating the VaR of a fund with a data set of 25 weekly returns. The mean and standard deviation of weekly returns are 7% and 10%, respectively. Assuming that weekly returns are independent and identically distributed, what is the standard deviation of the mean of the weekly returns?

- A. 0.4%
- B. 0.7%
- C. 2.0%
- D. 10.0%

Answer: C

In order to calculate the standard deviation of the mean of weekly returns, we must divide the standard deviation of the weekly returns by the square root of the sample size. Therefore the correct answer is $10\% / \sqrt{25} = 2\%$.

● Key Point: Chebyshev's Inequality

对任何一组观测值，个体落于均值周围 k 个标准差之内的概率不小于 $1 - 1/k^2$ ，对任意 $k > 1$ 。

$$P(|X - \mu| \leq k\sigma) \geq 1 - \frac{1}{k^2}, \quad k > 1$$

At least	$1 - \frac{1}{2^2} = 1 - \frac{1}{4} = \frac{3}{4} = 75\%$	Lie within	2	Standard deviations of the mean
	$1 - \frac{1}{3^2} = 1 - \frac{1}{9} = \frac{8}{9} = 89\%$		3	
	$1 - \frac{1}{4^2} = 1 - \frac{1}{16} = \frac{15}{16} = 94\%$		4	

73. Using Chebyshev's inequality, what is the proportion of observations from a population of 250 that must lie within three standard deviations of the mean, regardless of the shape of the distribution?

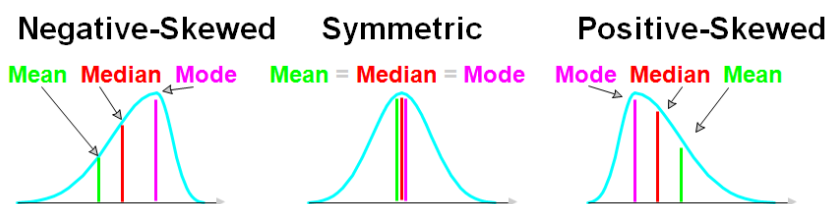
- A. 75%
- B. 99%
- C. 89%
- D. 54%

Answer: C

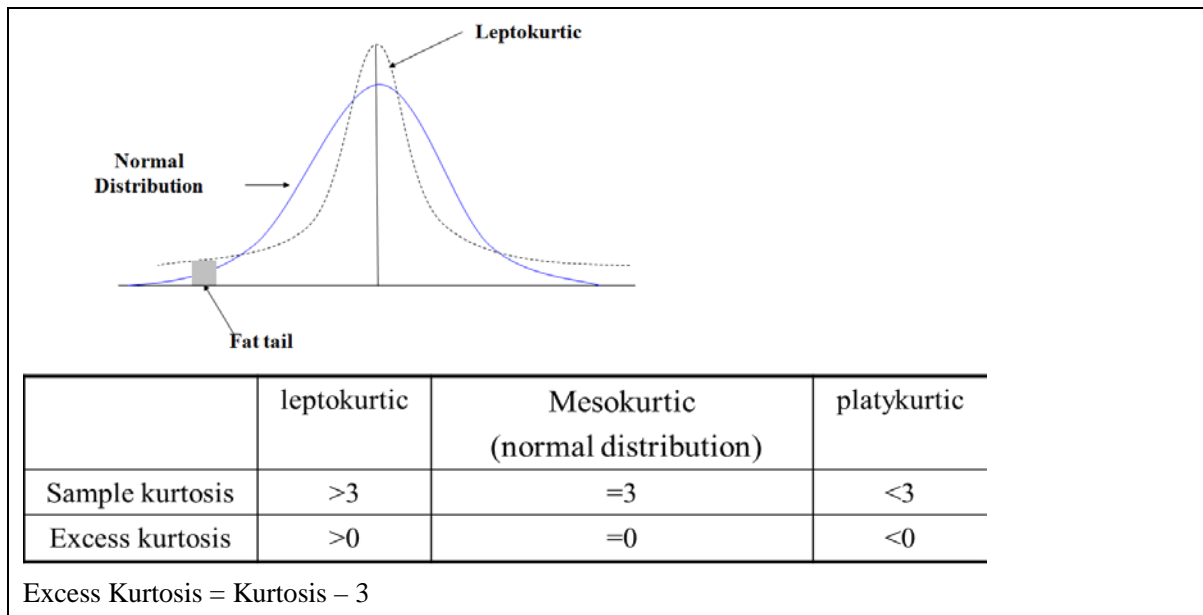
One can use Chebyshev's Inequality to calculate this proportion. $P(|X - \mu| \leq k\sigma) \geq 1 - \frac{1}{k^2}$, so is $1 - (1/3)^2 = 89\%$.

● Key Point: Skewness & Kurtosis

Skewness: $S = \frac{E(X - \mu)^3}{\sigma^3}$



Kurtosis: $K = \frac{E(X - \mu)^4}{\sigma^4}$



74. An analyst gathered the following information about the return distributions for two portfolios during the same time period:

Portfolio	Skewness	Kurtosis
A	-1.6	1.9
B	0.8	3.2

The analyst states that the distribution for Portfolio A is more peaked than a normal distribution and that the distribution for Portfolio B has a long tail on the left side of the distribution. Which of the following is correct?

- A. The analyst's assessment is correct.
- B. The analyst's assessment is correct for Portfolio A and incorrect for portfolio B.
- C. The analyst's assessment is incorrect for Portfolio A but is correct for portfolio B.
- D. The analyst is incorrect in his assessment for both portfolios.

Answer: D

The analyst's statement is incorrect in reference to either portfolio. Portfolio A has a kurtosis of less than 3, indicating that it is less peaked than a normal distribution (platykurtic). Portfolio B is positively skewed (long tail on the right side of the distribution).

75. Which of the following exhibit positively skewed distributions?

- I. Normal Distribution
 - II. Lognormal Distribution
 - III. The Returns of Being Short a Put Option
 - IV. The Returns of Being Long a Call Option
- A. II only

- B. III only
- C. II and IV only
- D. I, III, and IV only

Answer: C

A lognormal distribution is positively skewed because it cannot contain negative values. The returns on a long call position cannot be more negative than the premium paid for the option but has unlimited potential positive value, so it will also be positively skewed.

76. Which type of distribution produces the lowest probability for a variable to exceed a specified extreme value X which is greater than the mean assuming the distributions all have the same mean and variance?
- A. A leptokurtic distribution with a kurtosis of 4
 - B. A leptokurtic distribution with a kurtosis of 8
 - C. A normal distribution
 - D. A platykurtic distribution

Answer: D

A. Incorrect. A leptokurtic distribution has fatter tails than the normal distribution. The kurtosis indicates the level of fatness in the tails, the higher the kurtosis, the fatter the tails. Therefore, the probability of exceeding a specified extreme value will be higher.

B. Incorrect. Since answer A. has a lower kurtosis, a distribution with a kurtosis of 8 will necessarily produce a larger probability in the tails.

C. Incorrect. By definition, a normal distribution has thinner tails than a leptokurtic distribution and larger tails than a platykurtic distribution.

D. Correct. By definition, a platykurtic distribution has thinner tails than both the normal distribution and any leptokurtic distribution. Therefore, for an extreme value X, the lowest probability of exceeding it will be found in the distribution with the thinner tails.

77. An analyst is concerned with the symmetry and peakedness of a distribution of returns over a period of time for a company she is examining. She does some calculations and finds that the median return is 4.2%, the mean return is 3.7%, and the mode return is 4.8%. She also finds that the measure of kurtosis is 2. Based on this information, the correct characterization of the distribution of returns over time is:

<u>Skewness</u>	<u>Kurtosis</u>
-----------------	-----------------

- | | |
|-------------|-------------|
| A. Positive | Leptokurtic |
| B. Positive | Platykurtic |

- C. Negative Platykurtic
- D. Negative Leptokurtic

Answer: C

78. In looking at the frequency distribution of weekly crude oil price changes between 1984 and 2008, an analyst notices that the frequency distribution has a surprisingly large number of observations for extremely large positive price changes and a smaller number, but still a surprising one of observations for extremely large negative price changes. The analyst provides you with the following statistical measures. Which measures would help you identify these characteristics of the frequency distribution?

- I. Serial correlation of weekly price changes
 - II. Variance of weekly price changes
 - III. Skewness of weekly price changes
 - IV. Kurtosis of weekly price changes
- A. I, II, III and IV
 - B. II only
 - C. III and IV only
 - D. I, III and IV only

Answer: C

The question considers a skewed leptokurtic distribution. To measure the magnitude of these skewed tails, the analyst needs to consider both the skewness and kurtosis.

● Key Point: The Central Limit Theorem

If $x_1, x_2 \dots x_n$ represent n independent identically distributed random variables with mean μ and a finite variance σ^2 , regardless of the distribution of these n variables, as $n \rightarrow \infty$, the distribution of the sample mean $\bar{X} = \sum X_i / n$ is close to the normal distribution with mean μ and variance σ^2 / n .

79. If the mean P/E of 30 stocks in a certain industrial sector is 18 and the sample standard deviation is 3.5, standard error of the mean is CLOSEST to:

- A. 0.12
- B. 0.34
- C. 0.64
- D. 1.56

Answer: C

The standard error of the sample mean is the standard deviation of the distribution of the sample means.

And it is calculated as:

$\sigma_{\bar{x}} = \sigma / \sqrt{n}$, where σ , the population standard deviation is known.

$S_{\bar{x}} = S / \sqrt{n}$, where S , is the sample standard deviation.

So, standard error of the mean = $S / \sqrt{n} = 0.64$.

● Key Point: Distribution

➤ Bernoulli Distribution

$$p(x) = \begin{cases} p, & x=1 \\ 1-p, & x=0 \end{cases}$$

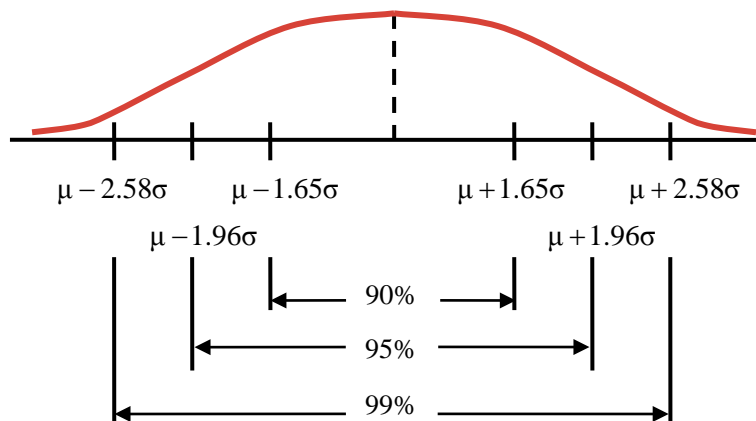
➤ Binomial distribution

$$p(x) = P(X = x) = C_n^x p^x (1-p)^{n-x} = \frac{n!}{x!(n-x)!} p^x (1-p)^{n-x}$$

	Expectation	Variance
Bernoulli random variable (Y)	p	p(1-p)
Binomial random variable (X)	np	np(1-p)

➤ Normal Distribution

$$\bar{X} \sim N(\mu, \sigma^2) \rightarrow Z = \frac{(\bar{X} - \mu)}{\sigma / \sqrt{n}} \sim N(0, 1)$$



➤ Lognormal Distribution

$$\ln X \sim N(\mu, \sigma^2)$$

If $\ln X$ is normal, then X is lognormal; if a variable is lognormal, its natural log is normal.

➤ Poisson Distribution

$$P(X = x) = \frac{\lambda^x e^{-\lambda}}{x!}$$

➤ t-Distribution

$$t = \frac{\bar{X} - \mu}{S / \sqrt{n}} \sim t_{(n-1)}$$

Fatter tail than normal distribution.

➤ **Chi-Square Distribution**

$$(n-1)\left(\frac{S^2}{\sigma^2}\right) \sim \chi^2_{(n-1)}$$

➤ **F-Distribution**

$$F = \frac{S_1^2}{S_2^2} \sim F_{(n_1-1), (n_2-1)}, (S_1 > S_2)$$

80. For a sample of the past 30 monthly stock returns for McCreary, Inc., the mean return is 4% and the sample standard deviation is 20%. Since the population variance is unknown, the standard error of the sample is estimated to be:

$$S_x = \frac{20\%}{\sqrt{30}} = 3.65\%$$

The related t-table values are ($t_{i,j}$ denotes the $(100-j)^{\text{th}}$ percentile of t-distribution value with i degrees of freedom):

$t_{29,25}$	2.045
$t_{29,50}$	1.699
$t_{30,25}$	2.042
$t_{29,50}$	1.697

What is the 95% confidence interval for the mean monthly return?

- A. [-3.453%, 11.453%]
- B. [-2.201%, 10.201%]
- C. [-2.194%, 10.194%]
- D. [-3.464%, 11.464%]

Answer: D

Here the t-reliability factor is used since the population variance is unknown. Since there are 30 observations, the degrees of freedom are $30 - 1 = 29$. The t-test is a two-tailed test. So the correct critical t-value is $t_{29,25} = 2.045$, thus the 95% confidence interval for the mean return is:

$$\left[4\% - 2.045\left(\frac{20\%}{\sqrt{30}}\right), 4\% + 2.045\left(\frac{20\%}{\sqrt{30}}\right)\right] = [-3.464\%, 11.464\%]$$

81. A fixed income portfolio manager currently holds a portfolio of bonds of various companies. Assuming all these bonds have the same annualized probability of default and that the defaults are independent, the number of defaults in this portfolio over the next year follows which type of distribution?
- A. Bernoulli
 - B. Normal
 - C. Binomial

D. Exponential

Answer: C

The result would follow a Binomial distribution as there is a fixed number of random variables, each with the same annualized probability of default. It is not a Bernoulli distribution, as a Bernoulli distribution would describe the likelihood of default of one of the individual bonds rather than of the entire portfolio (i.e. a Binomial distribution essentially describes a group of Bernoulli distributed variables). A normal distribution is used to model continuous variables, while in this case the number of defaults within the portfolio is discrete.

82. A multiple choice exam has ten questions, with five choices per question. If you need at least three correct answers to pass the exam, what is the probability that you will pass simply by guessing?

- A. 0.8%
- B. 20.1%
- C. 67.8%
- D. 32.2%

Answer: D

The probability of an event is between 0 and 1. If these are mutually exclusive events, the probability of individual occurrences are summed. This probability follows a binomial distribution with a p-parameter of 0.2. The probability of getting at least three questions correct is $1 - [p(0) + p(1) + p(2)] = 32.2\%$.

83. A call center receives an average of two phone calls per hour. The probability that they will receive 20 calls in an 8-hour day is closest to:

- A. 5.59%
- B. 16.56%
- C. 3.66%
- D. 6.40%

Answer: A

To solve this question, we first need to realize that the expected number of phone calls in an 8-hour day is $\lambda = 2 \times 8 = 16$. Using the Poisson distribution, we solve for the probability that X will be 20.

$$P(X = x) = \frac{\lambda^x e^{-\lambda}}{x!}$$

$$P(X = 20) = 0.0559 = 5.59\%$$

84. Hedge Fund has been in existence for two years. Its average monthly return has been 6% with a standard deviation of 5%. Hedge Fund has a stated objective of controlling volatility as measured by the standard deviation of monthly returns. You are asked to test the null hypothesis that the

volatility of Hedge Fund's monthly returns is equal to 4% versus the alternative hypothesis that the volatility is greater than 4%. Assuming that all monthly returns are independently and identically normally distributed, and using the tables below, what is the correct test to be used and what is the correct conclusion at the 2.5% level of significance?

t Table: Inverse of the one-tailed probability of the Student's *t*-distribution

Df	One-tailed Probability = 5.0%	One-tailed Probability 2.5%
22	1.717	2.074
23	1.714	2.069
24	1.711	2.064

Chi-Square Table: Inverse of the one-tailed probability of the Chi-Squared distribution

Df	One-tailed Probability = 5.0%	One-tailed Probability = 2.5%
22	33.9244	36.7807
23	35.1725	38.0757
24	36.4151	39.3641

- A. *t*-test; reject the null hypothesis
- B. Chi-square test; reject the null hypothesis
- C. *t*-test; do not reject the null hypothesis
- D. Chi-square test; do not reject the null hypothesis

Answer: D

The correct test is:

Null Hypothesis

Alternative Hypothesis

Critical Region, reject the null if:

$$\sigma^2 = 4\%^2 = 0.0016$$

$$\sigma^2 > 0.0016$$

$$\frac{(24-1)(0.05)^2}{(0.04)^2} > \chi^2_{2.5, 24-1} \rightarrow 36 > 38$$

Therefore, you would not reject the null hypothesis. A chi-square test is a statistical hypothesis test whereby the sampling distribution of the test statistic is a chi-squared distribution when the null hypothesis is true.

85. Which of the following statements are TRUE?

- I. The sum of two random normal variables is also a random normal variable.
 - II. The product of two random normal variables is also a random normal variable.
 - III. The sum of two random lognormal variables is also a random lognormal variable.
 - IV. The product of two random lognormal variables is also a random lognormal variable.
- A. I and II only
 - B. II and III only
 - C. III and IV only
 - D. I and IV only

Answer: D

Normal variables are stable under addition, so that (I) is true. For lognormal variables X_1 and X_2 , we know that their logs, $\ln(X_1)$ and $\ln(X_2)$ are normally distributed. Hence, the sum of their logs, or $\ln(X_1) + \ln(X_2) = \ln(X_1 \times X_2)$ must also be normally distributed. The product is itself lognormal, so that (IV) is true.

86. Suppose that a quiz consists of 20 true-false questions. A student has not studied for the exam and just randomly guesses the answers. How would you find the probability that the student will get 8 or fewer answers correct?

- A. Find the probability that $X = 8$ in a binomial distribution with $n = 20$ and $p = 0.5$.
- B. Find the area between 0 and 8 in a uniform distribution that goes from 0 to 20.
- C. Find the probability that $X = 8$ for a normal distribution with mean of 10 and standard deviation of 5.
- D. Find the cumulative probability for 8 in a binomial distribution with $n = 20$ and $p = 0.5$.

Answer: D

A binomial distribution is a probability distribution, and it refers to the various probabilities associated with the number of correct answers out of the total sample.

The correct approach is to find the cumulative probability for 8 in a binomial distribution with $N = 20$ and $p = 0.5$. The cumulative probability is to be calculated on the basis of a binomial distribution with number of questions (n) equaling 20 and probability of a single event occurring being 50% ($p = 0.5$).

87. Assume that a random variable follows a normal distribution with a mean of 80 and a standard deviation of 24. What percentage of this distribution is not between 32 and 116?

- A. 4.56%
- B. 8.96%
- C. 13.36%
- D. 18.15%

Answer: B

$$\begin{aligned}\text{Prob}(32 \leq X \leq 116) &= \text{Prob}\left(\frac{32-80}{24} \leq \frac{X-80}{24} \leq \frac{116-80}{24}\right) \\ &= \text{Prob}(-2 \leq Z \leq 1.5) = 0.0896\end{aligned}$$

88. Using a sample size of 61 observations, an analyst determines that the standard deviation of the returns from a stock is 21%. Using a 0.05 significance level, the analyst:

- A. Can conclude that the standard deviation of returns is higher than 14%.
- B. Cannot conclude that the standard deviation of returns is higher than 14%.
- C. Can conclude that the standard deviation of returns is not higher than 14%.
- D. None of the above.

Answer: A

The required test for testing the variance is the chi-squared test.

$$\text{test statistic} = (n-1) \frac{\text{sample variance}}{\text{hypothesized variance}} = 60 \times \frac{21\%^2}{14\%^2} = 135$$

To test whether the standard deviation is higher (H_0 : standard deviation is lower than or equal to 14%), the critical value of chi-squared will be 79.08 (using $df = 60$ and $p = 0.05$). Since the test statistic is higher than the critical value, the analyst can reject the null hypothesis and concludes that the standard deviation of returns is higher than 14%.

89. The recent performance of Prudent Fund, with USD 50 million in assets, has been weak and the institutional sales group is recommending that it be merged with Aggressive Fund, a USD 200 million fund. The returns on Prudent Fund are normally distributed with a mean of 3% and a standard deviation of 7% and the returns on Aggressive Fund are normally distributed with a mean of 7% and a standard deviation of 15%. Senior management has asked you to estimate the likelihood that returns on the combined portfolio will exceed 26%. Assuming the returns on the two funds are independent, your estimate for the probability that the returns on the combined fund will exceed 26% is closest to:
- A. 1.0%
 - B. 2.5%
 - C. 5.0%
 - D. 10.0%

Answer: C

Since these are independent normally distributed random variables, the combined expected mean return is: $\mu = 0.2 \times 3\% + 0.8 \times 7\% = 6.2\%$

$$\text{Combined volatility is: } \sigma = \sqrt{0.2^2 \times 0.07^2 + 0.8^2 \times 0.15^2} = 0.121 = 12.1\%$$

$$\text{The appropriate Z-statistic is } Z = \frac{26\% - 6.2\%}{12.1\%} = 1.64$$

$$\text{And therefore } P(Z > 1.64) = 1 - 0.95 = 0.05 = 5\%$$

90. Using the prior 12 monthly returns, an analyst estimates the mean monthly return of stock XYZ to be -0.75% with a standard error of 2.70%.

ONE-TAILED T-DISTRIBUTION TABLE

Degrees of Freedom	α		
	0.10	0.05	0.025
8	1.397	1.860	2.306
9	1.383	1.833	2.262
10	1.372	1.812	2.228
11	1.363	1.796	2.201
12	1.356	1.782	2.179

Using the t-table above, the 95% confidence interval for the mean return is between:

- A. -6.69% and 5.19%
- B. -6.63% and 5.15%
- C. -5.60% and 4.10%
- D. -5.56% and 4.06%

Answer: A

The confidence interval is equal to the mean monthly return plus or minus the t-statistic times the standard error. To get the proper t-statistic, the 0.025 column must be used since this is a two-tailed interval. Since the mean return is being estimated using the sample observations, the appropriate degrees of freedom to use is equal to the number of sample observations minus 1. Therefore we must use 11 degrees of freedom and therefore the proper statistic to use from the t-distribution is 2.201.

The proper confidence interval is: $-0.75\% + /- (2.201 * 2.70\%)$ or -6.69% to $+ 5.19\%$.

91. A portfolio manager holds three bonds in one of his portfolios and each bond has a 1-year default probability of 15%. The event of default for each of the bonds is independent.

What is the probability of exactly two bonds defaulting over the next year?

- A. 1.9%
- B. 5.7%
- C. 10.8%
- D. 32.5%

Answer: B

Since the bond defaults are independent and identically distributed Bernoulli random variables, the Binomial distribution can be used to calculate the probability of exactly two bonds defaulting.

The correct formula to use is
$$= \frac{n!}{k!(n-k)!} \times p^k \times (1-p)^{n-k}$$

Where n = the number of bonds in the portfolio, p = the probability of default of each individual bond, and k = the number of defaults for which you would like to find the probability. In this case $n = 3$, $p = 0.15$, and $k = 2$.

Entering the variables into the equation, this simplifies to $3 \times 0.152 \times 0.85 = 0.0574$.

92. What is the mean and variance of the number of bonds defaulting over the next year?

- A. Mean = 0.15, variance = 0.32
- B. Mean = 0.45, variance = 0.38
- C. Mean = 0.45, variance = 0.32
- D. Mean = 0.15, variance = 0.38

Answer: B

Letting n equal the number of bonds in the portfolio and p equal the individual default probability, the formulas to use are as follows:

Mean = $n * p = 3 * 15\% = 0.45$. Variance = $n p (1-p) = 3 * .15 * .85 = 0.3825$

93. Based on 21 daily returns of an asset, a risk manager estimates the standard deviation of the asset's daily returns to be 2%. Assuming that returns are normally distributed and that there are 260 trading days in a year, what is the appropriate Chi-square test statistic if the risk manager wants to test the null hypothesis that the true annual volatility is 25% at a 5% significance level?

- A. 25.80
- B. 33.28
- C. 34.94
- D. 54.74

Answer: B

The formula for the Chi-squared test statistic is:

$(n - 1) * (\text{sample variance} / \text{hypothesis variance})$

Since we are given a daily standard deviation, we must first annualize it by multiplying it by the square root of the number of trading days. Therefore:

Sample volatility = $\text{sqrt}(260) 2\% = 32.25\%$

And the Chi-squared test statistic = $(21 - 1) * 0.3225^2 / 0.25^2 = 33.28$

● Key Point: Type I & Type II errors

The P (Type I error) equals to the significance level α .

True Condition		
Decision	H_0 is true	H_0 is false
Do not reject H_0	Correct decision	Incorrect decision Type II error
Reject H_0	Incorrect decision Type I error Significance level, α , =P(Type I error)	Correct decision Power of the test =1 - P(Type II error)

Given the sample size, Type I and II errors cannot be reduced simultaneously.

Decision Rule:

- With critical value:
 - ✓ Reject H_0 if $|\text{test statistic}| > \text{critical value}$
 - ✓ Fail to reject H_0 if $|\text{test statistic}| < \text{critical value}$
- With p-value:
 - ✓ If $P\text{-value} < \alpha$, we reject null hypothesis

94. When testing a hypothesis, which of the following statements is correct when the level of significance of the test is decreased?

- A. The likelihood of rejecting the null hypothesis when it is true decreases.
- B. The likelihood of making a Type I error increases.
- C. The null hypothesis is rejected more frequently, even when it is actually false.
- D. The likelihood of making a Type II error decreases.

Answer: A

Decreasing the level of significance of the test decreases the probability of making a Type I error and hence makes it more difficult to reject the null when it is true. However, the decrease in the chance of making a Type I error comes at the cost of increasing the probability of making a Type II error, because the null is rejected less frequently, even when it is actually false.

95. An oil industry analyst with a large international bank has constructed a sample of 1,000 individual firms on which she plans to perform statistical analyses. She considers either decreasing the level of significance used to test hypotheses from 5% to 1%, or removing 500 state-run firms from her sample. What impact will these changes have on the probability of making Type I and Type II errors?

- | Level of significance decrease | Reduction in sample size |
|--------------------------------|----------------------------|
| A. P(Type I error) increases | P(Type I error) increases |
| B. P(Type I error) decreases | P(Type II error) increases |

- | | | |
|----|----------------------------|----------------------------|
| C. | P(Type II error) increases | P(Type I error) decreases |
| D. | P(Type II error) decreases | P(Type II error) decreases |

Answer: B

A Type I error is the error of rejecting a hypothesis when it is true. A Type II error is the error of accepting a false hypothesis.

A decrease in the level of significance decreases P(Type I error) but increases P(Type II error). Reducing the sample size increases P(Type II error).

96. According to the Basel back-testing framework guidelines, penalties start to apply if there are five or more exceptions during the previous year. The Type I error rate of this test is 11 percent. If the true coverage is 97 percent of exceptions instead of the required 99 percent, the power of the test is 87 percent. This implies that there is a (an):
- A. 89% probability regulators will reject the correct model.
 - B. 11% probability regulators will reject the incorrect model.
 - C. 87% probability regulators will not reject the correct model.
 - D. 13% probability regulators will not reject the incorrect model.

Answer: D

The power of the test refers to the probability of rejecting an incorrect model, which is one minus the probability of not rejecting an incorrect model. Given that the power of the test is 87 percent, the probability of a type 2 error, the probability of not rejecting the incorrect model is $1.0 - 0.87 = 13\%$.

97. Bob tests the null hypothesis that the population mean is less than or equal to 45. From a population size of 3,000,000 people, 81 observations are randomly sampled. The corresponding sample mean is 46.3 and sample standard deviation is 4.5. What is the value of the appropriate test statistic for the test of the population mean, and what is the correct decision at the 1 percent significance level?
- A. $z = 0.29$, and fail to reject the null hypothesis.
 - B. $z = 2.60$, and reject the null hypothesis.
 - C. $t = 0.29$, and accept the null hypothesis.
 - D. $t = 2.60$, and neither reject nor fail to reject the null hypothesis.

Answer: B

A is incorrect. The denominator of the z-test statistic is standard error instead of standard deviation. If the denominator takes the value of standard deviation 4.5, instead of standard error $4.5/\sqrt{81}$, the z-test statistic computed will be $z = 0.29$, which is incorrect.

B is correct. The population variance is unknown but the sample size is large (>30). The test statistics is: $z = (46.3 - 45) / (4.5 / (\text{sqrt}(81))) = 2.60$. Decision rule: reject H_0 if $z(\text{computed}) > z(\text{critical})$. Therefore, reject the null hypothesis because the computed test statistics of 2.60 exceeds the critical z-value of 2.33.

C is incorrect because z-test (instead of t-test) should be used for sample size $(81) \geq 30$.

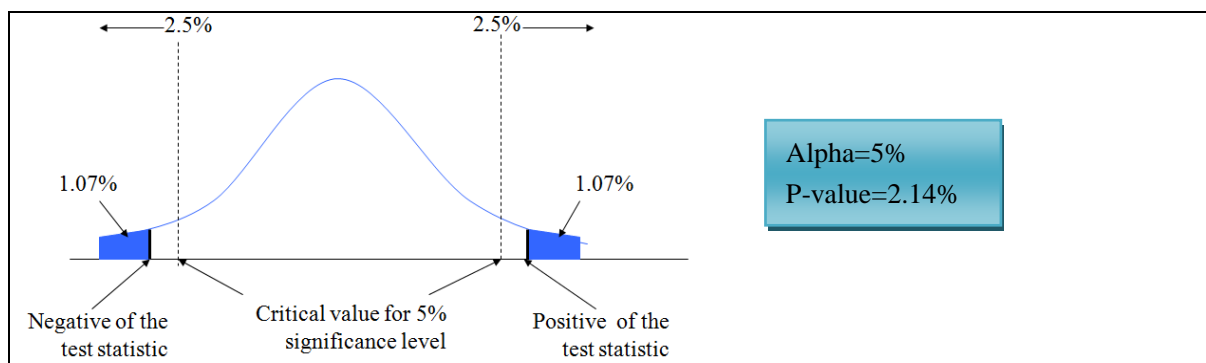
D is incorrect because z-test (instead of t-test) should be used for sample size $(81) \leq 30$.

98. Which one of the following four statements about hypothesis testing holds true if the level of significance decreases from 5% to 1%?

- A. It becomes more difficult to reject a null hypothesis when it is actually true.
- B. The probability of making a Type I error increases.
- C. The probability of making a Type II error decreases.
- D. The failure to reject the null hypothesis when it is actually false decreases to 1 %.

Answer: A

● Key Point: P-value Testing



99. Which of the following statements regarding hypothesis testing is correct?

- A. Type II error refers to the failure to reject the H_1 when it is actually false.
- B. Hypothesis testing is used to make inferences about the parameters of a given population on the basis of statistics computed for a sample that is drawn from another population.
- C. All else being equal, the decrease in the chance of making a Type I error comes at the cost of increasing the probability of making a Type II error.
- D. If the p-value is greater than the significance level, then the statistics falls into the reject intervals.

Answer: C

● Key Point: Summary of Hypothesis Testing

Test type	Assumptions	H_0	Test-statistic	distribution
Mean hypothesis testing	Normally distributed population, known population variance	$\mu = 0$	$z = \frac{\bar{x} - \mu_0}{\sigma / \sqrt{n}}$	$N(0,1)$
	Normally distributed population, unknown population variance	$\mu = 0$	$t = \frac{\bar{x} - \mu_0}{s / \sqrt{n}}$	$t(n-1)$
Variance hypothesis testing	Normally distributed population	$\sigma^2 = \sigma_0^2$	$\chi^2 = \frac{(n-1)s^2}{\sigma_0^2}$	$\chi^2(n-1)$
	Two independent normally distributed populations	$\sigma_1^2 = \sigma_2^2$	$F = s_1^2 / s_2^2$	$F(n_1 - 1, n_2 - 1)$

100. An analyst wants to test whether the standard deviation of return from pharmaceutical stocks is lower than 0.2. For this purpose, he obtains the following data from a sample of 30 pharmaceutical stocks. Mean return from pharmaceutical stocks = 8%. Standard deviation of return from pharmaceutical stocks = 12%. Mean return from the market = 12%. Standard deviation of return from the market = 16%. What is the appropriate test statistic for this test?

- A. t-statistic
- B. z-statistic
- C. F-statistic
- D. χ^2 statistic

Answer: D

Tests of the variance (or standard deviation) of a population requires the chi-squared test.

101. Which of the following statements regarding Hypothesis Testing is incorrect?

- A. Hypothesis testing is used to make inferences about the parameters of a given population on the basis of statistics computed for a sample that is drawn from that population.
- B. Type II error refers to the failure to reject the null hypothesis when it is actually false.
- C. The p-value decision rule is to reject the null hypothesis if the p-value is greater than the significance level.
- D. All else being equal, the decrease in the chance of making a Type I error comes at the cost of increasing the probability of making a Type II error.

Answer: C

The true statement is to reject H_0 if the p-value is smaller than the significance level.

- A. Incorrect. Statement A is correct regarding the primary use of Hypothesis Testing.
- B. Incorrect. Statement B is correct regarding the definition of Type II error.
- D. Incorrect. Statement D is correct because Type I error and Type II error are in tradeoff.

102. An analyst is testing a hypothesis that the beta, β , of stock CDM is 1. The analyst runs an ordinary least squares regression of the monthly returns of CDM, R_{CDM} , on the monthly returns of the S&P 500 index, R_m , and obtains the following relation:

$$R_{CDM} = 0.86 R_m - 0.32$$

The analyst also observes that the standard error of the coefficient of R_m is 0.80. In order to test the hypothesis $H_0: \beta = 1$ against $H_1: \beta \neq 1$, what is the correct statistic to calculate?

- A. t-statistic
- B. Chi-square test statistic
- C. Jarque-Bera test statistic
- D. Sum of squared residuals

Answer: A

The correct test is the t test. The t statistic is defined by:

$$t = \frac{\beta_{\text{estimated}} - \beta}{SE(\text{estimated } \beta)} = \frac{0.86 - 1}{0.8}$$

In this case $t = -0.175$. Since $|t| < 1.96$ we cannot reject the null hypothesis.

103. A risk manager is examining a Hong Kong trader's profit and loss record for the last week, as shown in the table below:

Trading Day	Profit/Loss (HKD million)
Monday	10
Tuesday	80
Wednesday	90
Thursday	-60
Friday	30

The profits and losses are normally distributed with a mean of 4.5 million HKD and assume that transaction costs can be ignored. Part of the t-table is provided below:

Percentage Point of the t-Distribution			
$P(T > t) = \alpha$			
	α		
Degrees of Freedom	0.3	0.2	0.15

4	0.569	0.941	1.19
5	0.559	0.92	1.16

According to the information provided above, what is the probability that this trader will record a profit of at least HKD 30 million on the first trading day of next week?

- A. About 15%
- B. About 20%
- C. About 80%
- D. About 85%

Answer: B

When the population mean and population variance are not known, the t-statistic can be used to analyze the distribution of the sample mean.

Sample mean = $(10 + 80 + 90 - 60 + 30)/5 = 30$

Unbiased sample variance = $(1/4)[(-20)^2 + 50^2 + 60^2 + (-90)^2 + 0^2] = 14600/4 = 3650$

Unbiased sample standard deviation = 60.4152

Sample standard error = $(\text{sample standard deviation})/\sqrt{5} = 27.0185$

Population mean of return distribution = 4.5 (million HKD)

Therefore the t-statistic = $(\text{Sample mean} - \text{population mean})/\text{Sample standard error} = (30 - 4.5)/27.02 = 0.9438$.

Because we are using the sample mean in the analysis, we must remove 1 degree of freedom before consulting the t-table; therefore 4 degrees of freedom are used. According to the table, the closest possibility is 0.2 = 20%.

● Key Point: Copula

- Interdependence of returns of two or more assets is usually calculated using the correlation coefficient, which only works well with normal distributions, whereas in practice, distributions in financial markets are mostly skewed.
- Copulas are used to describe the dependence between random variables. A copula is a multivariate probability distribution for which the marginal probability distribution of each variable is uniform.
- Gaussian Copula: To use Gaussian copula, variables having marginal distributions are mapped into new variables that have standard normal distributions in order to arrive at a bivariate normal joint distribution.
- Student-t copula: This is very similar to Gaussian copula, with the exception that variables are assumed to have a bivariate Student-t distribution rather than a bivariate normal distribution.
- Tail dependence is the tendency for extreme values for two variables to occur together. Tail dependence of a pair of random variables describes their co-movements in the tails of the

distributions. The choice of the copula affects tail dependence. Tail dependence is higher in a bivariate Student t-distribution than in a bivariate normal distribution.

104. Consider the following three statements about tail dependence:

- I. Tail dependence is the tendency for extreme values for two or more variables to occur together.
- II. The choice of the copula affects tail dependence.
- III. The tail dependence is higher in a bivariate Student t-distribution than in a bivariate normal distribution

Which of the above is (are) true?

- A. None are true.
- B. Only I is true.
- C. Only III is true.
- D. All are true.

Answer: D

105. Suppose a risk manager wishes to create a correlation copula to estimate the risk of loan defaults during a financial crisis. Which type of copula will most accurately measure tail risk?

- A. Gaussian copula
- B. Student's t-copula
- C. Gaussian one-factor copula
- D. Standard normal copula

Answer: B

There is greater tail dependence in a bivariate Student's t-distribution than a bivariate normal distribution. This suggests that the student's t-copula is better than a Gaussian copula in describing the correlation structure of assets that historically have extreme outliers in tails at the same time.

