

2013

FRM  
Examination  
Practice  
Exam

PART I and PART II

 GARP | Global Association  
of Risk Professionals

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## INTRODUCTION

The FRM Exam is a practice-oriented examination. Its questions are derived from a combination of theory, as set forth in the core readings, and “real-world” work experience. Candidates are expected to understand risk management concepts and approaches and how they would apply to a risk manager’s day-to-day activities.

The FRM Examination is also a comprehensive examination, testing a risk professional on a number of risk management concepts and approaches. It is very rare that a risk manager will be faced with an issue that can immediately be slotted into one category. In the real world, a risk manager must be able to identify any number of risk-related issues and be able to deal with them effectively.

The 2013 FRM Practice Exams I and II have been developed to aid candidates in their preparation for the FRM Examination in May and November 2013. These Practice Exams are based on a sample of questions from the 2010 through 2012 FRM Examinations and are suggestive of the questions that will be in the 2013 FRM Examination.

The 2013 FRM Practice Exam for Part I contains 25 multiple-choice questions and the 2013 FRM Practice Exam for Part II contains 20 multiple-choice questions. Note that the 2013 FRM Examination Part I will contain 100 multiple-choice questions and the 2013 FRM Examination Part II will contain 80 multiple-choice questions. The Practice Exams were designed to be shorter to allow candidates to calibrate their preparedness without being overwhelming.

The 2013 FRM Practice Exams do not necessarily cover all topics to be tested in the 2013 FRM Examination as the material covered in the 2013 Study Guide may be different from that that covered by the 2010 through 2012 Study Guides. The questions selected for inclusion in the Practice Exams were chosen to be broadly reflective of the material assigned for 2013 as well as to represent the style of question that the FRM Committee considers appropriate based on assigned material.

**For a complete list of current topics, core readings, and key learning objectives candidates should refer to the 2013 FRM Examination Study Guide and AIM Statements.**

Core readings were selected by the FRM Committee to assist candidates in their review of the subjects covered by the Exam. Questions for the FRM Examination are derived from the “core” readings. It is strongly suggested that candidates review these readings in depth prior to sitting for the Exam.

### Suggested Use of Practice Exams

To maximize the effectiveness of the Practice Exams, candidates are encouraged to follow these recommendations:

- 1. Plan a date and time to take each Practice Exam.**  
Set dates appropriately to give sufficient study/review time for the Practice Exam prior to the actual Exam.
- 2. Simulate the test environment as closely as possible.**
  - Take each Practice Exam in a quiet place.
  - Have only the practice exam, candidate answer sheet, calculator, and writing instruments (pencils, erasers) available.
  - Minimize possible distractions from other people, cell phones and study material.
  - Allocate 60 minutes for the Practice Exam and set an alarm to alert you when 60 minutes have passed. Complete the exam but note the questions answered after the 60 minute mark.
  - Follow the FRM calculator policy. You may only use a Texas Instruments BA II Plus (including the BA II Plus Professional), Hewlett Packard 12C (including the HP 12C Platinum and the Anniversary Edition), Hewlett Packard 10B II, Hewlett Packard 10B II+ or Hewlett Packard 20B calculator.
- 3. After completing the Practice Exam,**
  - Calculate your score by comparing your answer sheet with the Practice Exam answer key. Only include questions completed in the first 60 minutes.
  - Use the Practice Exam Answers and Explanations to better understand correct and incorrect answers and to identify topics that require additional review. Consult referenced core readings to prepare for Exam.



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**PART I**

Answer Sheet



	a.	b.	c.	d.		a.	b.	c.	d.
1.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	16.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	17.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	18.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	19.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	20.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	21.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	22.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	23.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	24.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	25.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					
12.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					
13.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<b>Correct way to complete</b>				
14.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	1.	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
15.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<b>Wrong way to complete</b>				
					1.	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>



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2013 Practice Exam

**PART I**

Questions



1. You are 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. You find 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.
  
2. Eric Meyers is a trader in the arbitrage unit of a multinational bank. He 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
  
3. The price of a six-month 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



4. 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.
5. 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
6. You are examining the exchange rate between the U.S. dollar and the euro and are given the following information regarding the USD/EUR exchange rate and the respective domestic risk-free rates:
- 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

7. 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 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?

	<i>Strategy</i>	<i>Maximum Profit</i>	<i>Maximum Loss</i>
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

8. 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.  $R_{LMD,t} = 0.04 + 1.85R_{S\&P,t} + \varepsilon_t$



9. 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:

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

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  $\beta_1$  is 0.07, and the p-value for the t-statistic for  $\beta_2$  is 0.06. The p-value for the F-statistic for the regression is 0.045. Which of the following statements is correct?

- You can reject the null hypothesis because each  $\beta$  is different from 0 at the 95% confidence level.
  - You cannot reject the null hypothesis because neither  $\beta$  is different from 0 at the 95% confidence level.
  - You can reject the null hypothesis because the F-statistic is significant at the 95% confidence level.
  - You cannot reject the null hypothesis because the F-statistic is not significant at the 95% confidence level.
10. 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?
- Bernoulli
  - Normal
  - Binomial
  - Exponential
11. 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?

- USD 43.33
- USD 43.77
- USD 44.21
- USD 45.10

12. 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?
- a. 1.00
  - b. 0.80
  - c. 0.64
  - d. -1.00
13. 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
14. 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% semi-annually?
- a. USD 98.10
  - b. USD 101.23
  - c. USD 103.35
  - d. USD 104.18



15. If the current market price of a stock is USD 50, which of the following options on the stock has the highest gamma?
- Call option expiring in 30 days with strike price of USD 50
  - Call option expiring in 5 days with strike price of USD 30
  - Call option expiring in 5 days with strike price of USD 50
  - Put option expiring in 30 days with strike price of USD 30
16. John Starwood is an investment advisor at Metuchen Investment Advisors (MIA). Starwood is advising Michael Cooke, a wealthy client of MIA. Cooke would like to invest USD 500,000 in a bond rated at least AA. Starwood is considering bonds issued by IBM, GE, and Microsoft, and wants to choose a bond that satisfies Cooke's rating requirement, but also has the highest yield to maturity. He has access to the following information:

	IBM	GE	Microsoft
S&P Bond Rating	AA+	A+	AAA
Semiannual Coupon	1.75%	1.78%	1.69%
Term to Maturity in years	5	5	5
Price (USD)	975	973	989
Par value (USD)	1000	1000	1000

Which bond should Starwood purchase for Cooke?

- GE bond
  - IBM bond
  - Microsoft bond
  - Either the Microsoft bond or the GE bond
17. After evaluating the results of your firm's stress tests, you are 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 you note the following, related to this strategy:
- While decreasing liquidity risk exposure, it will likely increase market risk exposure.
  - While decreasing correlation risk exposure, it will likely increase credit risk exposure.
  - While decreasing market risk exposure, it will likely increase credit risk exposure.
  - While decreasing credit risk exposure, it will likely increase model risk exposure.



18. A bank's foreign loan portfolio contains a large concentration of loans to a country whose government has been running large external deficits. To evaluate the transfer risk that might exist in the event of stress, the greatest concern should be given to the possibility that the sovereign will impose restrictions on which of the following?
- a. Imports
  - b. Interest rates
  - c. Exports
  - d. Currency convertibility
19. 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
20. 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.
21. 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.

22. 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
23. 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.
24. 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
25. 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.







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**PART I**

Answers



	a.	b.	c.	d.		a.	b.	c.	d.
1.	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	16.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	17.	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
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11.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>					
12.	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<b>Correct way to complete</b>				
13.	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	1.	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
14.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<b>Wrong way to complete</b>				
15.	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	1.	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>



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**PART I**

Explanations



1. You are 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. You find 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.

Correct answer: c

**Explanation:** 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.

**Reference:** John Hull, *Options, Futures and Other Derivatives, 8th Edition* (New York: Pearson, 2012), Chapter 5.

**AIMS:** Explain the relationship between forward and futures prices; Describe the differences between forward and futures contracts and explain the relationship between forward and spot prices.

**Section:** Financial Markets and Products

2. Eric Meyers is a trader in the arbitrage unit of a multinational bank. He 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?
- Short 2-year futures and long 1-year futures
  - Short 1-year futures and long 2-year futures
  - Short 2-year futures and long the underlying asset funded by borrowing for 2 years
  - Short 1-year futures and long the underlying asset funded by borrowing for 1 year

Correct answer: c

**Explanation:** The 1-year futures price should be  $1000 * e^{0.01} = 1010.05$ .  
The 2-year futures price should be  $1000 * e^{0.02} = 1020.20$ .

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 1000 at 1%, and buy the underlying asset. At the end of 2 years, you will sell the asset at USD 1025 and return the borrowed money with interest, which would be  $1000 * e^{0.02} = \text{USD } 1020.20$ , resulting in a USD 4.80 gain.

**Reference:** John Hull, *Options, Futures and Other Derivatives, 8th Edition* (New York: Pearson, 2012), Chapter 5, p. 92.

