QFI IRM Model Solutions
Spring 2019

1. Learning Objectives:

1. The candidate will understand the needs and methods of governing investments.

Learning Outcomes:

(1a) Compare the interest of key stakeholders.

(1b) Identify sources of unethical conduct and explain the role of a fiduciary.

Sources:

Investment Ethics, Peck, Sarah, 2011 , Ch. 1-3

Commentary on Question:

This question tested the candidate's knowledge of investment management ethics. Overall, candidates performed well on this question.

Solution:

(a)

(i) Identify the following in the above scenario:

- an issuer
- an intermediary
- an investor

(ii) Describe the interests of the stakeholders identified in (i).

Commentary on Question:

Candidates performed well on this question. Most candidates correctly identified each stakeholder and were able to describe respective interests.

(i) The issuers are companies that issue the stocks that make up the equity fund.
The intermediary is the portfolio manager.
The investor is Jane.

(ii) The companies issuing the stock are interested in issuing securities in exchange for capital.
The portfolio manager is trying to get Jane to invest for commission/fees.
Jane, the investor, is interested in earning return on her investment.

1. Continued

(b)

(i) List the four Fundamental Principles of Investment Ethics

(ii) Explain how the portfolio manager violated all of these principles

Commentary on Question:
Overall, candidates performed very well on this question. Almost all candidates were able to identify the four principles, and most could explain how the portfolio manager violated the principles.

Part (i) is a direct recall. For Part (ii), candidates performed well on identifying the unethical actions. Candidates gave various answers on tying the unethical actions to the four principals. Credits were given as long as there was appropriate justification.

(i) Principal 1: Ethical Understanding
Principal 2: Ethical Use of Information
Principal 3: Responsible Investing
Principal 4: Trust and Fairness

(ii) Failure to make sure his clients understand the investment opportunity and misrepresenting returns are violation of Principles 2, Ethical Use of Information and Principal 3, Responsible Investing.

- The portfolio manager is obligated to ensure that his clients are informed about all relevant information about company XYZ.
- Average return is not a good standalone measure for past performance.
- A return on an investment metric should be communicated with a risk-measure return.

Using soft dollars to pay for operating expenses violates Principal 1, Ethical Understanding and Principal 4, Trust and Fairness.

- Using trading commission to pay for operating expenses hides from the investor the fact that they are bearing the business expenses of their portfolio manager twice: once through management fees and again through trading commission.
- Operating expenses should be financed by management fees.

(c) Recommend three improvements to ensure ethical presentation of the funds' performance. Justify your response.

Commentary on Question:
Candidate performed well on this question. Some candidates only identified the unethical actions but did not provide any recommendations.

1. Continued

Corporate Bond Index as the benchmark is not appropriate. Equity index should be used.

The time horizon of 3 years is not long enough. The manager needs to present how the investment has performed in a variety of market conditions.

Equally weighted return can over-state the return from the smaller accounts. An asset-weighted average return is more representative of performance because it includes size as a determinant of performance.

(d) Explain whether Return X or Return Y is the more appropriate measure to demonstrate the performance. Justify your response.

Commentary on Question:
Candidates performed well on this question. Most candidates were able to identify and justify why Return X is more appropriate.

The return including terminated accounts is the more appropriate return to use. (Return X)

Client B is the weakest performing account. Excluding client B's performance, therefore, would be overstating the portfolio manager's past performance.

2. Learning Objectives:

3. Understand and be able to apply different approaches to risk measurement.

Learning Outcomes:

(3a) Evaluate a company's or a portfolio's exposures to various risks.

(3b) Explain the advantages and limitations of different risk metrics.

(3c) Explain how different approaches and tests form a set of complementary investment risk metrics.

(3d) Analyze and evaluate risk aggregation techniques, including the use and misuse of correlation, integrated risk distributions and copulas.

