

QFI IRM Model Solutions

Spring 2022

1. Learning Objectives:

1. The candidate will understand the value of governance and its key elements in general and in the context of an investment operation.
2. The candidate will understand and be able to apply different approaches to measuring risk exposures.

Learning Outcomes:

- (1b) Identify sources of unethical conduct and explain the role of a fiduciary.
- (1c) Describe governance mechanisms that attempt to address these conflicts.
- (1f) Demonstrate understanding of how ethics relates to business decision-making, and relate ethics in business to personal ethics.
- (3d) Evaluate different measures of rare event risks.

Sources:

Chapter 1, 3 (pages 43, 59-60, 62-63,66-67), 7, and 9 of “Investment Ethics”, Peck

QFII-103-14: Advances in Risk Management and Risk Governance, pg. 78

Commentary on Question:

This question aims to test candidates’ knowledge on the sources of unethical conduct and demonstrate understanding of how ethics relate to business decision-making. In addition, it tests candidates on risk management practices through compensation design. Candidates generally did well on this question. Many were able to get full points for section b and c.

Solution:

- (a) Some of your friends are interested in becoming portfolio managers at the firm ABC alongside you, but they aren’t sure they are suited for the investments industry. They know you have experience with investment ethics, so they ask for your opinion.

Describe two motivations for unethical behavior in the investment industry.

1. Continued

Commentary on Question:

This question aims to test candidates' knowledge on the two motivations for unethical behavior in the investment industry, based on the reading from page 18, chapter 1 of Investment Ethics by Peck. Candidates overall did very poorly on this question. Few candidates were able to correctly identify the two motivations, and some earned partial credits by providing relevant answers.

His friends should not be greedy or be arrogant/have an ego.

- 1) Greed is one reason people are unethical. The investments industry is centered around money, and money always creates temptations.
 - 2) Ego/arrogance is another trait that they should not have. People who fall into this category would rather act unethically than admit failure.
- (b) One of your friends John is hired at ABC to market the firm's funds. To illustrate the importance of corporate governance with respect to unethical behavior, you mention the actions of Nick Leeson and the consequences for Barings Bank.
- (i) Define the four principles of investment ethics.
 - (ii) Explain which principle was violated by Nick Leeson.

Commentary on Question:

Candidates did very well on this question by correctly identifying and defining the four principles of investment ethics. To receive full credits on section (ii), candidate must correctly identify one principle and provide justification. Some candidates answered this section by providing multiple principles when the question asked for one principle. These candidates did not receive credit.

- (i)
 - 1) **Ethical Understanding:** Portfolio managers should understand the return objective and risk tolerance of the client. They should also understand the investment transactions they are recommending to client.
 - 2) **Ethical use of Information:** Portfolio managers should not use hidden information that are not disclosed in the market. Also, they should not share the information to some clients only but not all.
 - 3) **Responsible Investing:** Portfolio managers should not knowingly make or recommend investments which can bring harms to others.
 - 4) **Trust and Fairness:** Portfolio managers should treat all the clients as equally and fairly, not to abuse trust placed in them.
- (ii) **Trust and Fairness:** Nick was not investing his own money and invested it in ways that violated his duties to his employer (and potentially their clients/customers as well). (Can also mention fiduciary duty)

1. Continued

(c)

Recommend four improvements to the chart to more accurately and ethically present historical performance.

Commentary on Question:

Candidates did well on this question by providing the appropriate recommendations to the chart.

- 1) Add a benchmark (SP 500, Russell 3000) for comparison of fund performance
- 2) Have a longer time window of historical performance of preferably 10 years or show a past historical performance that has a full market cycle
- 3) Performance of the fund needs to be shown as net of investing expenses and this needs to be explicitly stated on the graph.
- 4) Need to add information regarding amount of risk the portfolio has taken through measures such as beta, Sharpe Ratio or Morningstar style boxes

(d)

You suggest that John also show fund performance under alternative scenarios.

- (i) Describe three types of scenarios used to present performance in alternative economic environments.
- (ii) Identify the most appropriate type of scenario for this situation. Justify your answer.

Commentary on Question:

Candidates overall did well on this question by identifying some of the three types of scenarios from Notes for QFII-103-14: Advances in Risk Management and Risk Governance, page 78. Description must be provided in order to receive a full point for each scenario. In section (ii), many candidates were able to correctly identify the most appropriate type of scenario to use. Many received partial credits for not providing adequate justification as to why this type of scenario is the most suitable, or alternative, why the others are not suitable.