**AIMS:** Calculate the forward price, given the underlying asset's price, with or without short sales and/or consideration to the income or yield of the underlying asset. Describe an arbitrage argument in support of these prices.

**Section:** Financial Markets and Products



3. The price of a six-month 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?
- USD 3.60
  - USD 2.40
  - USD 4.37
  - USD 1.63

Correct answer: c

**Explanation:** 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

$$PV(K) = Ke^{-rt} \text{ and } PV(D) = De^{-rt}$$

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  $25 * e^{-0.05 * 0.5}$  or 24.38, while PV(D) is equal to  $1.00e^{-0.05 * 0.25}$ , or 0.99. Hence  $p = 3 + 24.38 + 0.99 - 24 = \text{US } 4.37$ .

**Reference:** John Hull, *Options, Futures, and Other Derivatives, 8th Edition* (New York: Pearson 2012), Chapter 10, p. 158.

**AIM:** Explain the effects of dividends on the put-call parity, the bounds of put and call option prices, and the early exercise feature of American options.

**Section:** Financial Markets and Products

4. 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.

Correct answer: a

**Explanation:** 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 bondholders or their representatives.

**Reference:** Frank Fabozzi, *The Handbook of Fixed Income Securities, 8th Edition* (New York: McGraw Hill, 2012), Chapter 12.

**AIM:** Describe a bond indenture and explain the role of the corporate trustee in a bond indenture.

**Section:** Financial Markets and Products

5. 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

Correct answer: d

**Explanation:** 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.

**Reference:** John Hull, *Options, Futures and Other Derivatives, 8th Edition* (New York: Pearson, 2012), Chapter 3 — “Hedging Strategies Using Futures”, p. 47.

**AIM:** Define the basis and the various sources of basis risk, and explain how basis risks arise when hedging with futures.

**Section:** Financial Markets and Products



6. You are examining the exchange rate between the U.S. dollar and the euro and are given the following information regarding the USD/EUR exchange rate and the respective domestic risk-free rates:

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

Correct answer: c

**Explanation:** The forward rate,  $F_t$ , is given by the interest rate parity equation:

$$F_t = S_0 * e^{(r-r_f)T}$$

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:

$$F_t = 1.25 * e^{(0.04-0.07)} = 1.21$$

**Reference:** Anthony Saunders and Marcia Millon Cornett, *Financial Institutions Management: A Risk Management Approach, 7th Edition* (New York: McGraw-Hill, 2010), Chapter 15, p. 236.

**AIM:** Describe how a no-arbitrage assumption in the foreign exchange markets leads to the interest rate parity theorem; use this theorem to calculate forward foreign exchange rates.

**Section:** Financial Markets and Products

7. 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 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?

	<i>Strategy</i>	<i>Maximum Profit</i>	<i>Maximum Loss</i>
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

Correct answer: a

**Explanation:** 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:

$$\text{USD } -10 + \text{USD } 2 = \text{USD } -8 \text{ (a negative cost, which represents an inflow of USD } 8 \text{ to the investor)}$$

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  $\text{USD } 8 - \text{USD } 10 = \text{USD } -2$ .

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.

**Reference:** John Hull, *Options, Futures, and Other Derivatives, 8th Edition* (New York: Pearson 2012), Chapter 10, pp. 167-168.

**AIM:** Identify, interpret and compute upper and lower bounds for option prices.

**Section:** Financial Markets and Products



8. 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.  $R_{LMD,t} = 0.04 + 1.85R_{S\&P,t} + \varepsilon_t$

Correct answer: b

**Explanation:** The regression coefficients for a model specified by  $Y = bX + a + \varepsilon$  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:

$$b = 0.06 / (0.18)^2 = 1.85$$

$$a = E(Y) - b \cdot E(X) = 0.11 - (1.85 \cdot 0.07) = -0.02$$

where  $\varepsilon$  represents the error term.

**Reference:** James Stock and Mark Watson, *Introduction to Econometrics, Brief Edition* (Boston: Pearson Education, 2008), Chapter 4, p. 64.

**AIM:** Explain how regression analysis in econometrics measures the relationship between dependent and independent variables.

**Section:** Quantitative Analysis

9. 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:

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

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  $\beta_1$  is 0.07, and the p-value for the t-statistic for  $\beta_2$  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  $\beta$  is different from 0 at the 95% confidence level.
- b. You cannot reject the null hypothesis because neither  $\beta$  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.

Correct answer: c

**Explanation:** 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.

**Reference:** James Stock and Mark Watson, *Introduction to Econometrics, Brief edition* (Boston, Pearson Education, 2008), Chapter 7, pp. 128-129.

**AIM:** Describe and interpret tests of single restrictions involving multiple coefficients, Define and interpret the F-statistic.

**Section:** Quantitative Analysis



10. 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

Correct answer: c

**Explanation:** 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.

**References:** Michael Miller, *Mathematics and Statistics for Financial Risk Management* (Hoboken, NJ: John Wiley & Sons, 2012), Chapter 4.

Svetlozar Rachev, Christian Menn, and Frank Fabozzi (2005), Chapter 3: *Continuous Probability Distributions, Fat-Tailed and Skewed Asset Return Distributions: Implications for Risk Management, Portfolio Selection and Option Pricing* (Hoboken, NJ: Wiley and Sons, 2005), Chapter 2: Discrete Probability Distributions.

**AIM:** Describe the key properties of the uniform distribution, Bernoulli distribution, Binomial distribution, Poisson distribution, normal distribution and lognormal distribution, and identify common occurrences of each distribution.

**Section:** Quantitative Analysis

11. 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

Correct answer: b

**Explanation:** 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:

$$(2000 \cdot 43 + 4000 \cdot 44 + 10000 \cdot 46 + 4000 \cdot 45) / 20000 = 45.10$$

Discounted payoff calculation:

$$45.10 \cdot e^{(-0.04 \cdot (9/12))} = 43.77$$

**Reference:** Philippe Jorion, *Value-at-Risk: The New Benchmark for Managing Financial Risk, 3rd Edition* (New York: McGraw-Hill, 2007), Chapter 12: Monte Carlo Methods, pp. 167, 170.

**AIM:** Explain how simulations can be used for computing VaR and pricing options.

**Section:** Quantitative Analysis



12. 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?
- a. 1.00
  - b. 0.80
  - c. 0.64
  - d. -1.00

Correct answer: a

**Explanation:** The following equation is used to calculate beta:

$$\beta = \rho * \frac{\sigma(\text{portfolio})}{\sigma(\text{benchmark})} = 0.8 * \frac{0.05}{0.04} = 1.00.$$

where  $\rho$  represents the correlation coefficient and  $\sigma$  the volatility.

**Reference:** Noel Amenc and Veronique Le Sourd, *Portfolio Theory and Performance Analysis* (West Sussex, England: Wiley, 2003), Chapter 4, section 4.2.

**AIM:** Define beta and calculate the beta of a portfolio.

**Section:** Foundations of Risk Management

13. 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

Correct answer: c

**Explanation:** 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.

**References:** "Risk Taking: A Corporate Governance Perspective," (International Finance Corporation, World Bank Group, June 2012.)

John Hull, *Options, Futures and Other Derivatives, 8th Edition*, Chapter 1.

René Stulz, *Risk Management & Derivatives* (Florence, KY: Thomson South-Western, 2002), Chapter 3, p. 30.

**AIM:** Identify the methods a firm can use to exploit risk better than its competitors, and explain how an organization can create a culture of prudent risk-taking among its employees.

**AIM:** Calculate and identify option and forward contract payoffs.

**Sections:** Foundations of Risk Management, Financial Markets and Products



14. 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% semi-annually?
- a. USD 98.10
  - b. USD 101.23
  - c. USD 103.35
  - d. USD 104.18

Correct answer: d

**Explanation:** 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, F1 and F2, which correspond to the proportion of the zero and the 10% bond to be held, respectively.

The two equations are as follows:

$$(100 * F1) + (105 * F2) = 104 \quad \text{(replicating the cash flow including principal and interest payments at the end of 1 year),}$$

and

$$(5 * F2) = 4 \quad \text{(replicating the cash flow from the coupon payment in 6 months.)}$$

Solving the two equations gives us  $F1 = 0.2$  and  $F2 = 0.8$ . Thus the price of the 8% bond should be  $0.2 (96.12) + 0.8 (106.2) = 104.18$ .

**Reference:** Bruce Tuckman, *Fixed Income Securities, 3rd Edition* (Hoboken, NJ: Wiley & Sons, 2011), Chapter 1. Originally based on the 2nd Edition.

**AIM:** Derive a replicating portfolio using multiple fixed income securities in order to match the cash flows of a single given fixed income security.

**Section:** Valuation and Risk Models

15. 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

Correct answer: c

**Explanation:** 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.

**Reference:** John Hull, *Options, Futures, and Other Derivatives, 8th Edition* (New York: Pearson, 2012), Chapter 18 — The Greek Letters, p. 104.