Sources:

QFII-107-14 "Chapter 14 Value at Risk" by Philippe Jorion

QFII-110-15 "The Devil is in the Tails: Actuarial Mathematics and the Subprime Mortgage Crisis" by Catherine Donnelly and Paul Embrechts

QFII-115-17 "Chapter 3 Liquidity Measurement and Management: A Practitioners Guide to Global Best Practices" by Leonard Matz

Commentary on Question:

This question tested the candidate's knowledge of various approaches to risk measurement including sensitivity testing, scenario tests and copulas. Many candidates performed poorly on this question.

Solution:

(a) Explain two ways that sensitivity testing supplements historical VaR.

Commentary on Question:

Candidates performed well on this question. Many candidates were able to explain two ways that sensitivity tests supplement VaR. Two possible answers are given below.

1. XYZ can simulate shocks that have never occurred or are more likely to occur than historical observation suggests.

2. Sensitivity tests are able to capture more extreme market movements. VaR only quantifies potential losses under "normal" market conditions.

2. Continued

(b) Recommend two sensitivity tests that will have the most adverse impact on XYZ from the list above. Justify your response.

Commentary on Question:
Candidates performed relatively well on this question. Many candidates correctly identified the correct sensitivity tests, but few candidates justified their choices.

Recommend 1: Policyholders have invested in foreign equity funds and will therefore have exposure to other currencies. Weaker foreign currencies (i.e. stronger domestic currency) will decrease the value of the policyholders' separate account in the home country.

Recommend 4: Lower equity values will decrease the value of the policyholders' separate accounts, which are the underlying assets of the option. This will increase the value of the embedded put options and thus increase the value of the liability for XYZ.

(c) Explain how to structure multivariate scenario tests for each of the above risks

Commentary on Question:
Candidates performed very poorly on this question. Most candidates were able to demonstrate knowledge of the two different events, but few were able to explain how to construct scenarios.

(i) In order to quantify the exposure to a similar event such as the financial crisis, create a multivariate scenario test which shocks interest rates, equity returns, volatility, defaults, and correlations.

(ii) In order to quantify the exposure to a liquidity crisis, create a multivariate scenario test which shocks the yield curve, credit spreads, increased borrowing costs, and decrease in funding sources.

2. Continued

(d) You propose that the firm set aside economic capital equivalent to 150% of the losses sustained in a scenario like the 2008 financial crisis.

(i) Explain which objective(s) are not met.

(ii) Recommend a strategy meeting all three objectives. Justify your response.

Commentary on Question:
Candidates performance varied on this question. Most candidates were able to explain which objective was not met, but very few were able to recommend an appropriate strategy to meet all three objectives.

(i) Objective 3 is not satisfied: Too often, the amount of capital required to fully absorb potential large losses is cripplingly large, reducing the return on capital. This directly violates the third objective.

(ii) Purchase protection through hedging. This will be much less capital intensive and will better satisfy the third objective than your original proposal. It is also easy to calculate hedge ratios and adjust the strategy based on the current situation and the desired exposures the firm wants to protect against, which satisfies the other two objectives.

(e) Describe how increasing θ will affect model results.

Commentary on Question:
Candidates performed poorly on this question. Candidates did not demonstrate sufficient knowledge that θ is the correlation parameter. Candidates were also not able to determine that defaults are expected to increase.

As it relates to MBS, higher values of theta will increase the probability of two defaults at the same time.

Theta can be interpreted as the correlation parameter.

(f) Assess the appropriateness of using the Gumbel copula for quantifying default risk of the MBS portfolio.

Commentary on Question:
Candidates performed poorly on this question. Candidates were unable to provide accurate statements comparing the Gumbel and Gaussian copulas. Most candidates were able to demonstrate that a Gumbel copula could produce fatter tails, but did not associate it with MBSs.