(i)

- 1) Stress testing generally only manipulates one assumption such as interest rates rising or falling, credit spreads narrowing or widening or equity prices going up or down.
- 2) Historical stress scenarios use all the major economic assumptions of a prior economic event happening such as the dot-com crash or the Great Recession.
- 3) “Nightmare scenarios” or synthetic scenarios comprise of a certain number of variables set to values that senior managers or board members believe to be the most worrisome.

1. Continued

(ii)

“Nightmare scenarios” or synthetic scenarios would be best suited in this situation because they can more realistically simulate potential future returns for a client in a worst case scenario compared to the other two. The new asset class makes historical stress scenarios inappropriate. The fact that the fund is susceptible to political risks makes it too complex for simple stress test scenarios of one variable to be appropriate.

- (e) You are considering adding company LMNO, a pharmaceutical firm, to a portfolio you manage. You observe that:
- Executive compensation at LMNO includes a competitive salary plus an annual bonus.
 - The bonus is issued as company stock and based solely on LMNO’s stock performance over the prior year.
- (i) Identify three issues with LMNO’s compensation structure.
- (ii) Recommend improvements to address these issues.

Commentary on Question:

Candidates did well on this question by recognizing the main issues with the compensation structure. While many candidates responded that stock-based bonus will incentivize excessive risk taking for short term gains, few candidates were able to point out that stock-based bonuses in fact do not incentivize sufficient risk-taking in order to maintain stable stock price in the near term.

(i)

- 1) Stock-based bonuses don’t incentivize sufficient risk-taking
- 2) Stock performance is subject to many not in control of management. Doesn’t properly align incentives.
- 3) One year is not sufficient time to base bonuses.

(ii)

- 1) Should use options instead or in addition, which increase in value with more volatility similar to equity holders
- 2) Base bonus on reported earnings
- 3) Use longer time-horizon/long-term incentive plans/have clawback provisions/vesting.

2. Learning Objectives:

1. The candidate will understand and be able to apply the components of an effective risk management system.
2. The candidate will understand and be able to apply different approaches to measuring risk exposures.

Learning Outcomes:

- (2a) Explain the importance of risk culture in an investment firm.
- (2b) Identify and describe the various kinds of risks, including market, credit, operational, etc.
- (2e) Evaluate a company's risk management process.
- (3e) Evaluate a company's or a portfolio's exposures to various risks.

Sources:

QFII-121-22: Chapter 2, Quantitative Enterprise Risk Management, Hardy & Saunders

QFII-120-20: IAA Note on ERM for Capital and Solvency Purposes in the Insurance Industry, pp. 9-38

QFII-125-22: Chapter 17, Value at Risk, Jorion, Philippe, 3rd Edition, 2007

Commentary on Question:

This question aims to test candidates' knowledge on explaining the importance of risk culture in a firm and evaluating the firm's risk management process. In addition, the question tests candidates' understanding on a portfolio's exposures to various risks, and ways to manage such risks. In general, candidates performed above average in sections a and b, as expected in sections c and d, and poorly on section e.

Solution:

You serve as a risk management consultant for a large casualty insurance company seeking to evaluate its risk culture. The managers identify the following risks facing the insurer.

1. The company has a large block of business in one region of the country.
 2. The company invests its assets in bonds, both domestic and international.
 3. The insurance market is supervised at the state and federal level.
 4. Recent changes allow more individuals in the target insurance market to opt out of coverage.
- (a)
- (i) Classify each of the risks using a risk taxonomy.
 - (ii) Explain how the risk arises from the situation presented.

2. Continued

Commentary on Question:

This question aims to test candidates' knowledge on the various kinds of risks, including market, credit, political, pricing etc. Candidates did well on the second and the third point, by identifying and justifying for the market risks and regulation risks. Some were able to receive partial credits for explaining the environmental risk from the first point. Only a few candidates correctly identified that the last risk is pricing risk.

- 3) Strategic risk or environmental risk. - The insurer faces large losses if there is an incident in that region.
- 4) Interest rate risk and exchange rate risk. – Bonds values fluctuate with interest rates, and the foreign bonds introduce the exchange rate risk.
- 5) Regulation/Political Risk. – Insurance is a heavily regulated industry, even more so due to two layers of government.
- 6) Pricing risk - Adverse selection can arise due to the better risks choosing to opt out of the insured population, leaving the worse risks, which means prices may have been set too low.