**AIM:** Define and describe theta, gamma, vega, and rho for option positions.

**Section:** Valuation and Risk Models



16. John Starwood is an investment advisor at Metuchen Investment Advisors (MIA). Starwood is advising Michael Cooke, a wealthy client of MIA. Cooke would like to invest USD 500,000 in a bond rated at least AA. Starwood is considering bonds issued by IBM, GE, and Microsoft, and wants to choose a bond that satisfies Cooke's rating requirement, but also has the highest yield to maturity. He has access to the following information:

	IBM	GE	Microsoft
S&P Bond Rating	AA+	A+	AAA
Semiannual Coupon	1.75%	1.78%	1.69%
Term to Maturity in years	5	5	5
Price (USD)	975	973	989
Par value (USD)	1000	1000	1000

Which bond should Starwood purchase for Cooke?

- GE bond
- IBM bond
- Microsoft bond
- Either the Microsoft bond or the GE bond

Correct answer: b

**Explanation:** To reach the correct answer, find the bond with the highest yield to maturity (YTM) that qualifies for inclusion in Cooke'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 GE bond does not qualify for the portfolio as its rating of A+ is below the AA rating required by Cooke. This leaves the IBM bond and the Microsoft bond. Comparing the two bonds, the IBM bond pays a higher coupon than the Microsoft bond, yet it is cheaper as well. Therefore the yield on the IBM 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 IBM bond equals 4.057%, while the YTM for the Microsoft bond equals 3.62%.

**Reference:** Bruce Tuckman, *Fixed Income Securities, 2nd Edition* (Hoboken, NJ: Wiley & Sons, 2002), Chapter 3 – Yield to Maturity.

**AIM:** Compute a bond's YTM given a bond structure and price.

**Section:** Valuation and Risk Models

17. After evaluating the results of your firm's stress tests, you are 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 you note the following, 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.

Correct answer: c

**Explanation:** The purchase of insurance protection can transform market risk into counterparty credit risk.

**Reference:** Philippe Jorion, *Value-at-Risk: The New Benchmark for Managing Financial Risk*, 3rd Edition (New York: McGraw-Hill 2007), Chapter 14, p. 264.

**AIM:** Explain how the results of a stress test can be used to improve our risk analysis and risk management systems.

**Section:** Valuation and Risk Models

18. A bank's foreign loan portfolio contains a large concentration of loans to a country whose government has been running large external deficits. To evaluate the transfer risk that might exist in the event of stress, the greatest concern should be given to the possibility that the sovereign will impose restrictions on which of the following?
- a. Imports
  - b. Interest rates
  - c. Exports
  - d. Currency convertibility

Correct answer: d

**Explanation:** Transfer risk arises when central banks or governments impose restrictions on currency convertibility. The consequences include payment defaults and debt restructurings.

**Reference:** John Caouette, Edward Altman, Paul Narayanan and Robert Nimmo (2008), *Managing Credit Risk: The Great Challenge for the Global Financial Markets, 2nd Edition*, (Hoboken, NJ: John Wiley & Sons, 2008), Chapter 23, p. 176.

**AIM:** Define and differentiate between country risk and transfer risk and describe some of the factors that might lead to each. Describe some of the challenges in country risk analysis.

**Section:** Valuation and Risk Models



19. 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?
- USD 112
  - USD 1,946
  - USD 3,243
  - USD 5,406

Correct answer: b

**Explanation:**

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:

$$0.6 * 3.24 = 1.946, \text{ and multiplying by 1,000 provides the VaR of the entire position: } 1,946.$$

**Reference:** Linda Allen, Jacob Boudoukh and Anthony Saunders (2004), *Understanding Market, Credit and Operational Risk: The Value at Risk Approach* (Oxford, Blackwell Publishing, 2004), Chapter 3.

**AIM:** Describe the delta-normal approach to calculating VaR for non-linear derivatives.

**Section:** Valuation and Risk Models

20. Which of the following statements concerning the measurement of operational risk is correct?
- Economic capital should be sufficient to cover both expected and worst-case operational risk losses.
  - Loss severity and loss frequency tend to be modeled with lognormal distributions.
  - Operational loss data available from data vendors tend to be biased towards small losses.
  - The standardized approach used by banks in calculating operational risk capital allows for different beta factors to be assigned to different business lines.

Correct answer: d

**Explanation:** 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.

**Reference:** John Hull, *Risk Management and Financial Institutions, 2nd Edition* (Boston: Pearson Prentice Hall, 2010), Chapter 18 – Operational Risk, p. 243.

**AIM:** Describe the allocation of operational risk capital and the use of scorecards.

**Section:** Valuation and Risk Models

21. 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.

Correct answer: a

**Explanation:** 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.

**Reference:** James Stock and Mark Watson (2008), *Introduction to Econometrics*, Brief Edition (Boston, Pearson Education, 2008), Chapter 6, pp. 186-190

**AIM:** Define, interpret, and describe methods for addressing omitted variable bias.

**Section:** Quantitative Analysis



22. 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?
- Treynor ratio
  - Sharpe ratio
  - Jensen's alpha
  - Sortino ratio

Correct answer: a

**Explanation:** 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  $\rho_{pM}$  is the correlation coefficient between the portfolio and the market,  $\sigma_p$  represents the standard deviation of the portfolio and  $\sigma_M$  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:

$$\beta_p \approx \sigma_p / \sigma_M$$

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  $\beta_p$ . Therefore, it plots excess return over systematic risk.

**Reference:** Noel Amenc and Veronique Le Sourd, *Portfolio Theory and Performance Analysis* (West Sussex, England: Wiley, 2003), Chapter 4, Section 4.2 – Applying the CAPM to Performance Measurement: Single-Index Performance Measurement Indicators, page 151.

**AIM:** Calculate, compare, and evaluate the Treynor measure, the Sharpe measure, and Jensen's alpha.

**Section:** Foundations of Risk Management

23. 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?
- LTCM had no active risk reporting.
  - At LTCM, stress testing became a risk management department exercise that had little influence on the firm's strategy.
  - LTCM's use of high leverage is evidence of poor risk management.
  - LTCM failed to account properly for the illiquidity of its largest positions in its risk calculations.

Correct answer: d

**Explanation:** 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 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.

**Reference:** Steve Allen, *Financial Risk Management: A Practitioner's Guide to Managing Market and Credit Risk* (New York: John Wiley & Sons, 2003), Chapter 4 – Financial Disasters, pp. 178-182.

**AIM:** Describe the key factors that led to and the lessons learned from the following risk management case studies:

- Long Term Capital Management

**Section:** Foundations of Risk Management



24. 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

Correct answer: c

**Explanation:** 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.

**Reference:** GARP Code of Conduct, *Applicability and Enforcement* section.

**AIM:** Describe the potential consequences of violating the GARP Code of Conduct.

**Section:** Foundations of Risk Management

25. 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.

Correct answer: b

**Explanation:** 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.

**Reference:** James Stock and Mark Watson, *Introduction to Econometrics, Brief Edition* (Boston, Pearson Education, 2008), Chapter 6, pp. 202-204.

**AIM:** Explain the assumptions of the multiple linear regression model.

**Section:** Quantitative Analysis



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**PART II**

Answer Sheet



	a.	b.	c.	d.		a.	b.	c.	d.
1.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	14.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	15.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	16.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	17.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	18.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	19.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	20.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					
9.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<b>Correct way to complete</b>				
10.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	1.	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
11.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<b>Wrong way to complete</b>				
12.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	1.	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
13.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					



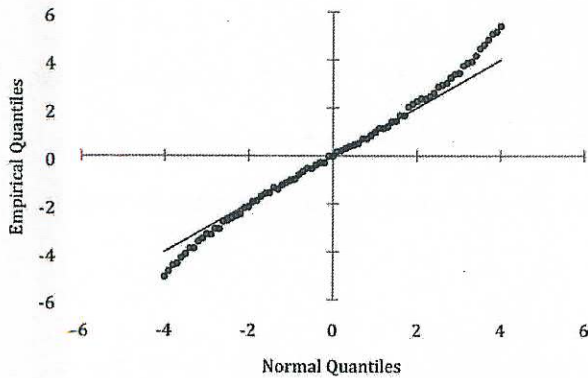
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**PART II**

Questions



1. You are examining a sample of return data. As a first step, you construct a QQ plot of the data as shown below:



Based on an examination of the QQ plot, which of the following statements is correct?