2. Continued

Gumbel is appropriate to use:
Although the Gaussian copula is frequently used to calculate dependence, the Gumbel, actually does a better job of generating extreme events.
Gumbel shows some level of upper tail dependence, while the Gaussian copula has asymptotic independence.
From a risk management perspective, we are interested in the risk of extreme events. Relative to other copula options, the Gumbel is most appropriate.

3. Learning Objectives:

3. Understand and be able to apply different approaches to risk measurement.

Learning Outcomes:

(3a) Evaluate a company's or a portfolio's exposures to various risks.

(3c) Explain how different approaches and tests form a set of complementary investment risk metrics.

Sources:

QFII-115-17: Liquidity Measurement and Management: A Practitioners Guide to Global Best Practices Chapters 2 and 3

Commentary on Question:

This question tested the candidate's knowledge of Balance Sheet Liquidity Analysis. The question required candidates to calculate and interpret the implications of liquidity ratios and identify the limitations of this method. Candidate knowledge and understanding of funding ratios was also assessed in this question.

Candidate performance varied on this question. Most candidates were able to make correct calculations, but many struggled with interpreting or explaining results.

Solution:

(a) Explain the difference between sticky assets and volatile assets.

Commentary on Question:

Candidates performed poorly on this question. Many candidates listed examples of sticky and volatile assets but failed to explain the differences between them.

The value of a sticky asset is resistant to change despite changes in the economic environment, while the value of a volatile asset is more likely to change based on changes in the economic environment.

(b)

(i) Calculate the liquidity ratios for each bank using balance sheet liquidity analysis.

(ii) Compare and contrast their liquidity positions based on the ratios from (i).

Commentary on Question:

Candidates performed well on this question. Most candidates calculated and interpreted liquidity ratios correctly. Some candidates failed to calculate all four liquidity ratio combinations and instead calculated only the sticky or volatile asset liquidity ratios for each bank.

3. Continued

(i) Bank A Sticky Asset Liquidity Ratio:
45/(35+10) = 1

Bank A Volatile Asset Liquidity Ratio:
(50+30)/80 = 1

Bank B Sticky Asset Liquidity Ratio:
80/(70+15) = 0.94

Bank B Volatile Asset Liquidity Ratio:
(10+10)/15 = 1.33

(ii) Bank A is in a better liquidity position than Bank B because both the sticky and volatile liquidity positions match. Bank B has sufficient volatile assets to match volatile liabilities but insufficient sticky assets to match sticky liabilities.

(c) Identify the two reasons why balance sheet liquidity analysis could not be used for this assignment. Justify your response.

Commentary on Question:
Candidates performed very well on this question. Most candidates were able to correctly identify the two most relevant shortcomings for this scenario. Some candidates did not provide justification

Balance sheet liquidity analysis does not consider time dimension. Liquidity issues can develop over time and having a high liquidity ratio now does not imply long-term liquidity will remain the same.

Balance sheet liquidity analysis does not capture off-balance sheet commitments. Bank A has an unused credit line of $100 million that is not accounted for under this analysis but has a significant impact on liquidity.

(d) Describe two appropriate qualitative assessments.

Commentary on Question:
Candidates performed poorly on this question. Many candidates provided two quantitative approaches to evaluating the liquidity position of Bank A instead of qualitative approaches.

3. Continued

Check for a liquidity contingency plan in place that outlining responsibilities and measures to be taken in case of a crisis.

Evaluate IT-infrastructure for capability to produce daily assessments of liquidity risk.

(e)

(i) Explain why the cash flows changed under scenario 2 in each asset.

(ii) Calculate Bank A's funding ratios above 1 year and 6 years in scenario 2.

(iii) Evaluate Bank A's long-term liquidity risk exposure based on the funding ratios from (ii).

Commentary on Question:
Candidates performed poorly on this part of the question. Many candidates did not explain why retail deposits would stay relatively constant when interest rates decrease. Many candidates also struggled to calculate and interpret funding ratios.