● Key Point: Regression & Variance Analysis

Simple Linear Regression: $Y_i = B_0 + B_1 \times X_i + \varepsilon_i$

Ordinary least squares (OLS):

$$\text{minimize } \sum e_i^2 = \sum [Y_i - (b_0 + b_1 \times X_i)]^2$$

$$\text{minimize } \sum e_i^2 = \sum [Y_i - (b_0 + \sum_{i=1}^k b_i \times X_i)]^2$$

The Assumptions of Classical Linear Regression Model:

- A linear relationship exists between X and Y;
- X is uncorrelated with the error term;
- The expected value of the error term is zero;
- The variance of the error term is constant (i.e., the error terms are homoskedastic);
- The error term is uncorrelated across observations;
- The error term is normally distributed.

Regression Assumption Violations:

- Heteroskedasticity occurs when the variance of the residuals is not rho same across all observations in the sample.
- Multicollinearity refers to the condition when two or more of the independent variables, or linear combinations of the independent variables, in a multiple regression are highly correlated with each other.
- Serial correlation refers to the situation in which the residual terms are correlated with one another.

Analysis of Variance (ANOVA) Table:

	df	SS	MSS
Regression	k=1	ESS	ESS/k
Residual	n-2	RSS	RSS/(n-2)
Total	n-1	TSS	-

Total sum of squares = explained sum of squares + sum of squared residuals

$$\begin{aligned} \sum (Y_i - \bar{Y})^2 &= \sum (\hat{Y} - \bar{Y})^2 + \sum (Y_i - \hat{Y})^2 \\ \text{TSS} &= \text{ESS} + \text{SSR} \\ R^2 &= \frac{\text{ESS}}{\text{TSS}} = 1 - \frac{\text{SSR}}{\text{TSS}}; \quad \rho = \pm \sqrt{R^2} \end{aligned}$$

Adjusted R-Squared:

$$\text{Adjusted } R^2 = 1 - (1 - R^2) \times \frac{n-1}{n-k-1}$$

Multiple Linear Regressions: $Y_i = B_0 + B_1 \times X_{1,i} + B_2 \times X_{2,i} + \varepsilon_i$

	df	SS	MSS
Regression	k	ESS	ESS/k
Residual	n-k-1	RSS	RSS/(n-k-1)
Total	n-1	TSS	-

106.Samantha Xiao is trying to get some insight into the relationship between the return on stock LMD

($R_{LMD,t}$) and the return on the S&P 500 index ($R_{S\&P,t}$). Using historical data she estimates the following:

Annual mean return for LMD	11%
Annual mean return for S&P 500 index	7%
Annual volatility for S&P 500 index	18%
Covariance between the returns of LMD and S&P 500 index	6%

Assuming she uses the same data to estimate the regression model given by:

$$R_{LMD,t} = \alpha + \beta R_{S\&P,t} + \varepsilon_t$$

Using the ordinary least squares technique, which of the following models will she obtain?

- A. $R_{LMD,t} = -0.02 + 0.54R_{S\&P,t} + \varepsilon_t$
- B. $R_{LMD,t} = -0.02 + 1.85R_{S\&P,t} + \varepsilon_t$
- C. $R_{LMD,t} = 0.04 + 0.54R_{S\&P,t} + \varepsilon_t$
- D. $R_{LMD,t} = 0.04 + 1.85R_{S\&P,t} + \varepsilon_t$

Answer: B

The regression coefficients for a model specified by $Y = bX + a + \varepsilon_i$ are obtained using the formula: $b = S_{XY}/S_X^2$, In this example: $S_{XY} = 0.06$, $S_X = 0.18$, $E(Y) = 0.11$, Then: $b = 0.06/(0.18)^2 = 1.85$, $a = E(Y) - b \times E(X) = 0.11 - 1.85 \times 0.07 = -0.02$. Where ε_i represents the error term.

107. For a sample of 400 firms, the relationship between corporate revenue (Y_i) and the average years of experience per employee (X_i) is modeled as follows:

$$Y_i = \beta_1 + \beta_2 X_i + \varepsilon_i, i = 1, 2, \dots, 400$$

You wish to test the joint null hypothesis that $\beta_1 = 0$ and $\beta_2 = 0$ at the 95% confidence level. The p-value for the t-statistic for β_1 is 0.07, and the p-value for the t-statistic for β_2 is 0.06. The p-value for the F-statistic for the regression is 0.045. Which of the following statements is correct?

- A. You can reject the null hypothesis because each β is different from 0 at the 95% confidence level.
- B. You cannot reject the null hypothesis because neither β is different from 0 at the 95% confidence level.
- C. You can reject the null hypothesis because the F-statistic is significant at the 95% confidence level.
- D. You cannot reject the null hypothesis because the F-statistic is not significant at the 95% confidence level.

Answer: C

The T-test would not be sufficient to test the joint hypothesis. In order to test the joint null hypothesis, examine the F-statistic, which in this case is statistically significant at the 95% confidence level. Thus

the null can be rejected.

108.The proper selection of factors to include in an ordinary least squares estimation is critical to the accuracy of the result. When does omitted variable bias occur?

- A. Omitted variable bias occurs when the omitted variable is correlated with the included regressor and is a determinant of the dependent variable.
- B. Omitted variable bias occurs when the omitted variable is correlated with the included regressor but is not a determinant of the dependent variable.
- C. Omitted variable bias occurs when the omitted variable is independent of the included regressor and is a determinant of the dependent variable.
- D. Omitted variable bias occurs when the omitted variable is independent of the included regressor but is not a determinant of the dependent variable.

Answer: A

Omitted variable bias occurs when a model improperly omits one or more variables that are critical determinants of the dependent variable and are correlated with one or more of the other included independent variables. Omitted variable bias results in an over-or under-estimation of the regression parameters.

109.Which of the following is assumed in the multiple least squares regression model?

- A. The dependent variable is stationary.
- B. The independent variables are not perfectly multicollinear.
- C. The error terms are heteroskedastic.
- D. The independent variables are homoskedastic.

Answer: B

One of the assumptions of the multiple regression model of least squares is that no perfect multicollinearity is present. Perfect multicollinearity would exist if one of the regressors is a perfect linear function of the other regressors.

None of the other choices are assumptions of the multiple least squares regression model.

110.Which of the following statements about the ordinary least squares regression model (or simple regression model) with one independent variable are correct?

- I. In the ordinary least squares (OLS) model, the random error term is assumed to have zero mean and constant variance.
- II. In the OLS model, the variance of the independent variable is assumed to be positively correlated with the variance of the error term.

- III. In the OLS model, it is assumed that the correlation between the dependent variable and the random error term is zero.
- IV. In the OLS model, the variance of the dependent variable is assumed to be constant.
- A. I, II, III and IV
- B. II and IV only
- C. I and IV only
- D. I, II, and III only

Answer: C

Use the following information to answer the following question .

Regression Statistics

R squared	0.8537
R sq. adj.	0.8120
Std. error	10.3892
Num obs.	10

ANOVA

	df	SS	MS	F	P-value
Explained	2	4410.4500	2205.2250	20.4309	0.0012
Residual	7	755.5500	107.9357		
Total	9	5166.0000			

	Coefficients	Std. Error	t-Stat	P-value
Intercept	35.5875	6.1737	5.7644	0.0007
X ₁	1.8563	1.6681	1.1128	0.3026
X ₂	7.4250	1.1615	6.3923	0.0004

111. Based on the results and a 5% level of significance, which of the following hypotheses can be rejected?
- I. $H_0: B_0 = 0$
- II. $H_0: B_1 = 0$
- III. $H_0: B_2 = 0$
- IV. $H_0: B_1 = B_2 = 0$
- A. I, II, and III
- B. I and IV
- C. III and IV
- D. I, III, and IV

Answer: D

The t-statistics for the intercept and coefficient on X_{2i} are significant as indicated by the associated p-values being less than 0.05: 0.0007 and 0.0004 respectively. Therefore, $H_0: B_0 = 0$ and $H_0: B_2 = 0$ can be rejected. The F-statistic on the ANOVA table has a p-value equal to 0.0012; therefore, $H_0: B_1 = B_2 = 0$ can be rejected. The p-value for the coefficient on X_{1i} is greater than five percent; therefore, $H_0: B_1 = 0$ cannot be rejected.

112. Paul Graham, FRM® is analyzing the sales growth of a baby product launched three years ago by a regional company. He assesses that three factors contribute heavily towards the growth and comes up with the following results:

$$Y = b + 1.5 X_1 + 1.2 X_2 + 3 X_3$$

$$\text{Sum of Squared Regression [SSR]} = 869.76$$

$$\text{Sum of Squared Errors [SEE]} = 22.12$$

Determine what proportion of sales growth is explained by the regression results.

- A. 0.36
- B. 0.98
- C. 0.64
- D. 0.55

Answer: B

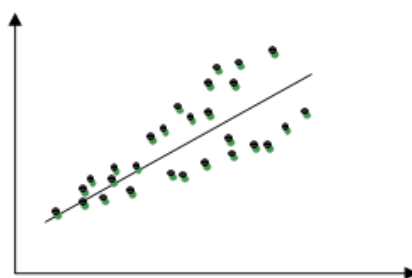
113. Many statistical problems arise when estimating relationships using regression analysis. Some of these problems are due to the assumptions behind the regression model. Which one of the following is NOT one of these problems?

- A. Stratification
- B. Multicollinearity
- C. Heteroscedasticity
- D. Autocorrelation

Answer: A

Stratification is not related to regression analysis. Choices B, C, and D describe situations that can produce inaccurate descriptions of the relationship between the independent and dependent variables. Multicollinearity occurs when the independent variables are themselves correlated, Heteroscedasticity occurs when the variances are different across observations, and autocorrelation occurs when successive observations are influenced by the proceeding observations.

114. An analyst is performing a regression. The dependent variable is portfolio return while the independent variable is the years of experience of the portfolio manager. In his analysis, the resulting scatter plot is as follow:



The analyst can conclude that the portfolio returns exhibit:

- A. Heteroskedasticity
- B. Homoskedasticity
- C. Perfect multicollinearity
- D. Non-perfect multicollinearity

Answer: A

115. A regression of a stock's return (in percent) on an industry index's return (in percent) provides the following results:

	Coefficient	Standard Error
Intercept	2.1	2.01
Industry index	1.9	0.31
	Degrees of Freedom	SS
Explained	1	92.648
Residual	3	24.512
Total	4	117.160

Which of the following statements regarding the regression is correct?

- I. The correlation coefficient between the X and Y variables is 0.889.
 - II. The industry index coefficient is significant at the 99% confidence interval.
 - III. If the return on the industry index is 4%, the stock's expected return is 10.3%.
 - IV. The variability of industry returns explains 21% of the variation of company returns.
- A. III only
 - B. I and II only
 - C. II and IV only
 - D. I, II, and IV

Answer: B

The R^2 of the regression is calculated as $ESS/TSS = (92.648/117.160) = 0.79$, which means that the variation in industry returns explains 79% of the variation in the stock return. By taking the square root of R^2 , we can calculate that the correlation coefficient (r) = 0.889. The t-statistic for the industry return

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coefficient is $1.91/0.31 = 6.13$, which is sufficiently large enough for the coefficient to be significant at the 99% confidence interval. Since we have the regression coefficient and intercept, we know that the regression equation is $R_{\text{stock}} = 1.9X + 2.1$. Plugging in a value of 4% for the industry return, we get a stock return of $1.9(4) + 2.1 = 9.7\%$.

116. A risk manager performs an ordinary least squares (OLS) regression to estimate the sensitivity of a stock's return to the return on the S&P 500. This OLS procedure is designed to:

- A. Minimize the square of the sum of differences between the actual and estimated S&P 500 returns.
- B. Minimize the square of the sum of differences between the actual and estimated stock returns.
- C. Minimize the sum of differences between the actual and estimated squared S&P 500 returns.
- D. Minimize the sum of squared differences between the actual and estimated stock returns.

Answer: D

The OLS procedure is a method for estimating the unknown parameters in a linear regression model.

The method minimizes the sum of squared differences between the actual, observed, returns and the returns estimated by the linear approximation. The smaller the sum of the squared differences between observed and estimated values, the better the estimated regression line fits the observed data points.

117. Using data from a pool of mortgage borrowers, a credit risk analyst performed an ordinary least squares regression of annual savings (in GBP) against annual household income (in GBP) and obtained the following relationship:

$$\text{Annual Savings} = 0.24 * \text{Household Income} - 25.66, R^2 = 0.50$$

Assuming that all coefficients are statistically significant, which interpretation of this result is correct?

- A. For this sample data, the average error term is GBP -25.66.
- B. For a household with no income, annual savings is GBP 0.
- C. For an increase of GBP 1,000 in income, expected annual savings will increase by GBP 240.
- D. For a decrease of GBP 2,000 in income, expected annual savings will increase by GBP 480.

Answer: C

An estimated coefficient of 0.24 from a linear regression indicates a positive relationship between income and savings, and more specifically means that a one unit increase in the independent variable (household income) implies a 0.24 unit increase in the dependent variable (annual savings). Given the equation provided, a household with no income would be expected to have negative annual savings of GBP 25.66. The error term mean is assumed to be equal to 0.

118. A risk manager has estimated a regression of a firm's monthly portfolio returns against the returns

of three U.S. domestic equity indexes: the Russell 1000 index, the Russell 2000 index, and the Russell 3000 index. The results are shown below.

Regression Statistics

Multiple R	0.9
R Square	0.9
Adjusted R Square	0.9
Standard Error	0.0
Observations	192

Regression Output	Coefficients	Standard Error	t-Stat	P-value
Intercept	0.0023	0.0006	3.530	0.0005
Russell 1000	0.1093	1.5895	0.068	0.9452
Russell 2000	0.1055	0.1384	0.762	0.4470
Russell 3000	0.3533	1.7274	0.204	0.8382

Correlation Matrix	Portfolio Returns	Russell 1000	Russell 2000	Russell 3000
Portfolio	1.000			
Russell 1000	0.937	1.000		
Russell 2000	0.856	0.813	1.000	
Russell 3000	0.945	0.998	0.845	1.000

Based on the regression results, which statement is correct?

- A. The estimated coefficient of 0.3533 indicates that the returns of the Russell 3000 index are more statistically significant in determining the portfolio returns than the other two indexes.
- B. The high adjusted R^2 indicates that the estimated coefficients on the Russell 1000, Russell 2000, and Russell 3000 indexes are statistically significant.
- C. The high p-value of 0.9452 indicates that the regression coefficient of the returns of Russell 1000 is more statistically significant than the other two indexes.
- D. The high correlations between each pair of index returns indicate that multicollinearity exists between the variables in this regression.

Answer: D

This is an example of multicollinearity, which arises when one of the regressors is very highly correlated with the other regressors. In this case, all three regressors are highly correlated with each other, so multicollinearity exists between all three. Since the variables are not perfectly correlated with each other this is a case of imperfect, rather than perfect, multicollinearity.

● Key Point: Best Linear Unbiased Estimator

Unbiasedness、Efficiency、Consistency、Linearity
The OLS estimator is BLUE.

119.If the variance of the sampling distribution of an estimator is smaller than all other unbiased estimators of the parameter of interest, the estimator is:

- A. Reliable
- B. Efficient
- C. Unbiased
- D. Consistent

Answer: B

If the probability distribution of an estimator has an expected value equal to the parameter it is supposed to be estimating, it is said to be unbiased.

Between two candidate estimators, the one with a smaller variance is said to use the information in the data more efficiently.

When the probability that an estimator is within a small interval of the true value approaches 1, it is said to be a consistent estimator.

120.Analyst Rob has identified an estimator, denoted $T(\cdot)$, which qualifies as the best linear unbiased estimator (BLUE). If $T(\cdot)$ is BLUE, which of the following must also necessarily be TRUE?

- A. $T(\cdot)$ must have the minimum variance among all possible estimators.
- B. $T(\cdot)$ must be the most efficient (the "best") among all possible estimators.
- C. It is possible that $T(\cdot)$ is the maximum likelihood (MLE) estimator of variance; i.e., $\text{SUM}([X - \text{average}(X)]^2)/(n-1)$.
- D. Among the class of unbiased estimators that are linear, $T(\cdot)$ has the smallest variance.

Answer: D

● Key Point: Modeling and Forecasting Trend

One of the ways of selecting best fit model is by estimating the Mean Squared Error (MSE) of the model. The model with least MSE would be chosen for fitting the data series. MSE is computed as:

$$\text{MSE} = \frac{\sum_{t=1}^T e_t^2}{T}$$

As degree of freedom represents the choice of freely selecting the variables during the model fitting exercise therefore, to reduce the MSE bias, the degree of freedom must be deducted from the sample size to arrive at adjusted MSE, commonly referred as S^2 .

$$S^2 = \frac{\sum_{t=1}^T e_t^2}{T - k}$$

Apart from S^2 , the other model selection criteria also resort to the technique of degree of freedom penalty for out of sample prediction. Those criteria are Akaike Information Criteria (AIC) & Schwarz

Information Criterion (SIC), which are given as follows:

$$AIC = e^{\left(\frac{2k}{T}\right)} \frac{\sum_{t=1}^T e_t^2}{T}$$

$$SIC = T^{\left(\frac{k}{T}\right)} \frac{\sum_{t=1}^T e_t^2}{T}$$

The penalty factors for s^2 , Akaike information criterion (AIC), and Schwarz information criterion (SIC) are $(T/T - k)$, $e^{(2k/T)}$, and $T^{(k/T)}$, respectively. SIC has the largest penalty factor.

121. Richard Frank, FRM, is running a regression model to forecast in-sample data. He is concerned about data mining and over-fitting the data. Which of the following criteria provides the highest penalty factor based on degrees of freedom?

- A. Mean squared error (MSE)
- B. Unbiased mean squared error (s^2)
- C. Akaike information criterion (AIC)
- D. Schwarz information criterion (SIC)

Answer: D

The Schwarz information criterion (SIC) has the highest penalty factor. The mean squared error (MSE) does not penalize the regression model based on the increased number of parameters, k . The penalty factors for s^2 , AIC, and SIC are $(T/T - k)$, $e^{(2k/T)}$, and $T^{(k/T)}$, respectively. Thus, SIC has the greatest penalty factor.

● Key Point: White Noise

If we want to forecast a series, we'd like its mean and covariance structure to be stable over time, in which case the series is covariance stationary.

Many economic, business, financial, and government series are not covariance stationary. For example, many series that are clearly non-stationary in levels appear covariance stationary in growth rates.

The autocorrelations are just the "simple" or "regular" correlations between $y(t)$ and $y(t-T)$. The partial autocorrelations measure the association between $y(t)$ and $y(t-T)$ after controlling for the effects of $y(t-1), \dots, y(t-T+1)$; they measure the partial correlation between $y(t)$ and $y(t-T)$.

We use y to denote the observed series.

$$y_t = \varepsilon_t$$

$$\varepsilon_t \sim N(0, \sigma^2)$$

Where the "shock" ε_t is uncorrelated over time. We say $y(t)$ is serially uncorrelated. Such a process, with zero mean, constant variance, and no serial correlation, is called zero-mean white noise, or simply white noise.

122. In regard to white noise, each of the following statements is true except which is false?

- A. If a process is zero-mean white noise, then it must be Gaussian white noise.
- B. If a process is Gaussian (aka, normal) white noise, then it must be (zero-mean) white noise.

- C. If a process is Gaussian (aka, normal) white noise, then it must be independent white noise.
- D. If a process is stationary, has zero mean, has constant variance and it serially uncorrelated, then the process is white noise.

Answer: A

First, zero-mean white noise may be uncorrelated but not necessarily serially independent (the difference between correlation and independence). Second, white noise (aka, zero-mean white noise) is not necessarily normally distributed.

● Key Point: Box-Pierce Q-statistic & Ljung-Box Q-statistic

H_0 : All the correlation observed in the series are independent of each other and hence Autocorrelation of the series is zero.

For Box-Pierce Q-statistic, the formula used is:

$$Q_{BP} = T \sum_{\tau=1}^m \hat{\rho}^2(\tau)$$

Whereas in case of Ljung-Box Q-statistic, the test statistic is derived as:

$$Q_{LB} = T(T+2) \sum_{\tau=1}^m \hat{\rho}^2(\tau) \left(\frac{1}{T-\tau} \right)$$

Where:

T = Sample size

$\hat{\rho}(\tau)$ = Sample autocorrelation function for τ lags

m = number of lags under observation

123. For a certain time series, you have produced a correlogram with an autocorrelation function that includes twenty four monthly observations; m = degrees of freedom = 24. Your calculated Box-Pierce Q-statistic is 19.50 and your calculated Ljung-Box Q-statistic is 27.90. You want to determine if the series is white noise. Which is your best conclusion (given $\text{CHISQ.INV}(0.95, 24) = 36.41$)?

- A. With 95% confidence, you accept the series as white noise (more accurately, you fail to reject the null).
- B. With 95% confidence, you accept the series as partial white noise (due to Box-Pierce) but reject the null (due to Ljung-Box).
- C. With 95% confidence, you reject both null hypotheses and conclude the series is not white noise.
- D. With 95% confidence, you reject both null hypotheses but conclude the series is white noise because the sum of the statistics is greater than the critical value.

Answer: A

$\text{CHISQ.INV}(0.95, 24) = 36.41$ such that both statistics are less than the critical values; i.e., fall into the

acceptance region of the chi-squared distribution.

● Key Point: Modeling Cycles: MA, AR, and ARMA Models

AR(1) model

$$y_t = \phi y_{t-1} + \varepsilon_t; \varepsilon_t \sim \text{WN}(0, \sigma^2)$$

$$(1 - \phi L)y_t = \varepsilon_t$$

The AR(1) model is capable of capturing much more persistent dynamics than is the MA(1). $|\phi| < 1$ is the condition for covariance stationary in the AR(1).

If ϕ is positive, the autocorrelation decay is one-sided. If ϕ is negative, the decay involves back-and-forth oscillations.

AR(p) model

$$y_t = \phi_1 y_{t-1} + \phi_2 y_{t-2} + \dots + \phi_p y_{t-p} + \varepsilon_t; \varepsilon_t \sim \text{WN}(0, \sigma^2)$$

$$\Phi(L)y_t = (1 - \phi_1 L - \phi_2 L^2 + \dots - \phi_p L^p)y_t = \varepsilon_t$$

MA(1) model

$$y_t = \varepsilon_t + \theta \varepsilon_{t-1} = (1 + \theta L)\varepsilon_t; \varepsilon_t \sim \text{WN}(0, \sigma^2)$$

The current value of the observed series is expressed as a function of current and lagged unobservable shocks.

MA(1) process with parameter $\theta = 0.95$ varies a bit more than the process with a parameter of $\theta = 0.4$.

MA(q) model

$$y_t = \varepsilon_t + \theta_1 \varepsilon_{t-1} + \dots + \theta_q \varepsilon_{t-q} = \Theta(L)\varepsilon_t; \varepsilon_t \sim \text{WN}(0, \sigma^2)$$

$$\Theta(L) = 1 + \theta_1 L + \dots + \theta_q L^q$$

ARMA(p,q) model

$$y_t = \phi_1 y_{t-1} + \phi_2 y_{t-2} + \dots + \phi_p y_{t-p} + \theta_1 \varepsilon_{t-1} + \dots + \theta_q \varepsilon_{t-q} + \varepsilon_t; \varepsilon_t \sim \text{WN}(0, \sigma^2)$$

ARMA models are often both highly accurate and highly parsimonious.

124. An analyst is given the data in the following table for a regression of the annual sales for Company XYZ, a maker of paper products, on paper product industry sales.

Parameters	Coefficient	Standard Error of the Coefficient
Intercept	-94.88	32.97
Slope (industry sales)	0.2796	0.0363

The correlation between company and industry sales is 0.9757. Which of the following is closest to the value and reports the most likely interpretation of the R^2 ?

- A. 0.048, indicating that the variability of industry sales explains about 4.8% of the variability of company sales.

- B. 0.048, indicating that the variability of company sales explains about 4.8% of the variability of industry sales.
- C. 0.952, indicating that the variability of industry sales explains about 95.2% of the variability of company sales.
- D. 0.952, indicating that the variability of company sales explains about 95.2% of the variability of industry sales.

Answer: C

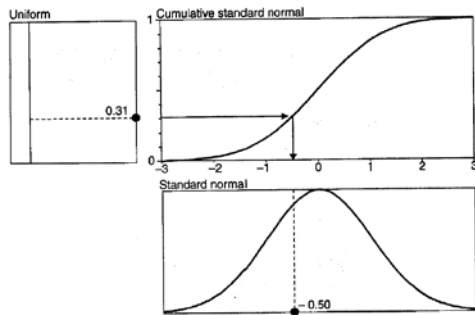
● Key Point: MC Simulation

GBM: $\Delta S_t = S_t(\mu\Delta t + \sigma\epsilon\sqrt{\Delta t})$

Monte Carlo Simulation	
Basic Steps	<ul style="list-style-type: none"> <input type="checkbox"/> Specify the data generating process. <input type="checkbox"/> Estimate an unknown variable. <input type="checkbox"/> Save the estimate from step 2. <input type="checkbox"/> Go back to step 1 and repeat this process N times.
Reducing Standard Error $\frac{s}{\sqrt{N}}$	<ul style="list-style-type: none"> <input type="checkbox"/> The standard error estimate of a Monte Carlo simulation can be reduced by a factor of 10 by increasing N by a factor of 100. <input type="checkbox"/> Variance reduction technique <ul style="list-style-type: none"> • Antithetic Variates • Control Variates • Random Number Re-Usage across Experiments

Variance Reduction Technique	
Antithetic Variates	<input type="checkbox"/> Reduces sampling error by rerunning the simulation using a complement set of the original set of random variables.
Control Variates	<input type="checkbox"/> Replaces a variable x that has unknown properties in a Monte Carlo simulation with a similar variable y that has known properties. The new x* variable estimate will have a smaller sampling error than the original x variable if the control statistic and statistic of interest are highly correlated.
Random Number Re-Usage	<input type="checkbox"/> Reusing sets of random number draws across Monte Carlo experiments reduces the estimate variability across experiments.

Inverse Transform Method:



Cholesky Factorization: $\Sigma = XX^T$

- $\varepsilon_1 = \eta_1$
- $\varepsilon_2 = \rho\eta_1 + (1-\rho^2)^{1/2}\eta_2$

125. A portfolio manager has asked each of four analysts to use Monte Carlo simulation to price a path-dependent derivative contract on a stock. The derivative expires in nine months and the risk-free rate is 4% per year compounded continuously. The analysts generate a total of 20,000 paths using a geometric Brownian motion model, record the payoff for each path, and present the results in the table shown below.

Analyst	Number of Paths	Average Derivative Payoff per Path (USD)
1	2,000	43
2	4,000	44
3	10,000	46
4	4,000	45

What is the estimated price of the derivative?

- A. USD 43.33
- B. USD 43.77
- C. USD 44.21
- D. USD 45.10

Answer: B

Following the risk neutral valuation methodology, the price of the derivative is obtained by calculating the weighted average nine month payoff and then discounting this figure by the risk free rate.

Average payoff calculation: $(2000 \times 43 + 4000 \times 44 + 10000 \times 46 + 4000 \times 45) / 20000 = 45.10$

Discounted payoff calculation: $45.10 \times e^{-0.04 \times (5/12)} = 43.77$

126. Which of the following statements about Monte Carlo simulation is incorrect?

- A. Correlations among variables can be incorporated into a Monte Carlo simulation.
- B. Monte Carlo simulations can handle time-varying volatility.
- C. Monte Carlo methods can be used to estimate value-at-risk (VaR) but cannot be used to price options.

- D. For estimating VaR, Monte Carlo methods generally require more computing power than historical simulations.

Answer: C

Monte Carlo simulations cannot price options with early exercise accurately. All of the other statements are correct. Correlation can be incorporated using the method of Cholesky decomposition, Monte Carlo simulations can be designed to handle time varying volatility, and Monte Carlo simulations are computationally more intensive than historic simulations.

127. Consider a stock that pays no dividends, has a vol. of 30% per annum, and provide an expected return of 15% per annum with continuous compounding. The stock price movements follow GBM. Consider a time interval of 1 week and the initial stock price is 100, then the stock price increase has a normal distribution with:

- A. Mean = 0.268%, standard deviation = 4.03%
- B. Mean = 0.278%, standard deviation = 4.13%
- C. Mean = 0.288%, standard deviation = 4.16%
- D. Mean = 0.288%, standard deviation = 4.27%

Answer: C

$$\text{Mean} = \frac{u}{n} = \frac{15\%}{52} = 0.288\%$$

$$\text{SD} = \frac{\sigma}{\sqrt{n}} = \frac{30\%}{\sqrt{52}} = 4.16\%$$

128. Consider a stock that pays no dividends, has a volatility of 25% per annum and an expected return of 13% per annum. Suppose that the current share price of the stock, S_0 , is USD 30. You decide to model the stock price behavior using a discrete-time version of geometric Brownian motion and to simulate paths of the stock price using Monte Carlo simulation. Let Δt denote the time interval used and let S_t denote the stock price at time interval t . So, according to your model, $S_{t+1} = S_t \times (1 + 0.13 \times \Delta t + 0.25 \times \sqrt{\Delta t} \times \varepsilon)$, where ε is a standard normal variable.

To implement this simulation, you generate a path of the stock price by starting at $t = 0$, generating a sample for ε updating the stock price according to the model, incrementing t by 1, and repeating this process until the end of the horizon is reached. Which of the following strategies for generating a sample for Δ will implement this simulation properly?

- A. Generate a sample for ε by using the inverse of the standard normal cumulative distribution of a sample value drawn from a uniform distribution between 0 and 1.
- B. Generate a sample for ε by sampling from a normal distribution with mean 0.13 and standard deviation 0.25.
- C. Generate a sample for ε by using the inverse of the standard normal cumulative distribution of

a sample value drawn from a uniform distribution between 0 and 1. Use Cholesky decomposition to correlate this sample with the sample from the previous time interval.

- D. Generate a sample for ε by sampling from a normal distribution with mean 0.13 and standard deviation 0.25. Use Cholesky decomposition to correlate this sample with the sample from the previous time interval.

Answer: A

Monte Carlo Simulation assumes independence across time so there is no need to correlate samples from time period to time period, eliminating c and d. Choice a describes a valid method for generating a sample from a standard normal distribution.

129. Monte Carlo simulation is suitable for pricing options in which of the following cases?

- I. An Asian option on a stock market index (payoff based on average stock price).
 - II. A look-back put option on XYZ stock (payoff based on maximum or minimum stock price).
 - III. An American call option on ABC stock (possible early exercise).
 - IV. A cash-or-nothing call option (i.e., binary option) on SCU stock (payoff is fixed amount or nothing).
- A. I and IV
 - B. I, II, and IV
 - C. II and III
 - D. III and IV

Answer: B

Monte Carlo simulation is suitable for pricing options in each case except when early exercise of the option is possible. This means that the Monte Carlo approach could not accurately price the American call option. Monte Carlo simulation is very useful for options with price-dependent paths (such as Asian options and look-back options) and can also handle options with complex payoff, such as binary options.

130. A risk manager has been requested to provide some indication of accuracy of a Monte Carlo simulation. Using 1,000 replications of a normally distributed variable S , the relative error in the one-day 99% VaR is 5%. Under these conditions:

- A. Using 1,000 replications of a long option position on S should create a larger relative error.
- B. Using 10,000 replications should create a larger relative error.
- C. Using another set of 1,000 replications will create an exact measure of 5.0% for relative error.
- D. Using 1,000 replications of a short option position on S should create a larger relative error.

Answer: D

Short option positions have long left tails, which makes it more difficult to estimate a left-tailed quantile precisely. Accuracy with independent draws increases with the square root of K . Thus increasing the number of replications should shrink the standard error, so answer B is incorrect.

131. Suppose you simulate the price path of stock HHF using a geometric Brownian motion model with drift $\mu = 0$, volatility $\sigma = 0.14$, and time step $\Delta t = 0.01$. Let S_t be the price of the stock at time t . If $S_0 = 100$, and the first two simulated (randomly selected) standard normal variables are $\varepsilon_1 = 0.263$ and $\varepsilon_2 = -0.475$, what is the simulated stock price after the second step?

- A. 96.79
- B. 99.79
- C. 99.97
- D. 99.70

Answer: D

The process for the stock prices has mean of zero and volatility of $\sigma\sqrt{\Delta t} = 0.14\sqrt{0.01} = 0.014$. Hence the first step is $S_1 = S_0(1 + 0.014 \times 0.263) = 100.37$.

The second step is $S_2 = S_1[1 + 0.014 \times (-0.475)] = 99.70$.

● Key Point: The Bootstrap

An alternative to generating random numbers from a hypothetical distribution is to Sample from historical data. $S_{t+1} = S_t [1 + R_{m(t)}]$

Advantage of bootstrap:

- Can include fat tails, jumps, or any departure from the normal distribution.
- Account for correlations across series because one draw consists of the simultaneous returns for N series, such as stock, bonds, and currency prices.

Limitation of bootstrap:

- For small sample sizes, it may be a poor approximation of the actual one.
- Relies heavily on the assumption that returns are independent.

132. Which of the following statements about simulation is invalid?

- A. The historical simulation approach is a nonparametric method that makes no specific assumption about the distribution of asset returns.
- B. When simulating asset returns using Monte Carlo simulation, a sufficient number of trials must be used to ensure simulated returns are risk neutral.
- C. Bootstrapping is an effective simulation approach that naturally incorporates correlations between asset returns and non-normality of asset returns, but does not generally capture autocorrelation of asset returns.
- D. Monte Carlo simulation can be a valuable method for pricing derivatives and examining asset return scenarios.

Answer: B

Risk neutrality has nothing to do with sample size.

● Key Point: GARCH, EWMA, and Vol. & Correlation Estimating

EWMA Model: $\sigma_n^2 = \lambda \sigma_{n-1}^2 + (1 - \lambda) u_{n-1}^2$

GARCH (1, 1) Model: $\sigma_n^2 = \omega + \alpha u_{n-1}^2 + \beta \sigma_{n-1}^2$

Correlation Estimation: $\hat{\rho}_{XY} = \frac{\text{COV}_n}{\sigma_{x,n} \sigma_{y,n}}$

$\text{COV}_n = \lambda \text{COV}_{n-1} + (1 - \lambda) x_{n-1} y_{n-1}$

$\text{COV}_n = \omega + \alpha x_{n-1} y_{n-1} + \beta \text{COV}_{n-1}$

133. The GARCH model is useful for simulating asset returns. Which of the following statements about this model is FALSE?

- A. The Exponentially Weighted Moving Average (EWMA) approach of RiskMetrics is a particular case of a GARCH process.
- B. The GARCH allows for time-varying volatility.
- C. The GARCH can produce fat tails in the return distribution.
- D. The GARCH imposes a positive conditional mean return.

Answer: D

The GARCH model allows for time-varying volatility by describing the conditional variance as a function of the previous period's volatility and the most recent variance estimate:

$\sigma_t^2 = \alpha_0 + \alpha_1 r_{t-1}^2 + \beta \sigma_{t-1}^2$, Where: $\alpha_0 = \gamma V_L$, $V_L = \frac{\alpha_0}{1 - \alpha_1 - \beta}$, $\alpha_1 + \beta + \gamma = 1$, $\alpha + \beta < 1$

It is useful in simulating leptokurtic return distributions with fat tails. The EWMA is a special case of the GARCH model with $\gamma = 1$, $\alpha_1 = 1 - \gamma$, and $\beta = \gamma$. The model does not impose the requirement of a positive conditional mean return.

134. Suppose that the current daily volatilities of asset X and asset Y are 1.0% and 1.2%, respectively.

The prices of the assets at close of trading yesterday were \$30 and \$50 and the estimate of the coefficient of correlation between the returns on the two assets made at this time was 0.50. Correlations and volatilities are updated using a GARCH (1, 1) model. The estimates of the model's parameters are $\alpha = 0.04$ and $\beta = 0.94$. For the correlation $\omega = 0.000001$, and for the volatilities $\omega = 0.000003$. If the prices of the two assets at close of trading today are \$31 and \$51, how is the correlation estimate updated?

- A. 0.539

- B. 0.549
- C. 0.559
- D. 0.569

Answer: D

$$\sigma_{u,n-1} = 0.01, \sigma_{v,n-1} = 0.012$$

The estimated covariance of n-1 is:

$$\text{cov}_{n-1} = 0.01 \times 0.012 \times 0.50 = 0.00006$$

$$u_{n-1} = 1/30 = 0.03333$$

$$v_{n-1} = 1/50 = 0.02$$

The covariance of n is:

$$\text{cov}_n = 0.000001 + 0.04 \times 0.03333 \times 0.02 + 0.94 \times 0.00006 = 0.0000841$$

The asset X's variance of n is:

$$\sigma_{u,n}^2 = 0.000003 + 0.04 \times 0.03333^2 + 0.94 \times 0.01^2 = 0.0001414$$

因此, $\sigma_{u,n} = \sqrt{0.0001414} = 1.189\%$

The asset Y's variance of n is::

$$\sigma_{v,n}^2 = 0.000003 + 0.04 \times 0.02^2 + 0.94 \times 0.012^2 = 0.0001544$$

So, $\sigma_{v,n} = \sqrt{0.0001544} = 1.242\%$

The correlation is: $0.0000841 / (0.01189 \times 0.01242) = 0.569$

135. Which of the following GARCH models will take the shortest time to revert to its mean?

- A. $h_t = 0.05 + 0.03r_{t-1}^2 + 0.96h_{t-1}$
- B. $h_t = 0.03 + 0.02r_{t-1}^2 + 0.95h_{t-1}$
- C. $h_t = 0.02 + 0.01r_{t-1}^2 + 0.97h_{t-1}$
- D. $h_t = 0.01 + 0.01r_{t-1}^2 + 0.98h_{t-1}$

Answer: B

The model that will take the shortest time to revert to its mean is the model with the lowest persistence defined by $\alpha + \beta$. So B is the right answer with $\alpha + \beta = 0.97$.

