

**Set 1 Questions**

1. Which of the following statements is *least accurate* regarding VaR?
  - A. VaR gives the probability of the minimum amount that one can lose over a certain period.
  - B. VaR can be expressed either in currency units or as a rate of return.
  - C. A 5% VaR of €2.0 million for one month is a loss of at least €2.0 million that would be expected to occur over one month 5% of the time.
2. Which of the following statements is *most likely* correct?
  - A. A 5% VaR is a move of 2.33 standard deviations less than the expected value.
  - B. One standard deviation downward movement is equal to 16% VaR.
  - C. A higher confidence level will produce a lower VaR.
3. Which of the following statements is *least likely* correct?
  - A. The parametric method of VaR estimation usually assumes a normal distribution.
  - B. A daily expected return of 0.0448% and daily standard deviation of 1.066% results in the 5% VaR for a \$100 million portfolio of approximately \$1.7 million.
  - C. The historical simulation method of VaR estimation like the parametric method gives equal weights to all observations in a sample.
4. Which of the following statements regarding the VaR estimation methods is *most likely* correct?
  - A. A primary advantage of using the parametric method that it can accurately estimate VaR of a portfolio containing options.
  - B. One of the disadvantages of the Monte Carlo simulation method is its inability to process complex distributions.
  - C. Compared to parametric method, Monte Carlo and historical simulation methods more accurately measure VaR of portfolios containing options and bonds with embedded options.
5. A 5% historical simulation VaR of \$850,000 is the:
  - A. fifth percentile – a point on the distribution beyond which 5% of the outcomes result in greatest gains.
  - B. fifth percentile – a point on the resulting distribution past which 5% of the outcomes end in larger losses.
  - C. value that is 2.33 standard deviations below the expected value.
6. Assume a daily expected return of 0.0448% and daily standard deviation of 1.066%, In dollars, which of the following values is *closest* to the annual 5% parametric VaR for a \$100 million portfolio?
  - A. \$16.6 million.
  - B. \$20.2 million.
  - C. \$1.7 million.
7. Which of the following is *least likely* an advantage of using VaR as a risk measure?

- A. VaR is a relatively simple concept, hence decision makers are not required to have a technical background to understand its implications.
  - B. VaR is useful in comparing risk within a particular asset class.
  - C. VaR can be used in capital allocation decisions of trading units or portfolios by providing management with a benchmark.
8. Which of the following is a limitation of VaR?
- A. Financial firms do not use VaR as it is not widely accepted by regulators.
  - B. The use of normal distribution in VaR estimation methods most often underestimates the likelihood of extreme events.
  - C. VaR is unlikely to be affected by a trending or volatile regime.
9. Which of the following statements is *least likely* correct regarding conditional VaR (CVaR)?
- A. CVaR is also known as expected tail loss.
  - B. CVaR gives the average of the losses beyond the VaR cutoff.
  - C. CVaR is best obtained from the parametric method.
10. Suppose the current portfolio allocations of 60% in a stock index fund and 40% in a long-term bond ETF are changed by increasing the investments in the stock index fund, the effect on the portfolio VaR due to a change in position is measured by:
- A. incremental VaR.
  - B. conditional VaR.
  - C. relative VaR.
11. The measure which gives the responsiveness of a portfolio to a change in one underlying risk factor is *best* known as:
- A. VaR.
  - B. hypothetical scenario analysis.
  - C. sensitivity analysis.
12. Scenario risk measures differ from sensitivity risk measures because they apply:
- A. a single factor movement to the factor exposures of the portfolio.
  - B. multiple factor movements of significant sizes to portfolio factor exposures.
  - C. parameters and probabilities to a given situation.
13. Which of the following statements regarding sensitivity risk measures is *least* accurate?
- A. Beta is used to measure equity exposure.
  - B. Gamma of an option is similar to duration, as it examines the effect on option value due to small changes in the underlying value.
  - C. For larger yield changes convexity is added to duration to assess the change in bond prices.
14. Reverse stress testing is helpful because it focuses on:
- A. a portfolio's most important exposures and examines their effect under various market movements.