(i) Decreased interest rates make the cost of borrowing cheaper, attracting more people to borrow.

Retail deposits stay relatively constant since short-term liquidity needs of retail customers dominates over interest rate changes.

Money market deposits and CDs decrease as customers move money to higher-earning investments.

(ii) Scenario 2 – Year 6 Funding Ratio:
$(53 + 30 + 55 + 33)/(162 + 138) = 0.57$

Scenario 2 – Year 1 Funding Ratio:
$(49 + 25 + 53 + 30 + 55 + 33)/(120 + 162 + 138) = 0.58$

(iii) The base scenario shows sufficient long-term liquidity as both the Year 1 and Year 6 funding ratios are greater than 1.
The funding ratios decreased significantly in scenario 2, implying increased long-term liquidity risk when interest rates decrease.

4. Learning Objectives:

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

1. The candidate will understand the needs and methods of governing investments.

Learning Outcomes:

(1a) Compare the interest of key stakeholders.

(2b) Identify and describe the various kinds of risks, including market, credit, operational, etc.

(2c) Identify and describe various approaches for managing risks including risk budgeting, position limits, etc.

(2d) Explain the features of a best practices enterprise risk management system.

Sources:

"Financial Enterprise Risk Management" by Paul Sweeting - Ch 1

"Managing Investment Portfolios" by Maginn & Tuttle - Ch 9

"Strategic Risk Management Practice: How to Deal Effectively With Major Corporate Exposures" by Andersen & Schroder - Ch.7

Commentary on Question:

Overall, candidates' performance varied on this question. This question, specifically parts (c), (d)(ii), and (e), challenged candidates to think critically by testing their ability to identify risks and risk management approaches for a different type of industry.

Solution:

(a) List the steps of an effective ERM framework.

Commentary on Question:

Candidates performed well on this question. This was a retrieval question and most candidates successfully recalled and listed key steps from one of the syllabus readings.

- Recognizing the context
- Identifying the risks
- Assessing and comparing the risks with the risk appetite
- Deciding on the extent to which risks are managed
- Taking appropriate action
- Reporting on and reviewing the action taken

4. Continued

(b) Propose an implementation plan for establishing an effective ERM framework.

Commentary on Question:
Candidates performed poorly on this question. In general, candidates had difficulty identifying four distinct, acceptable steps. A sample answer is provided below.

- Organize meetings to introduce the language of ERM to the key stakeholders
- Establish a central risk function headed by a CRO
- Determine the central risk function model that works best for the internal culture of the organization (ex. three lines of defense, offense/defense, etc.)
- Seek commitment of senior leaders to putting an ERM framework in place

(c) Identify and describe two risks per category based on the case above.

Commentary on Question:
Candidates performed well on this question. Many candidates were able to successfully identify, categorize, and describe a few risks using the provided information. Some candidates interpreted environmental risks to be related to pollution rather than exogenous factors outside the control of corporate management. A sample answer is provided below.

Environmental:
- Level of unemployment among graduates – government funding depends on employment outcomes
- Immigration issues - uncertainty regarding international students/immigration policies

Industry:
- The university is unable to integrate technology effectively in the classroom compared to the competition
- The university is unable to finance new facilities and renovations required to remain competitive

Company:
- Issues with buildings/grounds/traffic congestion/limited parking because of outdated infrastructure
- Issues with admission and registration processes because of lack of investment

4. Continued

(d)

(i) List the steps in a scenario planning approach.

(ii) Propose a scenario to be evaluated for each of the two environmental risks identified in (c) above.

Commentary on Question:
Candidates performed adequately on this question. Part (i) was retrieval. Most candidates who successfully identified environmental risks in (c) were able to identify scenarios for part (ii).

(i)

- Identify environmental risk factors through the SWOT analysis, risk mapping, etc.
- Elaborate themes that may characterize plausible alternative future developments.
- Describe environmental scenarios that arise under different assumptions about the risk factors.
- Evaluate consequences of key strategic risk factors.
- Formulate new strategic alternatives and evaluate them under the different scenarios.