- a. The returns are normally distributed.
  - b. The return distribution has thin tails relative to the normal distribution.
  - c. The return distribution is negatively skewed relative to the normal distribution.
  - d. The return distribution has fat tails relative to the normal distribution.
2. The annual mean and volatility of a portfolio are 10% and 40%, respectively. The current value of the portfolio is GBP 1,000,000. How does the 1-year 95% VaR that is calculated using a normal distribution assumption (normal VaR) compare with the 1-year 95% VaR that is calculated using the lognormal distribution assumption (lognormal VaR)?
- a. Lognormal VaR is greater than normal VaR by GBP 13,040
  - b. Lognormal VaR is greater than normal VaR by GBP 17,590
  - c. Lognormal VaR is less than normal VaR by GBP 13,040
  - d. Lognormal VaR is less than normal VaR by GBP 17,590
3. 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

4. Let  $X$  be a random variable representing the daily loss of your portfolio. The “peaks over threshold” (POT) approach considers a threshold value,  $u$ , of  $X$  and the distribution of excess losses over this threshold. Which of the following statements about this application of extreme value theory is correct?
- To apply the POT approach, the distribution of  $X$  must be elliptical and known.
  - If  $X$  is normally distributed, the distribution of excess losses requires the estimation of only one parameter,  $\beta$ , which is a positive scale parameter.
  - To apply the POT approach, one must choose a threshold,  $u$ , which is high enough that the number of observations in excess of  $u$  is zero.
  - As the threshold,  $u$ , increases, the distribution of excess losses over  $u$  converges to a generalized Pareto distribution.
5. A risk analyst is comparing the use of parametric and non-parametric approaches for calculating VaR and is concerned about some of the characteristics present in the loss data. Which of the following distribution characteristics would make parametric approaches the favored method to use?
- Skewness in the distribution
  - Fat tails in the distribution
  - Scarcity of high magnitude loss events
  - Heteroskedasticity in the distribution
6. Lin Ping is valuing a 1-year credit default swap (CDS) contract which will pay the buyer 75% of the face value of a bond issued by Xiao Corp. immediately after a default by Xiao. To purchase this CDS, the buyer will pay the CDS spread, which is a percentage of the face value, once at the end of the year. Lin estimates that the risk-neutral default probability for Xiao is 5% per year. The risk-free rate is 3% per year. Assuming defaults can only occur halfway through the year and that the accrued premium is paid immediately after a default, what is the estimate for the CDS spread?
- 380 basis points
  - 385 basis points
  - 390 basis points
  - 400 basis points



7. You are the risk manager at Vision, a small fixed-income hedge fund that specializes in bank debt. Vision's strategy utilizes both relative value and long-only trades using credit default swaps (CDS) and bonds. One of the new traders has the positions described in the table below.

Bank	Position	Credit Rating
SBU	Long USD 10 million CDS	A
Stanos	Long USD 5 million bond	BB+
CAB	Short USD 10 million CDS	A

Some of Vision's newest clients are restricted from withdrawing their funds for three years. You are currently evaluating the impact of various default scenarios to estimate future asset liquidity. You have estimated that the marginal probability of default of the Stanos bond is 5% in Year 1, 10% in Year 2, and 15% in Year 3. What is the probability that the bond makes coupon payments for 3 years and then defaults at the end of Year 3?

- a. 13%
- b. 15%
- c. 27%
- d. 73%
8. Consider a 1-year maturity zero-coupon bond with a face value of USD 1,000,000 and a 0% recovery rate issued by Company A. The bond is currently trading at 80% of face value. Assuming the excess spread only captures credit risk and that the risk-free rate is 5% per annum, the risk-neutral 1-year probability of default on Company A is closest to which of the following?
- a. 2%
- b. 14%
- c. 16%
- d. 20%
9. Portland General Electric (PGE) was an Enron subsidiary that was able to survive after the Enron implosion. At that time, there was a trend towards electric utility downgrades, particularly for those utilities operating within larger corporate structures. PGE survived in part due to ring-fencing. Which of the following statements about ring fencing is correct?
- a. A ring-fencing assets approach is typically only useful when a low quality firm wants to finance a high-quality project.
- b. When ring-fencing assets, options for credit enhancement include overcollateralization and financial guarantees provided by the parent against default of the subsidiary.
- c. A subsidiary holding the ring-fenced assets may be able to gain a higher credit rating than the parent, allowing it to issue bonds on the assets at a lower cost.
- d. Because the parent does not retain an equity interest in the subsidiary holding the ring-fenced assets, the subsidiary is not consolidated on the parent's balance sheet.

10. Bank A, a large international bank, engages in trading with counterparties throughout the world. Recently, it has started to pay more attention to wrong-way risk in its trading book. Which one of the following four scenarios would serve as an example of wrong-way risk from Bank A's perspective?
- Bank A has a large exposure to Bank B's equity, and Bank B offers to sell put options with long maturities on its own equity to Bank A.
  - Bank A enters into a medium-term repurchase agreement with Bank B using several different types of debt issued by bank B as collateral.
  - Bank A actively manages its credit portfolio using credit default swaps, and decides to sell long-term credit protection to Bank B.
  - Bank A enters into a forward rate agreement with Bank B to deliver at LIBOR+2.5%.
11. The Chief Risk Officer of your bank has put you in charge of operational risk management. As a first step, you collect internal data to estimate the frequency and severity of operational-risk-related losses. The table below summarizes your findings:

Frequency Distribution		Severity Distribution	
Number of Occurrences	Probability	Loss (USD)	Probability
0	0.6	1,000	0.5
1	0.3	100,000	0.4
2	0.1	1,000,000	0.1

Based on this information, what is your estimate of the expected loss due to operational risk?

- USD 20,000
  - USD 70,250
  - USD 130,600
  - USD 140,500
12. In its efforts to enhance its enterprise risk management function, Countryside Bank introduced a new decision-making process based on economic capital that involves assessing sources of risk across different business units and organizational levels. Which of the following statements regarding the correlations between these risks is correct?
- Correlations between the risks in the asset and liability sides of the balance sheet can be changed by management decisions.
  - Generally, correlations between broad risk types such as credit, market, and operational risk are well understood and are easy to estimate at the individual firm level.
  - Correlations between business units are only relevant in deciding total firm-wide economic capital levels and are not relevant for decisions at the individual business unit or project level.
  - The introduction of correlations into firm-wide risk evaluation will result in a total VaR that, in general, is greater than or equal to the sum of individual business unit VaRs.



13. In recent years, large dealer banks financed significant fractions of their assets using short-term, often overnight, repurchase (repo) agreements in which creditors held bank securities as collateral against default losses. The table below shows the quarter-end financing of four broker-dealer banks. All values are in USD billions:

	Bank A	Bank B	Bank C	Bank D
<b>Financial instruments owned</b>	823	629	723	382
<b>Pledged as collateral</b>	272	289	380	155

In the event that repo creditors become nervous about a bank's solvency, which bank is least vulnerable to a liquidity crisis?

- Bank A
  - Bank B
  - Bank C
  - Bank D
14. Galileo Vehicles (GV) and Leonardo Motors (LM) are both leading car manufacturers in hybrid car designs. Earlier this year, both companies introduced new hybrid models that are comparable to each other in almost every category. However, after both companies release pricing for their new models, LM's model is 20% less expensive than GV's. As a result, GV's stock price declined sharply while LM's stock price rose dramatically. Subsequently LM and GV announce that they have entered into merger discussions where the terms of the planned merger would give GV shareholders 1 share of LM per 3 shares of GV previously held. Post the announcement, GV's stock is trading at USD 20 and LM's stock is trading at USD 58. If you are confident that the merger will be completed, assuming zero transaction costs, which of the following investments should you make?
- Buy 300 shares of GV and short 100 shares of LM.
  - Short 300 shares of GV and buy 100 shares of LM.
  - Buy 300 shares of GV and buy 100 shares of LM.
  - Short 300 shares of GV and short 100 shares of LM.
15. At the end of 2007, Chad & Co.'s pension had USD 350 million worth of assets that were fully invested in equities and USD 180 million in fixed-income liabilities with a modified duration of 14. In 2008, the widespread effects of the subprime crisis hit the pension fund, causing its investment in equities to lose 50% of their market value. In addition, the immediate response from the government – cutting interest rates – to salvage the situation, caused bond yields to decline by 2%. What was the change in the pension fund's surplus in 2008?
- USD -55.4 million
  - USD -124.6 million
  - USD -225.4 million
  - USD -230.4 million

16. As investors found out that highly-rated securities backed by subprime mortgages were not risk-free, the subprime crisis affected other asset classes. Which of the following mechanisms played an important role in the transmission of the crisis from the subprime sector to other asset classes?
- a. Impact of cross-default clauses linking industrial bonds and commercial mortgages held by banks
  - b. Increase in repo haircuts causing banks to sell off assets to meet collateral calls
  - c. Tightening of discount window lending standards by the U.S. Federal Reserve
  - d. Exercise of credit default swap contracts tied to subprime mortgage pools held in off-balance sheet vehicles
17. In the years leading up to the collapse of the Icelandic banking system, how did the relationship between the Central Bank of Iceland (CBI) and the Icelandic banks change?
- a. The CBI supplemented credit ratings from the major rating agencies with market-implied ratings when determining the liquidity to provide to the banks.
  - b. The CBI began to issue loans to the banks that were denominated in Euros.
  - c. The CBI began to issue more loans to the banks that were collateralized by the bonds of other Icelandic banks.
  - d. The CBI began to issue loans to the banks that were denominated in U.S. dollars.
18. A portfolio has USD 2 million invested in Stock A and USD 1 million invested in Stock B. The 95% 1-day VaR for each individual position is USD 40,000. The correlation between the returns of Stock A and Stock B is 0.5. While rebalancing, the portfolio manager decides to sell USD 1 million of Stock A to buy USD 1 million of Stock B. Assuming that returns are normally distributed and that the rebalancing does not affect the volatility of the individual stocks, what effect will this have on the 95% 1-day portfolio VaR?
- a. There will be no effect.
  - b. It will increase by USD 20,370.
  - c. It will increase by USD 21,370.
  - d. It will increase by USD 22,370.