136. The current estimate of daily volatility is 1.5%. The closing price of an asset yesterday was \$30.00.

The closing price of the asset today is \$30.50. Using the EWMA (Exponentially Weighted Moving

Average) model (with $\lambda = 0.94$), the updated estimate of volatility is:

- A. 1.5096%
- B. 1.5085%
- C. 1.5092%
- D. 1.5083%

Answer: A

$$h_t = \lambda h_{t-1} + (1 - \lambda)(r_{t-1})^2$$

$$\sigma_t = \sqrt{(0.94)(0.0015)^2 + (1 - 0.94) \left[\ln \left(\frac{30.5}{30.0} \right) \right]^2} = 0.015096 = 1.5096\%$$

137. Given λ of 0.94, under an infinite series, what is the weight assigned to the seventh prior daily squared return?

- A. 4.68%
- B. 4.40%
- C. 4.14%
- D. 3.89%

Answer: C

$$\text{Weight} = 0.94^6 \times (1 - 0.94) = 4.14\%$$

138. A risk analyst is estimating the variance of stock returns on day n , given by σ_n^2 , using the equation:

$$\sigma_n^2 = \gamma V_L + \alpha \mu_{n-1}^2 + \beta \sigma_{n-1}^2$$

Where μ_{n-1} and σ_{n-1} represent the return and volatility on day $n-1$, respectively. If the values of α and β are as indicated below, which combination of values indicates that the variance follows a stable GARCH (1,1) process?

- A. $\alpha = 0.084427$ and $\beta = 0.909073$
- B. $\alpha = 0.084427$ and $\beta = 0.925573$
- C. $\alpha = 0.084427$ and $\beta = 0.925573$
- D. $\alpha = 0.090927$ and $\beta = 0.925573$

Answer: A

For a GARCH (1,1) process to be stable, the sum of parameters α and β need to be below 1.0.

139. Which of the following four statements on models for estimating volatility is INCORRECT?

- A. In the exponentially weighted moving average (EWMA) model, some positive weight is assigned to the long-run average variance.

- B. In the EWMA model, the weights assigned to observations decrease exponentially as the observations become older.
- C. In the GARCH (1,1) model, a positive weight is estimated for the long-run average variance.
- D. In the GARCH (1,1) model, the weights estimated for observations decrease exponentially as the observations become older.

Answer: A

The EWMA model does not involve the long-run average variance in updating volatility, in other words, the weight assigned to the long-run average variance is zero. Only the current estimate of the variance is used. The other statements are all correct.

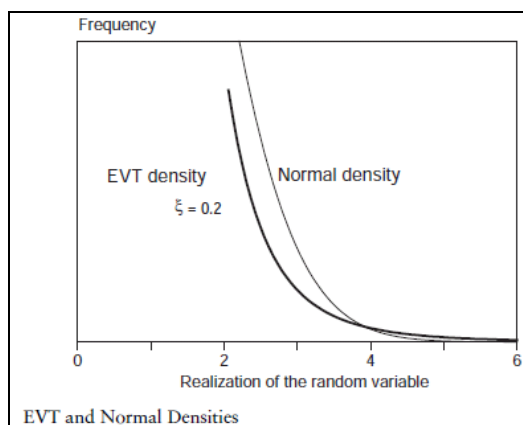
140. Which of the following statements about the exponentially weighted moving average (EWMA) model and the generalized autoregressive conditional heteroscedasticity (GARCH(1,1)) model is correct?

- A. The EWMA model is a special case of the GARCH(1,1) model with the additional assumption that the long-run volatility is zero.
- B. A variance estimate from the EWMA model is always between the prior day's estimated variance and the prior day's squared return.
- C. The GARCH(1,1) model always assigns less weight to the prior day's estimated variance than the EWMA model.
- D. A variance estimate from the GARCH(1,1) model is always between the prior day's estimated variance and the prior day's squared return.

Answer: B

The EWMA estimate of variance is a weighted average of the prior day's variance and prior day squared return.

● Key Point: EVT & Generalized Pareto Distribution



141. Which of the following statements about EVT is correct?

- A. EVT extends the central Limit Theorem to the distribution of the average of i.i.d random variables drawn from an unknown distribution.
- B. With $\xi = 0.2$, the EVT density has a fatter tail than the normal density, implying a lower probability of experiencing large losses.
- C. Given a generalized Pareto distribution, when the ξ is negative, the convergence speed of the tail distribution is faster than normal distribution.
- D. Normal distribution tails drop more slowly than for the empirical distribution for financial returns.

Answer: C

142. Which of the following statements regarding extreme value theory (EVT) is incorrect?

- A. In contrast to conventional approaches for estimating VAR, EVT only considers the tail behavior of the distribution.
- B. Conventional approaches for estimating VAR that assume that the distribution of returns follows a unique distribution for the entire range of values may fail to properly account for the fat tails of the distribution of returns.
- C. EVT attempts to find the optimal point beyond which all values belong to the tail and then models the distribution of the tail separately.
- D. By smoothing the tail of the distribution, EVT effectively ignores extreme events and losses that can generally be labeled outliers.

Answer: D

EVT only uses information in the tail, so statement a. is correct. Conventional approaches such as delta-normal VAR assume a fixed p.d.f. for the entire distribution, which may understate the extent of fat tails. So, statement b. is correct. The first step in EVT is to choose a cutoff point for the tail, then to estimate the parameters of the tail distribution, so statement c. is correct. Finally, EVT does not ignore extreme events (as long as they are in the sample).

143. Company A uses a Pareto distribution to model the loss severity of its low-frequency, high-severity operational risk events. A Pareto distribution has the following properties, given parameter X_m and k :

$$\text{Mean: } \frac{kX_m}{k-1}, \text{ for } k > 1$$

$$\text{Variance: } \frac{kX_m^2}{(k-1)^2(k-2)}, \text{ for } k > 2$$

$$\text{Cumulative distribution function: } 1 - \left(\frac{X_m}{X}\right)^k$$

After fitting the distribution to historical loss data, the parameters are estimated as $k = 2.4$, $X_m = 10,000$. What is the unexpected loss of a low-frequency, high severity operational risk event at 99% confidence level?

- A. 40703
- B. 23560
- C. 50986
- D. 68129

Answer: C

The first step, we must get the $E(X)$. So $k = 2.4$, $X_m = 10,000$, $\text{Mean} = 17143$;

The second step, we must get the X . So, $1 - (\frac{X_m}{X})^k = 0.99$, $X = 68,129$;

The third step, $\text{Unexpected Loss} = \text{VaR} = X - E(X) = 50,986$.



2016 FRM PART I

百题巅峰班

金融市场与产品 & 估值模型

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2016 年 5 月

Part 3 Financial Market and Products

● Key Point: Exchange VS. Over the Counter Market

1. Exchange Market

A derivatives exchange is a central marketplace where participants can trade standardized contracts, including futures and option contracts.

2. OTC

The over-the-counter (OTC) market is an alternative to exchanges where counterparties can engage in trades directly with each other.

Customization (a.k.a., “tailored” exposure): The terms of a contract do not have to be those specified by an exchange.

Counterparty risk

1. Which of the following statements is an advantage of an exchange trading system? On an exchange system:
- A. Terms are not specified.
 - B. Trades are made in such a way as to reduce credit risk.
 - C. Participants have flexibility to negotiate.
 - D. In the event of a misunderstanding, calls are recorded between parties.

Answer: B

2. Which of the following types of risk is least likely to be a source of risk in the commodities markets?
- A. Earnings risk
 - B. Price risk
 - C. Counterparty risk
 - D. Quality risk

Answer: A

Modern futures markets allow producers, distributors, dealers, and investors to manage the uncertainty of prices over time and participate in efficient price discovery. In addition to supply/demand price risk, risk can also come from storage problems, quality risk, and lack of standard payment terms, lack of price transparency, resale problems, counterparty risk, and lack of standardized contracts.

3. Client A buy one July wheat contract from Client B. On the same day, client B buy the same wheat contract from Client C. Assuming open interest started out at Zero, and no delivered were made,

what is the addition to open interest for July wheat contracts?

- A. 0 B. 1 C. 2 D. 3

Answer: B

Open interest includes contracts not yet liquidated either by an offsetting futures market transaction or delivery. When Client A buys one contract from Client B, the current open interest is one, assuming neither party started with a position in that contract. When Client B buys the same contract from Client C, Client B closes out their short transaction with an offsetting long transaction. The open interest would not change because Client C would simply take the place of Client B. Client A would still be long one contract, and now Client C would be short one contract. Thus, open interest would be one.

4. With regard to futures trading, which of the following statements best describe the principle of substitution?
- A. The clearinghouse changes the designated currency before settlement.
- B. The exchange takes on the role of the counterparty.
- C. The clearinghouse takes on the role of the counterparty.
- D. The exchange can substitute cash for a given commodity at its discretion.

Answer: C

The clearinghouse's primary role is to provide financial mechanisms and to guarantee performance on the exchange's futures and options contracts. The clearinghouse operates under the principle of substitution, substituting itself for each counterparty for the purpose of settling gains and losses, paying out funds to those receiving profits, and collecting funds from those with losses.

5. XYZ, a clearinghouse member, has recently contributed funds with its clearinghouse. The funds are designed to give the clearinghouse the ability to meet the financial obligations of any defaulting members. The funds may not be withdrawn by XYZ as long as it remains a member of the clearinghouse. Which of the following amounts best describe XYZ's contribution?
- A. Variation margin
- B. Original margin
- C. Membership dues
- D. Guaranty deposit

Answer: D

Clearinghouse members are required to provide not only original and variation margin to maintain their own and customer positions, but also must maintain a large guaranty deposit with the clearinghouse. The deposit, or reserve, must be maintained with the clearinghouse as long as the firm is a member of the clearinghouse. The deposit can be made with cash, securities, or letters of credit. The clearinghouse

has access to the funds at all times to meet the financial needs of any defaulting member.

6. ABC, a clearinghouse member, has not managed its debts very well. As a result, it is unable to meet its open contract obligations. Which of the following statements represents one of the first actions of the clearinghouse?
- A. Exchange membership is sold.
 - B. Under-margined customer positions are transferred to a solvent clearinghouse member.
 - C. Guaranty fund is used.
 - D. Fully margined positions are transferred to a solvent clearinghouse member.

Answer: D

The first action of the clearinghouse is to move fully margined customer positions to a solvent clearinghouse member.

7. Jack Johnson is going to receive a physical commodity from a settling long futures trade. Which of the following statements best describe the role of Johnson and the clearinghouse in this process?
- A. The clearinghouse will coordinate Johnson's settlement with any eligible settling shorts.
 - B. Johnson will have to contact the clearinghouse to coordinate with any eligible settling short.
 - C. Johnson will have to close his position with the original counterparty.
 - D. The clearinghouse will coordinate Johnson's settlement with the original counterparty only.

Answer: A

Futures market physical delivery is made easier by having the clearinghouse as the counterparty on every trade. Direct deliveries can be made by a short to a long even though the two parties never actually trade with one another. The clearinghouse receives delivery notices from sellers (shorts) and assigns the notices to buyers (longs).

8. Which of the following statements best describe the difference between a commodity trading advisor (CTA) and a commodity pool operator (CPO)?
- A. CTAs trade for single clients with individual accounts and CPOs trade for pooled funds.
 - B. The only difference relates to the fees charged.
 - C. Only CPOs must be registered as associated persons.
 - D. CTAs can only trade futures, while CPOs can trade futures and options.

Answer: A

CTAs trade individual accounts for single clients. CPOs pool the funds of many investors and trade for all individuals pooled under one account.

● Key Point: Effective Annual Rate

$$EAR = \left(1 + \frac{r}{n}\right)^n - 1$$

Where:

n: number of compounding periods per year

r: annual rate (quoted)

Continuously compounded rate: $n \rightarrow +\infty$, $EAR = e^r - 1$

9. An investor buys a Treasury bill maturing in 1 month for \$987. On the maturity date the investor collects \$1,000. Calculate effective annual rate (EAR).

- A. 17.0%
- B. 15.8%
- C. 13.0%
- D. 11.6%

Answer: A

$$EAR = \left(1 + \frac{r_{\text{year}}}{12}\right)^{12} - 1$$

$$r_{\text{month}} = \frac{1000 - 987}{987} = 0.0132$$

$$EAR = (1 + 0.0132)^{12} - 1 = 17.04\%$$

10. Lisa Smith, the treasure of bank AAA, has \$100 million to invest for one year. She has identified three alternative one-year certificates of deposits (CDs), with different compounding periods and annual rates. CD1: monthly, 7.82%; CD2: quarterly, 8.00%; CD3: semiannually, 8.05%; and CD4: continuous, 7.95%. Which CD has the highest EAR?

- A. CD1
- B. CD2
- C. CD3
- D. CD4

Answer: D

The effective annual rate is:

$$EAR = \left(1 + \frac{R_n}{n}\right)^n - 1, \quad EAR = e^{R_c} - 1$$

EAR of CD1 = 8.11%

EAR of CD2 = 8.24%

EAR of CD3 = 8.21%

EAR of CD4 = 8.27%

● Key Point: Forward Interest Rate

Forward rates are interest rates implied by the spot curve for a specified future period. The forward rate between T_1 and T_2 can be calculated as:

$$R_{\text{forward}} = \frac{R_2 T_2 - R_1 T_1}{T_2 - T_1} = R_1 + (R_2 - R_1) \times \frac{T_1}{T_2 - T_1}$$

11. The zero rate of three years is 4.6%, the zero rate of four years is 5.0%. Please calculate the 1-year forward rate there years from today.

- A. 6.2%
- B. 6.0%
- C. 5.5%
- D. 4.8%

Answer: A

$$R_{\text{forward}} = \frac{R_2 T_2 - R_1 T_1}{T_2 - T_1} = \frac{5.0\% \times 4 - 4.6\% \times 3}{4 - 3} = 6.2\%$$

12. The interest rate for a 1-year period is 5% and the rate for a 2-year period is 6%. Assuming continuous compounding, what is the forward rate for the period from the end of the first year to the second year?

- A. 6.9991%
- B. 7.0000%
- C. 7.0009%
- D. 8.0000%

Answer: B

$$e^{5\%} \times e^{F_{1,2}} = e^{6\% \times 2}. \text{ Taking the log of both side, } 5\% + F_{1,2} = 6\% \times 2, F_{1,2} = 7\%$$

13. Given the following bonds and forward rates:

Maturity	YTM	Coupon	Price
----------	-----	--------	-------

1 year	4.5%	0%	95.694
2 years	7%	0%	87.344
3 years	9%	0%	77.218

- 1-year forward rate one year from today = 9.56%
- 1-year forward rate two years from today = 10.77%
- 2-year forward rate one year from today = 11.32%

Which of the following statements about the forward rates, based on the bond prices, is true?

- A. The 1-year forward rate one year from today is too low.
- B. The 2-year forward rate one year from today is too high.
- C. The 1-year forward rate two years from today is too low.
- D. The forward rates and bond prices provide no opportunities for arbitrage.

Answer: C

1-year forward rate one year from today = $1.07^2/1.045 - 1 = 9.56\%$

1-year forward rate two years from today = $1.09^3/1.07^2 - 1 = 13.11\%$

2-year forward rate one year from today = $(1.09^3/1.045)^{0.5} - 1 = 11.32\%$

14. The term structure of interest rates is upward – sloping. Put the following in order of magnitude:

- The 5-year zero rate = a;
- The yield on a 5-year coupon-bearing bond = b;
- The forward rate corresponding to the period between 5 and 5.25 years in the future = c.

What is the answer to this question when the term structure of interest rates is upward-sloping?

- A. $c > a > b$
- B. $a > c > b$
- C. $c > b > a$
- D. $b > a > c$

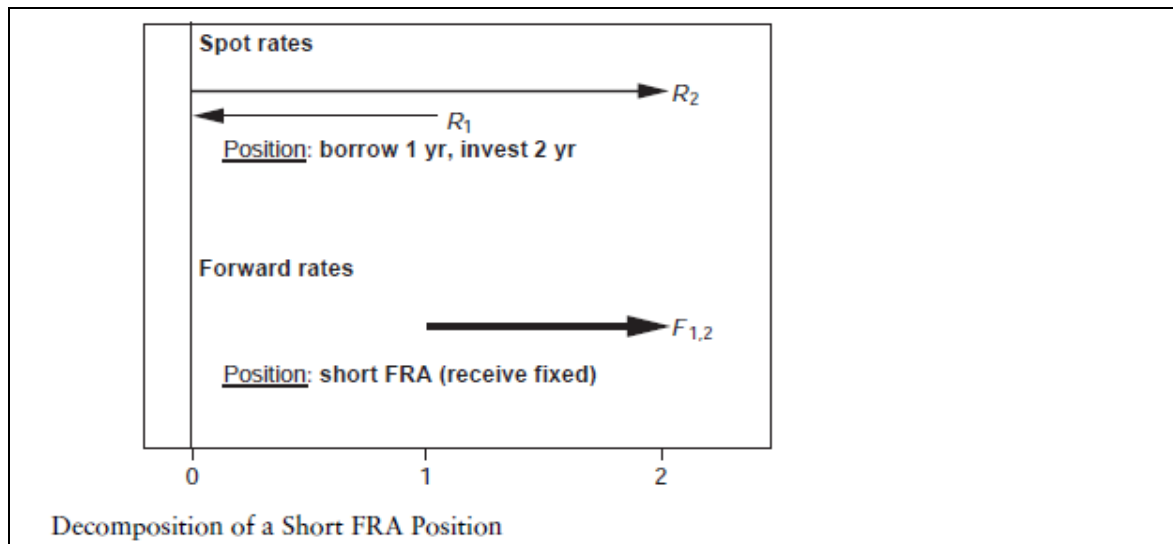
Answer: A

● Key Point: Forward Rate Agreement (FRA)

the settlement day value for the long = (Nominal Principal) $\times \frac{(L - FRA)(T_2 - T_1)}{1 + L \times (T_2 - T_1)}$

Key Concept

A long FRA position benefits from an increase in rates. A short FRA positions similar to a long position in a bond. Its duration is positive and equal to the difference between the two maturities.



15. A long position in a FRA 2×5 is equivalent to the following positions in the spot market:

- A. Borrowing in two months to finance a five-month investment.
- B. Borrowing in five months to finance a two-month investment.
- C. Borrowing half a loan amount at two months and the remainder at five months.
- D. Borrowing in two months to finance a three-month investment.

Answer: B

An FRA defined as $t_1 \times t_2$ involves a forward rate starting at time t_1 and ending at time t_2 . The buyer of this FRA locks in a borrowing rate for months 3 to 5. This is equivalent to borrowing for five months and reinvesting the funds for the first two months.

16. ABC, Inc., entered a forward rate agreement (FRA) to receive a rate of 3.75% with continuous compounding on a principal of USD 1 million between the end of year 1 and the end of year 2. The zero rates are 3.25% and 3.50% for one and two years. What is the value of the FRA when the deal is just entered?

- A. USD 35,629
- B. USD 34,965
- C. USD 664
- D. USD 0

Answer: D

The market – implied forward rate is given by $e^{-R_2 \times 2} = e^{-R_2 \times 1 - F_{1,2} \times 1}$, or $F_{1,2} = 2 \times 3.50 - 1 \times 3.25 = 3.75\%$. Given that this is exactly equal to the quoted rate, the value must be zero. If instead this rate was 3.50%, for example, the value would be:

$$V = \$1,000,000 \times (3.75\% - 3.50\%) \times (2 - 1) \times e^{(-3.5\% \times 2)} = 2,331$$

17. Consider the buyer of a 6×9 FRA. The contract rate is 6.35% on a notional amount of \$10 million. Calculate the settlement amount of the *seller* if the settlement rate is 6.85%. Assume a 30/360 day count basis.
- A. -12,500
 - B. -12,290
 - C. +12,500
 - D. +12,290

Answer: B

The seller of an FRA agrees to receive fixed. Since rates are now higher than the contract rate, this contract must show a loss for the seller. The losses $\$10,000,000 \times (6.85\% - 6.35\%) \times (90/360) = \$12,500$ when paid in arrears, i.e., in nine months. On the settlement date, i.e., brought forward by three months, the loss is $\$12,500 / (1 + 6.85\% \times 0.25) = \$12,290$.

● **Key Point: Volume and Open Interest**

Volume is defined as the total of purchases or sales during a trading session, not the total of purchases and sales combined.

Open interest represents a tabulation of the total number of futures contracts in a market that remain “open” at the end of a trading session, that is, those contracts not yet liquidated either by an offsetting futures market transaction or by delivery.

18. Consider four different futures market transactions between a buyer and a seller:
- I. Both buyer and seller are each taking on a new position (long and short, respectively).
 - II. Buyer (seller) is taking on a new position, but seller (buyer) is offsetting an existing long (short) position.
 - III. Both buyer and seller are offsetting existing positions.
 - IV. An existing short makes delivery to an existing long.
- Which of the above causes a decrease in the open interest?
- A. None of the above decrease the open interest.
 - B. II and IV decrease the open interest.
 - C. III and IV decrease the open interest.
 - D. All of the above decrease the open interest.

Answer: C

Both buyer and seller are each taking on a new position (long and short, respectively): open interest increases + 1.

Buyer (seller) is taking on a new position, but seller (buyer) is offsetting an existing long (short) position: no change in open interest.

Both buyer and seller are offsetting existing positions: open interest decrease -1.

An existing short makes delivery to an existing long: open interest decrease -1.

19. An experienced commodities risk manager is examining corn futures quotes from the CME Group. Which of the following observations would the risk manager most likely view as a potential problem with the quotation data?

- A. The volume in a specific contract is greater than the open interest.
- B. The prices indicate a mixture of normal and inverted markets.
- C. The settlement price for a specific contract is above the high price.
- D. There is no contract with maturity in a particular month.

Answer: C

The reported high price of a futures contract should reflect all prices for the day, so the settlement price should never be greater than the high price.

● Key Point: Margin

Margin account: Broker requires deposit.

Initial margin: Must be deposited when contract is initiated.

Mark-to-market: At the end of each trading day, margin account is adjusted to reflect gains or losses.

Maintenance margin: Investor can withdraw funds in the margin account in excess of the initial margin. A maintenance margin guarantees that the balance in the margin account never gets negative (the maintenance margin is lower than the initial margin).

Margin call: When the balance in the margin account falls below the maintenance margin, broker executes a margin call. The next day, the investor needs to “top up” the margin account back to the initial margin level.

Variation margin: Extra funds deposited by the investor after receiving a margin call.

There is only a variation margin if and when there is a margin call.

Variation margin = initial margin – margin account balance

20. To utilize the cash position of assets under management, a portfolio manager enters into a long futures position on the S&P 500 index with a multiplier of 250. The cash position is \$15 million with the current futures value of 1000, which requires the manager to long 60 contracts. If the current initial margin is \$12500 per contract, and the current maintenance margin is \$10000 per contract, what variation margin does the portfolio manager have to advance if the futures contract value falls to \$995 at the end of the first day of the position being placed?

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- A. \$30000
- B. \$0
- C. \$300000
- D. \$75000

Answer: B

Step 1: Initial margin $\$12500 \times 60 = \750000 ; Maintenance margin $\$10000 \times 60 = \600000

Step 2: The first day lose = $(1000 - 995) \times 250 \times 60 = \75000 ,

So the first day value = $\$750000 - \$75000 = \$675000 > \600000

It will not require a variation margin to bring the position to the proper margin level.

21. In late June, John purchased two December gold futures contracts. Each contract size is 5,000 ounces of silver and the futures price on the date of purchase was USD 18.62 per ounce. The required initial margin is USD 6,000 and a maintenance margin of USD 4,500. You are given the following price history for the December silver futures:

Day	Futures Price	Daily Gain
June 29	18.62	0
June 30	18.69	700
July 1	18.03	-6600
July 2	17.72	-3100
July 6	18.00	2800
July 7	17.70	-3000
July 8	17.60	-1000

On which days did John receive a margin call?

- A. July 1 only
- B. July 1 and July 2 only
- C. July 1, July 2 and July 7 only
- D. July 1, July 2 and July 8 only

Answer: B

22. Assume you enter into 5 long futures contracts to buy July gold for \$1,400 per ounce. A gold futures contract size is 100 troy ounces. The initial margin is \$14,000 per contract and the maintenance margin is 75% of the initial margin. What change in the futures price of gold will lead to a margin call?
- A. \$35 drop
 - B. \$70 drop

- C. \$175 drop
- D. \$350 drop

Answer: A

The maintenance margin = $75\% \times \$14,000 = \$10,500$ per contract; the margin call occurs when the loss is \$3,500 per contract or \$35 per ounce.

That is, if gold drops from \$1,400 to \$1,365 then value of margin account, per contract, drop \$3,500 ($\35×100) which is 25% of the initial margin.

● Key Point: Order Types

Market order: The market order is a simple (the simplest) request to execute the trade immediately at the best available price.

Limit Order: A limit order specifies a particular price. The order can be executed only at this price or at one more favorable to the investor.

Stop Loss: The order is executed at the best available price once a bid or offer is made at that particular price or a less-favorable price.

Stop-Limit: The order becomes a limit order as soon as a bid or offer is made at a price equal to or less favorable than the stop price.

Market-if-touched: A market-if-touched (MIT) order is executed at the best available price after a trade occurs at a specified price or at a price more favorable than the specified price.

Discretionary: A market order except that execution may be delayed at the broker's discretion in an attempt to get a better price.

23. Assume you have a long position in a stock with a current market price of \$35. You have two goals. First, to retain ownership as long as the stock continues to go up. Second, to exit the position completely if the stock drops below \$30. Which order best meets your dual objectives?

- A. Sell market order
- B. Sell limit order at \$37
- C. Stop-loss sell order at \$30
- D. Stop-and-limit sell order at \$30

Answer: C

In regard to (A), a market order sells immediately and does not meet the first objective.

In regard to (B), a sell limit will try to execute if the price rises to \$37 and does not meet the first objective.

In regard to (C), the stop-loss becomes a market order once the stock drops to \$30 and therefore best meets the second objective.

In regard to (D), the stop becomes a limit at \$30 and risks not being filled so does not meet the second objective as well as the stop-loss.

24. An investor with a long position in a futures contract wants to issue instructions to close out the position. A market-if-touched order would be used if the investor wants to:

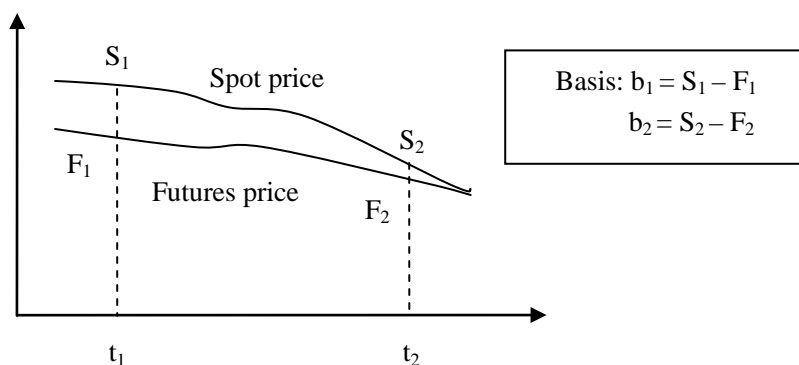
- A. Execute at the best available price once a trade occurs at the specified or better price.
- B. Execute at the best available price once a bid/offer occurs at the specified or worse price.
- C. Allow a broker to delay execution of the order to get a better price.
- D. Execute the order immediately or not at all.

Answer: A

A market-if-touched order executes at the best available price once a trade occurs at the specified or better price. A stop order executes at the best available price once a bid/offer occurs at the specified or worse price. A discretionary order allows a broker to delay execution of the order to get a better price. A fill-or-kill order executes the order immediately or not at all.

● Key Point: Basis and Basis Risk

Define the basis and the various sources of basis risk, and explain how basis risks arise when hedging with futures.



- The profit on the futures position is $F_1 - F_2$.
- The effective price that is obtained for the asset with hedging is therefore: $S_2 + F_1 - F_2 = F_1 + b_2$; The value of F_1 is known at time t_1 . If b_2 were also known at this time, a perfect hedge would result. The hedging risk is the uncertainty associated with b_2 and is known as basis risk.

25. Which of the following statements are true with respect to basis risk?

- I. Basis risk arises in cross-hedging strategies but there is no basis risk when the underlying asset and hedge asset are identical.
- II. Short hedge position benefits from unexpected strengthening of basis.

- III. Long hedge position benefits from unexpected strengthening of basis.
- A. I and II
- B. I and III
- C. II only
- D. III only

Answer: C

“II” is the only true statement. A short hedge position or a short forward contract benefits from any unexpected decline in future prices and subsequent strengthening of basis. An increase in basis is known as a strengthening of the basis. The payoff to the short hedge position is spot price at maturity (S_2) and the difference between futures price i.e., ($F_1 - F_2$). Thus, $\text{payoff} = S_2 + F_1 - F_2 = F_1 + b_2$, where b_2 is the basis.

Basis risk can also arise if underlying asset and hedge asset are identical. This can happen if the maturity of the hedge contract and the delivery date of asset do not match. A long hedge position benefits from weakening of basis.

- 26.** A buffalo farmer is concerned that the price he can get for his buffalo herd will be less than he has forecasted. To protect himself from price declines in the herd, the farmer has decided to hedge with live cattle futures. Specifically, he has entered into the appropriate number of cattle future position for September delivery that he believes will help offset any buffalo price declines during the winter slaughter season. The appropriate position and the likely sources of basis risk in the hedge are, respectively:
- A. Short; choice of futures delivery date.
- B. Short; choice of futures asset.
- C. Short; choice of futures delivery date and asset.
- D. Long; choice of futures delivery date and asset.

Answer: C

The farmer needs to be short the futures contracts. The two sources of basis risk confronting the farmer will result from the fact that he is using a cattle contract to offset the price movement of his buffalo herd. Cattle prices and buffalo prices may not be perfectly positively correlated. As a result, the correlation between buffalo and cattle prices will have an impact on the basis of the cattle futures contract and spot buffalo meat. Also the delivery date is a problem in this situation, because the farmer's hedge horizon is winter, which probability will not commence until December or January. In order to maintain a hedge during this period, the farmer will have to enter into another futures, which will introduce an additional source of basis risk.

27. You wish to hedge an investment in Zirconium using futures. Unfortunately, there are no futures that are based on this asset. To determine the best futures contract for you to hedge with, you run a regression of daily changes in the price of Zirconium against daily changes in the prices of similar assets which do have futures contracts associated with them. Based on your results, futures tied to which asset would likely introduce the least basis risk into your hedging position?

Change in price of Zirconium = α + β (Change in price of Asset)			
Asset	α	β	R^2
A	1.25	1.03	0.62
B	0.67	1.57	0.81
C	0.01	0.86	0.35
D	4.56	2.30	0.45

- A. Asset A
- B. Asset B
- C. Asset C
- D. Asset D

Answer B

Futures on an asset whose price changes are most closely correlated with the asset you are looking to hedge will have the least basis risk. This is determined by examining the R^2 of the regressions and choosing the highest one. R^2 is the most applicable statistic in the above chart to determine correlation with the price of Zirconium.

28. Imagine a stack-and-roll hedge of monthly commodity deliveries that you continue for the next five years. Assume the hedge ratio is adjusted to take into effect the mistiming of cash flows but is not adjusted for the basis risk of the hedge. In which of the following situations is your calendar basis risk likely to be greatest?
- A. Stack and roll in the front month in oil futures.
 - B. Stack and roll in the 12-month contract in natural gas futures.
 - C. Stack and roll in the 3-year contract in gold futures.
 - D. All four situations will have the same basis risk.

Answer: A

The oil term structure is highly volatile at the short end, making a front-month stack-and-roll hedge heavily exposed to basis fluctuations. In natural gas, much of the movement occurs at the front end, as well, so the 12-month contract won't move as much. In gold, the term structure rarely moves much at all and won't begin to compare with oil and gas.

29. Pear, Inc. is a manufacturer that is heavily dependent on plastic parts shipped from Malaysia. Pear wants to hedge its exposure to plastic price shocks over the next 7 ½ months. Futures contracts, however, are not readily available for plastic. After some research, Pear identifies futures contracts on other commodities whose prices are closely correlated to plastic prices. Futures on Commodity A have a correlation of 0.85 with the price of plastic, and futures on Commodity B have a correlation of 0.92 with the price of plastic. Futures on both Commodity A and Commodity B are available with 6-month and 9-month expirations. Ignoring liquidity considerations, which contract would be the best to minimize basis risk?

- A. Futures on Commodity A with 6 months to expiration
- B. Futures on Commodity A with 9 months to expiration
- C. Futures on Commodity B with 6 months to expiration
- D. Futures on Commodity B with 9 months to expiration

Answer: D

In order to minimize basis risk, one should choose the futures contract with the highest correlation to price changes, and the one with the closest maturity, preferably expiring after the duration of the hedge.

● Key Point: Cross Hedging

Optimal hedge ratio:

$$h^* = \rho \frac{\sigma_S}{\sigma_F}$$

Hedge Effectiveness:

$$R^2 = h^{*2} \frac{\sigma_F^2}{\sigma_S^2}$$

Optimal number of futures contracts:

$$N^* = \frac{h^* N_A}{Q_F}$$

Hedging with Stock Index Futures:

$$N^* = \beta \times \frac{P}{A}$$

Adjusting Portfolio Beta:

$$\# \text{ of contracts} = (\text{target beta} - \text{portfolio beta}) \times \frac{\text{portfolio value}}{\text{underlying asset}}$$

30. On Nov 1, Jimmy Walton, a fund manager of a USD 60 million US medium-to-large cap equity portfolio, considers locking up the profit from the recent rally. The S&P 500 index and its futures with the multiplier of 250 are trading at 900 and 910, respectively. Instead of selling off his holdings, he would rather hedge two-thirds of his market exposure over the remaining 2 months. Given that the correlation between Jimmy's portfolio and the S&P 500 index futures is 0.89 and the volatilities of the equity fund and the futures are 0.51 and 0.48 per year respectively, what position should he take to achieve his objective?
- A. Sell 250 futures contracts of S&P 500
 - B. Sell 169 futures contracts of S&P 500
 - C. Sell 167 futures contracts of S&P 500
 - D. Sell 148 futures contracts of S&P 500

Answer: C

The optimal hedge ratio is the product of the coefficient of correlation between the change in the spot price and the change in futures price, and the ratio of the volatility of the equity fund and the futures.

Two-thirds of the equity fund is worth USD 40 million. The optimal hedge ratio computed:

$$h = 0.89 \times (0.51 / 0.48) = 0.945$$

Computing the number of futures contracts:

$$N = 0.945 \times 40,000,000 / (910 \times 250) = 166.26 \approx 167, \text{ round up to nearest integer.}$$

● Key Point: Strip Hedge and Stack Hedge

As previously mentioned, electricity is not a storable commodity. Once it is produced it must be used. An oil producer may enter into a contract to supply a fixed amount of barrels of oil per month at a fixed price.

Strip hedge

He could set up a strip hedge by buying futures contracts that match the maturity and quantity for every month of the obligation.

Stack hedge

He could buy futures contracts with a single maturity, based on the present value of the future obligation.

31. An oil producer has an obligation under an agreement to supply 75,000 barrels of oil every month for one year at a fixed price. He wishes to hedge his liability to address the event of an upward surge in oil prices. The producer has opted for a stack and roll hedge rather than a strip hedge. Which of the following two statements are correct?
- I. A strip hedge increases transaction costs owing to active trading each month.
 - II. A strip hedge tends to have wider bid-ask spreads as compared to a stack & roll hedge.

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- A. I only
- B. II only
- C. I and II
- D. Neither

Answer: B

Statement II is correct. A strip hedge tends to have lower liquidity and wider bid-ask spreads owing to longer maturity contracts.

A strip hedge involves hedging a stream of obligations by offsetting each individual obligation with a futures contract matching the maturity and quantity of the obligation. Stacking futures contracts in the near-term contract and rolling over into the new near-term contracts is referred to as a stack and roll.

Statement I is incorrect. A strip hedge involves one time buying of futures contracts to match the maturity of liabilities.

● Key Point: Cost-of-Carry Model

Forward price when underlying asset does not have cash flows: $F_0 = S_0 e^{rT}$

Forward price when underlying asset has cash flows: $F_0 = (S_0 - I) e^{rT}$

Forward price with continuous dividend yield (q): $F_0 = S_0 e^{(r-q)T}$

Forward price with storage costs: $F_0 = (S_0 + U) e^{rT}$ or $F_0 = S_0 e^{(r+u)T}$

Forward price with convenience yield: $F_0 = S_0 e^{(r-c)T}$

Arbitrage: Remember to buy low, sell high.

- If $F_0 > S_0 e^{rT}$, borrow, buy spot, sell forward today; deliver asset, repay loan at end.
- If $F_0 < S_0 e^{rT}$, short spot, invest, buy forward today; collect loan, buy asset under futures contract, deliver to cover short sale.