(ii)

- High unemployment among college graduates.
- The government enacts stricter immigration laws.

(e)

(i) Propose the values for the influence matrix. Justify the values chosen.

(ii) Identify the most important risk based on the results from the matrix. Justify your response.

Commentary on Question:
Candidates performed poorly on this question. Many candidates failed to provide an answer. In part (i), candidates who did provide an answer often had difficulty providing sufficient justification. Some candidates provided a matrix without justification, which received little credit. In part (ii), some candidates incorrectly determined the most important risk using the column (vertical) matrix totals rather than the row (horizontal) totals. A sample answer is provided below, but credit was awarded for different matrix values so long as appropriate justification was provided.

4. Continued

(i)

Influence Matrix	Risk 1	Risk 2	Risk 3	Risk 4	Total
Risk 1	N/A	0	2	2	4
Risk 2	0	N/A	0	0	0
Risk 3	0	0	N/A	2	2
Risk 4	2	2	2	N/A	6

- Risk 1:
  - Affordability influences both relevant programs and enrollment/demand. A more affordable university collects less money, so it may have difficulty offering certain programs. More affordable universities will attract more applicants.
  - Affordability influences employee satisfaction less than the other risks.

- Risk 2:
  - Employee satisfaction has little influence on all other risks.

- Risk 3:
  - Relevant programs influence enrollment/demand because relevant programs will attract more students and differentiate the college from its competitors.
  - Relevant programs have less influence on affordability and employee satisfaction.

- Risk 4:
  - Enrollment/demand influences all other risks. More students means more revenue, so the college can lower tuition. The college needs sufficient demand in its programs for them to be worth offering. Higher demand could indicate a more prestigious university, leading to employee satisfaction since they are proud to work there.

(ii) Risk 4 (enrollment/demand) is the most important risk because it has the highest row total in the influence matrix, meaning it is the most influential on other risks.

5. Learning Objectives:

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

Learning Outcomes:

(2c) Identify and describe various approaches for managing risks including risk budgeting, position limits, etc.

(2e) Evaluate a company's risk management process.

(2f) Examine examples of risk management failure.

Sources:

"Managing Investment Portfolios" by Maginn & Tuttle - Ch 9

"The Four Faces of an Interest Rate Model" by Fitton & McNatt

Commentary on Question:

Candidates performed poorly on this question. Most candidates did not provide enough detail for full credit, especially for parts (b) and (c).

Solution:

(a) Describe risk neutral pricing.

Commentary on Question:

Candidates performed adequately on this question. Most candidates understood that risk neutral pricing is discounted at the short rates but did not provide enough additional detail to produce a more comprehensive response.

Estimates the price of an interest-sensitive instrument by averaging the present value of cash flows arising across a set of scenarios generated from a risk neutral interest rate model, discounted at the scenario-specific short rates.

(b) Explain the rationale for using risk neutral pricing on interest-sensitive securities.

Commentary on Question:

Candidates performed very poorly on this question. Most candidates were able to recall that without risk neutral pricing, the term premium would be extremely difficult to estimate. However, few candidates were able to explain how risk neutral pricing simplifies the valuation to only use the spot rate for discounting the respective term's cash flows.

Valuation is simpler by changing the probability distribution of the short rate so that the expected return of investing at the short rate over a given term is equal to the spot rate for that same term. Without risk neutrality, a sophisticated method of discounting that accounts for market risk is needed.

5. Continued

(c) Recommend the most appropriate interest rate model for pricing securities in HAQ's portfolio. Justify your response.

Commentary on Question:
Candidates performed poorly on this question. Most candidates were able to deduce that the risk neutral, equilibrium model is the most appropriate interest rate model to use. However, most did not tie to the circumstances of HAQ. Partial credit was given for candidates that provided reasons not to use other models.