You note the following upon interviewing both upper- and lower-level managers in the company and its subdivisions:

1. The company tracks progress on its risk culture objectives through use of an enterprise-wide survey taken at regular intervals. Metrics have been consistent over the past several years.
 2. The company hired a CRO to complete the risk management team, which now consists of the CRO and CEO.
 3. The company currently has a well-regarded incentive program for employees who report risk. The CRO recently implemented his own annual recognition of employees who report risk.
 4. The company holds an annual event for upper management to review and discuss the risk management processes at the company.
 5. Managers indicate significant reporting requirements to the CRO and are not able to provide examples of CRO follow-up.
 6. Besides some additional reporting, teams' processes have not changed since the introduction of the risk management team.
 7. Product lines must meet risk management benchmarks in order for managers to receive bonuses.
 8. Managers routinely express pride for “taking care of a risky situation” without needing to inform the CRO or involve higher management.
- (b) Critique the risk culture within the firm based upon each observation.

2. Continued

Commentary on Question:

Candidates did well on this question by providing the positives/negatives (if applicable) of the risk culture described in each point. For point 1, many candidates commented on the inappropriate use of survey but missed the more important issue that the metrics have not been improving over the years. For point 5, a number of candidates incorrectly commented that the issue was with the managers not producing CRO examples, when it was the CRO not following up on the managers' reporting. For point 6, few candidates were able to identify that the issue with the teams' processes remaining the same is that the risk management function is not influential and there is not enough integration between the risk management function and other teams.

Bullet 1:

Positives: The company is mindful of its risk culture and is attempting to measure it over time.

Negatives: The company's survey indicates metrics have not been improving over the past few years.

Bullet 2:

Positives: The company hired a CRO to oversee its risk management operations.

Negatives: The risk management team should consist of more individuals than just the CRO and CEO. Engage people with skills in change management, learning, human resources, project management.

Bullet 3:

Positives: The company currently has a well-regarded incentive program for employees who report risk. This indicates measures and consequences in their program.

Negatives: The CRO recently implemented an annual recognition of employees that competes with the already successful program. It's best to leverage existing organization-wide programs rather than starting new ones to both lessen the load of managers and staff and facilitate embedding as business as usual.

Bullet 4:

Positives: The company is demonstrating there is a focus on the risk management processes at the company by establishing the event. This event might be a way to establish the principles of the risk culture at the firm.

Negatives: None

Bullet 5:

Positives: The existence of risk reporting is a good sign, as it should improve management of the firm.

Negatives: Lack of CRO follow-up on reported risks.

2. Continued

Bullet 6:

Positives: None

Negatives: The risk management function is not influential as many teams have not changed how they do things much since its introduction.

Bullet 7:

Positives: Risk is being considered in compensation arrangements, better aligning incentives between the managers and company.

Negatives: None

Bullet 8:

Positives: None

Negatives: Managers routinely express pride for “taking care of a risky situation” without needing to inform the CRO or involve higher management. This indicates that senior management is acting without the full risk picture and potential issues for the measures and consequences of their risk culture. There does not seem to be all the elements of the risk management team working together and gaps in reporting.

(c)

Recommend four ways to improve risk culture deficiencies identified in part (b).

Commentary on Question:

Candidates did well on this question by recommending appropriate improvements. Some candidates received only partial credits for providing very general recommendations to the risk culture within a firm, but failed to address the specific deficiencies identified in part (b) as specified in the question.

Bullet 2: Include more employees on the risk management team from across the company and in different divisions

Bullet 3: Do not start annual recognition for employees as current incentive program is popular and working.

Bullet 6: There should be more integration between the risk management function and other teams so that some processes are changing to better consider risk.

Bullet 8: Either create procedures to ensure proper reporting of identified risk issues or educate employees to follow procedures to ensure identified risk issues are properly escalated and handled.

2. Continued

The insurer recently conducted an analysis of its pension fund investment strategy and determined the following.

Source of Risk	VaR
Policy-Mix VaR	15.2%
Active Mgt. VaR	12.1%
Asset VaR	20.0%

- (d)
- (i) Define Policy-Mix VaR and Active Management VaR.
 - (ii) Interpret what the above VaR values imply about the investment strategy.

Commentary on Question:

Candidates overall performed well in section (i) but poorly in section (ii). Many candidates answered section (ii) by indicating that there is diversification or negative correlation between Policy-Mix VaR and Active Management Var. However, because the Asset VaR is not lower than either of the two abovementioned VaR, the correlation is in fact positive or zero between the two VaR.

(i)
The Policy-Mix VaR is the risk of a dollar loss owing to the policy mix of the fund. This is related to the choice of asset classes (passive strategy).

Active-management VaR is the risk of a dollar loss owing to the total deviations from the policy mix.

(ii)
The high active-management VaR indicates that the fund relies heavily on active management and the fund may rely on a particular investment style or strategy or does not contain index funds.

The similar magnitude of the Policy-Mix VaR and Active Mgt. VaR indicates that the performance of the portfolio is driven by both the asset choices and active management strategies.