- B. every possible expected move of every market variable to assess their effect on the portfolio value.
  - C. portfolio's potential losses by examining the effect on a single exposure under stress in a market crisis.
15. Historical scenarios *least likely* measure portfolio returns by:
- A. assuming that the total price action movement occurs periodically by incorporating rebalancing across periods.
  - B. repricing the modeled fixed-income, equity or derivative holdings according to the conditions that existed during the scenario period.
  - C. recording the change in value of each portfolio position under a particular scenario.
16. Delta measure can be used to:
- A. understand the effect on option value due to change in volatility of the underlying.
  - B. estimate the price of an option as the underlying changes in value.
  - C. Indirectly reflect the change in the value of the underlying.
17. Relative to VaR, sensitivity risk measures *typically* account for:
- A. the probability of losses.
  - B. the broader risk picture by giving probability of change in the underlying risk factor.
  - C. the change in asset value due to a change in the underlying risk factor.
18. Which of the following is *least likely* an advantage of scenario risk measures? Scenarios
- A. do not rely on the assumption of a normal distribution to understand the effects of shocks on portfolio value.
  - B. may be built to assess the effects on concentrated positions due to adverse market movements.
  - C. based on historical observations specify assets future returns because of timely identification of movements in risk factors.
19. Which of the following is correct about sensitivities?
- A. Option delta is a measure of an option's sensitivity to changes in the price of the underlying.
  - B. Sensitivities can appropriately address volatilities of assets which is useful in understanding different asset exposures.
  - C. Duration is useful as it gives the change in the fixed-income portfolio value by applying historical interest rates.
20. Which of the following factors *least likely* affect the types of risk measures used by market participants?
- A. The degree of leverage of the market participant.
  - B. The maximum past returns achieved by the business.
  - C. Accounting or regulatory requirements.
21. Which of the following is *least likely* a risk measure used by banks?
- A. VaR.

- B. Activity ratios.
  - C. Duration measures and stress tests.
22. Which of the following risk measures is *least likely* used by a defined benefit pension plan?
- A. Interest rate and curve risk.
  - B. Surplus at risk.
  - C. Drawdown.
23. Which of the following is *most likely* correct regarding constraints used in risk budgeting?
- A. Banks more often apply limits on total economic capital or VaR.
  - B. Pension fund sponsors manage their surplus at risk by assigning each of their asset managers a VaR budget.
  - C. Portfolio managers may be allocated an ex post tracking error budget.
24. Which of the following is true regarding position limits? Position limits help mitigate risk by imposing limits on:
- A. gross size of long/short positions.
  - B. investments expected to not exceed a certain threshold in a certain strategy.
  - C. both gross size of long/short positions and investments expected to not exceed a certain threshold in a certain strategy.
25. Which of the following is *least likely* true? Economic capital is often used to:
- A. measure the amount of shareholders' equity needed to compensate for tail risk losses.
  - B. measure the firm's overall risk appetite.
  - C. estimate shareholders' equity required to meet losses for portfolios with normal distribution.