19. In calculating its risk-adjusted return on capital, your bank uses a capital charge of 2.50% for revolving credit facilities with a loan equivalent factor of 0.35 assigned to the undrawn portion. Recently, you have become concerned that the protective covenants embedded in these loans are weak and may not prevent customers from drawing on the facilities during times of stress. As such, you have recommended doubling the loan equivalent factor to 0.70. This recommendation has met with resistance from the loan origination team, and senior management has asked you to quantify the impact of your recommendation. For a typical facility that has an original principal of USD 1 billion and is 30% drawn, how much additional economic capital would have to be allocated if you increase the loan equivalent factor from 0.35 to 0.70?
- a. USD 3.50 million
  - b. USD 6.13 million
  - c. USD 8.75 million
  - d. USD 13.63 million
20. Which of the following statements regarding frictions in the securitization of subprime mortgages is correct?
- a. The arranger will typically have an information advantage over the originator with regard to the quality of the loans securitized.
  - b. The originator will typically have an information advantage over the arranger, which can create an incentive for the originator to collaborate with the borrower in filing false loan applications.
  - c. The major credit rating agencies are paid by investors for their rating service of mortgage-backed securities, and this creates a potential conflict of interest.
  - d. The use of escrow accounts for insurance and tax payments eliminates the risk of foreclosure.



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**PART II**

Answers



	a.	b.	c.	d.		a.	b.	c.	d.
1.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	14.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	15.	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
3.	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	16.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
4.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	17.	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
5.	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	18.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
6.	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	19.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
7.	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	20.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
8.	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>					
9.	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>					
10.	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<b>Correct way to complete</b>				
11.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	1.	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
12.	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<b>Wrong way to complete</b>				
13.	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	1.	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>



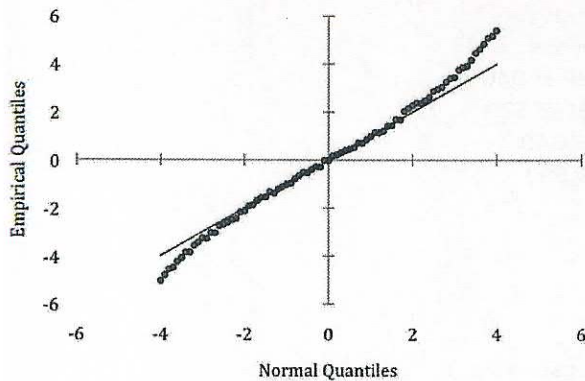
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**PART II**

Explanations



1. You are examining a sample of return data. As a first step, you construct a QQ plot of the data as shown below:



Based on an examination of the QQ plot, which of the following statements is correct?

- a. The returns are normally distributed.
- b. The return distribution has thin tails relative to the normal distribution.
- c. The return distribution is negatively skewed relative to the normal distribution.
- d. The return distribution has fat tails relative to the normal distribution.

Correct answer: d

**Explanation:** This Q-Q plot has steeper slopes at the tails of the plot, which indicate fat tails in the distribution.

A normal distribution would result in a linear QQ plot. A distribution with thin tails would produce a QQ plot with less steep slopes at the tails of the plot than a linear relationship, while this one is steeper at the tails. It is not a negatively skewed distribution, as the Q-Q plot is symmetric.

**Reference:** Kevin Dowd, *Measuring Market Risk, 2nd Edition*, Chapter 3, pp. 75, 77.

**AIM:** Describe the use of QQ plots for identifying the distribution of data.

**Section:** Market Risk Management and Measurement

2. The annual mean and volatility of a portfolio are 10% and 40%, respectively. The current value of the portfolio is GBP 1,000,000. How does the 1-year 95% VaR that is calculated using a normal distribution assumption (normal VaR) compare with the 1-year 95% VaR that is calculated using the lognormal distribution assumption (lognormal VaR)?
- a. Lognormal VaR is greater than normal VaR by GBP 13,040
  - b. Lognormal VaR is greater than normal VaR by GBP 17,590
  - c. Lognormal VaR is less than normal VaR by GBP 13,040
  - d. Lognormal VaR is less than normal VaR by GBP 17,590

Correct answer: c

Explanation: Normal VaR is calculated as follows:

$$\text{Normal VaR} = 0.1 - (1.645 * 0.4) = 0.558 \text{ (dropping negative sign)}$$

and lognormal VaR is calculated as follows:

$$\text{Lognormal VaR} = 1 - \exp [0.1 - (1.645 * 0.4)] = 0.4276$$

Hence, Lognormal VaR is smaller than Normal VaR by: 13.04% per year. With a portfolio of GBP 1,000,000 this translates to GBP 13,040.

Reference: Kevin Dowd, *Measuring Market Risk*, 2nd Edition, Chapter 3.

AIMS: Calculate VaR using a parametric estimation approach assuming that the return distribution is either normal or lognormal.

Section: Market Risk Management and Measurement



3. 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?
- USD 167.92
  - USD 174.60
  - USD 584.59
  - USD 591.27

Correct answer: a

**Explanation:** The principal payment for the 61st month is equal to the total monthly payment for the 61st month minus the total interest only payment for that month. First calculate the total monthly payment as shown below:

Total Monthly Payment = Mortgage payment factor \* Principal balance

Mortgage payment factor:  $r(1+r)^n / (1+r)^n - 1$

where

r = the interest rate, and

n = the number of payments over the loan term.

Note that the interest rate corresponds to the frequency of the payment, so when using a monthly payment as in this example, the annual percentage rate (APR) must be divided by 12.

In this case, given that the monthly interest rate equals 0.0041667 (0.05 / 12) and 300 monthly payments will be made in the 25 remaining years of the loan, the mortgage payment factor is:

$$[0.0041667 * (1.0041667)^{300}] / (1.0041667^{300} - 1) = .0058459.$$

So the total monthly payment equals .0058459 \* 100,000 or USD 584.59.

Next, compute the monthly interest payment, which is equal to 100,000 \* (0.05 / 12) or USD 416.67.

Hence, the correct answer is 584.59 - 416.67 or 167.92, which reflects the principal portion of the 61st month's payment.

**Reference:** Frank Fabozzi, Anand Bhattacharya, and William Berliner, *Mortgage Backed Securities, 2nd Edition* (Hoboken: John Wiley & Sons, 2006), Chapter 1, p. 13.

**AIMS:** Calculate the mortgage payment factor. Understand the allocation of loan principal and interest over time for various loan types.

**Section:** Market Risk Management and Measurement

4. Let  $X$  be a random variable representing the daily loss of your portfolio. The “peaks over threshold” (POT) approach considers a threshold value,  $u$ , of  $X$  and the distribution of excess losses over this threshold. Which of the following statements about this application of extreme value theory is correct?
- a. To apply the POT approach, the distribution of  $X$  must be elliptical and known.
  - b. If  $X$  is normally distributed, the distribution of excess losses requires the estimation of only one parameter,  $\beta$ , which is a positive scale parameter.
  - c. To apply the POT approach, one must choose a threshold,  $u$ , which is high enough that the number of observations in excess of  $u$  is zero.
  - d. As the threshold,  $u$ , increases, the distribution of excess losses over  $u$  converges to a generalized Pareto distribution.

Correct answer: d

**Explanation:** The distribution of excess losses over  $u$  converges to a generalized Pareto distribution as the threshold value  $u$  increases.

The distribution of  $X$  itself can be any of the commonly used distributions: normal, lognormal,  $t$ , etc., and will usually be unknown. The distribution of excess losses requires the estimation of two parameters, a positive scale parameter  $\beta$  and a shape or tail index parameter  $\xi$ . One must choose a threshold  $u$  that is high enough so that the theory applies but also low enough so that there are observations in excess of  $u$ .

**Reference:** Kevin Dowd, *Measuring Market Risk, 2nd Edition* (Wiley, 2005), Chapter 7 – Parametric Approaches (II): Extreme Value, pp. 201-202.