The insurer is confident in the current active management strategy and the benchmark choice.

- (e) Recommend a strategy to decrease asset VaR based on the information in the table.

2. Continued

Commentary on Question:

Candidates did very poorly on this question. The two constraints described in the question are to leave the active management strategy and benchmark choice unchanged, and the best strategy is for active managers to take smaller or fewer deviations from their benchmark to reduce the plan's total VaR. Many candidates received partial credits for other possible strategies if they violate one of the constraints.

Active managers could take smaller or fewer deviations from their benchmark to reduce the plan's total VAR.

Justification: This strategy will decrease the Active Mgt. VaR but does not involve changing either the benchmark or active management strategy, which were constraints established in the situ

3. Learning Objectives:

2. The candidate will understand and be able to apply the components of an effective risk management system.
3. Understand and be able to apply different approaches to measuring risk exposures.

Learning Outcomes:

- (2b) Identify and describe the various kinds of risks, including strategic, market, credit, operational, etc.
- (3a) Explain the advantages and limitations of different risk metrics
- (3b) Explain how different approaches and tests form a set of complementary investment risk metrics.
- (3d) Evaluate different measures of rare event risks.
- (3e) Evaluate a company's or a portfolio's exposures to various risks.

Sources:

QFII-121-22 "Quantitative Enterprise Risk Management" by Hardy & Saunders, 2021 (Chpt. 2)

QFII-127-22 "Quantitative Enterprise Risk Management" by Hardy & Saunders, 2021

QFII-123-21: IAA Note on Stress Testing and Scenario Analysis (pp. 14-17)

Commentary on Question:

The question is aimed to test candidates' understanding of risks of a new product from various aspects, including risk categorization, stress scenario testing, volatility modeling, loss modeling, and back-testing (hypothesis testing). On a high level, candidates performed fine for the memorization part (a & b) and most of them can make justifiable recommendation w.r.t the volatility modeling, i.e. part c. But candidates did not perform well for questions d & e.

Solution:

You work for a leading annuity provider in Country XYZ. Cryptocurrency holdings recently became prohibited in Country XYZ and there are no cryptocurrency derivatives markets. Your company's product managers see an immense market opportunity from the surging consumer interest in a specific cryptocurrency, CrypTik (CT). The product managers propose a new annuity with a crediting rate linked to CT's performance, which would make your company the only provider of (synthetic) exposure to CT in the country.

3. Continued

(a) (2 points)

- (i) Identify two categories of external risk and one category of internal risk (other than operational risk) applicable to the company's decision to sell a CT-linked annuity.
- (ii) Describe one specific risk within each category in (i).

Commentary on Question:

This question specifically asks for the names of a risk "category" for part (i), and specific risks under each "category" for part (ii). Candidates with clear understanding of risk category and detailed knowledge of specific risks under the categories will receive full credit. Those who did not identify all the correct categories receive partial credit. Most candidates did well on this question.

- (i) External: Financial Market, Political and Regulatory
Internal: Strategic

- (ii) **External:**

Financial Market:

Market Risk (Exchange Rate Risk or Stock Market Risk also acceptable) – The company is exposed to price movements and changes in volatility of CT. The CT exchange rate is a central determinant of the profits or losses of the product, with limited means of hedging. The ability of the company to find appropriate investments to support the product also subjects it to market risk.

Political and Regulatory:

Political Risk – The company appears to be circumventing the political will of Country XYZ, which comes with great risk. The political climate could directly oppose the company's interests beyond the scope of this product.

Internal:

Strategic:

Strategic Risk – The decision to launch this product represents a strategic risk for the company. This may be similar to the decisions with variable annuity guarantees in the US, with limited (or no) ability to hedge the exposure to CT.

3. Continued

(b) (1.5 point)

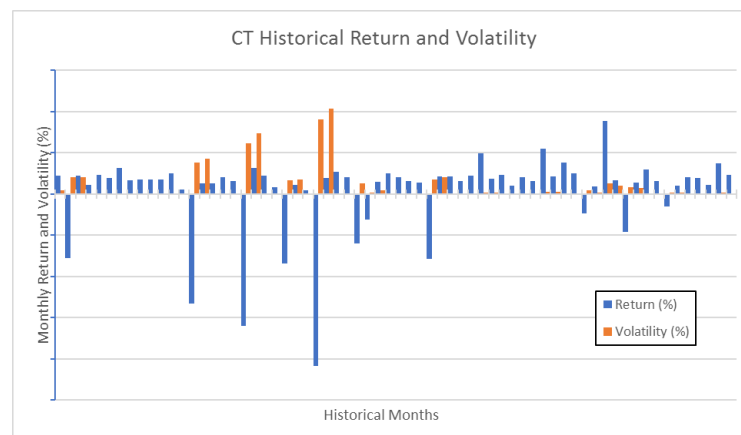
- (i) Recommend two types of scenario testing that could be used to assess the risks in the company's proposed CT-linked annuity.
- (ii) Explain how the annuity's risks could be captured by each type of scenario in (i).