Implied leasing rate:

$$F_{0,T} = S e^{(r-\delta)T} \Rightarrow \delta = r - \frac{1}{T} \ln \left(\frac{F_{0,T}}{S} \right)$$

- 32.** A stock index is valued at USD 750 and pays a continuous dividend at the rate of 2% per annum. The 6-month futures contract on that index is trading at USD 757. The risk free rate is 3.50% continuously compounded. There are no transaction costs or taxes. Is the futures contract priced so that there is an arbitrage opportunity? If yes, which of the following numbers comes closest to the arbitrage profit you could realize by taking a position in one futures contract?

- A. 4.18
- B. 1.35
- C. 12.60
- D. There is no arbitrage opportunity.

Answer: B

The formula for computing the forward price on a financial asset is:

$$F_{0,T} = S_0 e^{(r-\delta)T}$$

Where S_0 is the spot price of the asset, r is the continuously compounded interest rate, and δ is the continuous dividend yield on the asset.

The no-arbitrage futures price is computed as follows:

$$750 \times e^{(0.035-0.02) \times 0.5} = 755.65$$

Since the market price of the futures contract is higher than this price, there is an arbitrage opportunity.

The futures contract could be sold and the index purchased.

33. A trader in the arbitrage unit of a multinational bank finds that an asset is trading at USD 1,000, the price of a 1-year futures contract on that asset is USD 1,010, and the price of a 2-year futures contract is USD 1,025. Assume that there are no cash flows from the asset for 2 years. If the term structure of interest rates is flat at 1% per year, which of the following is an appropriate arbitrage strategy?

- A. Short 2-year futures and long 1-year futures
- B. Short 1-year futures and long 2-year futures
- C. Short 2-year futures and long the underlying asset funded by borrowing for 2 years
- D. Short 1-year futures and long the underlying asset funded by borrowing for 1 year

Answer: C

The 1-year futures price should be $1,000 \times e^{0.01} = 1,010.05$

The 2-year futures price should be $1,000 \times e^{0.01 \times 2} = 1,020.20$

The current 2-year futures price in the market is overvalued compared to the theoretical price. To lock in a profit, you would short the 2 year futures, borrow USD 1,000 at 1%, and buy the underlying asset. At the end of the 2nd years, you will sell the asset at USD 1,025 and return the borrowed money with interest, which would be $1,000 \times e^{0.01 \times 2} = 1,020.20$, resulting in a USD 4.80 gain.

● Key Point: Contango and Backwardation

Backwardation refers to a situation where the futures price is below the spot price. For this to occur, there must be a significant benefit to holding the asset.

Contango refers to a situation where the futures price is above the spot price. If there are no benefits to holding the asset (e.g., dividends, coupons, or convenience yield), contango will occur because the futures price will be greater than the spot price.

34. The current price of Commodity X in the spot market is \$42.47. Forward contracts for delivery of Commodity X in one year are trading at a price of \$43.11. If the current continuously compounded annual risk-free interest rate is 7.0%, calculate the implicit lease rate for Commodity X. Holding the calculated implicit lease rate constant, would the forward market for Commodity X be in backwardation or contango if the continuously compounded annual risk-free rate immediately fell to 5.0%?
- A. The implicit lease rate is 1.49%. Holding this rate constant, the forward market would be in contango if the continuously compounded annual risk-free rate immediately fell to 5.0%.
 - B. The implicit lease rate is 5.50%. Holding this rate constant, the forward market would be in backwardation if the continuously compounded annual risk-free rate immediately fell to 5.0%.
 - C. The implicit lease rate is 1.49%. Holding this rate constant, the forward market would be in backwardation if the continuously compounded annual risk-free rate immediately fell to 5.0%.
 - D. The implicit lease rate is 5.50%. Holding this rate constant, the forward market would be in contango if the continuously compounded annual risk-free rate immediately fell to 5.0%.

Answer: B

Step1: Calculate implicit lease rate = $0.07 - 0.0150 = 5.5\%$.

Step2: The forward price (\$43.11) is higher than the spot price (\$42.47), the market for Commodity X is currently in contango.

Step 3: If annual risk-free rate immediately fell to 5.0%, holding the lease rate constant, forward price $42.47e^{(r - \delta)t} = 42.47e^{(0.05 - 0.055)}$ is lower than the spot price (\$42.47) the market would be in backwardation.

35. In commodity markets, the complex relationships between spot and forward prices are embodied in the commodity price curve. Which of the following statements is true?
- A. In a backwardation market, the discount in forward prices relative to the spot price represents a positive yield for the commodity supplier.
 - B. In a backwardation market, the discount in forward prices relative to the spot price represents a positive yield for the commodity consumer.
 - C. In a contango market, the discount in forward prices relative to the spot price represents a positive yield for the commodity supplier.
 - D. In a contango market, the discount in forward prices relative to the spot price represents a positive yield for the commodity consumer.

Answer: B

When forward prices are as a discount to spot prices, a backwardation market is said to exist. The relatively high spot price represents a convenience yield to the consumer that holds the commodity for

immediate consumption.

● Key Point: Forward and Futures Contracts Application

36. A risk manager is deciding between buying a futures contract on an exchange and buying a forward contract directly from a counterparty on the same underlying asset. Both contracts would have the same maturity and delivery specifications. The manager finds that the futures price is less than the forward price. Assuming no arbitrage opportunity exists, what single factor acting alone would be a realistic explanation for this price difference?
- A. The futures contract is more liquid and easier to trade.
 - B. The forward contract counterparty is more likely to default.
 - C. The asset is strongly negatively correlated with interest rates.
 - D. The transaction costs on the futures contract are less than on the forward contract.

Answer: C

When an asset is strongly negatively correlated with interest rates, futures prices will tend to be slightly lower than forward prices. When the underlying asset increases in price, the immediate gain arising from the daily futures settlement will tend to be invested at a lower than average rate of interest due to the negative correlation. In this case futures would sell for slightly less than forward contracts, which are not affected by interest rate movements in the same manner since forward contracts do not have a daily settlement feature.

The other three choices would all most likely result in the futures price being higher than the forward price.

37. A 15-month futures contract on an equity index is currently trading at USD 3,767.52. The underlying index is currently valued at USD 3,625 and has a continuously-compounded dividend yield of 2% per year. The continuously compounded risk-free rate is 5% per year. Assuming no transactions costs, what is the potential arbitrage profit per contract and the appropriate strategy?
- A. USD 189, buy the futures contract and sell the underlying.
 - B. USD 4, buy the futures contract and sell the underlying.
 - C. USD 189, sell the futures contract and buy the underlying.
 - D. USD 4, sell the futures contract and buy the underlying.

Answer: D

This is an example of index arbitrage. The no-arbitrage value of the futures contract can be calculated as the future value of the spot price: $S_0 \times e^{(\text{risk free rate} - \text{dividend yield}) \times t}$, where S_0 equals the current spot price and t equals the time in years.

$$\text{Future value of the spot price} = S_0 \times e^{(\text{risk free rate} - \text{dividend yield}) \times t} = 3625 \times e^{(5\% - 2\%) \times 1.25} = 3,763.52$$

Since this value is different from the current futures contract price, a potential arbitrage situation exists. Since the futures price is higher than the future value of the spot price in this case, one can short sell the higher priced futures contract, and buy the underlying stocks in the index at the current price. The arbitrage profit would equal $3,767.52 - 3,763.52 = \text{USD } 4$.

- 38.** The six-month forward price of commodity X is USD 1,000. Six-month, risk-free, zero-coupon bonds with face value USD 1,000 trade in the fixed income market. When taken in the correct amounts, which of the following strategies creates a synthetic long position in commodity X for a period of 6 months?
- A. Short the forward contract and short the zero-coupon bond.
 - B. Short the forward contract and buy the zero-coupon bond.
 - C. Buy the forward contract and short the zero-coupon bond.
 - D. Buy the forward contract and buy the zero-coupon bond.

Answer: D

A synthetic commodity position for a period of T years can be constructed by entering into a long forward contract with T years to expiration and buying a zero-coupon bond expiring in T years with a face value of the forward price. The payoff function is as follows:

Payoff from long forward position = $S_T - F_{0,T}$, where S_T is the spot price of the commodity at time T and $F_{0,T}$ is the current forward price.

Payoff from zero coupon bond: $F_{0,T}$ at time T.

Hence, the total payoff function equals $(S_T - F_{0,T}) + F_{0,T}$ or S_T . This creates a synthetic commodity position.

● Key Point: Forward Contract Value

Initiation:

$$V_0(\text{long}) = S_0 - Fe^{-r_f T} = 0$$

During:

$$V_0(\text{long}) = S_t - Fe^{-r_f (T-t)}$$

Expiration:

$$V_0(\text{long}) = S_T - F$$

- 39.** Three months ago a company entered in a one-year forward contract to buy 100 ounces of gold. At

the time, the one-year forward price was USD 1,000 per ounce. The nine-month forward price of gold is now USD 1,050 per ounce. The continuously-compounded risk-free rate is 4% per year for all maturities and there are no storage costs. Which of the following is closest to the value of the contract?

- A. USD5,000
- B. USD 4,852
- C. USD 7,955
- D. USD1,897

Answer: B

The forward price is computed as follows:

$$F_0 = 100 \times (F_0 - K) e^{-rT} = 100 \times (1050 - 1000) e^{-4\% \times 0.75} = 4,852$$

40. A commodities trader observes quotes for futures contracts as follow:

Spot Price	321
July, 2014	312
October, 2014	310
December, 2014	309

This commodity is trading:

- A. As a normal futures market since the futures prices are consistent with the commodity's seasonality.
- B. As an inverted futures market since more distant delivery contracts are trading at lower prices than nearer-term ones.
- C. As a normal futures market because it is typical for more distant delivery contracts to trade lower than nearer-term delivery contracts.
- D. Consistently with convergence as futures prices will rise when the delivery period nears.

Answer: B

41. A French bank enters into a 6-month forward contract with an importer to sell GBP 40 million in 6 months at a rate of EUR 0.80 per GBP. If in 6 months the exchange rate is EUR 0.85 per GBP, what is the payoff for the bank from the forward contract?

- A. EUR -2,941,176
- B. EUR -2,000,000
- C. EUR 2,000,000
- D. EUR 2,941,176

Answer: B

The value of the contract for the bank at expiration: $40,000,000 \text{ GBP} \times 0.80 \text{ EUR/GBP}$

The cost to close out the contract for the bank at expiration: $40,000,000 \text{ GBP} \times 0.85 \text{ EUR/GBP}$

Therefore, the final payoff in EUR to the bank can be calculated as: $40,000,000 \times (0.80 - 0.85) = -2,000,000 \text{ EUR}$.

42. Company XYZ operates in the U.S. On April 1, 2009, it has a net trade receivable of EUR 5,000,000 from an export contract to Germany. The company expects to receive this amount on Oct. 1, 2009. The CFO of XYZ wants to protect the value of this receivable. On April 1, 2009, the EUR spot rate is 1.34, and the 6-month EUR forward rate is 1.33. The CFO can lock in an exchange rate by taking a position in the forward contract. Alternatively, he can sell a 6-month EUR 5,000,000 call option with strike price of 1.34. The CFO thinks that selling an option is better than taking a forward position because if the EUR goes up, XYZ can take delivery of the USD at 1.34, which is better than the outright forward rate of 1.33. If the EUR goes down, the contract will not be exercised. So, XYZ will pocket the premium obtained from selling the call option.

What can be concluded about the CFO's analysis?

- A. CFO's analysis is correct. The company is better off whichever way the EUR rate goes.
- B. CFO's analysis is not correct. The company will suffer if the EUR goes up sharply.
- C. CFO's analysis is not correct. The company will suffer if the EUR moves within a narrow range.
- D. CFO's analysis is not correct. The company will suffer if the EUR goes down sharply.

Answer: D

The CFO's analysis is incorrect because there is unlimited downside risk. The option premium received is a fixed amount, and if the EUR declines sharply, the value of the underlying receivable goes down as well. If instead the EUR moves in a narrow range, that would be good, but there is no guarantee of course that this will occur.

● Key Point: Interest Rate Parity

Using the interest rate parity relationship to calculate a forward foreign exchange rate:

$$F_0 = S_0 e^{(r - r_f)T}$$

43. Current spot CHF/USD rate: 1.3680 (1.3680CHF = 1USD)

3-month USD interest rates: 1.05%

3-month Swiss interest rates: 0.35%

(Assume continuous compounding)

A currency trader notices that the 3-month future price is USD 0.7350. In order to arbitrage, the trader should investment:

- A. Borrow CHF, buy USD spot, go long CHF futures
- B. Borrow CHF, sell CHF spot, go short CHF futures
- C. Borrow USD, buy CHF spot, go short CHF futures
- D. Borrow USD, sell USD spot, go long CHF futures

Answer: C

Step 1. The spot is quoted in terms of Swiss Francs per USD, theoretical future price of USD = $1.368 \times e^{(0.35\% - 1.05\%) \times 3/12} = 1.368 \times 0.99825 = 1.36561$ CHF

Step 2. 3-month future price is USD 0.7350 $\rightarrow 1/0.7350 = 1.3054$ CHF

Step 3. $1.36561 \text{ CHF} > 1.3054 \text{ CHF} \rightarrow$ USD future contract is undervalued

Step 4. Arbitrage strategies: borrow USD (buy CHF) spot, buy USD (short CHF) future.

44. You are examining the exchange rate between the U.S. dollar and the Euro and have the following information:

- Current USD/EUR exchange rate is 1.25.
- Current USD-denominated 1-year risk-free interest rate is 4% per year.
- Current EUR-denominated 1-year risk-free interest rate is 7% per year.

According to the interest rate parity theorem, what is the 1-year forward USD/EUR exchange rate?

- A. 0.78
- B. 0.82
- C. 1.21
- D. 1.29

Answer: C

The forward rate, F_t , is given by the interest rate parity equation:

$$F_t = S_0 \times e^{(r - r_f) \times t}$$

where S_0 is the spot exchange rate, r is the domestic (USD) risk-free rate, and r_f is the foreign (EUR) risk-free rate, t is the time to delivery.

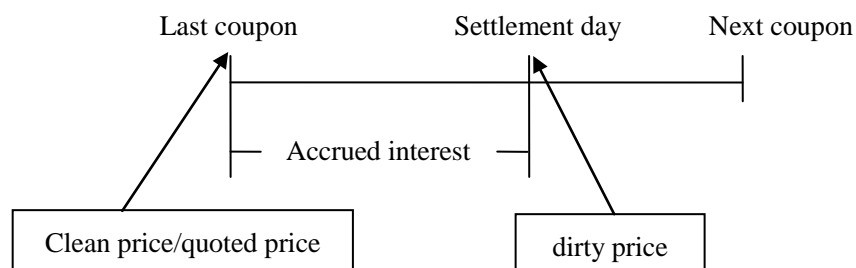
Substituting the values in the equation: $F_t = 1.25 \times e^{(0.04 - 0.07) \times 1} = 1.21$

● Key Point: Bond Pricing

$$P = \frac{C_1}{1+y} + \frac{C_2}{(1+y)^2} + \cdots + \frac{C_T}{(1+y)^T} = \sum_{t=1}^T \frac{C_t}{(1+y)^t}$$

Perpetual Bond:

$$P = \frac{cF}{1+y} + \frac{cF}{(1+y)^2} + \cdots = \sum_{t=1}^{+\infty} \frac{cF}{(1+y)^t} = \frac{cF}{y}$$

Clean Price & Dirty Price:

$$\text{dirty price} = \text{clean price} + \text{accrued price}$$

45. Given a one-year and a three-year zero coupon bonds price of 95.18 and 83.75 respectively, what should be the price of a two year zero coupon bond using linear interpolation on zero rates (semiannual compounding)?
- A. 95.18
B. 89.47
C. 89.72
D. 83.75

Answer: C

Step 1: Compute semiannual zero rates for the 1-and 3-year bonds.

1-year bond: FV = 100; N = 2; PMT = 0, PV = -95.18, CPT: I/Y = $2.5008 \times 2 = 5.0\%$

3-year bond: FV = 100; N = 6; PMT = 0, PV = -83.75, CPT: I/Y = $3 \times 2 = 6\%$

Step 2: Use linear interpolation on zero rates for 2-year bond

$(6\% - 5\%)/2 = 0.5\%$, zero rates for 2-year bonds = $5\% + 0.5\% = 5.5\%$

Step3: Compute 2-year bond price

FV = 100; N = 4; PMT = 0, I/Y = 2.75(5.5/2), CPT: PV = -89.72

46. A two-year zero-coupon bond issued by corporate XYZ is currently rated A. One year from now XYZ is expected to remain at A with 85% probability, upgraded to AA with 5% probability, and downgraded to BBB with 10% probability. The risk free rate is flat at 4%. The credit spreads are flat at 40, 80, and 150 basis points for AA, A, and BBB rated issuers, respectively. All rates are

compounded annually. Estimate the expected value of the zero-coupon bond one year from now (for USD 100 face amount).

- A. USD 92.59
- B. USD 95.33
- C. USD 95.37
- D. USD 95.42

Answer: C

It is the expected value of the zero coupon bond one year from now.

47. A \$1,000 par corporate bond carries a coupon rate of 6%, pays coupons semiannually, and has ten coupon payments remaining to maturity. Market rates are currently 5%. There are 90 days between settlement and the next coupon payment. The dirty and clean prices of the bond, respectively, are closest to:

- A. \$1,043.76, \$1,013.76
- B. \$1,043.76, \$1,028.76
- C. \$1,056.73, \$1,041.73
- D. \$1,069.70, \$1,054.70

Answer: C

The dirty price of the bond 90 days ago is calculated as $N = 10$, $I/Y = 2.5$, $PMT = 30$, $FV = 1,000$; $CPT \rightarrow PV = 1,043.76$. Adjusting the PV for the fact that there are only 90 days until the receipt of the first coupon, then the dirty price now is $1,043.76 \times 1.025^{(90/180)} = 1056.73$. Clean price = dirty price – accrued interest = $1056.73 - 30 \times (90/180) = 1041.73$.

48. The table below gives coupon rates and mid-market price for three U.S. Treasury bonds for settlement on (as of) May 31, 2013

Coupon	Maturity	Price
2 7/8	11/30/2013	\$100.62600
2 1/2	5/31/2014	\$99.45250
4 3/4	11/30/2014	\$100.38000

Which of the following is nearest to the implied discount function (set of discount factors) assuming semi-annual compounding?

- A. $d(0.5) = 0.9370$, $d(1.0) = 0.8667$, $d(1.5) = 0.9210$
- B. $d(0.5) = 0.9920$, $d(1.0) = 0.9700$, $d(1.5) = 0.9350$
- C. $d(0.5) = 0.9999$, $d(1.0) = 0.7455$, $d(1.5) = 0.8018$
- D. $d(0.5) = 1.0350$, $d(1.0) = 1.1175$, $d(1.5) = 0.6487$

Answer: B

The future value of \$1 invested for time t is $1/d(t)$.

$$d(0.5) = \frac{100.62600}{(100 + 2.875/2)} = 0.992$$

$$d(1) = \frac{(99.45250 - 1.25d(0.5))}{101.25} = 0.9700$$

$$d(1.5) = \frac{(100.3800 - 2.375d(0.5) - 2.375d(1))}{102.375} = 0.9350$$

● Key Point: T-bond futures, CTD bond

In a T-bond futures contract, any government bond with more than 15 years to maturity on the first of the delivery month (and not callable within 15 years) is deliverable on the contract.

The procedure to determine which bond is the cheapest-to-deliver (CTD) is as follows:

Cash received by the short = $(QFP \times CF) + AI$

Cost to purchase bond = $QBP + AI$

Where:

QFP = quoted futures price

CF = conversion factor

QBP = quoted bond price

The CTD is the bond that minimizes the following: $QBP - (QFP \times CF)$. This formula calculates the cost of delivering the bond.

49. The yield curve is upward sloping. You have a short T-bond futures position. The following bonds are eligible for delivery:

Bond	A	B	C
Spot price	102-14/32	106-19/32	98-12/32
Coupon	4%	5%	3%
Conversion factor	0.98	1.03	0.952

The futures price is 103-17/32 and the maturity date of the contract is September 1. The bonds pay their coupon semiannually on June 30 and December 31. The cheapest to deliver bond is:

- A. Bond A
- B. Bond B
- C. Bond C

D. Insufficient information

Answer: C

Cost of bond A: $(102-14/32) - (103-17/32) \times 0.98 = 0.9769$

Cost of bond B: $(106-19/32) - (103-17/32) \times 1.03 = -0.0435$

Cost of bond C: $(98-12/32) - (103-17/32) \times 0.952 = -0.1868$

50. A hedge fund has invested USD 100 million in mortgage-Backed securities. The risk manager is concerned about prepayment risk if interest rates fall. Which of the following strategies is an effective hedge against the potential loss due to a drop in interest rates?

- A. Short forward rate agreement (FRA), long T-bond futures
- B. Long FRA, short T-bond futures
- C. Long FRA, long T-bond futures
- D. Short FRA, short T-bond futures

Answer: A

When rates drop, the long position in the futures and the short position in the FRA both gain.

● Key Point: Eurodollar Futures

This contract settles in cash and the minimum price change is one “tick”, which is a price change of one basis point, or \$25 per \$1 million contract.

The interest rate underlying this contract is essentially the 3-month (90-day) forward LIBOR. If Z is the quoted price for a Eurodollar futures contract, the contract price is:

Eurodollar futures price = $\$10,000[100 - (0.25)(100 - Z)] = 10,000[100 - 0.25F_t]$

Convexity adjustment: The daily marking to market aspect of the futures contract can result in differences between actual forward rates and those implied by futures contracts.

Forward rate = Futures rate $- 0.5 \times \sigma^2 \times T_1 \times T_2$

51. Consider an FRA (forward rate agreement) with the same maturity and compounding frequency as a Eurodollar futures contract. The FRA has labor underlying. Which of the following statements are true about the relationship between the forward rate and the futures rate?

- A. The forward rate is normally higher than the futures rate.
- B. They have no fixed relationship.
- C. The forward rate is normally lower than the futures rate.
- D. They should be exactly the same.

Answer: C

Futures rate exceeds the forward rate.

52. The four-year Eurodollar futures quote is 97.00. The volatility of the short-term interest rate (LIBOR) is 1.0%, expressed with continuous compounding. What is the equivalent forward rate, adjusted for convexity, given in ACT/360 day count with continuous compounding (i.e., the Eurodollar futures contract gives LIBOR in quarterly compounding ACT/360, so convert to continuous but a day count conversion is not needed)?
- A. 2.90%
 - B. 2.95%
 - C. 2.99%
 - D. 3.00%

Answer: A

$$\text{futures rate} = \text{forward rate} + (1/2)\sigma^2 t_1 t_2$$

$$\text{futures rate (annual)} = (100 - 97)\% = 3\%$$

$$\text{futures rate (quarterly)} = 3\% \times \frac{90}{360} = 0.75\%$$

$$\text{futures rate (continuous)} = \ln(1.0075) \times \frac{360}{90} = 2.99\%$$

$$\text{forward rate} = 2.99\% - (1/2)(1\%^2)(4)(4.25) = 2.90\%$$

53. A German housing corporation needs to hedge against rising interest rates. It has chosen to use futures on 10-year German government bonds. Which position in the futures should the corporation take, and why?
- A. Take a long position in the futures because rising interest rates lead to rising futures prices.
 - B. Take a short position in the futures because rising interest rates lead to rising futures prices.
 - C. Take a short position in the futures because rising interest rates lead to declining futures prices.
 - D. Take a long position in the futures because rising interest rates lead to declining futures prices.

Answer: C

Government bond futures decline in value when interest rates rise, so the housing corporation should short futures to hedge against rising interest rates.

● Key Point: Duration-Based Hedge Ratio

The objective of a duration-Based hedge is to create a combined position that does not change in value when yields change by a small amount.

$$\# \text{ of contracts} = -\frac{\text{portfolio value} \times \text{duration}_p}{\text{futures value} \times \text{duration}_F}$$

54. A trader executes a \$420 million 5-year pay fixed swap (duration 4.433) with one client and a \$385 million 10 year receive fixed swap (duration 7.581) with another client shortly afterwards. Assuming that the 5-year rate is 4.15% and 10-year rate is 5.38% and that all contracts are transacted at par, how can the trader hedge his position?
- A. Buy 4,227 Eurodollar contracts
 - B. Sell 4,227 Eurodollar contracts
 - C. Buy 7,185 Eurodollar contracts
 - D. Sell 7,185 Eurodollar contracts

Answer: B

Step1. First swap is equivalent to a short position in a bond with similar coupon characteristics and maturity offset by a long position in a floating-rate note.

Its $DV01 = 420 \times 4.433 \times 0.0001 = 0.186$.

Step2. Second swap is equivalent to a long position in a bond with similar coupon characteristics and maturity offset by a short position in a floating-rate note.

Its $DV01 = 385 \times 7.581 \times 0.0001 = 0.291$.

Step3. Net $DV01$ of portfolio = $-0.186 + 0.291 = 0.105m = 105,683$

Step4. The optimal number is $N^* = -DV01_s / DV01_F = -105,683 / 25 = -4,227$ (Note that the DVBP of the Eurodollar futures is about 25.)

55. A portfolio manager controls USD 88 million par value of zero-coupon bonds maturing in 5 years and yielding 4%. The portfolio manager expects that interest rates will increase. To hedge the exposure, the portfolio manager wants to sell part of the 5-year bond position and use the proceeds from the sale to purchase zero-coupon bonds maturing in 1.5 years and yielding 3%. What is the market value of the 1.5-year bonds that the portfolio manager should purchase to reduce the duration on the combined position to 3 years?
- A. USD 41.17 million
 - B. USD 43.06 million
 - C. USD 43.28 million
 - D. USD 50.28 million

Answer: A

In order to find the proper amount, we first need to calculate the current market value of the portfolio (P), which is:

$$P = 88 * \exp(-0.04 * 5) = 72.05 \text{ million.}$$

The desired portfolio duration (after the sale of the 5-year bond and purchase of the 1.5 year bond) can be expressed as:

$[5 * (P-X) + 1.5 * X] / P = 3$ where X represents the market value of the zero-coupon bond with a maturity of 1.5 years.

This equation holds true when $X = (4/7) * P$, or 41.17 million.

● Key Point: Interest Rate Swap

Plain vanilla interest rate swap: exchanges fixed for floating-rate payments over the life of the swap.

At inception, the value of the swap is zero.

After inception, the value of the swap is the difference between the present value of the remaining fixed-and floating-rate payments:

$$V_{\text{swap to pay fixed}} = B_{\text{float}} - B_{\text{fix}}$$

$$V_{\text{swap to receive fixed}} = B_{\text{fix}} - B_{\text{float}}$$

$$B_{\text{fixed}} = (\text{PMT}_{\text{fixed}, t_1} \times e^{-rt_1}) + (\text{PMT}_{\text{fixed}, t_2} \times e^{-rt_2}) + \dots + [(\text{notional} + \text{PMT}_{\text{fixed}, t_n}) \times e^{-rt_n}]$$

$$B_{\text{floating}} = [\text{notional} + (\text{notional} \times r_{\text{float}})] \times e^{-rt_1}$$

56. Consider a \$1 million notional swap that pays a floating rate based on 6-month LIBOR and receives a 6% fixed rate semiannually. The swap has a remaining life of 15 months with pay dates at 3, 9 and 15 months. Spot LIBOR rates are as following: 3 months at 5.4%; 9 months at 5.6%; and 15 months at 5.8%. The LIBOR at the last payment date was 5.0%. Calculate the value of the swap to the fixed-rate receiver using the bond methodology.

- A. \$6,077
- B. -\$6,077
- C. -\$5,077
- D. \$5,077

Answer: D

$$\begin{aligned} B_{\text{fixed}} &= (\text{PMT}_{\text{fixed}, 3 \text{ months}} \times e^{-(r \times t)}) + (\text{PMT}_{\text{fixed}, 9 \text{ months}} \times e^{-(r \times t)}) + [(\text{notional} + \text{PMT}_{\text{fixed}, 15 \text{ months}}) \times e^{-(r \times t)}] \\ &= (\$30,000 \times e^{-(0.054 \times 0.25)}) + (\$30,000 \times e^{-(0.056 \times 0.75)}) + [(\$1,000,000 + \$30,000) \times e^{-(0.058 \times 1.25)}] \\ &= \$29,598 + \$28,766 + \$957,968 = \$1,016,332 \end{aligned}$$

$$B_{\text{floating}} = [\text{notional} + \text{notional} \times \frac{r_{\text{floating}}}{2}] \times e^{-(r \times t)}$$

$$= [\$1,000,000 + \$1,000,000 \times \frac{0.05}{2}] \times e^{-(0.054 \times 0.25)} = \$1,011,255$$

$$V_{\text{swap}} = B_{\text{fixed}} - B_{\text{floating}} = \$1,016,332 - \$1,011,255 = \$5,077$$

57. Below is a table of term structure of swap rates:

Maturity in Years Swap Rate

1	2.50%
2	3.00%
3	3.50%
4	4.00%
5	4.50%

The 2-year forward swap rate starting in three years is closest to:

- A. 3.50%
- B. 4.50%
- C. 5.51%
- D. 6.02%

Answer: D

Computing the 2-year forward swap rate starting in three years:

$$(1 + 4.50\%)^5 = (1 + 3.50\%)^3 \times (1 + r)^2$$

$$r = 6.02\%$$

58. Two companies, C and D, have the borrowing rates shown in the following table.

Borrowing Rates for C and D		
Company	Fixed Borrowing	Floating Borrowing
C	10%	LIBOR+ 50bps
D	12%	LIBOR+ 100bps

According to the comparative advantage argument, what is the total potential savings for C and D if they enter into an interest rate swap?

- A. 0.5%
- B. 1.0%
- C. 1.5%
- D. 2.0%

Answer: C

The difference of the differences is $(12\% - 10\%) - [\text{LIBOR} + 1\% - (\text{LIBOR} + 0.5\%)] = 1.5\%$.

59. An oil driller recently issued USD 250 million of fixed-rate debt at 4.0% per annum to help fund a new project. It now wants to convert this debt to a floating-rate obligation using a swap. A swap desk analyst for a large investment bank that is a market maker in swaps has identified four firms interested in swapping their debt from floating-rate to fixed-rate. The following table quotes available loan rates for the oil driller and each firm:

Firm	Fixed-rate (in %)	Floating-rate (in %)
Oil driller	4.0	6-month LIBOR + 1.5
Firm A	3.5	6-month LIBOR + 1.0
Firm B	6.0	6-month LIBOR + 3.0
Firm C	5.5	6-month LIBOR + 2.0
Firm D	4.5	6-month LIBOR + 2.5

A swap between the oil driller and which firm offers the greatest possible combined benefit?

- A. Firm A
- B. Firm B
- C. Firm C
- D. Firm D

Answer: C

Since the oil driller is swapping out of a fixed-rate and into a floating-rate, the larger the difference between the fixed spread and the floating spread the greater the combined benefit. See table below:

Firm	Fixed-rate	Floating-rate	Fixed-spread	Floating-spread	Possible Benefit
Oil driller	4.0	1.5			
Firm A	3.5	1.0	-0.5	-0.5	-0.0
Firm B	6.0	3.0	2.0	1.5	0.5
Firm C	5.5	2.0	1.5	0.5	1.0
Firm D	4.5	2.5	0.5	1.0	-0.5

60. Savers Bancorp entered into a swap agreement over a 2-year period on August 9, 2008, with which it received a 4.00% fixed rate and paid LIBOR plus 1.20% on a notional amount of USD 6.5 million. Payments were to be made every 6 months. The table below displays the actual annual 6-month LIBOR rates over the 2-year period.

Date	6-month LIBOR
Aug 9	3.11%
Feb 9	1.76%
Aug 9	0.84%

Feb 9	0.39%
Aug 9	0.58%

Assuming no default, how much did Savers Bancorp receive on August 9, 2010?

- A. USD 72,150
- B. USD 78,325
- C. USD 117,325
- D. USD 156,650

Answer: B

The proper interest rate to use is the 6-month LIBOR rate at February 9, 2010, since it is the 6-month LIBOR that will yield the payoff on August 9, 2010. Therefore the net settlement amount on August 9th, 2010 is as follows:

Savers receives: $6,500,000 \times 4.00\% \times 0.5$ years, or USD 130,000

Savers pays $6,500,000 \times (0.39\% + 1.20\%) \times 0.5$, or USD 51,675.

Therefore Savers would receive the difference, or 78,325.

● Key Point: Currency Swaps

$$V_{\text{swap}}(\text{DC}) = B_{\text{DC}} - (S_0 \times B_{\text{FC}})$$

Where: S_0 = spot rate in DC per FC

61. Your company is expecting a major export order from a London-Based client. The receivables under the contract are to be billed in GBP, while your reporting currency is USD. Since the order is a large sum, your company does not want to bear the exchange risk and wishes to hedge it using derivatives. To minimize the cost of hedging, which of the following is the most suitable contract?

- A. A chooser option for GBP/USD pair
- B. A currency swap where you pay fixed in USD and receive floating in GBP
- C. A barrier put option to sell GBP against USD
- D. An Asian call option on GBP against USD

Answer: C

A cross-currency swap is inappropriate because there is no stream of payment but just one. Also, one would want to pay GBP, not receive it. An Asian options generally cheap, but this should be a put option, not a call. Among the two remaining choices, the chooser option is more expensive because it involves a call and put.

62. Consider the following 3-year currency swap, which involves exchanging annual interest of 2.75%

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on 10 million US dollars for 3.75% on 15 million Canadian dollars. The CAD/USD spot rate is 1.52. The term structure is flat in both countries. Calculate the value of the swap in USD if interest rates in Canada are 5% and in the United States are 4%. Assume continuous compounding. Round to the nearest dollar.

- A. \$152,000
- B. \$145,693
- C. \$131,967
- D. \$127,818

Answer: C

$$V_{\text{swap}}(\text{USD}) = B_{\text{USD}} - (\text{Spot rate} \times B_{\text{CAD}})$$

$$B_{\text{USD}} = 275,000e^{-0.04 \times 1} + 275,000 \times e^{-0.04 \times 2} + 10,275,000e^{-0.04 \times 3} = \text{USD}9,631,182$$

$$B_{\text{CAD}} = 565,200e^{-0.05 \times 1} + 565,200e^{-0.05 \times 2} + 15,565,200e^{-0.05 \times 3} = \text{CAD}14,438,805$$

$$V_{\text{swap}}(\text{USD}) = 9,631,182 - 11,438,805 / 1.52 = \text{USD}131,967$$

● Key Point: Equity Swap

- 63.** As an asset manager, Sarah Peck wishes to reduce her exposure to fixed-income securities and increase her exposure to large-cap stocks. She enters into an equity swap with a dealer on the terms that she will pay the dealer a fixed rate of 5% and receive from him the return on the large-cap stock index. Assume that payments are made annually and that the notional principal is EUR 50 million. If the large-cap stock index had a value of 10,320 at the beginning of the year and a value of 11,219 at the end of the year, what is the net payment made at the end of the year and which party makes the net payment?

- | Net payment made | Party making net payment |
|---------------------|--------------------------|
| A. EUR 1.86 million | Asset manager |
| B. EUR 2.50 million | Dealer |
| C. EUR 1.86 million | Dealer |
| D. EUR 2.50 million | Asset manager |

Answer: C

Cash Flows for Peck:

(Inflow at the return (%) on stock index – Outflow at 5%) × Notional principal

Return on stock index = $(11219/10320) - 1 = 0.0871$ or 8.71%

Net amount owed by the dealer to Peck = $50 \text{ M} \times (0.0871 - 0.05) = 50,000,000 \times 0.0371 = \text{EUR } 1.86 \text{ million}$

● Key point: Swap

Swaps are OTC options that give the buyer the right to enter a swap at a fixed point in time at specified terms.

64. As your company's risk manager, you are looking for protection against adverse interest rate changes in five years. Using Black's model for options on futures to price a European swap option (swap) which gives the option holder the right to cancel a seven-year swap after five years, which of the following would you use in the model?

- A. The two-year forward par swap rate starting in five years' time
- B. The five-year forward par swap rate starting in two years' time
- C. The two-year par swap rate
- D. The five-year par swap rate

Answer: A

The forward rate should start at the beginning of the option in five years, with maturity equal to the duration of the option, or two years.

65. The yield curve is upward sloping and a portfolio manager has a long position in 10-year Treasury notes funded through overnight repurchase agreements. The risk manager is concerned with the risk that market rates may increase further and reduce the market value of the position. What hedge could be put on to reduce the position's exposure to rising rates?

- A. Enter into a 10-year pay-fixed and receive-floating interest rate swap.
- B. Enter into a 10-year receive-fixed and pay-floating interest rate swap.
- C. Establish a long position in 10-year Treasury note futures.
- D. Buy a call option on 10-year Treasury note futures.