**AIM:** Describe the peaks over threshold (POT) approach.

**Section:** Market Risk Management and Measurement



5. A risk analyst is comparing the use of parametric and non-parametric approaches for calculating VaR and is concerned about some of the characteristics present in the loss data. Which of the following distribution characteristics would make parametric approaches the favored method to use?
- a. Skewness in the distribution
  - b. Fat tails in the distribution
  - c. Scarcity of high magnitude loss events
  - d. Heteroskedasticity in the distribution

Correct answer: c

**Explanation:** Non-parametric approaches can accommodate fat tails, skewness, and any other non-normal features that can cause problems for parametric approaches. However, if the data period that is used in estimation includes few losses or losses with low magnitude, non-parametric methods will often produce risk measures that are too low. Hence parametric methods would be more appropriate in those situations.

**Reference:** Kevin Dowd, *Measuring Market Risk, 2nd Edition* (West Sussex, England: John Wiley & Sons, 2005), Chapter 4.

**AIM:** Describe the advantages and disadvantages of non-parametric estimation methods.

**Section:** Market Risk Management and Measurement

6. Lin Ping is valuing a 1-year credit default swap (CDS) contract which will pay the buyer 75% of the face value of a bond issued by Xiao Corp. immediately after a default by Xiao. To purchase this CDS, the buyer will pay the CDS spread, which is a percentage of the face value, once at the end of the year. Lin estimates that the risk-neutral default probability for Xiao is 5% per year. The risk-free rate is 3% per year. Assuming defaults can only occur halfway through the year and that the accrued premium is paid immediately after a default, what is the estimate for the CDS spread?
- 380 basis points
  - 385 basis points
  - 390 basis points
  - 400 basis points

Correct answer: c

**Explanation:** The key to CDS valuation is to equate the present value (PV) of payments to the PV of expected payoff in the event of default. Let  $s$  denote the CDS spread.

$\pi$  = probability of default during year 1 = 5%

$C$  = contingent payment in case of default = 75%

$d_t$  = discount factor =  $e^{-0.03 \times 1}$  for 1-year and  $e^{-0.03 \times 0.5}$  for half a year = 0.97044 and 0.98511

$s$  = CDS spread (to be solved)

The premium leg, which includes the spread payment and accrual, is:

$$s(0.5d_{0.5} \pi + d_1(1-\pi)) = s(0.02463 + 0.92192) = s \cdot 0.94655$$

The payoff leg is:

$$C * (d_{0.5}) * \pi = 0.03694$$

Solving for the spread:  $s \cdot 0.94655 = 0.03694 \rightarrow s = 0.03902$  or a spread of 390 basis points.

**Reference:** Allan Malz, *Financial Risk Management: Models, History, and Institutions* (Hoboken, NJ: John Wiley & Sons, 2011), chapter 7, pp. 250-253.

**AIM:** Define the different ways of representing spreads. Compare and differentiate between the different spread conventions and compute one spread given others when possible.

**Section:** Credit Risk Measurement and Management



7. You are the risk manager at Vision, a small fixed-income hedge fund that specializes in bank debt. Vision's strategy utilizes both relative value and long-only trades using credit default swaps (CDS) and bonds. One of the new traders has the positions described in the table below.

Bank	Position	Credit Rating
SEJ	Long USD 10 million CDS	A
Stanos	Long USD 5 million bond	BB+
CEB	Short USD 10 million CDS	A

Some of Vision's newest clients are restricted from withdrawing their funds for three years. You are currently evaluating the impact of various default scenarios to estimate future asset liquidity. You have estimated that the marginal probability of default of the Stanos bond is 5% in Year 1, 10% in Year 2, and 15% in Year 3. What is the probability that the bond makes coupon payments for 3 years and then defaults at the end of Year 3?

- a. 13%
- b. 15%
- c. 27%
- d. 73%

Correct answer: a

**Explanation:** The probability that the bond defaults in year 3 can be modeled as a Bernoulli trial given by the following equation where MP stands for marginal probability:

$$P(\text{Default at end of year 3}) = (1 - MP_{\text{year 1 default}}) * (1 - MP_{\text{year 2 default}}) * MP_{\text{year 3 default}}$$

$$= (1 - 0.05) * (1 - 0.10) * 0.15 = 0.1283 \text{ or } 12.83\%$$

**References:** Allan Malz, *Financial Risk Management: Models, History, and Institutions* (Hoboken, NJ: John Wiley & Sons, 2011), chapter 7, p. 236.

John Hull, *Options, Futures and Other Derivatives, 8th Edition* (New York: Pearson Prentice Hall, 2012), chapter 23.

**AIM:** Explain how default risk for a single company can be modeled as a Bernoulli trial.

**Section:** Credit Risk Measurement and Management

8. Consider a 1-year maturity zero-coupon bond with a face value of USD 1,000,000 and a 0% recovery rate issued by Company A. The bond is currently trading at 80% of face value. Assuming the excess spread **only** captures credit risk and that the risk-free rate is 5% per annum, the risk-neutral 1-year probability of default on Company A is closest to which of the following?
- 2%
  - 14%
  - 16%
  - 20%

Correct answer: c

**Explanation:** This can be calculated by using the formula which equates the future value of a risky bond with yield ( $y$ ) and default probability ( $\pi$ ) to a risk free asset with yield ( $r$ ):

$$1 + r = (1 - \pi) * (1 + y) + \pi R$$

$\pi$  = Probability of default;  $R$  = Recovery rate

In the situation where the recovery rate is assumed to be zero, the risk-neutral probability of default can be derived from the following equation:

$$1 + r = (1 - \pi) * (1 + y) - (1 - \pi) * (FV/MV)$$

where  $MV$  = market value and  $FV$  = face value.

Inputting the data into this equation yields  $\pi = 1 - (800,000 * 1.05) / 1,000,000 = 0.16$ .

**Reference:** Allan Malz, *Financial Risk Management: Models, History, and Institutions* (Hoboken, NJ: John Wiley & Sons, 2011), chapter 6, p. 203.

**AIM:** Explain the relationship between the yield spread and the probability of default and calculate default probability of a debt security using the credit spread.

**Section:** Credit Risk Management and Measurement



9. Portland General Electric (PGE) was an Enron subsidiary that was able to survive after the Enron implosion. At that time, there was a trend towards electric utility downgrades, particularly for those utilities operating within larger corporate structures. PGE survived in part due to ring-fencing. Which of the following statements about ring fencing is correct?
- A ring-fencing assets approach is typically only useful when a low quality firm wants to finance a high-quality project.
  - When ring-fencing assets, options for credit enhancement include overcollateralization and financial guarantees provided by the parent against default of the subsidiary.
  - A subsidiary holding the ring-fenced assets may be able to gain a higher credit rating than the parent, allowing it to issue bonds on the assets at a lower cost.
  - Because the parent does not retain an equity interest in the subsidiary holding the ring-fenced assets, the subsidiary is not consolidated on the parent's balance sheet.

Correct answer: c

**Explanation:** Ring fencing is often undertaken to provide a higher credit rating to a subsidiary than is available to the parent. Derivative product companies or unregulated subsidiaries of investment banks are examples of this structure. There are other reasons for ring fencing assets, including freeing the assets from restrictions, taxes or other laws specific to a particular country.

Ring-fencing can be useful in two main situations: either when a low-quality firm cannot finance a high-quality project, or when a high-quality firm does not want to run the risk of being the sole financier of a low-quality project. The parent cannot guarantee the ring fenced assets, as this would allow creditors of the subsidiary to seek relief through the parent in the event of default of the subsidiary. The purpose of ring fencing assets is to create a structure that is bankruptcy remote from the parent. The retention of equity is a common feature of ring fencing. A subsidiary may remain consolidated on the parent company's balance sheet in cases where the parent retains a substantial equity interest.

**Reference:** Christopher Culp, *The Structuring Process, Structured Finance and Insurance: The Art of Managing Capital and Risk* (Hoboken, NJ: John Wiley & Sons, 2006), Chapter 13 pp. 274-279.

**AIM:** Describe the process and benefits of ring-fencing assets.

**Section:** Credit Risk Measurement and Management

10. Bank A, a large international bank, engages in trading with counterparties throughout the world. Recently, it has started to pay more attention to wrong-way risk in its trading book. Which one of the following four scenarios would serve as an example of wrong-way risk from Bank A's perspective?
- a. Bank A has a large exposure to Bank B's equity, and Bank B offers to sell put options with long maturities on its own equity to Bank A.
  - b. Bank A enters into a medium-term repurchase agreement with Bank B using several different types of debt issued by bank B as collateral.
  - c. Bank A actively manages its credit portfolio using credit default swaps, and decides to sell long-term credit protection to Bank B.
  - d. Bank A enters into a forward rate agreement with Bank B to deliver at LIBOR+2.5%.

Correct answer: a

**Explanation:** According to Section 101 of Basel III, "a bank is exposed to "specific wrong-way risk" if future exposure to a specific counterparty is highly correlated with the counterparty's probability of default. For example, a company writing put options on its own stock creates wrong-way exposures for the buyer that is specific to the counterparty."