Commentary on Question:

This question tests candidates' knowledge of types of scenario testing. Candidates with solid knowledge of different types of scenario testing earn full credit. Candidates' performance was generally good.

- (i) Reverse Scenarios
Synthetic Scenarios
- (ii) **Reverse Scenarios** – start with an adverse outcome and determine scenarios that would give rise to it. In this case, scenarios may focus on the volatility or overperformance of CT returns.
Synthetic Scenarios – generating hypothetical conditions that have not been observed, perhaps adapting historical experience to be more relevant and not restricted to the most severe historical event. In this case, the company could borrow from other crypto or speculative assets or market bubbles or its own internal models for CT returns with wide tails.

You are provided the following historical data for CT:



The company is capable of creating three types of models:

- Lognormal
- GARCH
- Regime Switching

3. Continued

- (c) (1 point) Recommend which model above would best capture the features of CT's price.

Commentary on Question:

This question tests the understanding of features of different models. In general, candidates performed well. Full credit is given to responses that clearly identified various the patterns from the graph and related the patterns correctly with the models. Partial credit is also given if not all the patterns are explained correctly. In addition to the model solution below, recommending GARCH model is also acceptable if proper justification is provided.

Although it is unclear from this data that any of these models is appropriate, the Regime Switching Model would be most suitable for the following reasons:

- Volatility is clearly not constant, which is a limiting attribute of lognormal (i.e. a lognormal model would have a constant volatility). GARCH and RSLN models can exhibit this characteristic.
- Volatility appears to cluster. Again, this rules out lognormal but not GARCH or RSLN.
- High volatility seems to be correlated with sudden drops in prices/returns. A GARCH model would not handle this feature, but RSLN can.

The company will credit X% of CT's total return to annuitants over the period with a guarantee that the crediting rate will not go below 0%. Product management believes a value of X less than 80 will not be viable in the marketplace. The company has also set a risk limit of 1-year 99% VaR at 10% loss on assets under management for the product.

While the models are being developed, you decide to make some rough estimates with the following:

- 0.00 = Annual expected return on CT
- 0.53 = Δ of theoretical at-the-money 1-year call option on CT
- 0.15 = Approximate annual standard deviation of the return on CT
- 0.01 = Approximate annual standard deviation of the return on investment portfolio
- $\Phi(2.326) = 0.99$

3. Continued

- (d) (3 points) Calculate the minimum portfolio return for the product to be viable using the Delta-Normal method for both CT and portfolio returns, assuming they are independent.
- (i) Describe how the annuity from the company is related to a one-year call option on CT.
 - (ii) Explain how the Delta-Normal method approximates losses and provide a formulaic expression for the company's net position from selling an annuity contract.
 - (iii) Express the mean and variance of the Delta-Normal approximated loss as a function of the mean investment portfolio return R and annuity participation $X\%$.
 - (iv) Determine the minimum portfolio return required for the product to be viable.

Commentary on Question:

This question tests how the addition of the new product is affecting the company's portfolio as a whole. It further tests candidates' understanding of delta-normal method of loss modeling. Candidates did not perform well for this question. Partial credit is given if the response indicated basic understanding of delta-normal method, and if the mathematical derivation is in the generally correct direction.

- (i) The company is short call options on CT and long in its investment portfolio.

When the company receives one unit of investment, it invests in the portfolio but has effectively sold $X\% \cdot (1.00/\text{Price}_{\text{CT}}) = X\%/\text{Price}_{\text{CT}}$ call options to the account holder.

- (ii) The Delta-Normal method approximates the loss using Taylor's expansion through the first derivative, the Delta of the portfolio, where the Returns are assumed to be normally distributed.

The loss of a single instrument is given by $-\Delta(t)S(t)R(t,h)$.

Assuming independence, the net loss is approximated as:
 $-(\Delta_{\text{Port}}\text{Price}_{\text{Port}}\text{Return}_{\text{Port}} - \Delta_{\text{CT}}\text{Price}_{\text{CT}}\text{Return}_{\text{CT}})$

3. Continued

- (iii) Let R be the portfolio return. The loss random variable has expected return $= -R$.