Answer: A

● Key Point: Option Payoff

Call option payoff: $C_T = \max(0, S_T - X)$

Put option payoff: $P_T = \max(0, X - S_T)$

Where: S_T = spot price at maturity; K = delivery price

66. An American investor holds a portfolio of French stocks. The market value of the portfolio is €10 million, with a beta of 1.35 relative to the CAC index. In November, the spot value of the CAC index is 4,750. The exchange rate is USD 1.25/€ The dividend yield, euro interest rates, and dollar

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interest rates are all equal to 4%. Which of the following option strategies would be most appropriate to protect the portfolio against a decline of the euro that week? March Euro options (all prices in US dollars per €)

Strike	Call euro	Put euro
1.25	0.018	0.022

- A. Buy calls with a premium of USD 180,000
- B. Buy puts with a premium of USD 220,000
- C. Sell calls with a premium of USD 180,000
- D. Sell puts with a premium of USD 220,000

Answer: B

Buying puts would protect against a decline in the euro and the premium would be:

$$\text{USD}0.022 \times \text{€}10\text{m} = \text{USD}220,000$$

● Key Point: Option Factors & Pricing Bounds

Factor	European Call	European Put	American Call	American Put
S	+	—	+	—
X	—	+	—	+
T	?	?	+	+
σ	+	+	+	+
r	+	—	+	—
D	—	+	—	+

Option	Proxy	Min Value	Max value
European call	c	$\max(0, S_0 - Xe^{-rT})$	S_0
American call	C	$\max(0, S_0 - Xe^{-rT})$	S_0
European put	p	$\max(0, Xe^{-rT} - S_0)$	Xe^{-rT}
American put	P	$\max(0, X - S_0)$	X

● Key Point: Rules for Exercising American

Options

- It is never optimal to exercise an American call on a non-dividend-paying stock before its expiration date

- American puts can be optimally exercised early if they are sufficiently in-the-money.
- An American call on a dividend-paying stock may be exercised early if the dividend exceeds the amount of forgone interest.

67. The current stock price of a share is USD 100 and the continuously compounding risk-free rate is 12% per year. The maximum possible prices for a 3-month European call option, American call option, European put option, and American put option, all with strike price 90, are:

- A. 100, 100, 87.34, 90
- B. 100, 100, 90, 90
- C. 97.04, 100, 90, 90
- D. 97.04, 97.04, 87.34, 87.34

Answer: A

For European and American call options, the maximum possible price is equal to current stock price. The option price can never be higher than the stock. The stock price is thus the “upper bound”. For a European Put, the upper bound is the present value of strike price, while for American put it is equal to the strike price.

68. Consider an American call option and an American put option, each with 3 months to maturity, written on a non-dividend-paying stock currently priced at USD 40. The strike price for both options is USD 35 and the risk-free rate is 1.5%. What are the lower and upper bounds on the difference between the prices of the call and put options?

Scenario	Lower Bound (USD)	Upper Bound (USD)
A	5.13	40.00
B	5.00	5.13
C	34.87	40.00
D	0.13	34.87

- A. Scenario A
- B. Scenario B
- C. Scenario C
- D. Scenario D

Answer: B

Rationable: The put-call parity in case of American options leads to the inequality:

$$S_0 - X \leq (C - P) \leq S_0 - Xe^{-rT}$$

The lower and upper bounds are given by:

$$= 40 - 35 \leq (C - P) \leq 40 - 35e^{-0.015 \times 3/12}$$

$$= 5 \leq (C - P) \leq 5.13$$

Alternatively, the upper and lower bounds for American options are given by:

Option	Minimum Value	Maximum Value
American Call	$C \geq \max(0, S_0 - Xe^{-rT}) = 5.13$	$S_0 = 40$
American Put	$P \geq \max(0, X - S_0) = 0$	$X = 35$

Subtracting the put values from the call values in the table above, we get the same result:

$$= 5 \leq C - P \leq 5.13$$

(Note: the minimum and maximum values are obtained by comparing the results of the subtraction of the put price from the call price. For instance, in this example, the upper bound is obtained by subtracting the minimum value of the American put option from the minimum value of the American call option and vice versa).

● Key Point: Put-call Parity

Put-call parity

European option: $p + S = c + Xe^{-rT}$

American option: $S - X \leq C - P \leq S - Xe^{-rT}$

69. Jeff is an arbitrage trader, and he wants to calculate the implied dividend yield on a stock while looking at the over-the-counter price of a 5-year put and call (both European-style) on that same stock. He has the following data:

- Initial stock price = USD 85
- Strike price = USD 90
- Continuous risk-free rate = 5%
- Underlying stock volatility = unknown
- Call price = USD 10
- Put price = USD 15

What is the continuous implied dividend yield of that stock?

- A. 2.48%
- B. 4.69%
- C. 5.34%
- D. 7.71%

Answer: C

$C - P = S_0 e^{-qT} - Ke^{-rT}$, Solving for q , we get 5.34%.

70. Stock UGT is trading at USD 100. A 1-year European call option on UGT with a strike price of USD 80 is trading at USD 30. No dividends are being paid in the following year. What should be the lower bound for an American put option on UGT with a strike price of USD 80, in order to not have arbitrage opportunities? Assume a continuously-compounded risk-free rate of 4% per year.

- A. 6.1
- B. 7.7
- C. 5.7
- D. 6.9

Answer: D

The European call option is the same as an American call option, since there are no dividends during the life of the options. American call and put prices satisfy the inequality.

$S - K \leq C - P \leq S - Ke^{-rt}$, thus $Ke^{-rt} - S + C \leq P \leq K - S + C$, therefore: $6.86 \leq P \leq 10$.

6.9 falls between 6.86 and 10.

71. A trader writes the following 1-year European-style barrier options as protection against large movements in a non-dividend paying stock that is currently trading at EUR 40.96.

Option	Price (EUR)
Up-and-in barrier call, with barrier at EUR 45	3.52
Up-and-out barrier call, with barrier at EUR 45	1.24
Down-and-in barrier put, with barrier at EUR 35	2.00
Down-and-out barrier put, with barrier at EUR 35	1.01

All of the options have the same strike price. Assuming the risk-free rate is 2% per annum, what is the common strike price of these options?

- A. EUR 39.00
- B. EUR 40.00
- C. EUR 41.00
- D. EUR 42.00

Answer: B

The sum of the price of an up-and-in barrier call and an up-and-out barrier call is the price of an otherwise equivalent European call. The price of the European call is EUR 3.52 + EUR 1.24 = EUR 4.76.

The sum of the price of a down-and-in barrier put and a down-and-out barrier put is the price of an otherwise equivalent European put. The price of the European put is EUR 2.00 + EUR 1.01 = EUR 3.01.

Using put-call parity, where C represents the price of a call option and P the price of a put option,

$$C + Ke^{-r} = P + S$$

$$K = e^r (P + S - C)$$

$$\text{Hence, } K = e^{0.02} \times (3.01 + 40.96 - 4.76) = 40.00$$

72. The price of a six-month, USD 25 strike price, European call option on a stock is USD 3. The stock price is USD 24. A dividend of USD 1 is expected in three months. The continuously compounded risk-free rate for all maturities is 5% per year. Which of the following is closest to the value of a put option on the same underlying stock with a strike price of USD 25 and a time to maturity of six months?

- A. USD 3.60
- B. USD 2.40
- C. USD 4.37
- D. USD 1.63

Answer: C

From the equation for put-call parity, this can be solved by the following equation:

$$p = c + PV(K) + PV(D) - S_0$$

where PV represents the present value, so that:

$$PV(K) = Ke^{-rT} \text{ and } PV(D) = D \times e^{-rt}$$

Where:

p represents the put price,

c is the call price,

K is the strike price of the put option,

D is the dividend,

S_0 is the current stock price.

T is the time to maturity of the option, and

t is the time to the next dividend distribution.

Calculating PV (K), the present value of the strike price, results in a value of $25 \times e^{-0.05 \times 0.5}$ or 24.38, while PV (D) is equal to $1 \times e^{-0.05 \times 0.25}$ or 0.99. Hence $p = 3 + 24.38 + 0.99 - 24 = \text{USD } 4.37$.

● Key Point: Trading Strategies Involving Options

Covered call / Protective put

Spread strategies: bull spread, bear spread, butterfly spread, calendar spread, and diagonal spread

Combination strategies: straddles, strips, straps, and strangles

73. Consider the following bearish option strategy of buying one at-the-money put with a strike price of \$43 for \$6, selling two puts with a strike price of \$37 for \$4 each and buying one put with a strike price of \$32 for \$1. If the stock price plummets to \$19 at expiration, calculate the net

profit/loss per share of the strategy.

- A. -2.00 per share
- B. Zero – no profit or loss
- C. 1.00 per share
- D. 2.00 per share

Answer: D

The easiest thing to do is to find the net profit or loss for each position and then add them together, recognizing whether a position is short or long.

For 1 long \$43 strike put position: $[1 \times (43 - 19)] - 6 = 18$

For 2 short \$37 strike puts position: $[2 \times (37 - 19)] - (2 \times 4) = 28$

For 1 long \$32 strike put position: $[1 \times (32 - 19)] - 1 = 12$

The sum of these profit/loss numbers is a \$2 gain

74. An investor owns a stock and is bullish over the short term. Which of the following strategies will be the most appropriate one for this investor if the primary concern is to make a bet on the volatility of the stock?

- A. A covered call
- B. A protective put
- C. An at-the-money strip
- D. An at-the-money strap

Answer: D

A strap is betting on volatility in a bullish market since it pays off more on the upside.

75. Which option combination most closely simulates the economics of a short position in a futures contract?

- A. Payoff of a long call plus a short put
- B. Profit of a long call plus a short put
- C. Payoff of a long put plus short call
- D. Profit of long put plus short call

Answer: C

Payoff of the long put = $\text{Max}[0, K - S(t)]$ and payoff of short call = $-\text{Max}[0, S(t) - K] = \text{Min}[K - S(t)]$, such that the combination payoff = $K - S(t)$

In regard to D, please note: Profit = the payoff – initial investment [net premium]

sometime also profit = payoff – FV (initial investment)

76. A butterfly spread involves positions in options with three different strike prices. It can be created by buying a call option with a low strike of X_1 ; buying a call option with a high strike X_3 ; and selling two call options with a strike X_2 halfway between X_1 and X_3 . What can be said about the upside and downside of the strategy?
- A. Both the upside and downside is unlimited.
 - B. Both the upside and downside is limited.
 - C. The upside is unlimited but the downside is limited.
 - D. The upside is limited but the downside is unlimited.

Answer: B

The pay-off structure to this strategy leaves the upside and downside potential at the difference between the premium collected on the calls sold and the premium paid on the calls purchased.

77. The payoff on a calendar spread is most similar to which of the following option strategies?
- A. Bull spread
 - B. Bear spread
 - C. Long straddle
 - D. Butterfly spread

Answer: D

A calendar spread is created by transacting in two options that have different expirations. Both options have the same strike price. The strategy sells the short-dated option and buys the long-dated option. The investor profits only if the stock remains in a narrow range, but losses are limited. Overall, the payoff is most similar to the butterfly spread.

78. A stock is trading at USD 100. A box spread with 1 year to expiration and strikes at USD 5 and the price of trading at USD 20. The price of 1-year European call option with strike USD 120 is USD 5 and the price of a European put option with same strike and expiration is USD 25. What strategy exploits an arbitrage opportunity, if any?
- A. Short one put, short one unit of spot, buy one call, and buy six units box spread.
 - B. Buy one put, short one unit of spot, short one call, and buy four units of box spread.
 - C. Buy one put, buy one unit of spot, short one call, and short six units of box spread.
 - D. There are no arbitrage opportunities.

Answer: A

79. An investor sells a January 2014 call on the stock of XYZ Limited with a strike price of USD 50 for USD 10, and buys a January 2014 call on the same underlying stock with a strike price of USD

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60 for USD 2. What is the name of this strategy, and what is the maximum profit and loss the investor could incur at expiration?

	Strategy	Maximum Profit	Maximum Loss
A.	Bear spread	USD 8	USD 2
B.	Bull spread	USD 8	Unlimited
C.	Bear spread	Unlimited	USD 2
D.	Bull spread	USD 8	USD 2

Answer: A

This strategy of buying a call option at a higher strike price and selling a call option at lower strike price with the same maturity is known as a bear spread. To establish a bull spread, one would buy the call option at a lower price and sell a call on the same security with the same maturity at a higher strike price.

The cost of the strategy will be:

USD -10 + USD 2 = USD -8 (a negative cost, which represents an inflow of USD 8 to the investor)

The maximum payoff occurs when the stock price $S_T \leq \text{USD } 50$ and is equal to USD 8 (the cash inflow from establishing the position) as none of the options will be exercised. The maximum loss occurs when the stock price $S_T \geq 60$ at expiration, as both options will be exercised. The investor would then be forced to sell XYZ shares at 50 to meet the obligations on the call option sold, but could exercise the second call to buy the shares back at 60 for a loss of USD -10. However, since the investor received an inflow of USD 8 by establishing the strategy, the total profit would be USD 8 - USD 10 = USD -2.

When the stock price is $\text{USD } 50 < S_T \leq \text{USD } 60$, only the call option sold by the investor would be exercised, hence the payoff will be $50 - S_T$. Since the inflow from establishing the original strategy was USD 8, the net profit will be $58 - S_T$, which would always be higher than USD -2.

● Key Point: Corporate Bonds

80. As it relates to the bond indenture, the corporate trustee acts in a fiduciary capacity for:

- I. bond investors
 - II. bond issuers
 - III. bond underwriters
 - IV. regulators
- A. I only
 - B. II only
 - C. I and IV
 - D. II and III

Answer: A

The promises of corporate bond issuers and the rights of investors who buy them are set forth in great detail in contracts generally called indentures. The indenture is made out to the corporate trustee as a representative of the interests of bondholders; that is, the trustee acts in a fiduciary capacity for investors

who own the bond issue.

81. Relative to coupon-bearing bonds of same maturity, zero-coupon bonds are NOT subject to which type of risk?

- A. Interest rate risk
- B. Credit risk
- C. Reinvestment risk
- D. Liquidity risk

Answer: C

Since zero-coupon bonds have no coupons, there is nothing to reinvest. They are subject to all of the other risks listed, however.

82. You have been asked to check for arbitrage opportunities in the Treasury bond market by comparing the cash flows of selected bonds with the cash flows of combinations of other bonds. If a 1-year zero-coupon bond is priced at USD 96.12 and a 1-year bond paying a 10% coupon semi-annually is priced at USD 106.20, what should be the price of a 1-year Treasury bond that pays a coupon of 8% semiannually?

- A. USD 98.10
- B. USD 101.23
- C. USD 103.35
- D. USD 104.18

Answer: D

The solution is to replicate the 1 year 8% bond using the other two treasury bonds. In order to replicate the cash flows of the 8% bond, you could solve a system of equations to determine the weight factors, F_1 and F_2 , which correspond to the proportion of the zero and the 10% bond to be held, respectively.

The two equations are as follows:

$(100 \times F_1) + (105 \times F_2) = 104$ (replicating the cash flow including principal and interest payments at the end of 1 year), and $(5 \times F_2) = 4$ (replicating the cash flow from the coupon payment in 6 months.)

Solving the two equations gives us $F_1 = 0.2$ and $F_2 = 0.8$. Thus the price of the 8% bond should be $0.2(96.12) + 0.8(106.2) = 104.18$.

83. The following table gives the prices of two out of three US Treasury notes for settlement on August 30, 2008. All three notes will mature exactly one year later on August 30, 2009. Assume annual coupon payments and that all three bonds have the same coupon payment date.

Coupon	Price
--------	-------

2 7/8	94.40
4 1/2	?
6 1/4	101.30

Approximately what would be the price of the 4 1/2 US Treasury note?

- A. 99.20
- B. 99.40
- C. 97.71
- D. 100.20

Answer: C

$$\left(2\frac{7}{8}/2 + 100\right)X_1 + \left(6\frac{1}{4}/2 + 100\right)(1 - X_2) = \left(4\frac{1}{2}/2 + 100\right)$$

$$X_1 = 0.52$$

$$\text{Price} = 0.52 \times 94.40 + 0.48 \times 101.30 = 97.71$$

84. Which of the following statements regarding the trustee named in a corporate bond indenture is correct?

- A. The trustee has the authority to declare a default if the issuer misses a payment.
- B. The trustee may take action beyond the indenture to protect bondholders.
- C. The trustee must act at the request of a sufficient number of bondholders.
- D. The trustee is paid by the bondholders or their representatives.

Answer: A

According to the Trust Indenture Act, if a corporate issuer fails to pay interest or principal, the trustee may declare a default and take such action as may be necessary to protect the rights of bondholders. Trustees can only perform the actions indicated in the indenture, but are typically under no obligation to exercise the powers granted by the indenture even at the request of bondholders. The trustee is paid by the debt issuer, not by bond holders or their representatives.

● Key Point: Foreign Currency Risk

A net long (short) currency position means a bank faces the risk that the FX rate will fall (rise) versus the domestic currency.

$$\text{net currency exposure} = (\text{assets} - \text{liabilities}) + (\text{bought} - \text{sold})$$

85. Samantha Fore, FRM, is examining foreign asset-liability positions that are mismatched in individual currencies at regional financial institutions. Fore is specifically looking at the overall currency exposure of the western region consisting of three banks: Mountain West, First Interstate,

and Glacier Bank. Given the uncertainty in non-U.S. markets, Fore is concerned about a euro collapse.

	Mountain West	First Interstate	Glacier Bank
EUR Assets	1,350,000	500,000	875,000
EUR Liabilities	2,000,000	400,000	1,550,000
EUR Bought	275,000	150,000	2,450,000
EUR Sold	650,000	375,000	1,875,000

On an aggregate basis, how would this region's euro exposure be characterized?

- The aggregate euro exposure faces the risk that the euro will rise in value against the domestic currency.
- The aggregate euro exposure faces the risk that the euro will fall in value against the domestic currency.
- The banks, collectively, are net long euros.
- The banks, collectively, are close to evenly matched and face little euro exposure.

Answer: A

	Mountain West	First Interstate	Glacier Bank	Totals
EUR Assets	1,350,000	500,000	875,000	2,275,000
EUR Liabilities	2,000,000	400,000	1,550,000	3,950,000
EUR Bought	275,000	150,000	2,450,000	2,875,000
EUR Sold	650,000	375,000	1,875,000	2,900,000

The region's net euro exposure is computed as follows:

(EUR Assets – EUR Liabilities) + (EUR Bought – EUR Sold)

$$= (2,275,000 - 3,950,000) + (2,875,000 - 2,900,000) = -\text{EUR } 1,250,000$$

The banks, collectively, have a negative net exposure. A negative net exposure position means that the region is net short in a currency. The region faces the risk that the euro will rise in value against the domestic currency.

● Key Point: Exotic Options

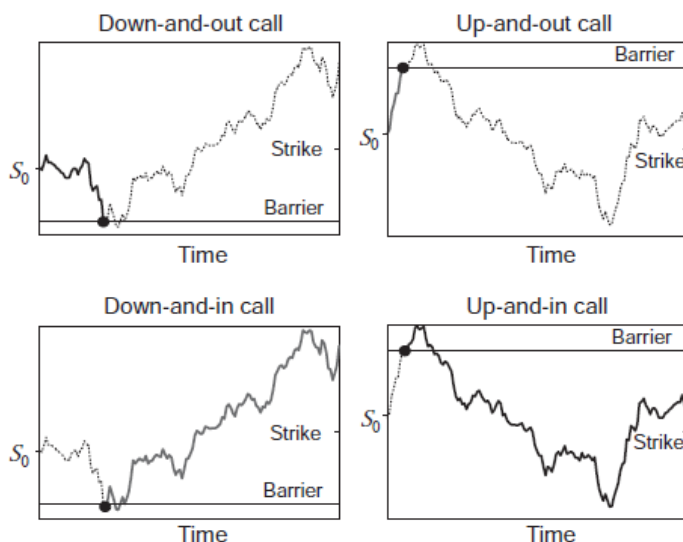
Compound option: option on another option.

- Call on a call: right to buy a call option at a set price for a set period of time.
- Call on a put: right to buy a put option at a set price for a set period of time.
- Put on a call: right to sell a call option at a set price for a set period of time.
- Put on a put: right to sell a put option at a set price for a set period of time.

Chooser option: owner chooses whether option is call or put after initiation.

Barrier option: payoff and existence depend on price reaching a certain barrier level.

- Down-and-out call (put): ceases to exist if the underlying asset price hits the barrier level, which is set below the current stock value.
- Down-and-in call (put): only comes into existence if the underlying asset price hits the barrier level, which is set below the current stock value.
- Up-and-out call (put): ceases to exist if the underlying asset price hits a barrier level, which is set above the current stock value.
- Up-and-in call (put): only comes into existence if the underlying asset price hits the above – current stock – price barrier level.



Paths for Knock-Out and Knock-In Call Options

Binary option: pay either nothing or a fixed amount.

- Cash-or-nothing call: a fixed amount, Q , is paid if the asset ends up above the strike price. $N(d_2)$ is the probability of the asset price being above the strike price, the value of a cash-or-nothing call is equal to $Qe^{-rT}N(d_2)$.
- Asset-or-nothing call: pays the value of the stock when the contract is initiated if the stock price ends up above the strike price at expiration. The corresponding value for this option is: $S_0e^{-qT}N(d_1)$. (as equivalent strike price equal to zero $c = S_0e^{-qT}N(d_1) - Ke^{-rT}N(d_2)$)

Lookback option: payoff depends on the maximum (call) or minimum (put) value of the underlying asset over the life of the option. Can be fixed or floating depending on the specification of a strike price.

Shout option: owner receives intrinsic value of option at shout date or expiration, whichever is greater.

Asian option: payoff depends on average of the underlying asset price over the life of the option; less volatile than standard option..

Basket options: options to purchase or sell baskets of securities. These baskets may be defined specifically for the individual investor and may be composed of specific stocks, indices, or currencies. Any exotic options that involve several different assets are more generally referred to as **rainbow options**. (One example is the bond futures contract traded on the CBOT (described in Level I). The party with the short position is allowed to choose between a large numbers of different bonds when making delivery.)

86. A cash-or-nothing call (also known as a digital call) pays a fixed amount to the buyer if the asset finishes above the strike price. Assume that at the end of a 1-year investment horizon, the stock is equal to \$50, the fixed payment amount is equal to \$45, and $N(d_1)$ and $N(d_2)$ from the Black-Scholes-Merton model are equal to 0.9767 and 0.9732, respectively. The value of this cash-or-nothing call when the risk-free rate equals 3% is closest to:
- A. \$5
 - B. \$42
 - C. \$44
 - D. \$47

Answer: B

87. A 1-year forward contract on a stock with a forward price of USD 100 is available for USD 1.50. The table below lists the prices of some barrier options on the same stock with a maturity of 1 year and strike of USD 100. Assuming a continuously compounded risk-free rate of 5% per year what is the price of a European put option on the stock with a strike of USD 100.

Option	Price
Up-and-in barrier call, barrier USD 95	USD 5.21
Up-and-out barrier call, barrier USD 95	USD 1.40
Down-and-in barrier put, barrier USD 80	USD 3.5

- A. USD 2.00
- B. USD 4.90
- C. USD 5.11
- D. USD 6.61

Answer: C

The sum of the price of up-and-in barrier call and up-and-out barrier call is the price of an otherwise the same European call. The price of the European call is therefore $\text{USD } 5.21 + \text{USD } 1.40 = \text{USD } 6.61$. The put-call parity relation gives $\text{Call} - \text{put} = \text{Forward}$ (with same strikes and maturities). Thus $6.61 - \text{put} = 1.50$. Thus $\text{put} = 6.61 - 1.50 = 5.11$

88. You are an institutional portfolio manager. One of your clients is very interested in the flexibility of options but expresses great concern about the high cost of some of them. In general, which of the following options would be the *least* costly to purchase?
- A. Shout options
 - B. American options

- C. Lookback options
- D. Bermudan options

Answer: D

Bermudan options may be exercised early (like American options) but exercise is restricted to certain dates. Therefore, the restriction suggests that Bermudan options must be cheaper than American options. Choice A is incorrect because a shout option is a European option where the holder has a valuable right to “shout” to the writer at one time during the option’s life. At the end of the option’s life, the payoff is the greater of the payoff from the European option and the payoff at the time of the shout. The added upside potential makes this option more expensive. Choice C is incorrect because the holder of a lookback option is guaranteed the most favorable underlying price during the life of the option, so it makes this option one of the most expensive to purchase.

- 89.** You believe that a stock will increase in price and would like to buy a call option. You would like to choose the date during the option’s term when the option payoff is determined. However, if the option payoff is greater at the option’s maturity, you want to be paid this value. What type of option should you buy?
- A. Chooser option
 - B. Compound option
 - C. Shout option
 - D. Asian option

Answer: C

The shout option allows the buyers to choose the date when he “shouts” to the option seller that the intrinsic value should be determined. At expiration, the option buyer receives the maximum of the shout value or the intrinsic value at expiration.

Choice A is incorrect because a chooser option buyer chooses whether the option is a put option or a call option, after a certain period of time has elapsed.

Choice B is incorrect because a compound option is an option on an option.

Choice D is incorrect because an Asian option based the payoff on average stock prices.

- 90.** Looking at a risk report. Mr. Woo finds that the options book of Ms. Yu has only long positions and yet has a negative delta. He asks you to explain how that is possible. What is a possible explanation?
- A. The book has a long position in up-and-in call options.
 - B. The book has a long position in binary options.
 - C. The book has a long position in up-and-out call options.

D. The book has a long position in down-and-out call options.

Answer: C

As the underlying assets' price increases the up-and-out call options become more vulnerable since they will cease to exist when the barrier is reached. Hence their price decreases. This is negative delta.

91. Of the following options, which one does not benefit from an increase in the stock price when the current stock price is \$100 and the barrier has not yet been crossed:

- A. A down-and-out call with out barrier at \$90 and strike at \$110
- B. A down-and-in call with in barrier at \$90 and strike at \$110
- C. An up-and-in put with barrier at \$110 and strike at \$100
- D. An up-and-in call with barrier at \$110 and strike at \$100

Answer: B

A down-and-out call where the barrier has not been touched is still alive and hence benefits from an increase in S , so a. is incorrect. A down-and-in call only comes alive when the barrier is touched, so an increase in S brings it away from the barrier. This is not favorable, so b. is correct. An up-and-in put would benefit from an increase in S as this brings it closer to the barrier of \$110, so c. is not correct. Finally, an up-and-in call would also benefit if S gets closer to the barrier.

92. Vega is the sensitivity of an option's price to changes in volatility. Increases in an underlying instrument's volatility will usual increase the value of options since increases in volatility produce a greater probability that an option will find its way into the money. Of the four options listed below, which investment has the potential to produce a negative Vega measure?

- A. Shout option
- B. Call option
- C. Put option
- D. Barrier option

Answer: D

Increased volatility on down-and-out and up-and-out barrier options does not increase value because the closer the underlying instrument gets to the barrier price, the greater the chance the option will expire. Therefore, Vega may be negative for a barrier option.

93. Steve, a market risk manager at Marcat Securities, is analyzing the risk of its S&P 500 index options trading desk. His risk report shows the desk is net long gamma and short Vega. Which of the following portfolios of options shows exposures consistent with this report?

- A. The desk has substantial long-expiry long call positions and substantial short-expiry short put positions.
- B. The desk has substantial long-expiry long put positions and substantial long-expiry short call positions.
- C. The desk has substantial long-expiry long call positions and substantial short-expiry short call positions.
- D. The desk has substantial short-expiry long call positions and substantial long-expiry short call positions.

Answer: D

Long gamma means that the portfolio is long options with high gamma, typically short-term (short-expiry) ATM options. Short Vega means that the portfolio is short options with high vega, typically long-term (long-expiry) ATM options

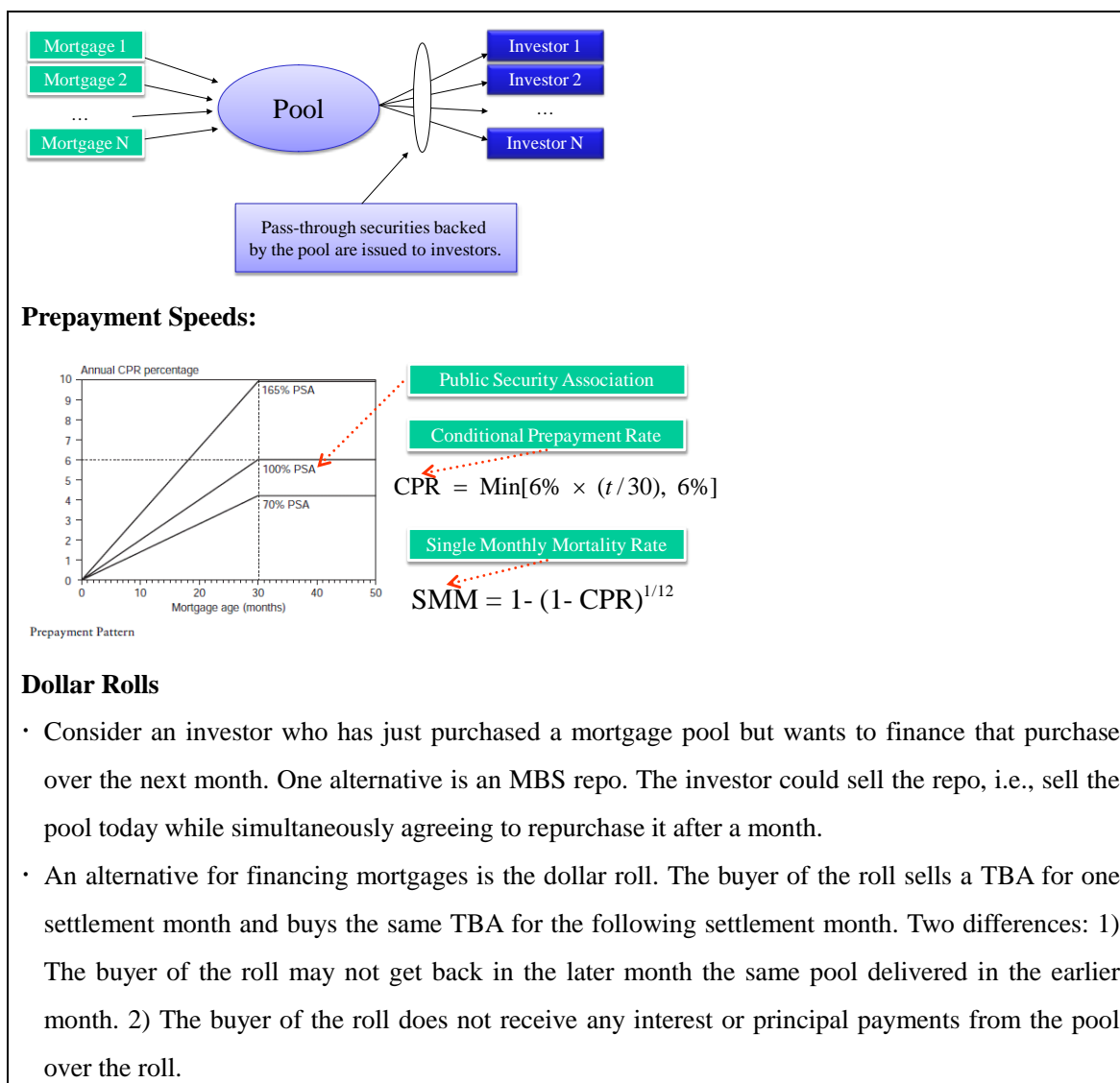
- 94.** Assume a European chooser option where stock price is \$10, strike price is \$10, volatility is 20%, dividend yield is 0%, and risk-free rate is 4%. The choice can be made within the next six months ($T_1 = 0.5$ year) and the option will expire in one year ($T_2 = 1.0$ year). What is a synthetic (portfolio) equivalent to the chooser option?
- A. A call option with strike price 10 and maturity 1 year and a put option with strike price 9.80 and maturity 0.5 year.
 - B. A call option with strike price 10 and maturity 0.5 year and a put option with strike price 9.80 and maturity 1 year.
 - C. A put option with strike price 10 and maturity 1 year and a put option with strike price 9.80 and maturity 0.5 year.
 - D. A put option with strike price 10 and maturity 0.5 year and a call option with strike price 9.80 and maturity 1 year.

Answer: A

$$\begin{aligned}\max(c, p) &= \max\left[c, c + Ke^{-r(T_2-T_1)} - S_1\right] = c + \max\left[0, Ke^{-r(T_2-T_1)} - S_1\right] \\ &= \max\left[p, p + S_1 - Ke^{-r(T_2-T_1)}\right] = p + \max\left[0, S_1 - Ke^{-r(T_2-T_1)}\right]\end{aligned}$$

● Key Point: Mortgage and Mortgage Market

Mortgage Pass-through Securities:



95. If a pool of mortgage loans begins the month with a balance of \$10,500,000, has a scheduled principal payment of \$54,800, and ends the month with a balance of \$9,800,000, what is the CPR for this month?

- A. 6.18%
- B. 42.24%
- C. 53.47%
- D. 66.67%

Answer: C

We use the following formulas: $SMM = (\text{prepayment}/\text{beg. bal} - \text{scheduled principal payment})$ and $(1 - SMM)^{12} = (1 - CPR)$.

Prepayment = actual payment - scheduled payment = $(\$10,500,000 - \$9,800,000) - \$54,800 = \$700,000 - \$54,800 = \$645,200$

So: $\$645,200/(\$10,500,000 - \$54,800) = 0.06177$ and $CPR = 1 - (1 - 0.06177)^{12} = 0.5347 = 53.47\%$

96. How would you describe the typical price behavior of a low premium mortgage pass-through security?
- A. It is similar to a U.S. Treasury bond.
 - B. It is similar to a plain-vanilla corporate bond.
 - C. When interest rates fall, its price increase would exceed that of a comparable duration U.S. Treasury bond.
 - D. When interest rates fall, its price increase would lag that of a comparable duration U.S. Treasury bond.

Answer: D

MBSs are unlike regular bonds, Treasuries, or corporates, because of their negative convexity. When rates fall, homeowners prepay early, which means that the price appreciation is less than that of comparable duration regular bonds.

97. Bennett Bank extends a 5% APR (annual percentage rate) USD 100,000 30-year mortgage requiring monthly payments. If the mortgage is structured so that it requires interest-only payments for the first 5 years, after which point it becomes a self-amortizing mortgage, what would be the portion of the monthly payment applied to the principal in the 61st month?
- A. USD 167.92
 - B. USD 174.60
 - C. USD 584.59
 - D. USD 591.27

Answer: A

$N = (30 - 5) \times 12$, $I/Y = 5 \div 12$, $PV = 0$, $FV = 100,000$, $CPT PMT = -167.92$

98. A fixed-income portfolio manager purchases a seasoned 5.5% agency mortgage-Backed security with a weighted average loan age of 60 months. The current balance on the loans is USD 20 million, and the conditional prepayment rate is assumed to be constant at 0.4% per year. Which of the following is closest to the expected principal prepayment this month?
- A. USD 1,000
 - B. USD 7,000
 - C. USD 10,000
 - D. USD 70,000

Answer: B

The expected principal prepayment is equal to: $20,000,000 \times (1 - (1 - 0.004)^{(1/12)}) = \text{USD } 6,679$.

99. Consider an investor who wants to finance the purchase of a mortgage pool over a one month period. One alternative is to sell an MBS repo, in which case the investor could sell the pool today while simultaneously agreeing to repurchase it after a month. This trade has the same economics as a secured loan: the investor effectively borrows cash today by posting the pool as collateral, and upon paying back the loan with interest after a month, retrieves the collateral. An alternative is the “dollar roll”. In the dollar roll, the buyer of the roll sells a TBA for one settlement month (the “earlier month”) and buys the same TBA for the following settlement month (the “later month”). For example, the investor who just purchased a 30-year 4% FNMA pool might sell the FNMA 30-year 4% January TBA and buy the FNMA 30-year 4% February TBA. Delivering the pool just purchased through the sale of the January TBA, which raises cash, and purchasing a pool through the February TBA, which returns cash, is very close to the economics of a secured loan.

But there are two important differences between dollar roll and repo financing:

- I. The buyer of the roll may not get back in the later month the same pool delivered in the earlier month. The buyer of the roll delivers a particular pool, for example, in January but will have to accept whatever eligible pool is delivered in the next February. By contrast, an MBS repo seller is always returned the same pool that was originally posted as collateral.
- II. The buyer of the roll does not receive any interest or principal payments from the pool over the roll. For example, the buyer of the Jan/Feb roll, who delivers the pool in January, does not receive the January payments of interest and principal. By contrast, a repo seller receives any payments of interest and principal over the life of the repo. While the prices of TBA contracts reflect the timing of payments, so that the buyer of a roll does not, in any sense, lose a month of payments relative to a repo seller, the risks of the two transactions are different. The buyer of a roll does not have any exposure to prepayments over the month being higher or lower than what had been implied by TBA prices while the repo seller does.

Which of these two differences is (are) correct?

- A. Neither is correct.
- B. I is true but II is incorrect.
- C. I is incorrect but II is true.
- D. Both are correct.

Answer: D

Both are correct.