## Set 1 Solutions

1. A is correct. “Value at risk is the minimum loss that would be expected a certain percentage of the time over a certain period of time given the assumed market conditions.” It is NOT the probability of a minimum amount that one can lose but a minimum loss that would be expected over a certain period at a certain percentage of time. B and C are correct statements regarding VaR. Section 2.1. LO.a.
2. B is correct. A 16% VaR is a move of one standard deviation below the expected value. A is incorrect because a 5% VaR is equal to a move of 1.65 standard deviations below the expected value assuming normal distribution. C is incorrect because a higher confidence level results in a higher VaR. Section 2.1. LO.a.
3. C is correct. Although the historical simulation method has a similar limitation of equally weighing all observations like the parametric method, but it can adjust this problem by allocating more weights to recent observations and less weights to ones that are relatively distant in time. A and B are correct statements. Section 2.2.2. LO.b.
4. C is correct. Parametric method is difficult to use when portfolios consist of options because of the non-normal distribution followed by options. Monte Carlo method can use any distribution and the historical simulation method uses data that actually happened hence these methods are not limited by the assumption of a normal distribution. Hence, A and B are incorrect. Section 2.2.3. LO.b.
5. B is correct. A 5% historical simulation VaR of \$850,000 is the fifth percentile of the distribution – a point beyond which 5% of the observations result in larger losses. Section 2.2.2. LO.c.
6. A is correct. The annual return and standard deviation are:  
 $0.000448 \times 250 = 0.112$ ;  $0.01066 \times \sqrt{250} = 0.1686$ . Annual 5% VaR =  $[0.112 - (1.65 \times 0.1686)](-1)(\$100,000,000) = \$16,619,000$ . Section 2.2.1. LO.c.
7. B is correct. VaR can be used for comparing risk **across** asset classes, trading units and portfolios by indicating which constituents are responsible for the most or least risk to the overall risk. A & C are advantages of VaR. Section 2.3.1. LO.d.
8. B is correct. Because of its reliance on the normal distribution in parametric method and sometimes in Monte Carlo simulation method, VaR underestimates the frequency of extreme events occurring in the left tail of the distribution. A is incorrect as VaR is widely accepted by SEC and bank regulators. C is incorrect as VaR is affected by volatile and trending regimes. Section 2.3.2. LO.d.
9. C is correct. Historical simulation or Monte Carlo methods are used for CVaR calculation since the returns can be observed easily along the distribution. The parametric method has a continuous distribution which require complex mathematics for CVaR calculations. A and B are correct statements regarding CVaR. Section 2.4. LO.e.

10. A is correct. Incremental Var (IVaR) measures the impact on the total VaR of the portfolio if a position size is changed or a new asset is added relative to other positions. Section 2.4. LO.e.
11. C is correct. Sensitivity analysis is a risk measure which measures performance based on changes in the underlying risk factors. A hypothetical scenario measures the portfolio return based on a hypothetical change in markets. Section 3.1. LO.f.
12. B is correct. The two features of scenario risk measures which are distinct from sensitivity risk measures are: multiple factor movements as opposed to single factor movements, and larger size of factor movements. VaR is based on assumptions about probability distributions and hence the parameters of the distribution. Section 3.2. LO.f.
13. B is correct. Gamma is the second-order effect for options analogous to convexity of a fixed-income security. It measures the sensitivity of the option delta to a change in the underlying value. A & C are correct statements. Section 3.1. LO.g.
14. A is correct. Reverse stress testing is helpful as it focuses on material exposures and their reaction to various market movements. It estimates potential losses if a number of significant exposures are impacted by a market crisis. These hypothetical scenarios do not examine every single movement of the market variable but the risk drivers that are important to portfolios to deal with the vulnerabilities. Section 3.2. LO.h.
15. A is correct. Historical scenario or stress test is conducted under the premise that the total price action movement across the period occurs instantaneously, prior to any rebalancing or management action. B and C are correct. Section 3.2.1. LO.h.
16. B is correct. Delta can be used to estimate the new price of an option as the underlying changes. Vega reflects the effect of volatility of the underlying on the option value. Gamma indirectly reflect the change in underlying by measuring the change in delta. Section 3.1.3. LO.h.
17. C is correct. VaR gives a broader view of risk and losses by giving probability of losses. Sensitivity risk measures do **not** account for **probability of losses** but give the change in value as a result of a change in the underlying risk factor. Section 3.3. LO.i.
18. C is correct. Historical scenarios provide information of portfolio performance under past market stress conditions. However, there is no assurance that the past will repeat itself in future, hence other risk measures such as hypothetical scenarios are used in conjunction. A and B are advantages of scenario risk measures. Section 3.3.1. LO.i.
19. A is correct. B is incorrect because sensitivities do not typically differentiate assets based on volatilities. C is incorrect because duration measures a 1bp change applied to current rates. Section 3.3.1. LO.i.