The loss random variable is then multivariate with variance (assuming independence) of:

$$\Delta_{CT}^2 \text{Price}_{CT}^2 \sigma_{CT}^2 + \Delta_{Port}^2 \text{Price}_{Port}^2 \sigma_{Port}^2 = (X\% / \text{Price}_{CT} * 0.53)^2 \text{Price}_{CT}^2 (15\%)^2 + 1^2 (1\%)^2 = 6.3E-7 * X^2 + 1E-4$$

- (iv) We require 99% VaR to be less than 10% loss:
 $-R + 2.326 * \text{sqrt}(6.3E-7 * X^2 + 1E-4) \leq 10\%$

$$R \geq 2.326 * \text{sqrt}(6.3E-7 * X^2 + 1E-4) - 10\%$$

$$X \geq 80 \text{ from Product Management, means } R \geq 2.326 * \text{sqrt}(6.3E-7 * 80^2 + 1E-4) - 10\%$$

$$R \geq 5\%$$

Backtesting with 1-year exposure for a model of 1,000 contracts produced 15 cases where losses exceeded the calculated 99% VaR (\leq loss of 10%).

- (e) (0.5 points) Assess the backtesting results using a 5% significance level.

Commentary on Question:

This question tests on the analysis of the backtesting result. Candidates did poorly. Most of the candidates only received partial credit by identifying a larger than expected number of exceptions. Very few candidates identified the binomial distribution associated and the hypothesis testing that's actually needed in this case.

The number of exceptions is higher than the expected 10 (1,000*1%). The likelihood of observing at least 15 exceptions given a 1% probability is $1 - F_{1000}(14, 1\%) = 8.24\%$. It is possible at the 5% significance level for this to occur and we can't reject that the model is reasonably producing 99% VaR.

4. Learning Objectives:

2. The candidate will understand and be able to apply the components of an effective risk management system.

Learning Outcomes:

- (2b) Identify and describe the various kinds of risks, including market, credit, operational, etc.
- (2f) Examine examples of risk management failure.

Sources:

Financial Enterprise Risk Management, Sweeting, Paul, 2nd Edition, 2017

- Ch. 8: Risk Identification
- Ch. 20: Case Studies

Commentary on Question:

The question tests on precise memorization on risk management failure events and risk management techniques. Candidates demonstrated good understanding of risk management concepts, however were challenged to attribute the concepts to specific risk management failure case studies or to specific risk management techniques. On a high level, candidates performed well on recalling the case studies and be able to make connection with the case studies in part a. Candidates have some challenges when performing for part b and part c.

Solution:

- (a)
 - (i) Identify two case studies most relevant for each organization.
 - (ii) Explain how the identified case studies apply to each organization.

Commentary on Question:

Candidates performed as expected in this question. Candidates able to identify case studies precisely relevant to the specific circumstances of the organizations are awarded full points.

Candidates will be awarded full score with two relevant case studies for each of the organizations.

4. Continued

Organization A:

Case	Risk/context:
Korean Air	importance of risk culture (risk of hierarchical culture)
Bernard Madoff	small organization with little or no internal oversight
Robert Maxwell	avoid dominance or concentration of risk at the head of a company

Organization B

Case	Risk/context:
Barings Bank	Should separate parties responsible for trading and back-office work Importance of incentives: Bonuses should reflect the term of the instrument being traded; Full bonuses should not be awarded until the risk inherent in any deal has run its course
LTCM	Model risk – heavy reliance on models at the expense of good judgement can be damaging
The 2007-2011 global financial crisis	Model risk: should be used as tools; those making decisions using the output from models should understand the model's capabilities and limitations

Organization C

Case	Risk/context:
Equitable Life	important to avoid conflicts of interest – CEO vs appointed actuary for Equitable Life (CRO for Org. C) Risk culture – unwilling to learn from practices adopted by other firms, which meant that there was insufficient scrutiny of its own business model and slowness to respond to external environment
The 2007-2011 global financial crisis	The manager in charge of ERM needs a higher status with the authority to stop undue risk being taken (concentration risk). The CEO/CRO is limiting what the other manager can do by declaring his comfort with the current risk.

4. Continued

- (b)
- (i) Recommend the two risk identification tools best suited to each organization from the list provided. (Note that each tool from the list must be used exactly once in your recommendations.)
 - (ii) Justify your recommendations.

Commentary on Question:

Candidates performed generally good in this question. Their performance differed by how well they differentiated the objectives of each risk identification tools. Some candidates mixed up risk prompt list, risk checklist and risk-focused process analysis. Partial credit was given where one of the proper risk identification tools was identified with proper rationale.

Organization A:

SWOT analysis: covers both internal and external risk management contexts. Covers both positive and negative aspects of the risks for the small company. These align with the goal for the workshop.