● Key Point: Mortgage-Backed Securities

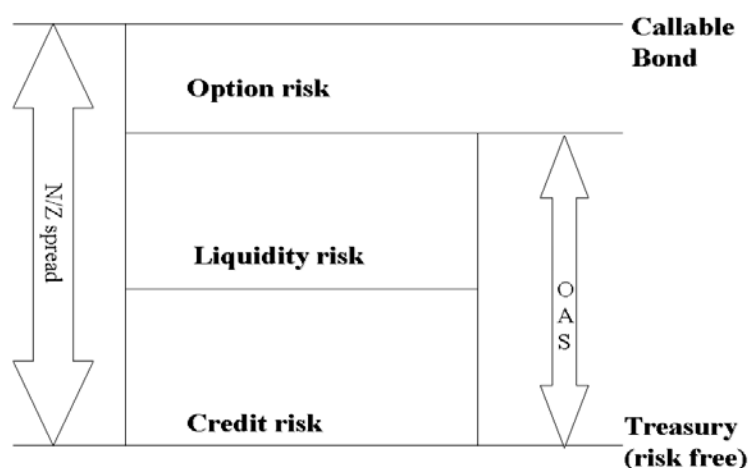
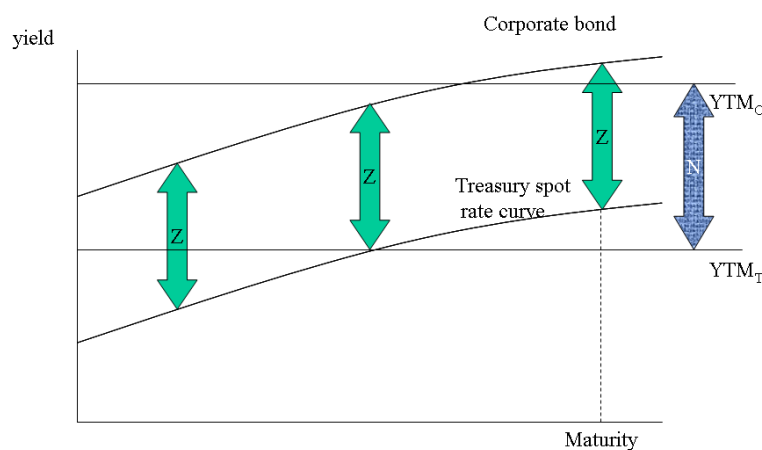
Nominal spread

Zero-volatility spread

Option-adjusted spread (OAS):

Option-cost = Z-spread – OAS

	Description	Character
Nominal spread	= Bond yield to maturity-yield on a comparable-maturity government treasury security $P_{\text{market}} = \frac{CF_1}{(1+R+N)^1} + \frac{CF_2}{(1+R+N)^2} + \dots$	Use a single interest rate to discount each cash flow.
Z-spread	$P_{\text{market}} = \frac{CF_1}{(1+R_1+N)^1} + \frac{CF_2}{(1+R_2+N)^2} + \dots$	Assume the interest rate volatility is zero.
OAS	OAS = Z-spread – Option cost $P_{\text{market}} = \frac{CF_1}{(1+R_1^*+N)^1} + \frac{CF_2}{(1+R_2^*+N)^2} + \dots$	



100. Which of the following about the duration of a mortgage-Backed, interest-only security (IO) is correct?

- A. An IO has positive duration.
- B. An IO has negative duration.
- C. An IO has exactly the same duration as a mortgage-Backed security (MBS) with the same coupon.
- D. An IO has exactly the same duration as a mortgage-Backed, principal-only security stripped off the same MRS.

Answer: B

The IO holder benefits from rising rates. If rates are rising, prepays slow. Thus, IOs have negative duration and can be used for hedging purposes. An IO's price moves in the same direction as interest rate changes, implying negative duration. An MBS has positive duration, as it is inversely proportional to interest rate changes. Likewise, a PO has positive duration, as it is inversely proportional to interest rate changes.

101. A fund holds a portfolio of principal-only strips of mortgage-Backed securities. All other things being equal, which of the following will most likely reduce the weighted average maturity of the portfolio?

- A. An increase in interest rates.
- B. An increase in prepayment speed.
- C. A small decrease in the value of the homes backing the mortgage pool.
- D. A small decrease in the real incomes of the underlying mortgage holders.

Answer: B

An increase in prepayment speed will reduce the weighted average maturity of the portfolio, however, the rest of the choices will not have this effect.

102. Mortgage-Backed securities (MBS) are a class of securities where the underlying is a pool of mortgages. Assume that the mortgages are insured, so that they do not have default risk. The mortgages have prepayment risk because the borrower has the option to repay the loan early (at any time) usually due to favorable interest rate changes. From an investor's point of view, a mortgage-backed security is equivalent to holding a long position in a non-prepayable mortgage pool and which of the following?

- A. A long American call option on the underlying pool of mortgages.
- B. A short American call option on the underlying pool of mortgages.
- C. A short European put option on the underlying pool of mortgages.
- D. A long American put option on the underlying pool of mortgages.

Answer: B

Prepayment risk is equivalent to an American call option because the borrower can repay at any time and the position is short because the option lies with the borrower.

103. Which of the following concerning the role of a support tranche in a planned amortization class (PAC) collateralized mortgage obligation (CMO) is (are) correct?

- I. The purpose of a support tranche is to provide prepayment protection for one or more PAC tranches.
 - II. Support tranches are exposed to high levels of prepayment risk.
 - III. If prepayments are too low to maintain the PAC schedule, the shortfall is provided by the support tranche.
 - IV. As prepayments occur, the amount of prepayment protection provided by the support tranche increases.
- A. I only
 - B. I, II and IV
 - C. I, II and III
 - D. II, III and IV

Answer: C

Support tranches are included in a structure with a PAC specifically to provide prepayment protection for the PAC tranches. Since the support tranches receive prepayments before the PAC tranches, they are exposed to high levels of prepayment risk. Also, if prepayments are slower than expected, cash flows are diverted from the support tranches to keep the PAC tranches on schedule. Note that as prepayments occur and the support tranches gets closer to being paid off, the support tranche will have less capacity for further prepayments and will therefore provide less prepayment protection.

104. Consider a collateralized mortgage obligation (CMO) structure with one planned amortization class (PAC) tranche and one support tranche outstanding. Also, assume that the prepayment speed is higher than the upper collar on the PAC. Which of the following statements is most accurate? The:

- A. PAC tranche has no risk of prepayments.
- B. Average life of the support tranche will contract.
- C. Average life of the PAC tranche will extend.
- D. Average life of the support tranche will extend.

Answer: B

If the prepayment speed is faster than the PAC collar, the support tranche receives a higher level of

prepayments (so that the PAC tranche remains at the upper collar of the PAC). The average life of the support tranche will contract (shorten). The PAC tranche could receive higher prepayments if eventually the support tranche is fully repaid its principal (i.e., a busted PAC). However, the question says that the support tranche is still outstanding, which means that hasn't happened yet.

105. Jack recently completed a Monte Carlo simulation analysis of a CMO tranche. Jack's analysis includes six equally weighted paths, with the present value of each calculated using four different discount rates, which are shown in the following table. If the actual market price of the CMO tranche being valued is 70.17, what is the tranche's option-adjusted spread (OAS)?

Representative Path	PV if Spread is 50 bps	PV if Spread is 60 bps	PV if Spread is 70 bps	PV if Spread is 75 bps
1	70	68	66	65
2	73	70	68	66
3	68	66	64	63
4	71	69	68	67
5	77	75	73	71
6	75	73	71	70

- A. 50 basis points
- B. 60 basis points
- C. 70 basis points
- D. 75 basis points

Answer: B

The problem tells us that the market price of the CMO tranche is 70.17. The OAS is the spread that is added to the interest rates along the interest rate path that makes the market and the theoretical value equal. The price of the CMO will be the weighted average of the values of each interest path. Because we are told in the problem that the paths are equally weighted, we simply find the arithmetic average for each path and choose the theoretical value that equals the market price. In this case, the average of the 60bp spread column is:

$$\frac{68 + 70 + 66 + 69 + 75 + 73}{6} = \frac{421}{6} = 70.17$$

The OAS must be 60 bps.

106. In regard to the prepayment option embedded in a mortgage, the borrower (the homeowner) is most similar to:

- A. Corporate issuer of a bond with a put option
- B. Corporate issuer of a bond with a call option

- C. Corporate issuer of a bond with an interest rate cap
- D. Corporate issuer of a bond with an interest rate floor

Answer: B

In a previous section it was noted that mortgage obligors generally have the ability to prepay their loans before they mature either by selling the property or by refinancing the loan to lower their interest rate or monthly payment. For the holder of the mortgage asset, the borrower's prepayment option creates a unique form of risk. In cases where the obligor refinances the loan in order to capitalize on a drop in market rates, the investor has a high-yielding asset payoff that can be replaced only with an asset carrying a lower yield. Prepayment risk is analogous to "call risk" for a corporate and municipal bond in terms of its impact on returns, and it also creates uncertainty with respect to the timing of investor cash flows.

107. Which is the primary advantage of the option-adjusted spread (OAS) over the static spread?

- A. OAS uses the entire term structure instead of a single point
- B. OAS, being a valuation model, is not biased by the market price of the bond
- C. OAS allows for cash flow changes due to interest rate changes
- D. None, they are the same

Answer: C

This is the key idea: while static (Z) spread treats the term structure of rates as static, the OAS simulates several interest rate paths and therefore can model cash flow changes. In regard to (A), this is not correct because both OAS and static spread use the entire term structure. In regard to (B), this is false: OAS solves for yield that equates to market price.

108. A homeowner has a 30-year, 5% fixed-rate mortgage with a current balance of USD 250,000.

Mortgage rates have been decreasing. If the existing mortgage was refinanced into a new 30-years, 4% fixed rate mortgage, which of the following is closest to the amount that the homeowner would save in monthly mortgage payments?

- A. USD 145
- B. USD 150
- C. USD 155
- D. USD 160

Answer: B

Calculate the mortgage payment factors for the 30-year, 5% and 4% fixed rate mortgages, then calculate the mortgage payment savings.

$N=30 \times 12$, $I/Y=5/12$, $PV=250,000$, $FV=0$, $CPT PMT=-1342$

$N=30 \times 12$, $I/Y=4/12$, $PV=250,000$, $FV=0$, $CPT PMT=-1194$

$1342 - 1194 = 148$

● Key Point: CCPs

Central Counterparties (CCPs):

When trades are centrally cleared, a CCP becomes the seller to a buyer and the buyer to a seller.

Advantages of CCPs:

Transparency, offsetting, loss mutualization, legal and operational efficiency, liquidity, and default management.

Disadvantages of CCPs:

Moral hazard, adverse selection, separation of cleared and non-cleared products, and margin procyclicality.

Risks faced by CCPs:

Default risk, model risk, liquidity risk, operational risk, and legal risk.

Default of a clearing member and its flow through effects is the most significant risk for a CCP.

109. Which of the following statements least likely describe a problem with bilaterally cleared over-the-counter (OTC) derivatives trades?

- A. The defaults of individual counterparties could lead to systemic problems.
- B. Bilateral OTC derivatives are often non-standard with exotic features.
- C. Closing out trades may be difficult.
- D. Loss mutualization may not spread all the losses among participants.

Answer: D

Loss mutualization is a feature of central clearing, whereby losses arising from a party's default are spread across all other members. Bilaterally cleared OTC derivatives do not have a loss mutualization feature.

110. A feature that is unique to central clearing and is not a feature of bilateral clearing is:

- I. Variation margin.
 - II. Initial margin.
- A. I only.
 - B. II only.
 - C. Both I and II.
 - D. Neither I nor II.

Answer: D

Neither initial margin nor variation margin is unique to centrally cleared trades. It is worth noting, however, that many bilaterally cleared OTC derivatives do not require posting initial margin, or the requirement is lower than under central clearing.

111. Which of the following functions is least likely performed by an exchange?

- A. Derivatives contract design and specifying contract terms.
- B. Price negotiation through a bilateral process.
- C. Limiting access to approved firms and individuals.
- D. Reporting transaction prices to trading participants and data vendors.

Answer: B

Exchanges set specific prices and standardize contracts. They do not negotiate prices bilaterally. Price negotiation through a bilateral process is a feature of the OTC derivatives market.

112. Alex Dell, a derivatives trader, has some reservations about the central clearing of OTC derivatives with a central counterparty (CCP). Specifically, he is worried that clearing members' willingness to monitor credit risk may decline since the CCP assumes most of the risks, and that CCPs may increase margin requirements during a period of market stress. "Which of the following concepts best describe Dell's reservations?"

<u>Decline in Willingness</u>	<u>Higher Margin Requirements</u>
A. Moral hazard	Procyclicality
B. Adverse selection	Offsetting
C. Moral hazard	Offsetting
D. Adverse selection	Procyclicality

Answer: A

Dell's reservations describe moral hazard and procyclicality, respectively. In central clearing, moral hazard is the risk that members have less incentive to monitor risk knowing that the CCP assumes most of the risks of the transactions. Procyclicality describes a scenario where a CCP increases margin requirements (initial margin) in volatile markets or during a crisis, which may aggravate systemic risk. Offsetting describes the elimination of duplicate bilateral contracts by transacting through a CCP, which improves flexibility and reduces costs. Adverse selection is the risk that participants with a better understanding of product risks and pricing will trade more products whose risks the CCP underprices, and fewer products whose risks the CCP overprices.

113. Which of the following risks facing a central counterparty (CCP) is most likely to be introduced

during a market crisis?

- A. Default risk.
- B. Liquidity risk.
- C. Operational risk.
- D. Settlement and payment risk.

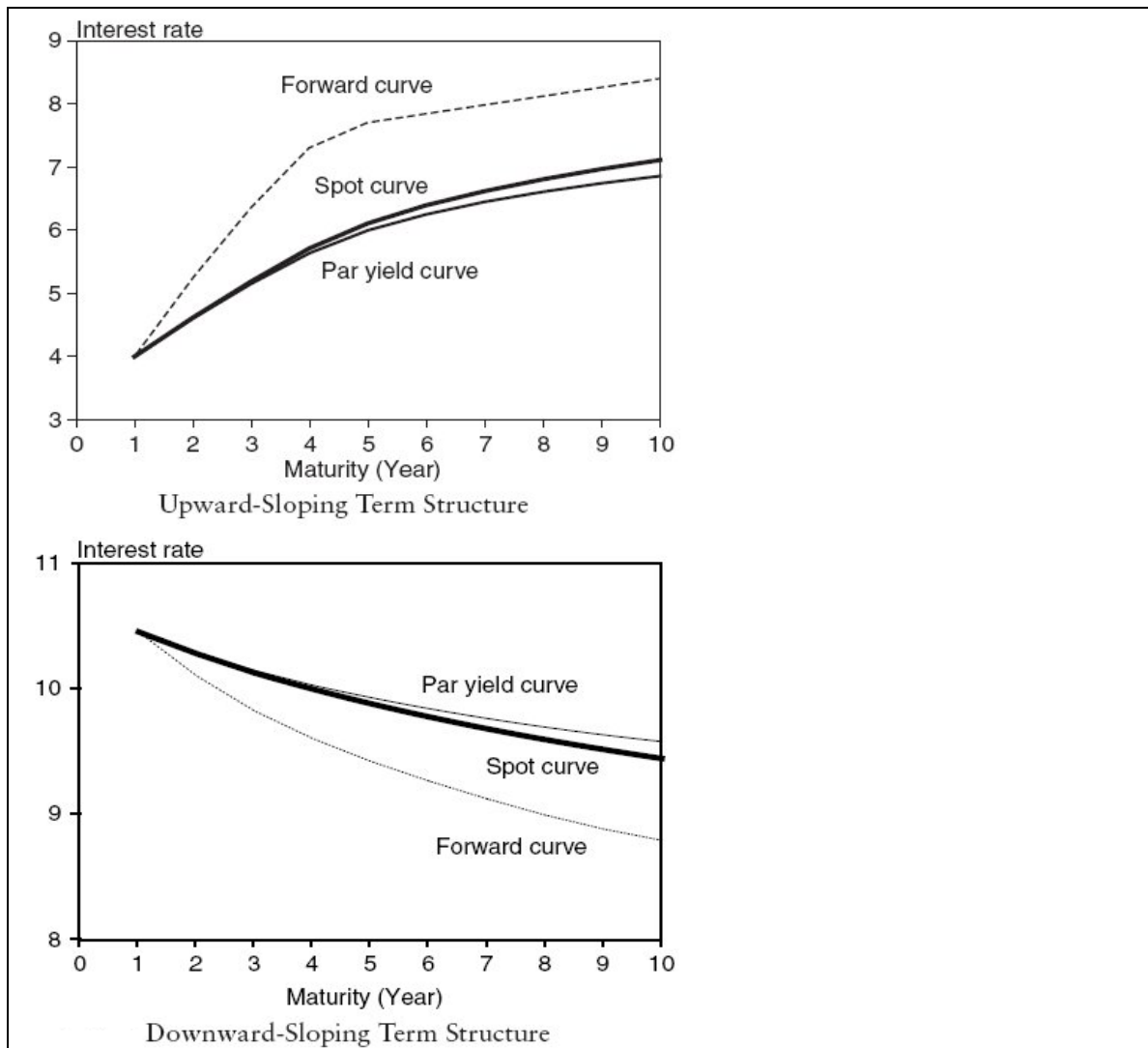
Answer: D

Settlement and payment risk refers to the risk that a bank no longer provides cash settlement services between a CCP and its members. Such risk is not likely to be present during normal periods but is much more likely to be present during crisis periods.

The other risks mentioned are present in both normal and crisis periods. For example, liquidity and default risks are always present but would be exacerbated during a crisis period. Operational risks such as inadequate information systems that give rise to business interruption could be present in a normal period.

Part 4: Valuation and Risk Models

● Key Point: Spot, Forward, and Par Rates



114. Suppose that the yield curve is upward sloping. Which of the following statements is TRUE?

- A. The forward rate yield curve is above the zero-coupon yield curve, which is above the coupon-bearing bond yield curve.
- B. The forward rate yield curve is above the coupon-bearing bond yield curve, which is above the zero-coupon yield curve.
- C. The coupon-bearing bond yield curve is above the zero-coupon yield curve, which is above the forward rate yield curve.
- D. The coupon-bearing bond yield curve is above the forward rate yield curve, which is above the zero-coupon yield curve.

Answer: A

With an upward sloping curve, the coupon curve is the lowest, the zero-coupon curve is above the coupon curve and the forward curve is above the zero-coupon curve. The order is reversed if the curve is downward sloping.

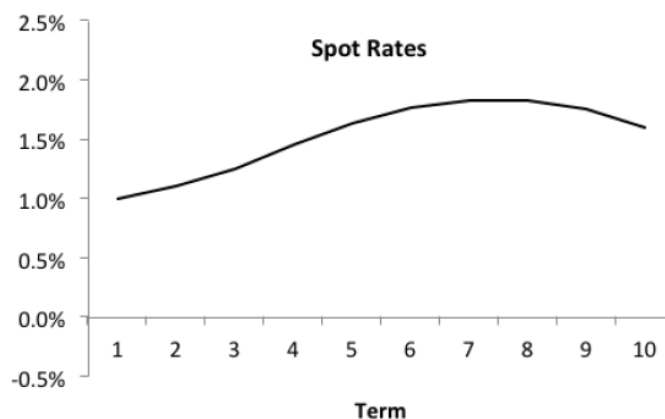
115. The price of a three-year zero coupon government bond is 85.16. The price of a similar four-year bond is 79.81. What is the one-year implied forward rate from year 3 to year 4?

- A. 5.4%
- B. 5.5%
- C. 5.8%
- D. 6.7%

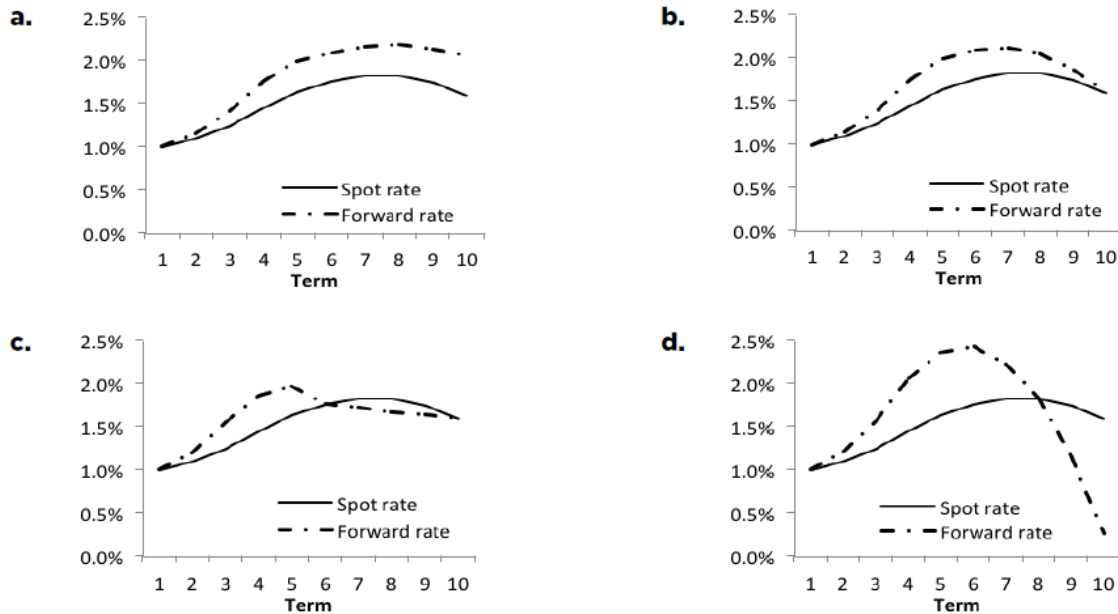
Answer: D

The forward rate can be inferred from $P_4 = P_3(1 + F_{3,4})$, or $(1 + R_4)^4 = (1 + R_3)^3(1 + F_{3,4})$. Solving, this gives $F_{3,4} = (85.16/79.81) - 1 = 0.067$.

116. Below is a chart showing the term structure of risk-free spot rates:



Which of the following charts presents the correct derived forward rate curve?



Answer: D

The forward curve will be above the spot curve when the spot curve is rising. The forward curve will also cross the spot curve when the spot curve reaches its maximum (or extreme) value. The forward curve will be below the spot curve when the spot curve is declining. The only chart that reflects these three conditions is choice D.

117. An investment advisor is advising a wealthy client of the company. The client would like to invest USD 500,000 in a bond rated at least AA. The advisor is considering bonds issued by Company X, Company Y, and Company Z, and wants to choose a bond that satisfies the client's rating requirement, but also has the highest yield to maturity. The advisor has gathered the following information:

	X	Y	Z
Bond Rating	A	A+	AAA
Semiannual	1.7	1.7	1.69
Term to Maturity in	5	5	5
Price (USD)	97	97	989
Par value (USD)	10	10	1000

Which bond should the investment advisor purchase for the client?

- A. Y bond
- B. X bond
- C. Z bond
- D. Either the Z bond or the Y bond

Answer: B

To reach the correct answer, find the bond with the highest yield to maturity (YTM) that qualifies for inclusion in the client's portfolio. Although we can calculate the YTM for each bond using a modern business calculator, it is unnecessary to do so in this case. Of the three bonds, the Y bond does not qualify for the portfolio as its rating of A+ is below the AA rating required by the client. This leaves the X bond and the Z bond. Comparing the two bonds, the X bond pays a higher coupon than the Z bond, yet it is cheaper as well. Therefore the yield on the X bond is higher. To formally calculate the yield, you could also use the following equation describing the relationship between price and yield:

$$P = \frac{c}{y} \left[1 - \left(\frac{1}{1 + y/2} \right)^{2T} \right] + F \left(\frac{1}{1 + y/2} \right)^{2T}$$

Using this equation (or an equivalent calculator function), the YTM for the X bond equals 4.057%, while the YTM for the Z bond equals 3.62%.

● Key Point: Duration and DV01

Duration

Macauley Duration → Modified Duration

DV01 & DD

DV01~1bps ↔ DD~100bps

Portfolio Duration

$$D_{\text{Port}} = \sum_{i=1}^K w_j \times D_j$$

118. Suppose a 30-year fixed-rate bond with a market value of 100 million is split into a floater and an inverse floater with a market value of 80 million and 20 million respectively. Assume the floater has duration of zero and the 30-year bond has duration of 8. What is the duration of the inverse floater?

- A. 8
- B. 16
- C. 32
- D. 40

Answer: D

The duration of the bond must be the market weighted duration of the floater and inverse floater components, modified duration of the portfolio = $W_F D_F + W_{IF} D_{IF} = 8.0$. Since $D_F = 0$, $D_{IF} = 8/W_{IF} = 8/0.2 = 40$.

119. A trading portfolio consists of two bonds, A and B. Both have modified duration of 3 years and face value of USD 1000, but A is a zero-coupon bond and its current price is USD 900, and bond B pays annual coupons and is priced at par. What do you expect will happen to the market prices of A and B if the risk-free yield curve moves up by 1 basis point?

- A. Both bond prices will move up by roughly the same amount.
- B. Both bond prices will move up, but bond B will gain more than bond A.
- C. Both bond prices will move down by roughly equal amounts.
- D. Both bond prices will move down, but bond B will lose more than bond A.

Answer: D

Assuming parallel movements to the yield curve, the expected price change is:

$\Delta P = -P\Delta y \times D$ where P is the current price or net present value Δy is the yield change D is duration

All else equal, a negative impact of yield curve move is stronger in absolute terms at the bond which is currently priced higher. Upward parallel curve movements makes bonds cheaper.

120. A hedge fund manager wants to change her interest rate exposure by investing in fixed-income securities with negative duration. Which of the following securities should she buy?

- A. Short maturity calls on zero-coupon bonds with long maturity.
- B. Short maturity puts on interest-only strips from long maturity conforming mortgages.
- C. Short maturity puts on zero-coupon bonds with long maturity.
- D. Short maturity calls on principal-only strips from long maturity conforming mortgages.

Answer: C

In order to change her interest rate exposure by acquiring securities with negative duration, the manager will need to invest in securities that decrease in value as interest rates fall (and increase in value as interest rates rise). Zero coupon bonds with long maturity will increase in value as interest rates fall, so calls on these bonds will increase in value as rates fall but puts on these bonds will decrease in value and this makes C the correct choice. Interest-only strips from long maturity conforming mortgages will decrease in value as interest rates fall, so puts on them will increase in value, while principal strips on these same mortgages will increase in value, so calls on them will also increase in value.

121. Which of the following assumptions are made when using DV01 as a measure of interest rate risk?

- I. Changes in the interest rates are small.
 - II. The yield curve is flat.
 - III. Changes to the yield curve are parallel.
 - IV. The yield curve is downward sloping.
- A. I and III

- B. I and II
- C. I and IV
- D. II and III

Answer: A

DV01 may not be a reliable measure when interest rates changes are not small. Also, when applying DV01 we assume that the yield curve shifts are parallel.

122. Calculate the impact of a 10 basis point increase in yield on the following bond portfolio.

Bond	Value (USD)	Modified Duration
1	4,000,000	7.5
2	2,000,000	1.6
3	3,000,000	6.0
4	1,000,000	1.3

- A. USD -41,000
- B. USD -52,500
- C. USD -410,000
- D. USD -525,000

Answer: B

(A)	(B)	(C)	(D)	(E)
Bond	Value (USD)	Modified Duration	(B × C)	(D/B)
1	4,000,000	7.5	30,000,000	
2	2,000,000	1.6	3,200,000	
3	3,000,000	6	18,000,000	
4	1,000,000	1.3	1,300,000	
SUM	10,000,000		52,500,000	5.25

The portfolio modified duration is 5.25. This is obtained by multiplying the value of each bond by the modified duration(s), then taking the sum of these products, and dividing it by the value of the total bond portfolio.

The change in the value of the portfolio will be $-10,000,000 \times 5.25 \times 0.1\% = -52,500$

123. A risk manager is evaluating the price sensitivity of an investment-grade callable bond using the firm's valuation system. The table below presents information on the bond as well as on the embedded option. The current interest rate environment is flat at 5%.

Value in USD per USD 100 face value

Interest Rate Level	Callable Bond	Call Option
4.98%	102.07848	2.0871
5.00%	101.61158	2.0501
5.02%	100.92189	2.0131

The DV01 of a comparable bond with no embedded options having the same maturity and coupon rate is closest to:

- A. 0.0185
- B. 0.2706
- C. 0.2891
- D. 0.3077

Answer: D

The call option reduces the bond price, therefore the bond with no embedded options will be the sum of the callable bond price and the call option price.

Therefore the price of the bond with no embedded options at a rate of 4.98% would be 104.1657 and the price at a rate of 5.02% would be 102.9351.

DV01 is a measure of price sensitivity of a bond. To calculate the DV01, the following equation is used:

$$DV01 = -\frac{\Delta P}{10,000 \times \Delta y}$$

Where ΔP is the change in price and Δy is the change in yield. Therefore

$$DV01 = -\frac{102.9351 - 104.1657}{10,000 \times (5.02\% - 4.98\%)} = 0.3077$$

● Key Point: Convexity

$$C = \frac{1}{P} \frac{d^2 P}{dy^2} = \frac{1}{P(1+y)^2} \left[\sum_{t=1}^n t(t+1) \frac{CF_t}{(1+y)^t} \right]$$

$$\Delta P = -D^* \times P \times \Delta y + \frac{1}{2} \times C \times P \times (\Delta y)^2$$

124. A risk manager is evaluating the price sensitivity of an investment-grade callable bond using the firm's valuation system. The table below presents information on the bond as well as on the embedded option. The current interest rate environment is flat at 5%.

Value in USD per USD 100 face value		
Interest Rate Level	Callable Bond	Call Option

4.98%	102.07848	2.0871
5.00%	101.61158	2.0501
5.02%	100.92189	2.0131

The convexity of the callable bond can be estimated as:

- A. -55,698
- B. -54,814
- C. -5.5698
- D. -5.4814

Answer: B

Convexity is defined as the second derivative of the price-rate function divided by the price of the bond. To estimate convexity, one must first estimate the difference in bond price per difference in the rate for two separate rate environments, one a step higher than the current rate and one a step lower. One must then estimate the change across these two values per difference in rate. This is given by the formula:

$$C = \frac{1}{P_0} \times \frac{\frac{P_1 - P_0}{\Delta r} - \frac{P_0 - P_{-1}}{\Delta r}}{\Delta r} = \frac{1}{P_0} \times \frac{P_1 - 2P_0 + P_{-1}}{(\Delta r)^2}$$

where Δr is the change in the rate in one step; in this case, 0.02%.

Therefore, the best estimate of convexity is:

$$C = \frac{1}{101.61158} \times \frac{(100.92189 - 2 \times 101.61158 + 102.07848)}{(0.02\%)^2} = -54,814$$

125. A portfolio contains a long position in an option contract on a US Treasury bond. The option exhibits positive convexity across the entire range of potential returns for the underlying bond. This positive convexity:

- A. Implies that the option's value increases at a decreasing rate as the option goes further into the money.
- B. Makes a long option position a superior investment compared to a long bond position of equivalent duration.
- C. Can be effectively hedged by the sale of a negatively convex financial instrument.
- D. Implies that the option increases in value as market volatility increases.

Answer: D

The relationship between convexity and volatility for a security can be seen most clearly through the second-order Taylor approximation of the change in price given a small change in yield. The resulting change in price can be estimated as:

$$\frac{\Delta P}{P} \approx -D\Delta y + \frac{1}{2}C\Delta y^2$$

where D is equal to the duration, C is the convexity and y is the change in the interest rate. Since Δy is always positive, positive convexity will lead to an increase in return as long as interest rates move, with larger interest moves in either direction leading to a greater return benefit from the positive convexity. Therefore, a position in a security with positive convexity can be considered a long position in volatility. This relationship can also be explained graphically. The price curve of a security with positive convexity will lie above and tangentially to the price curve of the underlying. If volatility of the underlying increases, then so will the volatility of either a long call or a long put, but the deviation from the price of the underlying will be positive when there is positive convexity, and negative with negative convexity. Therefore, the expected terminal value over the in-the-money region will increase while the expected terminal value over the out-of-the-money region will remain zero, an aggregate effect of increasing the total expected value of the option.

● Key Point: Effective Duration& Effective Convexity

$$\text{Effective Duration} = \frac{P_- - P_+}{2 \times P_0 \times \Delta y}$$

$$\text{Effective convexity} = \frac{P_- + P_+ - 2 \times P_0}{P_0 \times \Delta y^2}$$

126. An 8-year 5% coupon bond with at par value of 100 is currently trading at a price of 94.65. The price of this bond rises to 96.35 when interest rates fall by 30 basis points and falls to 92.75 when interest rates rise by 30. The effective duration of this bond is closest to:

- A. 5.99
- B. 6.34
- C. 6.69
- D. 7.04

Answer: B

$$D = (P_- - P_+) / (2P_0\Delta Y) = (96.35 - 92.75) / (2 \times 94.65 \times 0.003) = 6.34$$

127. A portfolio manager uses her valuation model to estimate the value of a bond portfolio at USD 125.482 million. The term structure is flat. Using the same model, she estimates that the value of the portfolio would increase to USD 127.723 million if all interest rates fell by 30 basis points and would decrease to USD 122.164 million if all interest rates rose by 30 basis points. Using these estimates, the effective duration of the bond portfolio is closest to:

- A. 7.38
- B. 8.38
- C. 14.77
- D. 16.76

Answer: A

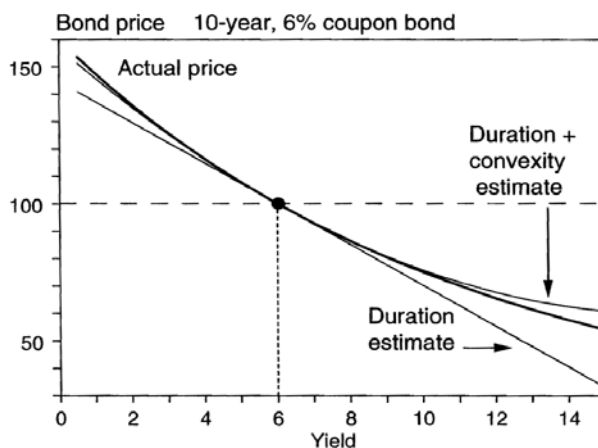
$$D = \frac{V_- - V_+}{2 \times V_0 \times \Delta y} = \frac{127.723 - 122.164}{2 \times 125.482 \times 0.003} = 7.38$$

● Key Point: Price Approximation, Effect of Convexity

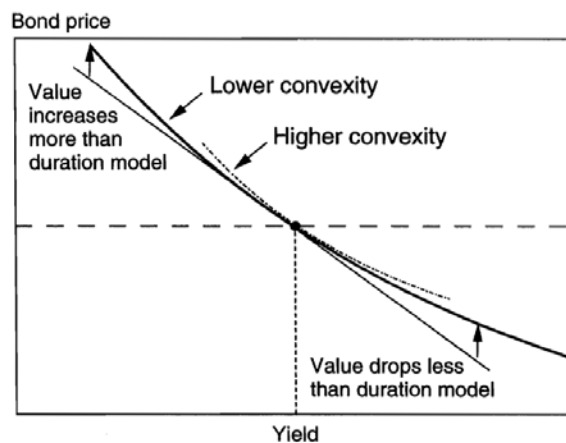
1. The actual, exact price: $P = f(y_0 + \Delta y)$

2. The duration estimate: $P = P_0 - D^* P_0 \Delta y$

3. The duration and convexity estimate: $P = P_0 - D^* P_0 \Delta y + \frac{1}{2} CP_0 (\Delta y)^2$



Price Approximation



Effect of Convexity

128.For an option-free bond, which of the following are the effects of the convexity adjustment on the magnitude (absolute value) of the approximate bond price change in response to an increase in yield and in response to a decrease in yield and in response to a decrease in yield, respectively?

Decrease in Yield	Increase in Yield
A. Increase in magnitude	Decrease in magnitude
B. Increase in magnitude	Increase in magnitude
C. Decrease in magnitude	Decrease in magnitude
D. Decrease in magnitude	Increase in magnitude

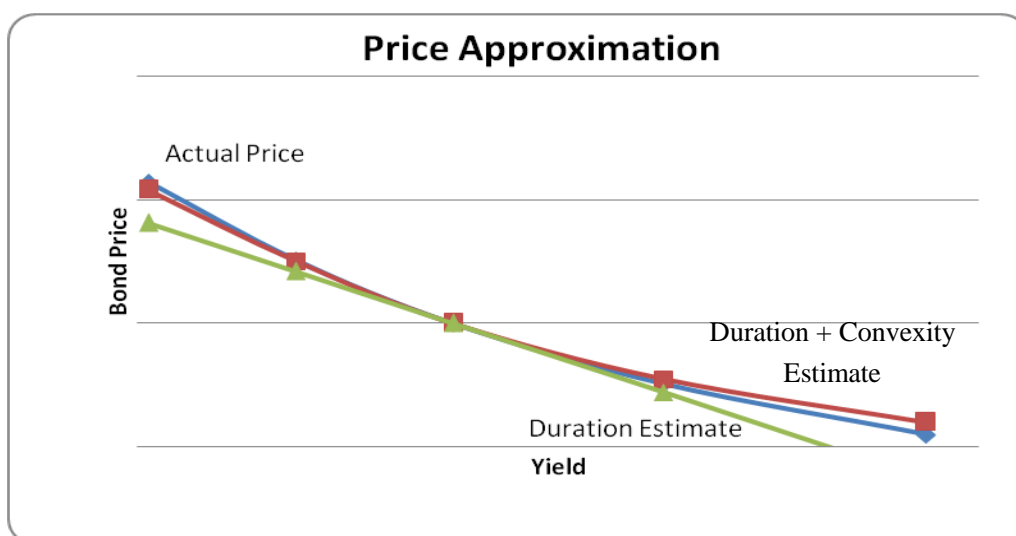
Answer: A

Option-free bonds have positive convexity and the effect of (positive) convexity is to increase the magnitude of the price increase when yield fall and to decrease the magnitude of the price decrease when yields rise.

129.Consider the following three methods of estimating the profit and loss (P&L) of a bullet bond: full repricing, duration (PV01), and duration plus convexity. Rank the methods to estimate the P&L impact of a large negative yield shock from the lowest to the highest.