**Reference:** Basel Committee on Banking Supervision (February 16, 2012), *Basel III: A Global Regulatory Framework for More Resilient Banks and Banking Systems* (December 2010, revised June 2011) Note: [www.bis.org/publ/bcbs189.pdf](http://www.bis.org/publ/bcbs189.pdf).

**AIM:** Describe changes to the regulatory capital framework, including changes to: Risk coverage, the use of stress tests, the treatment of counter-party risk with credit valuations adjustments, the use of external ratings, and the use of leverage ratios.

**Section:** Operational and Integrated Risk Management



11. The Chief Risk Officer of your bank has put you in charge of operational risk management. As a first step, you collect internal data to estimate the frequency and severity of operational-risk-related losses. The table below summarizes your findings:

Frequency Distribution		Severity Distribution	
Number of Occurrences	Probability	Loss (USD)	Probability
0	0.6	1,000	0.5
1	0.3	100,000	0.4
2	0.1	1,000,000	0.1

Based on this information, what is your estimate of the expected loss due to operational risk?

- a. USD 20,000
- b. USD 70,250
- c. USD 130,600
- d. USD 140,500

Correct answer: b

**Explanation:** The expected loss can be calculated by multiplying the expected frequency and the expected severity.

Expected frequency is equal to:

$$(0 * 0.6) + (1 * 0.3) + (2 * 0.1) = 0.5,$$

Expected severity is equal to:

$$(1000 * 0.5) + (100,000 * 0.4) + (1,000,000 * 0.1) = 140,500$$

The expected loss is therefore:

$$0.5 * 140,500 = 70,250$$

**Reference:** Mo Chaudhury, "A Review of the Key Issues in Operational Risk Capital Modeling", *The Journal of Operational Risk*, Volume 5/Number 3, Fall 2010: pp. 37-66.

**AIM:** Describe how a loss distribution is obtained from frequency and severity distributions.

**Section:** Operational and Integrated Risk Management

12. In its efforts to enhance its enterprise risk management function, Countryside Bank introduced a new decision-making process based on economic capital that involves assessing sources of risk across different business units and organizational levels. Which of the following statements regarding the correlations between these risks is correct?
- a. Correlations between the risks in the asset and liability sides of the balance sheet can be changed by management decisions.
  - b. Generally, correlations between broad risk types such as credit, market, and operational risk are well understood and are easy to estimate at the individual firm level.
  - c. Correlations between business units are only relevant in deciding total firm-wide economic capital levels and are not relevant for decisions at the individual business unit or project level.
  - d. The introduction of correlations into firm-wide risk evaluation will result in a total VaR that, in general, is greater than or equal to the sum of individual business unit VaRs.

Correct answer: a

**Explanation:** Management has the ability to influence the correlations between these risks by changing the asset/liability mix, so management decision-making is indeed quite relevant.

**Reference:** Brian Nocco and René Stulz, "Enterprise Risk Management: Theory and Practice," *Journal of Applied Corporate Finance* 18, No. 4 (2006): pp. 8-20.

**AIM:** Describe the role of and issues with correlation in risk aggregation.

**Section:** Operational and Integrated Risk Management



13. In recent years, large dealer banks financed significant fractions of their assets using short-term, often overnight, repurchase (repo) agreements in which creditors held bank securities as collateral against default losses. The table below shows the quarter-end financing of four broker-dealer banks. All values are in USD billions:

	Bank A	Bank B	Bank C	Bank D
Financial instruments owned	823	629	723	382
Pledged as collateral	272	289	380	155

In the event that repo creditors become nervous about a bank's solvency, which bank is least vulnerable to a liquidity crisis?

- a. Bank A
- b. Bank B
- c. Bank C
- d. Bank D

Correct answer: a

**Explanation:** A liquidity crisis could materialize if repo creditors become nervous about a bank's solvency and choose not to renew their positions. If enough creditors choose not to renew, the bank could likely be unable to raise sufficient cash by other means on such short notice, thereby precipitating a crisis. However, this vulnerability is directly related to the proportion of assets a bank has pledged as collateral.

Bank A is least vulnerable since it has the least dependence on short-term repo financing (i.e. the lowest percentage of its assets out of the four banks is pledged as collateral:

$272/823$ , or 33%

**Reference:** Darrell Duffie (2010), "Failure Mechanics of Dealer Banks", *Journal of Economic Perspectives* (24:1), pp. 51-72.

**AIM:** Identify factors that can precipitate or accelerate a liquidity crisis at a dealer bank and what prudent risk management steps can be taken to mitigate these risks.

**Section:** Operational and Integrated Risk Management

14. Galileo Vehicles (GV) and Leonardo Motors (LM) are both leading car manufacturers in hybrid car designs. Earlier this year, both companies introduced new hybrid models that are comparable to each other in almost every category. However, after both companies release pricing for their new models, LM's model is 20% less expensive than GV's. As a result, GV's stock price declined sharply while LM's stock price rose dramatically. Subsequently LM and GV announce that they have entered into merger discussions where the terms of the planned merger would give GV shareholders 1 share of LM per 3 shares of GV previously held. Post the announcement, GV's stock is trading at USD 20 and LM's stock is trading at USD 58. If you are confident that the merger will be completed, assuming zero transaction costs, which of the following investments should you make?
- a. Buy 300 shares of GV and short 100 shares of LM.
  - b. Short 300 shares of GV and buy 100 shares of LM.
  - c. Buy 300 shares of GV and buy 100 shares of LM.
  - d. Short 300 shares of GV and short 100 shares of LM.

Correct answer: b

**Explanation:** If the merger goes through, the companies' prices should correspond on a 3:1 basis, with 1 share of LM corresponding to 3 shares of GV. However, at the given trading prices the ratio does not hold, with one share of LM being equal to USD 58 / USD 20, or 2.9 shares of GV. This shows that LM is undervalued compared to GV given the terms of the merger agreement. If the merger is completed, LM's stock will appreciate and/or GV's stock will depreciate relative to each other until the ratio reaches 3:1.

In order to exploit this potential arbitrage opportunity, you can short 300 shares of the relatively overvalued stock GV, resulting in a cash inflow of USD 6000, while buying 100 shares of the relatively undervalued stock LM for USD 5800, resulting in a net cash inflow of USD 200. If the merger is completed, then the long and the short positions will exactly offset each other given the 3:1 ratio and the trade will be closed. The original cash inflow of USD 200 would be your profit from this arbitrage trade if the merger is completed.

**Reference:** David P. Stowell (2010), *An Introduction to Investment Banks, Hedge Funds, and Private Equity*, Chapter 12.

**AIM:** Describe and interpret a numerical example of the following strategies: merger arbitrage, pairs trading, distressed investing and global macro strategy.

**Section:** Risk Management and Investment Management



15. At the end of 2007, Chad & Co.'s pension had USD 350 million worth of assets that were fully invested in equities and USD 180 million in fixed-income liabilities with a modified duration of 14. In 2008, the widespread effects of the subprime crisis hit the pension fund, causing its investment in equities to lose 50% of their market value. In addition, the immediate response from the government — cutting interest rates — to salvage the situation, caused bond yields to decline by 2%. What was the change in the pension fund's surplus in 2008?
- USD -55.4 million
  - USD -124.6 million
  - USD -225.4 million
  - USD -230.4 million

Correct answer: c

**Explanation:** The change in the pension fund's surplus for the year 2008 is equal to the initial surplus  $S_0$  at the end of 2007 less the ending surplus  $S_1$  at the end of 2008. The initial surplus is calculated as  $S_0 = A_0 - L_0 = 350 - 180 = 170$ , where  $A_0$  = the firm's initial assets and  $L_0$  the firm's initial liabilities.

Next we have to calculate the surplus at the end of 2008. Given the 50% decline in the equity market, the new level of assets  $A_1$  at the end of 2008 is equal to:

$$(1 - 0.5) * 350, \text{ or } 175$$

The new level of liabilities  $L_1$  can be calculated as:

$$L_1 = (1 - (MD * \Delta y)) * L_0$$

where MD is the modified duration, and

$\Delta y$  is the change in yield.

Liabilities at end of 2008 are equal to:

$$L_1 = (1 - (14 * -0.02)) * 180 = 230.4.$$

Therefore the 2008 surplus  $S_1$  is equal to  $A_1 - L_1 = 175 - 230.4 = -55.4$  (which implies the pension fund is actually in a deficit situation at the end of 2008). The change in surplus for 2008 is hence  $S_1 - S_0 = -55.4 - 170 = -225.4$  million.

**Reference:** Philippe Jorion, *Value-at-Risk: The New Benchmark for Managing Financial Risk, 3rd Edition* (New York: McGraw-Hill, 2007), Chapter 17 — VaR and Risk Budgeting in Investment Management, p. 433.