Risk check lists: The company has been established for sufficiently long (since 2012) that experience is likely available to draw from in creating the risk check list. Having the COO (a founder) in the group brings experiential knowledge, and documentation provides historical information, both of which act as sources for creating the check list.

Organization B:

Risk prompt lists: identify various categories of risk that should be considered. These can prompt a broader and more specific range of risks for the firm in question. This aligns with the goal for the workshop to start at a high level.

Risk taxonomy: more detailed than the prompt list, containing a wide range of risks, suitable for a relatively new firm. This aligns with the goal for the workshop to produce a detailed categorization of risks.

These two tools are more appropriate for Org B, since it is a new company (founded in 2021), so it will not have the experience/history to do some of the other tools like risk check list and risk trigger questions. It also has an unrepresentative group (too many portfolio managers), so a risk-focused process analysis is not appropriate.

Organization C:

Risk trigger questions: derived from situations or areas where risks have emerged previously – suitable since the company has been established for over 10 years with past experiences available (even from the past year)

4. Continued

Risk-focused process analysis: The group includes representatives from all key areas and is experienced, so they can establish flow charts for every process used and analyze the points at which risks can occur.

- (c)
- (i) Critique your co-worker's choice of technique for each organization.
 - (ii) Recommend an alternative technique for Organization A, other than those listed prior to part (b).

Commentary on Question:

There is a typo in part (ii) of the question – it should be “... other than those listed prior to part (c)(i).”

Candidates performed unsatisfactory in the question. They were not able to assess different risk identification techniques with regards to the length, representation and specific knowledge held by participants.

- (i) Org A: Delphi technique;
 - Inappropriate given several iterations are required, need time between iterations for analysis. The workshop will only be 1-hour long.Org B: Independent group analysis;
 - Inappropriate since too many portfolio managers – finance/model risk may be ranked too highlyOrg C: Brainstorming;
 - Appropriate given representatives from key areas are already present, with a facilitator present to ensure as broad a range of points as possible is investigated
- (ii) Gap analysis: with both senior and junior members present, junior employees have clearer ideas of the actual risk exposure and COO has strong views on the desired levels of risk exposure

5. Learning Objectives:

1. The candidate will understand the value of governance and its key elements in general and in the context of an investment operation.

Learning Outcomes:

- (1a) Compare the interest of key stakeholders.
- (1c) Describe governance mechanisms that attempt to address these conflicts.
- (1e) Explain how governance may be structured to gain competitive advantages and efficiencies.

Sources:

QFII-101-14: Chapter 11 of Strategic Management: An Integrated Approach
Investment Ethics, Peck, Sarah, 2011, Ch 7

Commentary on Question:

This question's aim was to evaluate the candidate's ability to analyze the interests of different stakeholders in an IPO transaction. It then assessed the candidate's ability to apply these conflicts to governance practices in a sample setting.

Solution:

- (a) Explain the key issue addressed with agency theory.

Commentary on Question:

Candidates performed as expected on this question. Most candidates who attempted this question received at least partial credit on this question. The bulk of candidates correctly stated the conflict of interest between the principal and the agent, but only the minority commented on the information asymmetry between them.

The agency problem arises because principals and agents have:

1. Different goals, creating a conflict of interest
2. Asymmetric information

- (b) Explain how agency risks apply to the proposed relationship between ABC and XYZ.

Commentary on Question:

Candidates performed as expected on this question. While the majority discussed aspects related to the ABC's flat compensation, only a small number mentioned the information asymmetry in market knowledge.

- XYZ aims to maximize the IPO price, while ABC is focused on compensation.
- ABC has more knowledge of the markets and regulatory environment.

5. Continued

- (c) Describe two actions XYZ could take to mitigate these agency risks.

Commentary on Question:

Candidates performed as expected on this question. Most correctly recommended a change to the compensation structure. Fewer, however, recommended adding an additional level of review.

- Compensation to XYZ could be based on the IPO price
- ABC can hire an additional/independent review to assess XYZ's actions

- (d)

- (i) List the five characteristics used to assess the suitability of individual board members.

- (ii) Assess the composition of the current board with respect to these characteristics.

Commentary on Question:

Candidates performed as expected on this question. The majority were able to state the characteristics to earn most credit for part i). For part ii), most candidates scored at least partial credit and were able to correctly assess the components. Where most candidates did not earn full credit is providing sufficient details on a characteristic, or not providing details based on the full list of characteristics in part i).

- Independence: too many members are in management, which compromises independence
- Tenure: too many members with long tenures, which compromises independence and may lead to complacency
- Competence: there is a good mix - finance, accounting, and engineering fields are all represented
- Time Limitations: there is a good mix - independent board members have more time; others have professional reputation at stake
- Age: Most are older, which means there is not a good mix – the current board has a lot of experience, but may have less concern for the business as a going concern

- (e) Recommend four improvements to the current board structure based on this new information.