- A. Duration, duration plus convexity, full repricing
- B. Duration, full repricing, duration plus convexity
- C. Duration plus convexity, duration, full repricing
- D. Full repricing, duration plus convexity, duration estimating

Answer: A



● Key Point: Key Rate

The key rate shift technique is an approach to nonparallel shifts in the yield curve, which allows for changes in all rates to be determined by changes from selected key rates.

The rate of a given maturity is affected solely by its closest key-rate.

Shifts in the key-rates are decline linearly.

130. The main problem associated with using single-factor approaches to hedge interest rate risk is:

- A. No method can hedge interest rate risk.
- B. Single-factor models assume mean-reversion between one short-term and one long-term rate.
- C. Single-factor models assume effects across the entire curve dictated by one rate.
- D. Single-factor models assume risk-free securities have credit exposure.

Answer: C

Single-factor models assume that any change in any rate across the maturity spectrum can indicate changes across the maturity spectrum can indicate changes across any other portion of the curve.

131. You are using key rate shifts to analyze the effect of yield changes on bond prices. Suppose the 10-year yield has increased by 10 basis points and this shock decreases linearly to zero for the 20-year yield. What is the effect of this shock on the 14-year yield?

- A. Increase of 0 basis points
- B. Increase of 4 basis points
- C. Increase of 6 basis points
- D. Increase of 10 basis points

Answer: C

The 10 basis point shock to the 10-year yield is supposed to decline linearly to zero for the 20-year yield. Thus, the shock decrease by 1 basis point per year and will result in an increase of 6 basis points for the 14-year yield.

132. Using key rates of 2-year, 5-year, 7-year, and 20-year exposures assumes all of the following except that the:

- A. 2-year rate will affect the 5-year rate
- B. 7-year rate will affect the 20-year rate
- C. 5-year rate will affect the 7-year rate
- D. 2-year rate will affect the 20-year rate

Answer: D

Key rate exposures assume that key rates chosen adjacent to the rate of interest are affected, not across other key rates.

Use the following information to answer the following two questions:

The following table provides the initial price of a C-strip and its present value after application of a one basis shift in four key rates.

Value	
Initial value	25.11584
2-year shift	25.11681
5-year shift	25.11984
10-year shift	25.13984
30-year shift	25.01254

133.What is the key rate '01 for a 30-year shift?

- A. -0.058
- B. 0.024
- C. 0.103
- D. 0.158

Answer: C

Key rate'01 with respect to the 30-year shift is calculated as follows:

$$-1/10,000 (25.01254 - 25.11584) / (0.01\%) = 0.103$$

This implies that the C-strip decreases in price by 0.103 per 100 face amount for a positive one basis point 30-year shift.

134.What is the key-rate duration for a 30-year shift?

- A. -4.57
- B. 15.80
- C. 38.60
- D. 41.13

Answer: D

Key rate duration for the 30-year shift is calculated as follows:

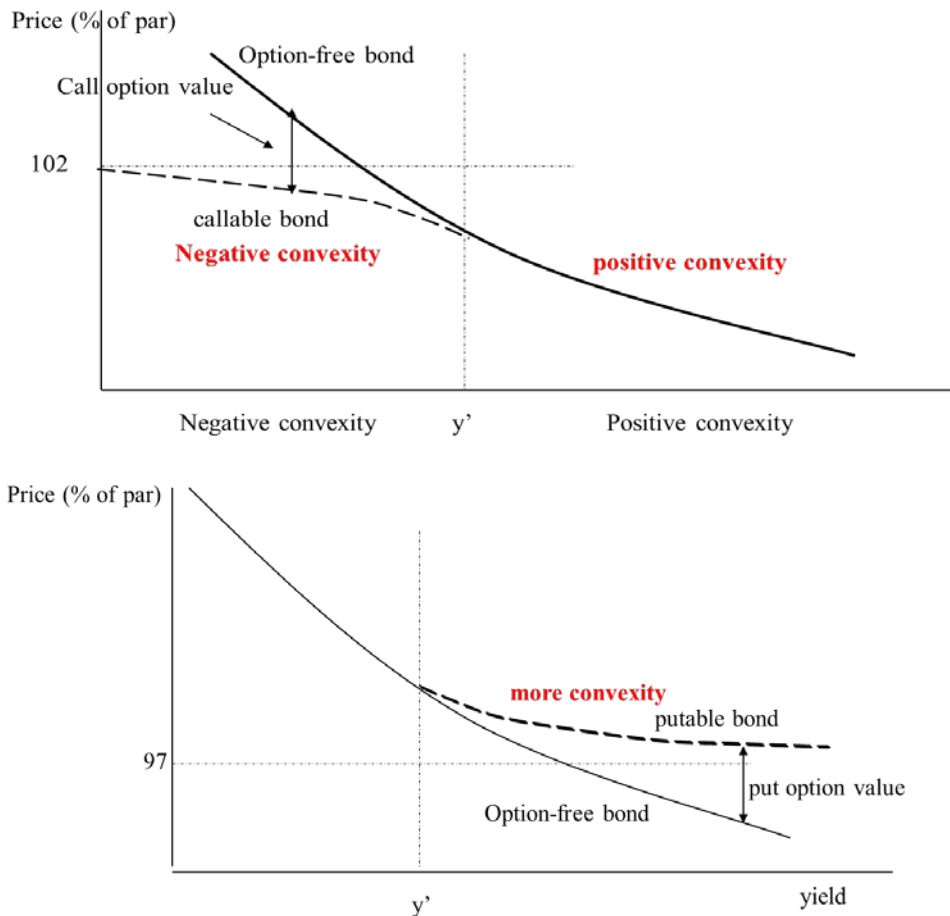
$$-1/25.11584 (25.01254 - 25.11584) / (0.01\%) = 41.13$$

● Key Point: Callable, Puttable Bond & Convertible Bond

Callable bond: issuer has the right to buy back the bond in the future at a set price; as yields fall,

bond is likely to be called; prices will rise at a decreasing rate-negative convexity.

Puttable bond: bondholder has the right to sell bond back to the issuer at a set price.



135. An investment in a callable bond can be analytically decomposed into a:

- A. Long position in a non-callable bond and a short position in a put option
- B. Short position in a non-callable bond and a long position in a call option
- C. Long position in a non-callable bond and a long position in a call option
- D. Long position in a non-callable bond and a short position in a call option

Answer: D

A callable bond includes an embedded option for the issuer to call the bond at a stated redemption or call price. If the issuer is long the call option, then the holder of a callable bond is short the call option.

136. Which of the following statements about a puttable bond and a callable bond is correct?

- A. The put option of a puttable bond is more expensive than the call option of the callable bond.
- B. A puttable bond will have a lower yield than a comparable callable bond.
- C. The value of a callable bond increases when interest rate volatility increases.
- D. Long position in a puttable bond has more interest rate risk than a long position in a callable

bond.

Answer: B

Callable bond can be decomposed into a long position in a straight bond minus a call option on the bond price. Puttable bond can be decomposed into a long position in a straight bond plus a put option on bond price.

137. Consider a convertible bond that is trading at a conversion premium of 20 percent. If the value of the underlying stock rises by 25 percent, the value of the bond will:

- A. Rise by less than 25%
- B. Rise by 25%
- C. Rise by more than 25%
- D. Remain unchanged

Answer: A

The convertible bond implicitly gives bondholders a call option on the underlying stock. The delta of this option will vary between 0 (when the option is extremely out of the money) and 1 (when the option is extremely in the money). In this case, the bond is trading at a conversion premium of 20% so the delta must be somewhere between zero and one, and hence the price of the convertible bond will rise by less than the price of the underlying stock.

138. Bonds issued by the XYZ Corp. are currently callable at par value and trade close to par. The bonds mature in 8 years and have a coupon of 8%. The yield on the XYZ bonds is 175 basis points over 8-year US Treasury securities, and the Treasury spot yield curve has a normal, rising shape. If the yield on bonds comparable to the XYZ bond decreases sharply, the XYZ bonds will most likely exhibit:

- A. Negative convexity
- B. Increasing modified duration
- C. Increasing effective duration
- D. Positive convexity

Answer: A

As yields in the market declines, the probability that the call option will get exercised increases. This causes the price to reduce relative to an otherwise comparable option free bond, which is also known as a negative convexity.

139. Which of the following statements are TRUE?

- I. The convexity of a 10-year zero coupon bond is higher than the convexity of a 10-year, 6%

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bond.

- II. The convexity of a 10-year zero coupon bond is higher than the convexity of a 6% bond with a duration of 10 years.
 - III. Convexity grows proportionately with the maturity of the bond.
 - IV. Convexity is always positive for all types of bonds.
 - V. Convexity is always positive for “straight” bonds.
- A. I only
 - B. I and II only
 - C. I and V only
 - D. II, III, and V only

Answer: C

All else equal, convexity increase for longer maturities, lower coupons, and lower yields.

Bonds with embedded options (e.g., callable bonds) exhibit negative convexity over certain ranges of yields while straight bonds with no embedded options exhibit positive convexity over the entire range of yields.

● Key Point: Immunization

Immunization for a single liability

Select a bond or a bond portfolio with a modified duration equal to the duration of the liability.

Set the PV of the bond or the portfolio equal to the PV of the liability.

140.A pension plan reports \$12 billion in assets and \$10 billion in present value of the benefit obligations. Future pension benefits are indexed to the rate of inflation. To immunize its liabilities, the plan should

- A. Invest \$12 billion of assets in fixed-coupon long-term bonds
- B. Invest \$10 billion of assets in fixed-coupon long-term bonds
- C. Invest \$10 billion of assets in cash
- D. Invest \$10 billion of assets in Treasury Inflation-Protected Securities

Answer: D

Immunization occurs when assets are invested so as to perfectly hedge changes in liabilities. So the amount to invest is \$10 billion, which is the value of liabilities. In this case, we are told that the pension payments are indexed to the rate of inflation. Because the liabilities are tied to inflation, immunization requires that the assets should react in a similar way to inflation. This can be achieved with Treasury Inflation-Protected Securities (TIPS).

● Key Point: Value Option Using a Binomial Tree

$$f = e^{-rt} [pf_u + (1-p)f_d]$$

$$p = \frac{e^{rt} - d}{u - d} \quad u = e^{\sigma\sqrt{\Delta t}} \quad d = \frac{1}{u}$$

Stocks with dividends and stock indices: replace e^{-rt} with $e^{-(r-q)t}$ where q is the dividend yield of a stock or stock index.

Common text for questions following two questions:

A risk manager for Bank XYZ, Mark is considering writing a 6 month American put option on a non-dividend paying stock ABC. The current stock price is USD 50 and the strike price of the option is USD 52. In order to find the no-arbitrage price of the option Mark uses a two-step binomial tree model. The stock price can go up or down by 20% each period. Mark's view is that the stock price has an 80% probability of going up each period and a 20% probability of going down. The annual risk-free rate is 12% with continuous compounding.

141. What is the risk-neutral probability of the stock price going up in a single step?

- A. 34.5%
- B. 57.6%
- C. 65.5%
- D. 80.0%

Answer: B

Calculation follows:

$$P_{up} = \frac{e^{r\Delta t} - d}{u - d} = \frac{e^{0.12 \times 3/12} - 0.8}{1.2 - 0.8} = 57.61\%$$

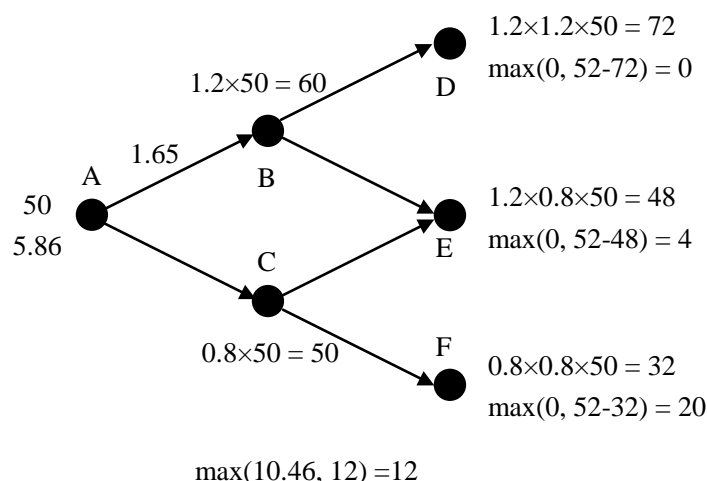
$$P_{down} = 1 - P_{up} = 42.39\%$$

142. The no-arbitrage price of the option is closest to:

- A. USD 2.00
- B. USD 2.93
- C. USD 5.22
- D. USD 5.86

Answer: D

The risk neutral probability of an up move is 57.61% (calculated in the previous question).



The figure shows the stock price and the respective option value at each node. At the final nodes the value is calculated as $\max(0, K - S)$.

Node B: $(0.5761 \times 0 + 0.4239 \times 4) \times \exp(-0.12 \times 3/12) = 1.65$, which is greater than the intrinsic value of the option at this node equal to $\max(0, 52 - 60) = 0$, so the option should not be exercised early at this node.

Node C: $(0.5761 \times 4 + 0.4239 \times 20) \times \exp(-0.12 \times 3/12) = 10.46$, which is lower than the intrinsic value of the option at this node equal to $\max(0, 52 - 40) = 12$, so the option should be exercised early at node C, and the value of the option at node C is 12.

Node A: $(0.5761 \times 1.65 + 0.4239 \times 12) \times \exp(-0.12 \times 3/12) = 5.86$, which is greater than the intrinsic value of the option at this node equal to $\max(0, 52 - 50) = 2$, so the option should not be exercised early at this node.

143. Which of the following statements about American options is incorrect?

- A. American options can be exercised at any time until maturity.
- B. American options are always worth at least as much as European options.
- C. American options can easily be valued with Monte Carlo simulation.
- D. American options can be valued with binomial trees.

Answer: C

144. Which of the following statements is correct about the early exercise of American options?

- A. It is always optimal to exercise an American call option on a non-dividend-paying stock before the expiration date.
- B. It can be optimal to exercise an American put option on a non-dividend-paying stock early.
- C. It can be optimal to exercise an American call option on a non-dividend-paying stock early.
- D. It is never optimal to exercise an American put option on a non-dividend-paying stock before

the expiration date.

Answer: B

It is never optimal to exercise an American call option on a non-dividend-paying stock before the expiration date, but at any given time during its life, a put option should always be exercised early if it is sufficiently deep in the money. Thus, it can be optimal to exercise an American put option on a non-dividend-paying stock early.

● **Key Point: Black-Scholes-Merton Model**

Black-Scholes-Merton model on a non-dividend-paying stock

$$c = S_0 N(d_1) - Ke^{-rT} N(d_2)$$

$$p = Ke^{-rT} N(-d_2) - S_0 N(-d_1)$$

$$d_1 = \frac{\ln(S_0/K) + (r + \sigma^2/2)T}{\sigma\sqrt{T}}$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

Black-Scholes-Merton model on a dividend-paying stock

$$\text{call}(c) = (S_0 e^{-\delta T}) N(d_1) - Xe^{-rT} N(d_2)$$

145. What is the price of a three month European put option on a non-dividend-paying stock with a strike price of \$50 when the current stock price is \$50, the risk-free interest rate is 10% per annum, and the volatility is 30% per annum.

- A. 2.37
- B. 2.48
- C. 2.25
- D. 2.63

Answer: A

In this case $S_0 = 50$, $K = 50$, $r = 0.1$, $\sigma = 0.3$, $T = 0.25$, and

$$d_1 = \frac{\ln(50/50) + (0.1 + 0.09/2)0.25}{0.3\sqrt{0.25}} = 0.2417$$

$$d_2 = d_1 - 0.3\sqrt{0.25} = 0.0917$$

The European put price is:

$$\begin{aligned} & 50N(-0.0917)e^{-0.1 \times 0.25} - 50N(-0.2417) \\ &= 50 \times 0.4634e^{-0.1 \times 0.25} - 50 \times 0.4045 = 2.37 \\ & \text{or } \$2.37 \end{aligned}$$

146. A non-dividend-paying stock is currently trading at USD 40 and has an expected return of 12% per year. Using the Black-Scholes-Merton (BSM) model, a 1-year, European-style call option on the stock is valued at USD 1.78.

The parameters used in the model are:

$$N(d_1) = 0.29123 \quad N(d_2) = 0.20333$$

The next day, the company announces that it will pay a dividend of USD 0.5 per share to holders of the stock on an ex-dividend date 1 month from now and has no further dividend payout plans for at least 1 year. This new information does not affect the current stock price, but the BSM model inputs change, so that:

$$N(d_1) = 0.29928 \quad N(d_2) = 0.20333$$

If the risk-free rate is 3% per year, what is the new BSM call price?

- A. USD 1.61
- B. USD 1.78
- C. USD 1.95
- D. USD 2.11

Answer: C

The value of a European call is equal to $SN(d_1) - Ke^{-rT}N(d_2)$, where S is the current price of the stock. In the case that dividends are introduced, S in the formula is reduced by the present value of the dividends. Furthermore, the announcement would affect the values of S , d_1 and d_2 . However, since we are given the new values, and d_2 is the same, the change in the price of the call is only dependent on the term $S \times N(d_1)$.

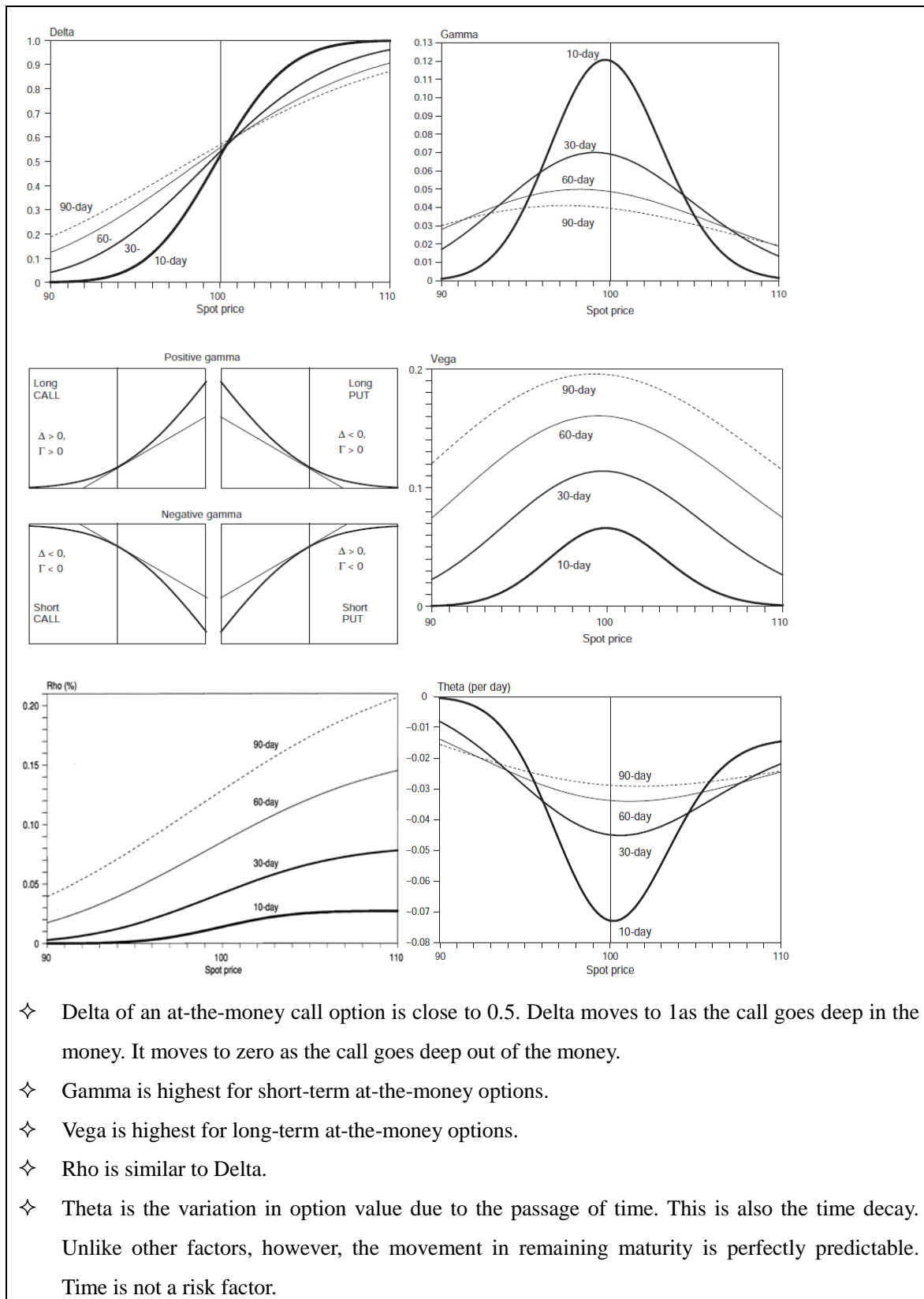
$$\text{Previous } S \times N(d_1) = 40 \times 0.29123 = 11.6492$$

$$\text{New } S \times N(d_1) = (40 - (0.5 \times \exp(-3\%/12))) \times 0.29928 = 11.8219$$

$$\text{Change} = 11.8219 - 11.6492 = 0.1727$$

So the new BSM call price would increase in value by 0.1727, which when added to the previous price of 1.78 equals 1.9527.

● Key Point: Greek Letters



147. If risk is defined as a potential for unexpected loss, which factors contribute to the risk of a short call option position?

A. Delta, Vega, Rho

- B. Vega, Rho
- C. Delta, Vega, Gamma, Rho
- D. Delta, Vega, Gamma, Theta, Rho

Answer: C

For a short call, Delta Vega, Gamma, and Rho contribute to the risk of the position. Theta is not a risk factor.

148. Mr. Black has been asked by a client to write a large put option on the S&P 500 index. The option has an exercise price and a maturity that is not available for options traded on exchanges. He, therefore, has to hedge the position dynamically. Which of the following statements about the risk of his position are not correct?

- A. He can make his portfolio delta neutral by shorting index futures contracts.
- B. There is a short position in an S&P 500 futures contract that will make his portfolio insensitive to both small and large moves in the S&P 500.
- C. A long position in a traded option on the S&P 500 will help hedge the volatility risk of the option he has written.
- D. To make his hedged portfolio gamma neutral, he needs to take positions in options as well as futures.

Answer: B

The short index futures makes the portfolio delta neutral. It does not help with large moves.

149. Portfolio manager Sally has a position in 100 option contracts with the following position Greeks: theta = +25,000; vega = +330,000 and gamma = -200; ie., positive theta, positive vega and negative gamma. Which of the following additional trades, utilizing generally at-the-money (ATM) options, will neutralize (hedge) the portfolio with respect to theta, vega and gamma?

- A. Sell short-term options + sell long-term options (all roughly at-the-money)
- B. Sell short-term options + buy long-term options (~ ATM)
- C. Buy short-term options + sell long-term options (~ ATM)
- D. Buy short-term options + buy long-term options (~ ATM)

Answer: C

For ATM options, vega and theta are increasing functions with maturity; and gamma is a decreasing function with maturity.

To buy short-term options + sell long-term options \geq negative position theta, negative position vega, and positive position gamma.

In regard to (A), sell short-term + sell long-term options \geq positive theta, negative vega; negative gamma.

In regard to (B), sell short-term + buy long-term options \geq positive theta, positive vega; and negative gamma.

In regard to (D), buy short-term + buy long-term \geq negative theta, positive vega; and positive gamma.

Note: the above are approximately actual numbers for 100 option contracts.

(100 options each = 10,000 options) with the following properties: Strike = Stock = \$100; volatility = 15.0%, risk-free rate = 4.0%; term = 1.0 year. Under these assumptions:

- a) 1-year term: percentage theta = -5.0, vega = +37, gamma = +0.025
- b) 10-year term: percentage theta = -2.5, vega = +70, gamma = +0.005

150. Which of the following statements is correct?

- I. The rho of a call option changes with the passage of time and tends to approach zero as expiration approaches, but this is not true for the rho of put options.
 - II. Theta is always negative for long calls and long puts and positive for short calls and short puts.
- A. I only.
 - B. II only
 - C. I and II
 - D. Neither

Answer: D

Statement I is false – rho of a call and a put will change, with expiration of time and it tends to approach zero as expiration approaches.

151. Which of the following statements is true regarding options Greeks?

- A. Theta tends to be large and positive when buying at-the-money options.
- B. Gamma is greatest for in-the-money options with long maturities.
- C. Vega is greatest for at-the-money options with long maturities.
- D. Delta of deep in-the-money put options tends toward +1.

Answer: C

Theta is negative for long positions in ATM options, so A is incorrect. Gamma is small for ITM options, so B is incorrect. Delta of ITM puts tends to -1, so D is incorrect.

152. Which position is most risky?

- A. Gamma-negative, delta-neutral

- B. Gamma-positive, delta-positive
- C. Gamma-negative, delta-positive
- D. Gamma-positive, delta-neutral

Answer: C

A riskier position is one that is expected to move around a lot in value. A delta neutral position should not change in value as the value of the underlying asset changes. This eliminates Choice A and Choice D. Choice C is correct because a gamma-negative position means that delta and the change in the underlying asset move inversely with each other.

153. A portfolio of stock A and options on stock A is currently delta neutral, but has a positive gamma. Which of the following actions will make the portfolio both delta and gamma neutral?

- A. Buy call options on stock A and sell stock A
- B. Sell call options on stock A and sell stock A
- C. Buy put options on stock A and buy stock A
- D. Sell put options on stock A and sell stock A

Answer: D

To reduce positive gamma, one needs to sell options. When call options are sold, the delta becomes negative and one needs to buy stock to keep delta neutrality. When put options are sold, the delta becomes positive, and one needs to sell stock to keep delta neutrality.

154. Which of the following choices will effectively hedge a short call option position that exhibits a delta of 0.5?

- A. Sell two shares of the underlying for each option sold.
- B. Buy two shares of the underlying for each option sold.
- C. Sell the number of shares of the underlying equal to one-half the options sold.
- D. Buy the number of shares of the underlying equal to one-half the options sold.

Answer: D

In order to hedge a short call option position, a manager would have to buy enough of the underlying to equal the delta times the number of options sold. In this case, $\text{delta} = 0.5$, so for every two options sold, the manager would have to buy a share of the underlying security. (Stop-loss strategies with call options are designed to limit the losses associated with short option positions. The strategy requires purchasing the underlying asset for a naked call position when the asset rises above the option's strike price.)

155. Consider the following statements, which one is incorrect?

- A. Short a coupon bond is equivalent to long effective duration and short effective convexity.
- B. Long a plain vanilla call option is equivalent to long delta and also long gamma.
- C. Short a plain vanilla put option is equivalent to short vega.
- D. Long a deep in the money up and out call option is equivalent to long delta and short vega.

Answer: D

156. The current stock price of a company is USD 80. A risk manager is monitoring call and put options on the stock with exercise prices of USD 50 and 5 days to maturity. Which of these scenarios is most likely to occur if the stock price falls by USD 1?

Scenario	Call Value	Put Value
A	Decrease by USD 0.94	Increase by USD 0.08
B	Decrease by USD 0.94	Increase by USD 0.89
C	Decrease by USD 0.07	Increase by USD 0.89
D	Decrease by USD 0.07	Increase by USD 0.08

- A. Scenario A
- B. Scenario B
- C. Scenario C
- D. Scenario D

Answer: A

The call option is deep in-the-money and must have a delta close to one. The put option is deep out-of-the-money and will have a delta close to zero. Therefore, the value of the in-the-money call will decrease by close to USD 1, and the value of the out-of-the-money put will increase by a much smaller amount close to 0. The choice that is closest to satisfying both conditions is A.

157. Wanda Zheng (FRM) is responsible for the options desk in a London bank. Zheng is concerned about the impact of dividends on the options held by the options desk. She asks you to assess which options are the most sensitive to dividend payments. What would be your answer if the value of the options is found by using the Black-Scholes model adjusted for dividends?

- A. Everything else equal, out-of-the-money call options experience a larger decrease in value than in-the-money call options as expected dividends increase.
- B. The increase in the value of in-the-money put options caused by an increase in expected dividends is always larger than the decrease in value of in-the-money call options.
- C. Keeping the type of option constant, in-the-money options experience the greatest absolute change in value and out-of-the-money options the smallest absolute change in value as expected dividends increase.

- D. Keeping the type of option constant, at-the-money options experience the largest absolute change in value and out-of-the-money options the smallest absolute change in value as a result of dividend payment.

Answer: C

In the Black-Scholes framework, an in-the-money option is expected to change its value the most and out-of-the-money the least as a result of dividend payments. For the purpose of illustration, the impact of dividend payment on the option is characterized by:

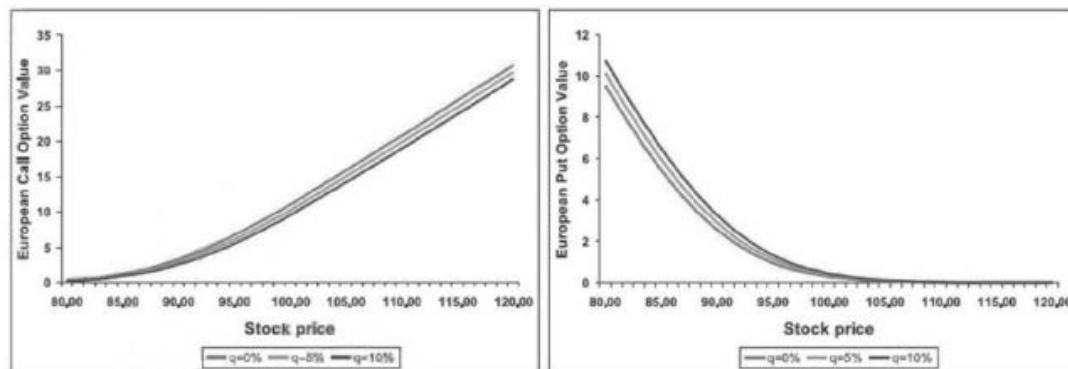
$$S = 93$$

$$K = 90$$

$$T = 60 \text{ days}$$

$$r = 5\%$$

$$\sigma = 20\%$$



158. In evaluating the dynamic delta hedging of a portfolio of short option positions, which of the following is correct?

- A. The interest cost of carrying the delta hedge will be highest when the options are deep out-of-the-money.
- B. The interest cost of carrying the delta hedge will be highest when the options are deep in-the-money.
- C. The interest cost of carrying the delta hedge will be lowest when the options are at-the-money.
- D. The interest cost of carrying the delta hedge will be highest when the options are at-the-money.

Answer: B

The deeper into-the-money the options are, the larger their deltas and therefore the more expensive to delta hedge.

159. If the current market price of a stock is USD 50, which of the following options on the stock has

the highest gamma?

- A. Call option expiring in 30 days with strike price of USD 50
- B. Call option expiring in 5 days with strike price of USD 30
- C. Call option expiring in 5 days with strike price of USD 50
- D. Put option expiring in 30 days with strike price of USD 30

Answer: C

Gamma is defined as the rate of change of an option's delta with respect to the price of the underlying asset, or the second derivative of the option price with respect to the asset price. Therefore the highest gamma is observed in shorter maturity and at-the-money options, since options with these characteristics are much more sensitive to changes in the underlying asset price.

The correct choice is a call option both at-the-money and with the shorter maturity.

● Key Point: Delta Hedging

160. A bank has sold USD 300,000 of call options on 100,000 equities. The equities trade at 50, the option strike price is 49, the maturity is in 3 months, volatility is 20%, and the interest rate is 5%. How does it the bank delta hedge? (round to the nearest thousand share)

- A. Buy 65,000 shares
- B. Buy 100,000 shares
- C. Buy 21,000 shares
- D. Sell 100,000 shares

Answer: A

Delta hedging the short call option position requires buying shares in an amount equal to the hedge ratio times the 100,000 shares underlying the call position. We can calculate the hedge ratio as $N(d_1)$ from the Black Scholes option pricing model. First we need to compute $N(d_1)$.

$$d_1 = \frac{\ln\left(\frac{50}{49}\right) + \left(0.05 + \frac{0.20^2}{2}\right) \times 0.25}{0.20 \times \sqrt{0.25}} = 0.3770$$

We know that $N(0.3770)$ has to be between 0.5 and 1.0, which means we need to buy somewhere between 50,000 and 100,000 shares. The only answer that fits is A, buy 65,000 shares. If you did have access to a probability table, you could determine that $N(0.3770) = 0.6469$, which means we need to buy exactly 64,690 shares to delta hedge the position.

161. Initially, the call option on Big Kahuna Inc. with 90 days to maturity trades at USD 1.40. The option has a delta of 0.5739. A dealer sells 200 call option contracts, and to delta-hedge the position, the dealer purchases 11,478 shares of the stock at the current market price of USD 100

per share. The following day, the prices of both the stock and the call option increase. Consequently, delta increases to 0.7040. To maintain the delta hedge, the dealer should:

- A. sell 2602 shares
- B. sell 1493 shares
- C. purchase 1493 shares
- D. purchase 2602 shares

Answer: D

Changes of Stock number = $(0.7040 - 0.5739) \times 200 \times 100 = 2602$

● Key Point: Gamma and Vega Hedging

162. An option portfolio exhibits high unfavorable sensitivity to increases in implied volatility and while experiencing significant daily losses with the passage of time. Which strategy would the trader most likely employ to hedge his portfolio?

- A. Sell short dated options and buy long dated options
- B. Buy short dated options and sell long dated options
- C. Sell short dated options and sell long dated options
- D. Buy short dated options and buy long dated options

Answer: A

Such a portfolio is short vega (volatility) and short theta (time). We need to implement a hedge that is delta-neutral and involves buying and selling options with different maturities. Long positions in short-dated options have high negative theta and low positive vega. Hedging can be achieved by selling short-term options and buying long-term options.

● Key Point: Value at Risk

$$\text{VAR} = Z_{\alpha} \times \sigma$$

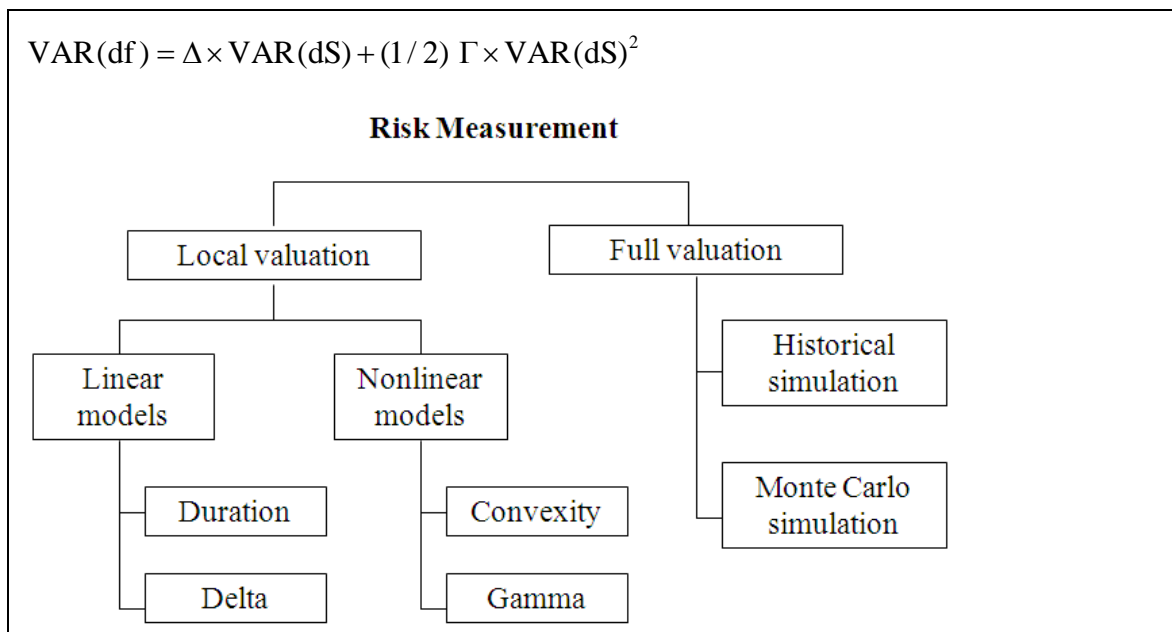
$$\text{VAR}_{T\text{-days}} = \text{VAR}_{1\text{-days}} \times \sqrt{T}$$

$$\text{VAR}_p^2 = \text{VAR}_1^2 + \text{VAR}_2^2 + 2\rho \times \text{VAR}_1 \times \text{VAR}_2$$

$$\text{VAR}(dP) = -D^*P \times \text{VAR}(dy)$$

$$\text{VAR}(df) = \Delta \times \text{VAR}(dS)$$

$$\text{VAR}(dP) = -D^*P \times \text{VAR}(dy) + (1/2)(C \times P) \times \text{VAR}(dy)^2$$



163. There exist two portfolios A and B. Each has their individual VaR. When putting them together in a new portfolio C, which of the following will be always true?

- A. $\text{VaR}(C) < \text{VaR}(A) + \text{VaR}(B)$
- B. $\text{VaR}(C) > \text{VaR}(A) + \text{VaR}(B)$
- C. $\text{VaR}(C) = \text{VaR}(A) + \text{VaR}(B)$
- D. None of the above

Answer: D

One important drawback of VaR is that it is not sub-additive.

164. A commodity-trading firm has an options portfolio with a two-day Value-at-Risk (VaR) of 2.5 million. What would be an appropriate translation of this VaR to a ten-day horizon under normal conditions?