**AIM:** Describe the investment process of large investors such as pension funds.

**Section:** Risk Management and Investment Management

16. As investors found out that highly-rated securities backed by subprime mortgages were not risk-free, the subprime crisis affected other asset classes. Which of the following mechanisms played an important role in the transmission of the crisis from the subprime sector to other asset classes?
- a. Impact of cross-default clauses linking industrial bonds and commercial mortgages held by banks
  - b. Increase in repo haircuts causing banks to sell off assets to meet collateral calls
  - c. Tightening of discount window lending standards by the U.S. Federal Reserve
  - d. Exercise of credit default swap contracts tied to subprime mortgage pools held in off-balance sheet vehicles

Correct answer: b

**Explanation:** A brief excerpt from the article provides a summary: "Uncertain about the solvency of counterparties, repo depositors became concerned that the collateral bonds might not be liquid; if all firms wanted to hold cash – a flight to quality – then collateral would have to decline in price to find buyers. This is the crucial link between the subprime shock and other asset categories".

This decline in the value of collateral became evident in the rapid increase in the "repo haircut", which is the percentage difference between the market value of the pledged collateral and the amount of funds lent. For example, with a 5% "repo haircut", a bank would only allow a USD 95 deposit against USD 100 face value of collateral. This repo haircut rose dramatically in late 2007 and 2008, from zero at the beginning of August 2007 to almost 10% in early 2008 and reaching over 45% by early 2009. As the value of collateral began to fall, this led to a deterioration in valuations across asset classes which also commenced in August 2007 when the LIBOR-OIS spread jumped. This occurred even though the subprime fundamentals (as measured by the ABX index of credit derivatives) had been deteriorating for months prior to that.

**Reference:** Gary Gorton (05-2009), *Slapped in the Face by the Invisible Hand: Banking and the Panic of 2007*, p. 33.

**AIMS:** Explain the function of and define repos, and discuss their use as the primary mechanism driving shadow banking. Explain how the shock from the subprime mortgage collapse affected asset classes that were unrelated and evolved into the 2007 banking system panic.

**Section:** Current Issues in Financial Markets



17. In the years leading up to the collapse of the Icelandic banking system, how did the relationship between the Central Bank of Iceland (CBI) and the Icelandic banks change?
- a. The CBI supplemented credit ratings from the major rating agencies with market-implied ratings when determining the liquidity to provide to the banks.
  - b. The CBI began to issue loans to the banks that were denominated in Euros.
  - c. The CBI began to issue more loans to the banks that were collateralized by the bonds of other Icelandic banks.
  - d. The CBI began to issue loans to the banks that were denominated in U.S. dollars.

Correct answer: c

**Explanation:** In 2007 and 2008, the amount of Icelandic banks' debt held by other Icelandic banks grew dramatically, from around one percent of GDP in January 2007 to almost 30% of GDP by September 2008. In turn, a large proportion of these bonds was used as collateral at the CBI. One example occurred in 2008 when the Icelandic banks issued debt to the savings bank, Icebank, which then used the debt as collateral at the CBI. Other banks such as Kaupthing and Glitnir also issued covered bonds which were used for collateralized loans at the CBI.

CBI's rules for the credit standards of eligible collateral were broadly similar to the rules of the European System of Central Banks (ESCB), stating that unsecured bonds and bills were required to have a minimum long-term rating of "A-" by S&P or Fitch or "A3" by Moody's, as well as having their securities traded on a regulated market in the EEA. There was no use of market-implied ratings. The CBI only issued loans to the banks that were denominated in krona.

**Reference:** Arthur M. Berd (editor), *Lessons From the Financial Crisis* (London: Risk Books, 2010), Chapter 4: The Collapse of the Icelandic Banking System, pp. 111.

**AIMS:** Describe the severity of the banking crisis, the currency crisis, and the public debt crisis. Understand how banks funded their risky business models before and after the 2006 mini-crisis.

**Section:** Current Issues in Financial Markets

18. A portfolio has USD 2 million invested in Stock A and USD 1 million invested in Stock B. The 95% 1-day VaR for each individual position is USD 40,000. The correlation between the returns of Stock A and Stock B is 0.5. While rebalancing, the portfolio manager decides to sell USD 1 million of Stock A to buy USD 1 million of Stock B. Assuming that returns are normally distributed and that the rebalancing does not affect the volatility of the individual stocks, what effect will this have on the 95% 1-day portfolio VaR?
- There will be no effect.
  - It will increase by USD 20,370.
  - It will increase by USD 21,370.
  - It will increase by USD 22,370.

Correct answer: d

**Explanation:** The first step is to calculate the VaR of the original portfolio. This can be done by using the following equation:

$$VaR_{Port(A,B)} = \sqrt{(VaR_A^2 + VaR_B^2 + (2\rho * VaR_A * VaR_B))}$$

where  $\rho$  is the correlation coefficient.

Portfolio VaR (before):

$$\sqrt{40000^2 + 40000^2 + (2 * 0.5 * 40000 * 40000)} = \text{USD } 69,282.$$

After the rebalance, the market value of the position in Stock A is halved, so VaR(A) is now equal to \$20,000. Meanwhile the market value for the position in B has doubled so that VaR(B) is now \$80,000. Hence we can now calculate the VaR of the new portfolio as follows:

$$\text{Portfolio VaR (after)} = \sqrt{20000^2 + 80000^2 + (2 * 0.5 * 20000 * 80000)} = \text{USD } 91,652.$$

So the VaR will increase by (91,652 - 69,282), or USD 22,370.

**Reference:** Philippe Jorion, *Value-at-Risk: The New Benchmark for Managing Financial Risk*, 3rd Edition, Chapter 7: Portfolio Risk – Analytical Methods, pp. 161-164.

**AIM:** Compute diversified VaR, individual VaR, and undiversified VaR of a portfolio.

**Section:** Risk Management and Investment Management



19. In calculating its risk-adjusted return on capital, your bank uses a capital charge of 2.50% for revolving credit facilities with a loan equivalent factor of 0.35 assigned to the undrawn portion. Recently, you have become concerned that the protective covenants embedded in these loans are weak and may not prevent customers from drawing on the facilities during times of stress. As such, you have recommended doubling the loan equivalent factor to 0.70. This recommendation has met with resistance from the loan origination team, and senior management has asked you to quantify the impact of your recommendation. For a typical facility that has an original principal of USD 1 billion and is 30% drawn, how much additional economic capital would have to be allocated if you increase the loan equivalent factor from 0.35 to 0.70?
- USD 3.50 million
  - USD 6.13 million
  - USD 8.75 million
  - USD 13.63 million

Correct answer: b

**Explanation:** The required economic capital to support a loan in the RAROC model can be calculated using the following formula:

$$\text{Required Capital} = [B_{\text{DRAWN}} + (B_{\text{UNDRAWN}} * LEF)] * CF$$

where LEF represents the loan equivalent factor and CF represents the capital factor.

Therefore the initial required economic capital is calculated as follows:

$$[(1 \text{ billion} * 0.3) + (1 \text{ billion} * 0.7 * 0.35)] * 2.5\% = \text{USD } 13.625 \text{ million,}$$

and the required capital if the change is implemented would be:

$$[(1 \text{ billion} * 0.3) + (1 \text{ billion} * 0.7 * 0.70)] * 2.5\% = \text{USD } 19.75 \text{ million.}$$

Hence the additional required economic capital would be 19.75 - 13.625 or 6.13 million.

**Reference:** Michel Crouhy, Dan Galai and Robert Mark, *Risk Management* (New York: McGraw-Hill, 2001), Chapter 14, p. 550.

**AIM:** Compute and interpret the RAROC for a loan or loan portfolio, and use RAROC to compare business unit performance.

**Section:** Operational and Integrated Risk Management

20. Which of the following statements regarding frictions in the securitization of subprime mortgages is correct?
- a. The arranger will typically have an information advantage over the originator with regard to the quality of the loans securitized.
  - b. The originator will typically have an information advantage over the arranger, which can create an incentive for the originator to collaborate with the borrower in filing false loan applications.
  - c. The major credit rating agencies are paid by investors for their rating service of mortgage-backed securities, and this creates a potential conflict of interest.
  - d. The use of escrow accounts for insurance and tax payments eliminates the risk of foreclosure.

Correct answer: b

**Explanation:** One of the key frictions in the process of securitization involves an information problem between the originator and arranger. In particular, the originator has an information advantage over the arranger with regard to the quality of the borrower. Without adequate safeguards in place, an originator can have the incentive to collaborate with a borrower in order to make significant misrepresentations on the loan application. Depending on the situation, this could be either construed as predatory lending (where the lender convinces the borrower to borrow too large of a sum given the borrower's financial situation) or predatory borrowing (the borrower convinces the lender to lend too large a sum).

The major rating agencies are not paid by the investors. Escrow accounts can forestall but not eliminate the risk of foreclosure.

**Reference:** Adam Ashcroft and Til Schuermann, "Understanding the Securitization of Subprime Mortgage Credit", FRB of NY Staff reports, No. 318 (March 2008), page i.

**AIM:** Identify and describe key frictions in subprime mortgage securitization, and assess the relative contribution of each factor to the subprime mortgage problems.

**Section:** Credit Risk Measurement and Management



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