- 20. B is correct. The past business returns do not influence the choice of risk measures. A and C are correct factors. Section 4.1. LO.j.
- 21. B is correct. Banks typically assess their liquidity gap, leverage ratios, economic capital, VaR, duration analysis, and scenarios. Section 4.1.1. LO.j.
- 22. C is correct. Maximum drawdown also known as “the worst-returning month or quarter for the portfolio is a risk measure used by hedge funds. A & B are correct. Section 4.1.3. LO.j.
- 23. A is correct. Banks usually impose total economic capital or VaR limits. B and C are incorrect as pension fund sponsors and portfolio managers apply ex ante tracking error budget. Section 5.1. LO.k.
- 24. C is correct. Position limits address risk by applying limits on size of long/short positions or on derivative activity, and limit investments in certain categories so as to not breach a minimum while following a certain strategy. Section 5.2. LO.k.
- 25. C is correct. Economic capital measures the shareholders’ equity required to overcome losses under stress market conditions. A and B are true statements. Section 5.5. LO.l.

**Set 2 Questions**

**The following information relates to questions 1 - 5.**

Martin Cross, senior risk manager and Julia Bing, analyst at Gloria AMC are discussing the VaR measure of risk management. Martin states, "It's important to understand the three points in the VaR concept. (1) VaR can be measured in either currency units or in percentage terms, (2) it tells us how much one can lose, and (3) it references a time horizon, losses that would be expected to occur a certain time." Martin then asks Julia, "What does a VaR of \$15 million at 5% for one month indicate?"

Martin and Julia then talk about the advantages of VaR as a risk management tool. Julia comments, "The advantages of VaR are: (1) it can be used for performance evaluation, (2) it provides an estimate of losses during a worst-case scenario, and (3) it is an objective method rather than a subjective method."

Martin next calculates the VaR of one of the company's equity funds; the Gloria Delta fund. He estimates the dollar VaR at the 5% level using the parametric method with the following inputs:

**Exhibit 1: Data for Gloria Delta fund**

Portfolio Value	\$600 million
Daily Expected Return	0.05%
Daily Expected Volatility	1.20%

Martin and Julia then discuss other methods of estimating VaR. Martin states, "Historical simulation to estimate VaR is useful however it has a limitation that mean and variance estimates could be biased". Julia says, "Monte Carlo method of estimating VaR has the advantage that the number of necessary simulations is determined by the parameters".

- Which of the following statements made by Martin about VaR is *least likely* correct?
  - VaR can be measured either in currency units or percentage terms.
  - VaR represents the maximum loss.
  - A VaR statement references a time horizon i.e. losses that would be expected to occur over a given period of time.
- The VaR of \$15 million at 5% for one month *most likely* means:
  - There is a 5% chance of losing \$15 million over one month.
  - There is a 95% chance that the expected loss over the next month is less than \$15 million.
  - The minimum loss that would be expected to occur over one month 5% of the time is \$15 million.
- Julia's comments on the advantages of VaR are *most likely* correct with respect to:
  - Losses in a worst-case scenario.
  - performance evaluation.
  - objective method.



4. Using the inputs given in Exhibit 1, the estimate of VaR is *closest* to:
  - A. \$11.6 million.
  - B. \$12.4 million.
  - C. \$18.9 million.
5. Regarding the alternative methods of estimating VaR, who is correct?
  - A. Martin only.
  - B. Julia only.
  - C. Neither Martin nor Julia.

**The following information relates to question 6 - 10**

Vilma Atkinson is the head of risk at Preston Investments. She is having a discussion with her assistant, Kyle Lee about the use of risk management tools in portfolio management. She asks Kyle about the advantages and disadvantages of using scenario risk measures in risk management along with VaR. Kyle states, "Scenario analysis can complement VaR as it accounts for market liquidity, however, it carries a limitation that it has greater reliance on historical market data than VaR."

Kyle further states, "An example of scenario analysis is reverse stress test, where the most significant exposures of a portfolio are identified and generate a hypothetical stress that adversely affects these exposures".