- A. \$3.713 million
- B. \$4.792 million
- C. \$5.590 million
- D. Cannot be determined

Answer: C

$$\text{VaR}_{10\text{-day}} = \text{VaR}_{2\text{-day}} \times \frac{\sqrt{10}}{\sqrt{2}} = 5.59$$

165. Mixed Fund has a portfolio worth USD 12,428,000 that consists of 42% of fixed income investments and 58% of equity investments. The 95% annual VaR for the entire portfolio is USD 1,367,000 and the 95% annual VaR for the equity portion of the portfolio is USD 1,153,000.

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专业来自101%的投入!

Assume that there are 250 trading days in a year and that the correlation between stocks and bonds is zero. What is the 95% daily VaR for the fixed income portion of the portfolio?

- A. USD 21,263
- B. USD 46,445
- C. USD 55,171
- D. USD 72,635

Answer: B

The computation follows: $VaR^2(\text{portfolio}) = VaR^2(\text{stocks}) + VaR^2(\text{fixed income})$, assuming the correlation is 0. $(1,367,000)^2 = (1,153,000)^2 + VaR^2(\text{fixed income})$, $VaR(\text{fixed income}) = 734,357$. Next convert the annual VaR to daily VaR: $734,357/(250)^{(1/2)} = 46,445$

166. You have been asked to estimate the VaR of an investment in Big Pharma Inc. The company's stock is trading at USD 23 and the stock has a daily volatility of 1.5%. Using the delta-normal method, the VaR at the 95% confidence level of a long position in an at-the-money put on this stock with a delta of -0.5 over a 1-day holding period is closest to which of the following choices?

- A. USD 0.28
- B. USD 0.40
- C. USD 0.57
- D. USD 2.84

Answer: A

$$VaR = |\Delta| \times 1.645 \times \sigma \times S = 0.5 \times 1.645 \times 0.015 \times \$23 = \$0.28$$

The Δ of an at-the-money put is -0.5 and the absolute value of the Δ is 0.5.

167. Rational Investment Inc. is estimating a daily VaR for its fixed income portfolio currently valued at USD 800 million. Using returns for the last 400 days (ordered in decreasing order, from highest daily return to lowest daily return), the daily returns are the following:

1.99%, 1.89% 1.88% 1.87%, -1.76%, -1.82%, -1.84%, -1.87%, -1.91%

At the 99% confidence level, what is your estimate of the daily VaR using the historical simulation method?

- A. USD 14.08 million
- B. USD 14.56 million
- C. USD 14.72 million
- D. USD 15.04 million

Answer: B

- 168.** A market risk manager uses historical information on 1,000 days of profit/loss information to calculate a daily VaR at the 99th percentile, of USD 8 million. Loss observations beyond the 99th percentile are then used to estimate the conditional VaR. If the losses beyond the VaR level, in millions, are USD 9, USD 10, USD 11, USD 13, USD 15, USD 18, USD 21, USD 24, and USD 32, then what is the conditional VaR?
- A. USD 9 million
 - B. USD 32 million
 - C. USD 15 million
 - D. USD 17 million

Answer: D

- A. is incorrect. This is the minimum.
- B. is incorrect. This is the maximum.
- C. is incorrect. This is the median.
- D. is correct. Conditional VaR is the “mean” of the losses beyond the VaR level.

- 169.** A portfolio manager invests \$100 million in a 5-year inverse floater paying $18\% - 2 \times \text{LIBOR}$. Assume that the modified duration of a 6% 5-year bond is 4.5 years, and the inverse floater is just before a reset day. The worst change in yields at the 95% level over a month is 0.66%. What is the VaR of this inverse floater at the 95% level over a month?
- A. \$3.0 million
 - B. \$5.9 million
 - C. \$8.9 million
 - D. \$10.5million

Answer: C

$$18\% - 2 \times L = 3 \times 6\% - 2 \times L$$

$$(18\% - 2 \times L) + (2 \times L) = 3 \times 6\%$$

$$D_{\text{IF}} = 3 \times D_{6\%} = 3 \times 4.5 = 13.5$$

$$\text{VAR}_{\text{IF}} = D \times P (\text{worst change in yields}) = 13.5 \times 100\text{million} \times 0.66\% = 8.91\text{million}$$

- 170.** A trader has an option position in crude oil with a delta of 100000 barrels and gamma of -50000 barrels per dollar move in price. Using the delta-gamma methodology, compute the VaR on this position, assuming the extreme move on crude oil is \$2.00 per barrel.
- A. \$100,000
 - B. \$200,000

- C. \$300,000
- D. \$400,000

Answer: C

$$\text{VaR} = \Delta(\text{dS}) - \frac{1}{2} \Gamma(\text{dS})^2 = 100000 \times 2 - \frac{1}{2} \times (-50000) \times 2^2 = \$300000$$

171. The hybrid method is a combination of historical simulation and:

- A. Historical Standard Deviation
- B. MDE
- C. EWMA
- D. GARCH

Answer: C

The hybrid approach combines the two simplest approaches, HS and Risk Metrics, by estimating the percentiles of the return directly (similar to HS), and using exponentially declining weights on past data (similar to Risk Metrics)

172. The historical simulation approach is more likely to provide an accurate estimate of the VaR than the Risk Metrics approach for a portfolio that consists of:

- A. A small number of emerging market securities.
- B. A small number of broad market indexes.
- C. A large number of emerging market securities.
- D. A large number of board market indexes.

Answer: A

The Risk Metrics approach is a delta-normal model that requires the returns to be approximately normally distributed, while the historical simulation model requires much less stringent assumptions. The returns on a portfolio with small number of securities is less likely to be normally distributed than a larger portfolio and an emerging markets index is less likely to be normally distributed than a broad market index. Therefore the historical simulation approach will most likely provide a better VaR estimate than Risk Metrics for a portfolio with a small number of emerging market securities.

173. Which of the following is a disadvantage of the historical simulation method over the Risk Metrics model? The historical method requires:

- I. A worst-case scenario as an input.
- II. The future is determined by the past.
- III. Standard deviations and correlations.

IV. The assumption of normal distributions for asset returns.

- A. I and III only
- B. II only
- C. II and IV only
- D. III only

Answer: B

The historical method requires that the future be determined by past asset price movements.

174. Which of the following is not a disadvantage of nonparametric methods compared to parametric methods?

- A. Data is used more efficiently with parametric methods than nonparametric methods.
- B. Identifying market regimes and conditional volatility increases the amount of usable data as well as the estimation error for historical simulations.
- C. MDE may lead to data snooping or over-fitting in identifying required assumptions regarding an appropriate kernel function.
- D. MDE requires a large amount of data that is directly related to the number of conditioning variables used in the model.

Answer: B

The use of market regimes and identifying conditional means and volatility actually reduces not increases the amount of data from the full sample. The full sample of data is split into subgroups used to estimate conditional volatility. Therefore, the amount of data available for estimating future volatility is significantly reduced.

175. The hybrid approach for estimating VaR is the combination of a parametric and a nonparametric approach. It specifically combines the historical simulation approach with:

- A. The delta normal approach.
- B. The exponentially weighted moving average approach.
- C. The multivariate density estimation approach.
- D. The generalized autoregressive conditional heteroskedasticity approach.

Answer: B

The hybrid approach combines two approaches to estimating VaR, the historical simulation and the exponential smoothing approach (i.e. an EWMA approach). Similar to a historical simulation approach, the hybrid approach estimates the percentiles of the return directly, but it also uses exponentially declining weights on past data similar to the exponentially weighted moving average approach.

176.An at-the-money European call option on the DJ EURO STOXX 50 index with a strike of 2200 and maturing in 1 year is trading at EUR 350, where contract value is determined by EUR 10 per index point. The risk-free rate is 3% per year, and the daily volatility of the index is 2.05%. If we assume that the expected return on the DJ EURO STOXX 50 is 0%, the 99% 1-day VaR of a short position on a single call option calculated using the delta-normal approach is closest to:

- A. EUR 8
- B. EUR 53
- C. EUR 84
- D. EUR 525

Answer: D

Since the option is at-the-money, the delta is close to 0.5. Therefore a 1 point change in the index would translate to approximately $0.5 \times \text{EUR } 10 = \text{EUR } 5$ change in the call value. Therefore, the percent delta, also known as the local delta, defined as $\%D = (5/350) / (1/2200) = 31.4$.

So the 99% VaR of the call option = $\%D \times \text{VaR}(99\% \text{ of index}) = \%D \times \text{call price} \times \alpha(99\%) \times 1\text{-day volatility} = 31.4 \times \text{EUR } 350 \times 2.33 \times 2.05\% = \text{EUR } 525$. The term $\alpha(99\%)$ denotes the 99th percentile of a standard normal distribution, which equals 2.33.

There is a second way to compute the VaR. If we just use a conversion factor of EUR 10 on the index, then we can use the standard delta, instead of the percent delta:

$\text{VaR}(99\% \text{ of Call}) = D \times \text{index price} \times \text{conversion} \times \alpha(99\%) \times 1\text{-day volatility} = 0.5 \times 2200 \times 10 \times 2.33 \times 2.05\% = \text{EUR } 525$, with some slight difference in rounding.

Both methods yield the same result.

177.Howard Freeman manages a portfolio of investment securities for a regional bank. The portfolio has a current market value equal to USD 6,247,000 with a daily variance of 0.0002. Assuming there are 250 trading days in a year and that the portfolio returns follow a normal distribution, the estimate of the annual VaR at the 95% confidence level is closest to which of the following?

- A. USD 32,595
- B. USD 145,770
- C. USD 2,297,854
- D. USD 2,737,868

Answer: C

$\text{Annual VaR} = 6,247,000 \times (250^{0.5}) \times (0.0002^{0.5}) \times 1.645 = 2,297,854$

178.A portfolio manager bought 1,000 call options on a non-dividend-paying stock, with a strike price of USD 100, for USD 6 each. The current stock price is USD 104 with a daily stock return

volatility of 1.89%, and the delta of the option is 0.6. Using the delta-normal approach to calculate VaR, what is an approximation of the 1-day 95% VaR of this position?

- A. USD 112
- B. USD 1,946
- C. USD 3,243
- D. USD 5,406

Answer: B

The delta of the option is 0.6. The VaR of the underlying is:

$$1.89\% * 1.65 * 104 = 3.24$$

Therefore, the VaR of one option is:

$0.6 * 3.24 = 1.946$, and multiplying by 1,000 provides the VaR of the entire position: 1,946.

179. Bank A and Bank B are two competing investment banks that are calculating the 1-day 99% VaR for an at-the-money call on a non-dividend-paying stock with the following information:

- Current stock price: USD 120
- Estimated annual stock return volatility: 18%
- Current Black-Scholes-Merton option value: USD 5.20
- Option delta: 0.6

To compute VaR, Bank A uses the linear approximation method, while Bank B uses a Monte Carlo simulation method for full revaluation. Which bank will estimate a higher value for the 1-day 99% VaR?

- A. Bank A.
- B. Bank B.
- C. Both will have the same VaR estimate.
- D. Insufficient information to determine.

Answer: A

The option's return function is convex with respect to the value of the underlying; therefore the linear approximation method will always underestimate the true value of the option for any potential change in price. Therefore the VaR will always be higher under the linear approximation method than a full revaluation conducted by Monte Carlo simulation analysis. The difference is the bias resulting from the linear approximation, and this bias increases in size with the change in the option price and with the holding period.

180. Assume that portfolio daily returns are independently and identically normally distributed. A new quantitative analyst has been asked by the portfolio manager to calculate portfolio VaRs for 10-

15-, 20-, and 25-day periods. The portfolio manager notices something amiss with the analyst's calculations displayed below. Which one of following VaRs on this portfolio is inconsistent with the others?

- A. $\text{VaR}(10\text{-day}) = \text{USD } 316\text{M}$
- B. $\text{VaR}(15\text{-day}) = \text{USD } 465\text{M}$
- C. $\text{VaR}(20\text{-day}) = \text{USD } 537\text{M}$
- D. $\text{VaR}(25\text{-day}) = \text{USD } 600\text{M}$

Answer: A

The calculations follow. Calculate $\text{VaR}(1\text{-day})$ from each choice:

$$\text{VaR}(10\text{-day}) = 316 \rightarrow \text{VaR}(1\text{-day}) = 316 / \sqrt{10} = 100$$

$$\text{VaR}(15\text{-day}) = 465 \rightarrow \text{VaR}(1\text{-day}) = 465 / \sqrt{15} = 120$$

$$\text{VaR}(20\text{-day}) = 537 \rightarrow \text{VaR}(1\text{-day}) = 537 / \sqrt{20} = 120$$

$$\text{VaR}(25\text{-day}) = 600 \rightarrow \text{VaR}(1\text{-day}) = 600 / \sqrt{25} = 120$$

$\text{VaR}(1\text{-day})$ from A is different from those from other answers.

● Key Point: Stress Testing

181. After evaluating the results of a firm's stress tests, an analyst is recommending that the firm allocate additional economic capital and purchase selective insurance protection to guard against particular events. In order to give management a fully informed assessment, it is important that the following is noted related to this strategy:

- A. While decreasing liquidity risk exposure, it will likely increase market risk exposure.
- B. While decreasing correlation risk exposure, it will likely increase credit risk exposure.
- C. While decreasing market risk exposure, it will likely increase credit risk exposure.
- D. While decreasing credit risk exposure, it will likely increase model risk exposure.

Answer: C

The purchase of insurance protection can transform market risk into counterparty credit risk.

182. An implementation principle recommended by the Basel Committee to banks for the governance of sound stress testing practices is that stress testing reports should:

- A. Not be passed up to senior management without first being approved by middle management.
- B. Have limited input from their respective business areas to prevent biasing of the results.
- C. Challenge prior assumptions to help foster debate among decision makers.
- D. Be separated by business lines to help identify risk concentrations.

Answer: C

The Basel Committee states “At banks that were highly exposed to the financial crisis and fared comparatively well, senior management as a whole took an active interest in the development and operation of stress testing... stress testing at most banks, however, did not foster internal debate nor challenge prior assumptions...” Therefore, the Basel Committee recommends that prior assumptions used in stress testing be challenged to ensure that the stress test best captures the potential for extreme scenarios given current market conditions.

● Key Point: Operational Risk

- ✧ The definition of Operational Risk for Basel Committee: the risk of loss resulting from inadequate or failed internal processes, people and systems, or from external events, includes legal risk, but excludes strategic and reputational risk, which would be very difficult to measure.
- ✧ Three methods for capital requirements of Operational Risk

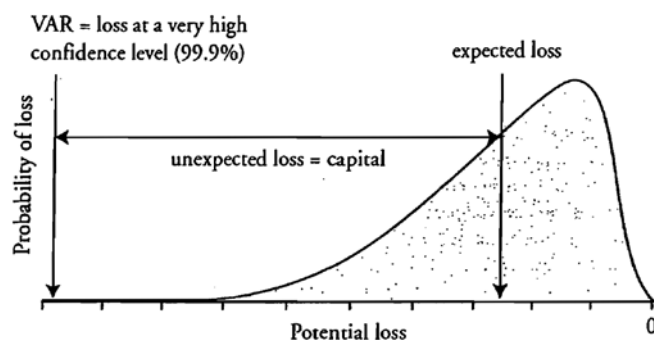
1) Basic Indicator Approach: $ORC^{BIA} = \alpha \times GI$

2) Standardized Approach: $ORC^{SA} = \sum_{i=1}^8 \beta_i \times GI_i$

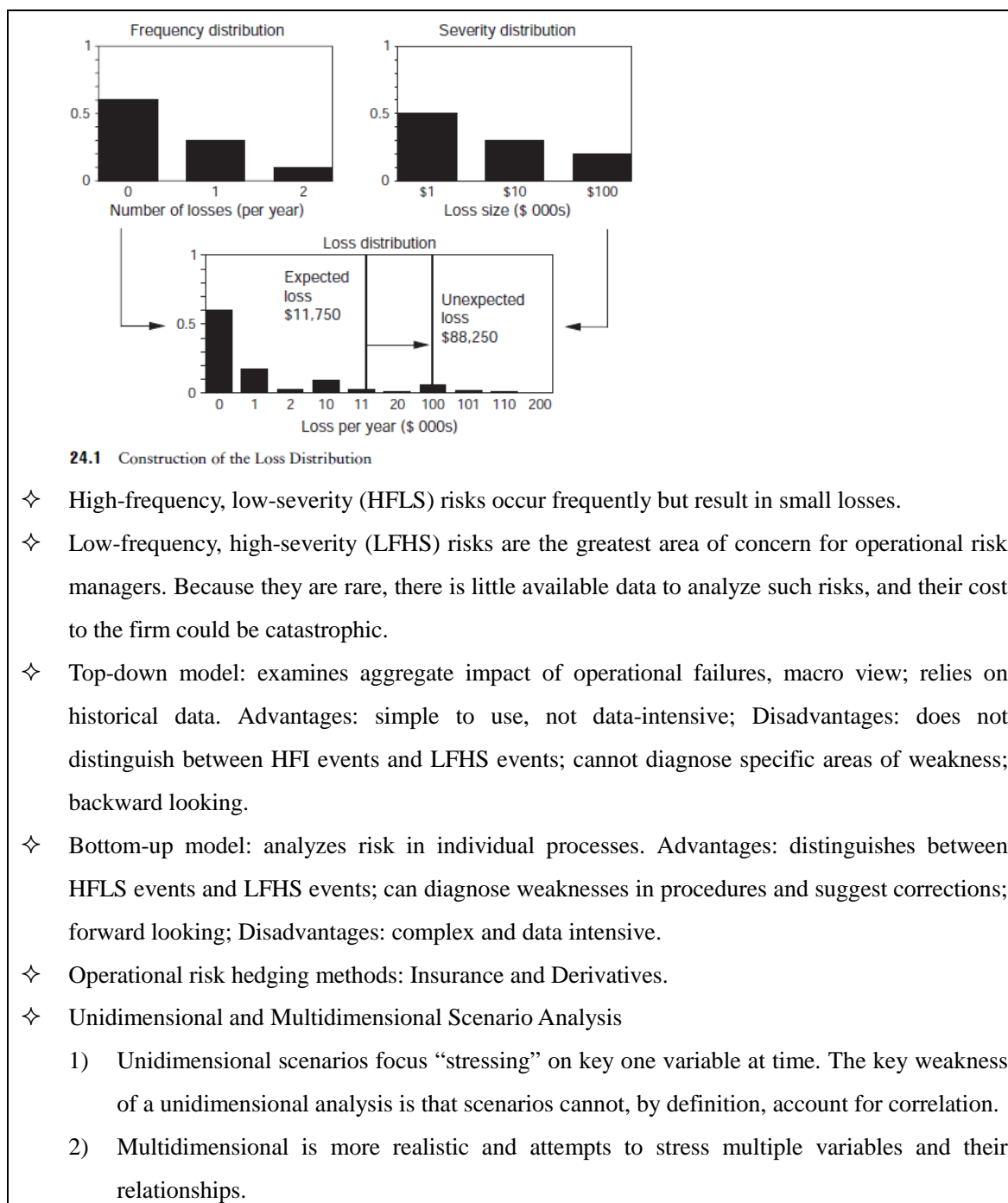
Business Line	Beta Factor
Corporate finance	18%
Trading and sales	18%
Retail banking	12%
Commercial banking	15%
Payment, settlement	18%
Agency services	15%
Asset management	12%
Retail brokerage	12%

3) Advanced Measurement Approach: $ORC^{AMA} = VaR(1\text{-year}, 99.9\% \text{ confidence})$

Figure 1: Capital Requirement



- ✧ Construction of the Loss Distribution: loss frequency (Poisson distribution) and loss severity (lognormal distribution)



183. According to current Basel committee proposals, banks using the advanced measurement approach must calculate the operational risk capital charge at a:

- 99 percentile confidence level and a 1-year time horizon.
- 99 percentile confidence level and a 5-year time horizon.
- 99.9 percentile confidence level and a 1-year time horizon.
- 99.9 percentile confidence level and a 5-year time horizon.

Answer: C

184. Which of the following measurement approaches for assessing operational risk would be most appropriate for small banks?

- A. Loss frequency approach
- B. Basic indicator approach
- C. Standardized approach
- D. Advanced measurement approach (AMA)

Answer: B

185. Which of the following statements about insurance and derivatives as a means of hedging operational risk is correct?

- A. Hedging through insurance is inexpensive.
- B. Hedging through derivative securities is subject to the moral hazard problem.
- C. The insurance market is less developed than the market for operational derivative securities.
- D. Insurance policies can be used to hedge a wider array of operational risks than derivative securities.

Answer: D

186. In comparison to the bottom-up approach to measuring operational risk exposure, the top down approach would be most appropriate for which of the following:

- A. Determining firm-wide economic capital levels.
- B. Designing risk reduction techniques at the business-unit level.
- C. Diagnosing specific weak points in a process.
- D. Incorporating changes in the risk environment.

Answer: A

Top-down operational risk measurement techniques may be appropriate for the determination of overall economic levels for the firm. However, top-down operational risk techniques tend to be of little use in designing procedures to reduce operational risk in any particularly vulnerable area of the firm. That is, they do not incorporate any adjustment for the implementation of operational risk controls, nor can they advise management about specific weak points in the production process. They over-aggregate the firm's processes and procedures and are thus poor diagnostic tools. Top-down techniques are also backward looking and cannot incorporate changes in the risk environment that might affect the operational loss distribution over time.

187. Which of the following statements concerning the measurement of operational risk is correct?

- A. Economic capital should be sufficient to cover both expected and worst-case operational risk losses.
- B. Loss severity and loss frequency tend to be modeled with lognormal distributions.
- C. Operational loss data available from data vendors tend to be biased towards small losses.
- D. The standardized approach used by banks in calculating operational risk capital allows for different beta factors to be assigned to different business lines.

Answer: D

In the standardized approach to calculating operational risk, a bank's activities are divided up into several different business lines, and a beta factor is calculated for each line of business. Economic capital covers the difference between the worst-case loss and the expected loss. Loss severity tends to be modeled with a lognormal distribution, but loss frequency is typically modeled using a Poisson distribution. Operational loss data available from data vendors tends to be biased towards large losses.

● Key Point: Credit Ratings

Explanation	Standard & Poor's	Moody's Services
Investment grade:		
Highest grade	AAA	Aaa
High grade	AA	Aa
Upper medium grade	A	A
Medium grade	BBB	Baa
Speculative grade:		
Lower medium grade	BB	Ba
Speculative	B	B
Poor standing	CCC	Caa
Highly speculative	CC	Ca
Lowest quality, no interest	C	C
In default	D	
Modifiers: A+, A, A-, and A1, A2, A3		

188. You are considering an investment in one of three different bonds. Your investment guidelines require that any bond you invest in carry an investment grade rating from at least two recognized bond rating agencies. Which, if any, of the bonds listed below would meet your investment guidelines?

- A. Bond A carries an S&P rating of BB and a Moody's rating of Baa.
- B. Bond B carries an S&P rating of BBB and a Moody's rating of Ba.
- C. Bond C carries an S&P rating of BBB and a Moody's rating of Baa.
- D. None of the above.

Answer: C

189. Which of the following is not a true statement about internal credit ratings?

- A. The "at-the-point-in-time" approach makes heavy use of econometric modeling that relates current financial variables to estimated default risk.
- B. The "through-the-cycle" approach is forward-looking and attempts to incorporate future economic scenarios into current default risk estimates.
- C. "at-the-point-in-time" credit scores volatility is much higher than "through-the-cycle" score volatility.
- D. A sound internal system uses at-the-point-in-time scoring for small-to-medium-sized companies and private firms and through-the-cycle scoring for large firms.

Answer: D

The approaches are not compatible or directly comparable, and using the two approaches for different firms can yield highly inconsistent and misleading results.

190. The rating agencies have analyzed the creditworthiness of Company XYZ and have determined that the company currently has adequate payment capacity, although a negative change in the business environment could affect its capacity for repayment. The company has been given an investment grade rating by S&P and Moody's. Which of the following S&P/Moody's ratings has Company XYZ been assigned?

- A. AA/Aa
- B. A/A
- C. BBB/Baa
- D. BB/Ba

Answer: C

The interpretation given by the above statement refers to a rating of BBB/Baa, which is a lower investment grade rating. A rating of BB/Ba is not investment grade, an AA/Aa rating is a very high investment grade rating and an A/A rating still reflects a strong capacity to make payments.

191. The following statement is made by S&P about the creditworthiness of company XYZ: "Strong capacity to meet financial commitments, but somewhat susceptible to adverse economic conditions

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and changes in circumstances." What is the rating assigned by S&P to company XYZ?

- A. AAA
- B. A
- C. B
- D. C

Answer: B

The interpretation the statement refers to is a rating of A. The interpretations for each of the ratings are:

AAA — Extremely strong capacity to meet financial commitments

A — Strong capacity to meet financial commitments

B — Very speculative with significant credit risk

C — In bankruptcy or default

● Key Point: Transition Matrix

192. Which of the following statements is incorrect, given the following one-year rating transition matrix?

From/To (%)	AAA	AA	A	BBB	BB	B	CCC/C	D	Non Rated
AAA	87.44	7.37	0.46	0.09	0.06	0.00	0.00	0.00	4.59
AA	0.60	86.65	7.78	0.58	0.06	0.11	0.02	0.01	4.21
A	0.05	2.05	86.96	5.50	0.43	0.16	0.03	0.04	4.79
BBB	0.02	0.21	3.85	84.13	4.39	0.77	0.19	0.29	6.14
BB	0.04	0.08	0.33	5.27	75.73	7.36	0.94	1.20	9.06
B	0.00	0.07	0.20	0.28	5.21	72.95	4.23	5.71	11.36
CCC/C	0.08	0.00	0.31	0.39	1.31	9.74	46.83	28.83	12.52

- A. BBB loans have a 4.08% chance of being upgraded in one year.
- B. BB loans have a 75.73% chance of staying at BB for one year.
- C. BBB loans have an 88.21% chance of being upgraded in one year.
- D. BB loans have a 5.72% chance of being upgraded in one year.

Answer: C

A is incorrect. The chance of BBB loans being upgraded over 1 year is 4.08% ($0.02 + 0.21 + 3.85$).

B is incorrect. The chance of BB loans staying at the same rate over 1 year is 75.73%.

C is correct. 88.21% represents the chance of BBB loans staying at BBB or being upgraded over 1 year.

D is incorrect. The chance of BB loans being downgraded over 1 year is 5.72% ($0.04 + 0.08 + 0.33 +$

5.27).

193. Given the following ratings transition matrix, calculate the two-period cumulative probability of default for a B credit.

Rating at beginning of period	Rating at End of period			
	A	B	C	D
A	0.95	0.05	0.00	0.00
B	0.03	0.90	0.05	0.02
C	0.01	0.10	0.75	0.14
Default	0.00	0.00	0.00	1.00

- A. 2.0%
- B. 2.5%
- C. 4.0%
- D. 4.5%

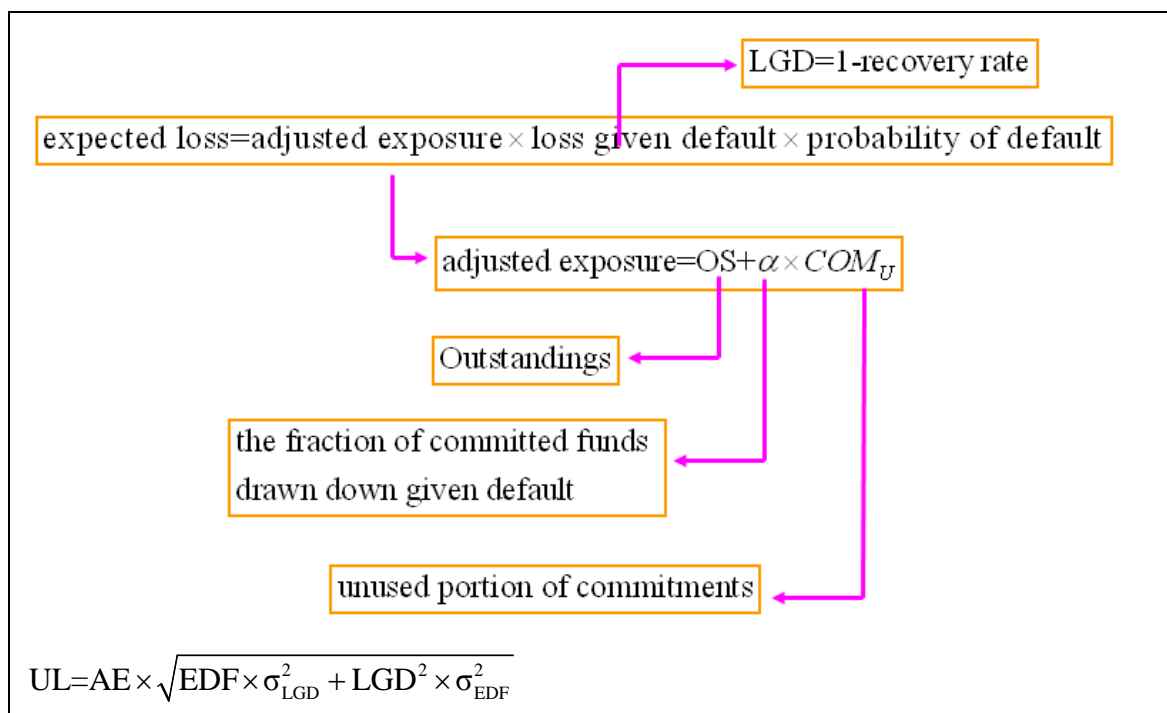
Answer: D

The first period probability of default for a B-rated bond is 2%. In second period the probability of default is the probability of surviving year 1 and defaulting in year 2. The year 2 probability of default = $(0.03 \times 0.00) + (0.90 \times 0.02) + (0.05 \times 0.14) = 2.5\%$. Therefore, the two-period cumulative probability of default = $2\% + 2.5\% = 4.5\%$.

● Key Point: Expected Credit Loss and Unexpected Credit Loss

$$\text{Adjusted Exposure} = \text{OS} + \alpha \times \text{COM}_U$$

$$\text{EL} = \text{AE} \times \text{EDF} \times \text{LGD}$$



194. An investor holds a portfolio of \$100 million. This portfolio consists of A-rated bonds (\$40 million) and BBB-rated bonds (\$60 million). Assume that the one-year probabilities of default for A-rated and BBB-rated bonds are 3% and 5%, respectively, and that they are independent. If the recovery value for A-rated bonds in the event of default is 70% and the recovery value for BBB-rated bonds is 45%, what is the one-year expected credit loss from this portfolio?

- A. \$1672000
- B. \$1842000
- C. \$2010000
- D. \$2218000

Answer: C

$$\text{EL}_P = 40 \times 3\% \times (1 - 70\%) + 60 \times 5\% \times (1 - 45\%) \text{ million} = 2,010,000$$

195. An exposure has a default probability (PD) of 4.0% and loss given default of 50.0%. The standard deviation of the LGD is 25.0%. What is the ratio of the unexpected loss to the expected loss, UL/EL?

- A. 1.33
- B. 3.72
- C. 5.50
- D. 9.64

Answer: C

$$\text{Unexpected loss (\%)} = \text{SQRT} [\text{EDF} \times \text{variance (LGD)} + \text{LGD}^2 \times \text{variance (EDF)}] =$$

$$\text{SQRT} [4\% \times 25\%^2 + 50\%^2 \times 4\% \times 96\%] = 11.00\%$$

$$\text{Expected loss (\%)} = \text{EDF} \times \text{LGD} = 4\% \times 50\% = 2.0\%$$

$$\text{Ratio of UL/EL} = 11.0\%/2.0\% = 5.50$$

196. Over the next year, an operational process model predicts a 95% probability of no loss occurrence and a 5% probability of a single loss occurrence. If the single loss occurs, the severity is characterized by three possible outcomes: \$10.0 million loss with 20% probability, \$18.0 million loss with 50% probability, and \$25.0 million loss with 30% probability. What is the model's one-year 90% expected shortfall (ES)?

- A. \$9.25 million
- B. \$10.00 million
- C. \$13.88 million
- D. \$18.50 million

Answer: A.

The 10% loss tail includes 5% of no loss (i.e., the 90% to 95% CDF) and 5% of the loss event.

The average of this 10% tail is therefore given by:

$$50\% \times 0 + 50\% \times [\text{E (loss | loss event)}] = 50\% \times [20\% \times 10 + 50\% \times 18 + 30\% \times 25] = \$9.25 \text{ million}$$

197. Suppose ABC bank has booked a loan with following characteristics, it has total commitment of 3,000,000, outstanding is 2,000,000. The bank estimates 1% default probability (EDF) in one year, and draw down on default is 65%. The bank is currently experienced 60% of loss given default. The standard deviation of EDF and LGD is 5% and 30%, respectively. Please find the adjusted exposure.

- A. 2,350,000
- B. 2,650,000
- C. 3,000,000
- D. 3,300,000

Answer: B

$$\begin{aligned} \text{adjust exposure} &= \text{OS} + (\text{COM} - \text{OS}) \times \text{UGD} \\ &= 2,000,000 + (3,000,000 - 2,000,000) \times 0.65 \\ &= 2,650,000 \end{aligned}$$

● Key Point: Country Risk

Sources of country risk:

- 1) where the country is in the economy growth life cycle;
- 2) political risks;
- 3) the legal systems of a country, including both the structure and the efficiency of legal system;
- 4) the disproportionate reliance of a country on one commodity or service.

Factors influencing sovereign default risk:

- 1) a country's level of indebtedness;
- 2) obligations such as pension and social service commitments;
- 3) a country's level of and stability of tax receipts;
- 4) political risks;
- 5) backing from other countries or entities.

198. One of the traders whose risk you monitor put on a carry trade where he borrows in yen and invests in some emerging market bonds whose performance is independent of yen. Which of the following risks should you not worry about?

- A. Unexpected devaluation of the yen.
- B. A currency crisis in one of the emerging markets the trader invests in.
- C. Unexpected downgrading of the sovereign rating of a country in which the trader invests.
- D. Possible contagion to emerging markets of a credit crisis in a major country.

Answer: A

Unexpected devaluation of the yen would result in a gain to the trader.

199. Which of the following reasons most completely describes why country risk assessment is prone to error?

- A. While data is accurate, it is often incomplete.
- B. Different accounting standards are used in different countries.
- C. Disclosure requirements are inconsistent across international borders.
- D. The exchange rate correlations are unstable during economic downturns.

Answer: D

In addition to contagion, there are other reasons why country risk assessment is prone to error. First of all, the interrelationship among the relevant variables is complex and hard to model. Also, many sovereign and foreign borrowers provide incomplete and/or inaccurate information.

200. There are several challenges analysts face when using agency ratings on foreign debt as an indicator of default risk. Which of the following statements is false regarding weaknesses of rating agency sovereign debt ratings?

- A. Ratings can be politically influenced.
- B. Ratings are often subjective interpretations of available data.
- C. Ratings are often delayed relative to changes in real-life situations.
- D. Rating agencies are required to use government data for quantitative assessments of the likelihood of repayment.

Answer: D

Despite large and often comprehensive amounts of data used in analysis, actual ratings may be based on subjective interpretations of the data. Also, ratings are often delayed relative to the dynamic business and political environments. Ratings may be influenced by politics. Also, ratings may not be considered useful in assessing a country's ability and willingness to pay 5 to 10 years in the future. Rating agencies are not required to use government data for quantitative assessments of the likelihood of repayment although, like other analyses, government data is often heavily relied upon for conclusions regarding default risk.

201. A risk analyst is analyzing several indicators for a group of countries. If he specifically considers the Gini coefficient in his analysis, in which of the following factors is he most interested?

- A. Standard of living
- B. Peacefulness
- C. Perceived corruption
- D. Income inequality

Answer: D

The Gini coefficient is commonly used to measure income inequality on a scale of zero to one, with zero being total equality and one being total inequality. Therefore, nations with lower Gini coefficients have a more even distribution of income, while higher Gini coefficients indicate a wider disparity between higher and lower income households.

202. In an attempt to understand country risk, Mary Ann Small, an analyst at Global Funds, examines multiple sources of information to determine the truest measure of risk. She considers sovereign risk ratings, default risk spreads, and composite measures of risk. Which of the following sources relies on surveys of several hundred economists to measure sovereign risk?

- A. Political Risk Services.
- B. The Economist.
- C. Standard and Poor.
- D. Euromoney.

Answer: D

Numerous services attempt to evaluate country risk in its entirety. They include Political Risk Services (PRS), The Economist, Euromoney, and the World Bank. Euromoney surveys 400 economists who assess country risk factors and rank countries from 0 to 100, with higher numbers indicating lower risk.

203. Which of the following statements regarding foreign currency defaults is true?

- A. African countries are responsible for the greatest number of defaults in the last 50 years.
- B. Prior to the 20th century, no country had ever defaulted on funds borrowed in a foreign currency.
- C. Latin America accounted for more than 600/o of foreign currency defaults in the 1990s.
- D. Countries are more likely to default on funds borrowed from foreign banks than on sovereign bond issues.

Answer: D

Historically, countries have been more likely to default on foreign bank debt than on sovereign bonds. Latin America is responsible for the greatest number of foreign currency defaults over the last five decades with more than 60o/o of defaults in each decade with the exception of the 1990s. Over the last 200 years there are many instances of default. The defaults primarily occur in seven distinct time periods: 1824-1834, 1867-1882, 1890-1900, 1911-1921, 1931-1940, 1976-1989, and 1998-2003. Thus, countries did borrow and default in the 19th century.