The most appropriate model would be a risk neutral, equilibrium model.

HAQ's assets are below investment grade and private, which are relatively illiquid and thus might have unrealistic prices. An equilibrium model should be used because arbitrage-free models do not consider the reasonability of prices in input data.

HAQ's assets are bonds, which are interest-sensitive securities. Risk neutral models are better suited to pricing interest-sensitive securities than realistic models are, as they consider the behavior of the term structure over time.

(d)

(i) Identify the above model.

(ii) Explain two limitations of using this type of model for stress testing.

(iii) Recommend a more appropriate type of model for stress testing. Justify your response.

Commentary on Question:
Candidates performed adequately on this question. Most candidates were able to identify the model as an arbitrage-free, realistic model in part (i), identify that the term premium cannot be reliably estimated in part (ii), and propose a realistic equilibrium model in part (iii).

5. Continued

(i) The above model is an arbitrage-free, realistic Black Karasinski model

(ii) This model's term premium cannot be reliably estimated. Stress testing requires a realistic term structure process.

(iii) A realistic equilibrium model would be more appropriate because companies want to review results for stress testing under real-world conditions and this model type has a function for term premium that will allow for results that reflect these conditions.

6. Learning Objectives:

1. The candidate will understand the needs and methods of governing investments.

Learning Outcomes:

(1a) Compare the interest of key stakeholders.

(1e) Explain how governance may be structured to gain competitive advantages and efficiencies.

Sources:

Strategic Management Ch 11

Investment Ethics, Peek Ch 7

Commentary on Question:

This question tested the candidate's ability to assess the impact of company actions on various stakeholders. It also required the candidate to apply their knowledge of governance to a specific business case. Overall, candidates performed well this question.

Solution:

(a) Describe the impacts of the two actions on the three stakeholders:

(i) Over a short-term period.

(ii) Over a long-term period.

Commentary on Question:

Candidates performed well on this question. While candidates were consistently able to assess the impact for both the short-term and long-term for stockholders, as well as the long-term impact on consumers, several candidates did not fully consider the short-term impacts on employees and consumers.

(i) <u>Short-term:</u>
Employees – work longer hours to learn new processes
Consumers – not directly impacted
Stockholders – profits will decrease due to initial investment and shift of employee focus

(ii) <u>Long-term:</u>
Employees – potential layoffs after processes have been automated; better job satisfaction for those who remain
Consumers – cheaper prices with automation and better customer service experience
Stockholders – profits expected to increase

6. Continued

(b) Critique the positive and negative characteristics of this board.

Commentary on Question:
Candidates performed well on this question. Many candidates provided the negative characteristics of the structure, but fewer could explain the positive characteristics.

Positive:
Members have an understanding of company and its culture since many have worked at the company
Good balance of tenure period
Retired members should have more time for board responsibilities

Negative:
Less independence with few outside directors
Older members may be less concerned with company reputation in the long term
Those with long tenures may be entrenched

(c) Recommend whether the board should approve the stock options. Justify your response.

Commentary on Question:
Candidate performance varied on this question. While the majority of candidates were able to correctly recommend not to approve this action, only a small portion addressed the effect that this action would have on management incentive.

No, the board should not approve this action. This is called "option spring loading", which lowers management's incentive to raise the stock price.

(d) Recommend the most appropriate type of compensation for each of these objectives. Justify your response.

Commentary on Question:
Candidates performance varied on this question. While most candidates appropriately mentioned the use of restricted stock and/or accounting-based bonuses, few recommended a stable base salary.

6. Continued

1. Salary – solid base salary encourages management to stay with the company

2. Accounting-based bonus – directly tied to the earnings of the company, will incentive employees to maximize earnings relative to competitors

3. Restricted stock units - can be awarded so that the transfer of ownership occurs after 1-5 years which would encourage management to grow the stock over the long term