Vilma then discusses option risk measures and how they can be used to assess the risk exposures of options positions. Kyle states, "Delta measures the sensitivity of option value to the price of the underlying and it ranges from 0 to +0.5. Gamma is a second-order effect that measures the sensitivity of delta to price changes in the underlying. Vega is a first-order effect for options reflecting the relationship between the option price and the volatility of the underlying."

Later, Vilma asks Kyle to draft a risk management policy for the company's balance fund, which is designed primarily for investors with a low risk tolerance and a goal to limit the likelihood of severe downside losses. Kyle drafts the following risk management policy:

"The balanced fund has a 10-day, 2% VaR limit of \$5 million and the fund will undertake hedging activities if its cumulative 15 day loss ever exceeds \$10 million."

Vilma then asks Kyle, "We have a diverse investor base including banks, corporations and long-only asset managers. Which of these investors will prefer risk measures such as VaR expressed as a percentage of assets and relative to a benchmark?"

6. Is Kyle's statement about scenario analysis *correct*?
  - A. Yes.
  - B. No, because scenario analysis doesn't account for market liquidity better than VaR.
  - C. No, because scenario analysis does not need to rely on historical data.
7. Does Kyle give the example of scenario analysis correctly?

- A. Yes.
  - B. No, because reverse stress test is not an example of scenario analysis.
  - C. No, because he does not explain reverse stress test correctly.
8. Which option sensitivity measure does Kyle describe *least accurately*?
- A. Delta.
  - B. Gamma.
  - C. Vega.
9. Kyle's risk management policy is *least likely* an example of:
- A. risk budgeting.
  - B. scenario limits.
  - C. stop-loss limits.
10. Regarding Vilma's question on risk measures by market participants, which answer is *most likely* correct? The market participants that favor VaR expressed in percentage terms are:
- A. banks.
  - B. corporations.
  - C. long-only asset managers.

**Set 2 Solutions**

1. B is correct. VaR is a minimum loss not “how much one can lose.” A & C are correct statements. Section 2.1. LO.a.
2. C is correct. 5% VaR means that the minimum loss over one month 5% of the time would be \$15 million. VaR does not represent the probability of occurrence of losses. Section 2.1. LO.a.
3. B is correct. VaR can be used for risk adjustment of returns, required for performance evaluation. VaR is a subjective method and does not give a worst-case scenario. Losses can exceed VaR. Section 2.3. LO.d.
4. A is correct. First, multiply portfolio standard deviation by 1.65;  $0.012 \times 1.65 = 0.0198$ . Subtract this from the expected return;  $0.0005 - 0.0198 = -0.0193$ . Taking the absolute value  $= -0.0193 \times (-1) = 0.0193$ . Multiplying this by the portfolio value gives a VaR estimate of  $0.0193 \times 600 = \$11.58$  million. Section 2.2.1. LO.c.
5. C is correct. Neither Martin nor Julia is correct. Historical simulation does not require the estimation of mean and variance and there is no industry standard on the number of necessary simulations under the Monte Carlo method. Section 2.2.2-2.2.3. LO.b.
6. C is correct. Since scenario analysis does not need to rely on history, it can be free of the volatility and correlation behavior of recent market history, which may not be representative of market stress conditions. Section 3.3.1. LO.i.
7. A is correct. Kyle correctly explains the reverse stress test, which is an example of hypothetical scenario analysis. Section 3.2.2. LO.h.
8. A is correct. Call option deltas range from a value of 0 to a value of 1, whereas put option deltas range from a value of 0 to a value of -1. The explanations of Gamma and Vega are correct. Section 3.1.3. LO.g.
9. B is correct. A scenario limit establishes a limit on the loss for a given scenario, which is not implemented by the policy drafted by Kyle. The 10-day, 2% VaR limit of \$5 million is an example of risk-budgeting. The initiation of hedges above a certain loss level is an alternative form of a stop-loss limit called drawdown control or portfolio insurance. Section 5. LO.k.
10. C is correct. Long-only asset managers generally prefer to express VaR in percentage terms and use a benchmark as a relevant risk measure. Banks and corporations measure VaR more commonly in currency units and in absolute terms. Section 4.1. LO.j.