5. Continued

Commentary on Question:

Candidates performed better than expected on this question. Most were able to list at least three improvements, including the first two listed below; however, a smaller number correctly stated four valid and separate improvements, including the final two listed below.

Potential improvements include (only four are needed):

- The CEO should not be present for all board meetings
- The Chairman should not be the CEO
- There should be separate committees, including committees for compensation and nominations, not just an audit committee
- The audit committee should only consist of independent members
- Majority of board members should be independent directors (current board is split evenly)

6. Learning Objectives:

3. Understand and be able to apply different approaches to measuring risk exposures.

Learning Outcomes:

- (3a) Explain the advantages and limitations of different risk metrics
- (3e) Evaluate a company's or a portfolio's exposures to various risks.

Sources:

Quantitative Enterprise Risk Management, Hardy & Saunders, 2021 Ch 3, Risk Measures

Aggregation of Risks and Allocation of Capital, by Milliman, 2009, Sections 5-7

Commentary on Question:

The question tests student's ability to recall and explain different risk metrics, apply formula to measure risk exposures, and analyze and evaluate a specific risk metric. Students are generally doing well in applying the formula. Some students have difficulty to identify and fully understand the four conditions needed to be a coherent risk metric. Students generally are doing well to assess the colleague's statements on a specific risk metric's real world application.

Solution:

- (a) Calculate $\rho(X)$ and $\rho(Y)$.

You are given that $\sqrt{\text{Var}[X + Y]} \leq \sqrt{\text{Var}[X]} + \sqrt{\text{Var}[Y]}$ for any two claims variables X and Y whose variances exist.

$$\begin{aligned}\rho(X) &= E[X] + 3\sqrt{\text{Var}[X]} = \frac{2 + (-8)}{2} + 3\sqrt{\frac{(2 - (-8))^2}{12}} = -3 + 3\sqrt{\frac{100}{12}} \\ &= 5.66\end{aligned}$$

$$\rho(Y) = E[Y] + 3\sqrt{\text{Var}[Y]} = \frac{3 + 2}{2} + 3\sqrt{\frac{(3 - 2)^2}{12}} = \frac{5}{2} + 3\sqrt{\frac{1}{12}} = 3.37$$

- (b)
- (i) Define the conditions needed to be a coherent risk metric.
- (ii) Demonstrate whether ρ satisfies each of these conditions.

6. Continued

Translation invariance: $\rho(X + c) = E[X + c] + \alpha\sqrt{\text{Var}[X + c]} = E[X] + c + \alpha\sqrt{\text{Var}[X]} = \rho(X) + c.$

Hence, translation variance holds.

Positive homogeneity: $\rho(\lambda X) = E[\lambda X] + \alpha\sqrt{\text{Var}[\lambda X]} = \lambda E[X] + \alpha\sqrt{\lambda^2 \text{Var}[X]} = \lambda E[X] + \alpha\lambda\sqrt{\text{Var}[X]} = \lambda(E[X] + \alpha\sqrt{\text{Var}[X]}) = \lambda\rho(X).$

Hence, positive homogeneity holds.

Subadditivity:
$$\begin{aligned}\rho(X + Y) &= E[X + Y] + \alpha\sqrt{\text{Var}(X + Y)} \\ &= E[X] + E[Y] + \alpha\sqrt{\text{Var}(X + Y)} \\ &\leq E[X] + E[Y] + \alpha(\sqrt{\text{Var}[X]} + \sqrt{\text{Var}[Y]}) \\ &= E[X] + \alpha\sqrt{\text{Var}[X]} + E[Y] + \alpha\sqrt{\text{Var}[Y]} \\ &= \rho(X) + \rho(Y)\end{aligned}$$

Hence, subadditivity holds.

Monotonicity: does not hold. Let X, Y be as defined in Part (a). Then, $\Pr[X \leq Y] = 1$ but $\rho(X) > \rho(Y).$

Therefore ρ is not a coherent risk metric in general.

(c) Your colleague makes the following statements about the risk measure ρ :

- (i) ρ is desirable because the risk metric for two combined risks will not exceed the sum of the risk metrics of each individual risk.
- (ii) ρ is desirable for economic capital purposes because it captures the tail risk well.

Assess the validity of your colleague's statements.

- (i) This statement is valid. It is describing the property of subadditivity which ρ was demonstrated to have in Part (b)
- (ii) This statement is not valid because ρ relies only on the expected value and variance of the underlying risk, which captures limited information about tail risk.