QFI IRM Model Solutions
Fall 2014

1. Learning Objectives:

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

Learning Outcomes:

(1e) Understand the importance of an organizations culture in effectuating governance.

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

(1g) Demonstrate understanding of how ethics relates to business decision-making, and relate ethics in business to personal ethics.

Sources:

Governance and Investment of Public Pension Assets: A Practioners Perspective

Strategic Management: An Integrated Approach, Hill & Jones, Chapter 11: Corporate Performance, Governance and Business Ethics

Commentary on Question:

The question provided candidates with an opportunity to discuss governance and ethics. The question also asked to student to identify reasons for underperformance.

Solution:

(a) Recommend a candidate for the position on the governance board.

Recommend Ms. Jones.
Both have appropriate backgrounds and qualifications. Ms. Jones has shown independence.

(b) Evaluate the above statement and support your response with an example.

Commentary on Question:

Candidates were expected to know that ethics goes beyond just compliance with the law and to provide an example. While there were other reasonable examples, most chose an example from the reading.

1. Continued

It's possible to act within the bounds of the law and still not meet ethical standards. An example would be a company that operates with sub-standard wages and working conditions in a third world country, but meets the legal standards of that country.

(c) Describe three additional ways to promote ethical decision making in the management of the pension fund.

Commentary on Question:
Candidates would need to list and describe 3 items. No credit was given beyond three items. The items below were typical.

Make sure that leaders with the firm not only articulate the rhetoric of ethical behaviour but also act in a manner that is consistent with that rhetoric. Setting an example will encourage ethical behavior from employees.

Require that ethics be considered as part of the decision making process.

Use ethics officers monitor and promote ethical behavior

Put a strong governance process in place, take necessary steps to assure ethical standards are met.

(d) Identify two additional governance factors and describe why they are critical to the successful management of the pension fund.

Commentary on Question:
Many Candidates had difficulty with this section of the question.

The plan should have a clear mission, for example clear objectives as to investment policy.

A strong governance structure will help in managing agency issues.

(e) Identify what areas should be the focus of an investigation into the fund's cost structure.

Commentary on Question:
There was a range of candidate answers. The four items below would earn full credit.

- The cost of price discovery
- Possible high portfolio turnover
- Any trades not in best interest of plan
- is the plan realizing efficiencies and economies of scale

2. Learning Objectives:

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

Learning Outcomes:

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

Sources:

"Correlation: Pitfalls and Alternatives" RISK, Vol. 12, No. 5, (May 1999), pp. 69-71

Risk Aggregation Basel Committee on the Developments of Risk Aggregation

Commentary on Question:

The general theme is correlation and the limitations of common modeling approaches. Specific comments below by section.

Solution:

(a) List four drawbacks for the use of linear correlation as a dependency measure of the risks.

Commentary on Question:

The candidate would earn credit for four items. The following 6 items were common responses.

Correlation is simply a scalar measure and does not adequately capture the dependence structure of risks.

Perfectly positively dependent risks do not necessarily have a correlation of 1; Perfectly negatively dependent risks do not necessarily have a correlation of -1.

A correlation of zero does not indicate independence of the risks.

Possible values of correlation depend on the marginal distributions of the risks. All values between -1 and 1 are not necessarily attainable.

Correlation is defined only when variances of the risks are finite.

Correlation is not invariant under transformations of the risks.

(b) Describe one class of multivariate distribution for which the use of correlation to measure dependence between risks would be appropriate.

Elliptical distribution, for example multivariate normal.

2. Continued

(c)

(i) Describe tail dependence in the context of two risks.

(ii) Explain whether the Gaussian copula is a good choice for modeling tail dependence.

Commentary on Question:
The candidate should have a clear understanding of the concept of tail dependence, and be able to recognize that the Gaussian copula fails to adequately model tail dependence.

Tail dependence occurs when there is a higher correlation between two risks as extreme (i.e. tail values are realized). Large losses from both risks may occur simulataneously. The Gaussian copula is not a good choice for modeling tail dependence, large losses from multiple risks understated.

(d) Calculate the aggregate loss for the third scenario.
(Note: The cumulative distribution function and the probability density function of an exponentially distributed random variable x is $F(x) = 1 - e^{-\lambda x}$, respectively with the mean being $1/\lambda$.)

Commentary on Question:
This part is a straight forward calculation. Step 1, invert the CDF. Then parameterize and solve.

We have $F(x) = 1 - e^{-\lambda x}$, so x = -ln(1-u)/λ

For X_1, λ=1/8

x = 8*-ln(1-.864)=15.96

For X_2, λ=1/13

x = 13*-ln(1-.160)=2.27

Aggregate loss = $X_1 + X_2$ = 18.23

2. Continued

(e) Demonstrate that each marginal risk distribution is uniform on [0, 1].

$C_\beta(u, 1) = e^{(-(-\ln u)^{(1/\beta)}+(-\ln 1)^{(1/\beta)}\}^\beta}$
$= e^{(-\{(-\ln u)^{(1/\beta)}+ 0\}^\beta}$
$= e^{\ln u}$
$= u$

Repeat for $C_\beta(v, 1)$

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 risk measurement.

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.

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

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

Sources:

Chapter 14: Merging the Risk Management Objectives of the Client and Investment Manager,

Chapter 2: Practical Issues in Choosing and Applying Risk Management Tools

Commentary on Question:

This question tests the candidate's ability to apply risk management and risk analysis tools to a specific set of circumstances

Solution:

(a) Identify advantages and disadvantages of using the tracking error metric..

Commentary on Question:

This was a straightforward recall item that most candidates did well on

Advantages

- Simple to use and explain
- Can be decomposed into sources of risk

Disadvantages

- Does not consider tail events
- Does not give intuition into size or probability of underperformance

(b) Calculate the ex-ante tracking error of David's forecast.

Commentary on Question:

About 1/3 of candidates received full credit on this section. Many candidates did not solve for tracking error

3. Continued

Differences are: { 0.02, 0.02, 0.04, 0, 0.01}

Average difference is 0.018

Standard deviation = $\sum_{j=0}^{n} (X_{j-} \bar{X})^2$ / n

= 0.01326 (Accepted answers quoted in % as well.)

(c) Critique each statement

Commentary on Question:
Candidates general did well in identifying the first two statements as false and providing appropriate justification but were less successful in identifying the 3rd statement as being false

1st statement is false. Even if the duration is lower, the tracking error may be higher.

2nd statement is false. Even if the portfolio exposure does not change, the underlying economic circumstances and environment could change.

3rd statement is false. Even if the spread duration gap is larger, the full level of risk is a function of spread duration gap and level of spread volatility. Since the overall level of interest volatility is greater, multiplying by a lower level of interest duration gap could still result in more risk overall.

(d) Identify the issues with both portfolios with respect to the three aspects above.

Commentary on Question:
While many candidates made isolated observations, very few candidates accurately describe all three attributes of portfolio performance

David's portfolio tracks well the first half of the projection but then shows evidence of style drift

David's portfolio shows evidence of extreme events in periods 15 and 16

David's portfolio shows less volatility than Jackie's

3. Continued

(e) David would like to reduce tracking error in the future by improving his model (described earlier). Recommend a process for improving the accuracy of David's model.

Commentary on Question:
Even the best candidates were typically only able to identify 2 or 3 items

Marginal analysis to identify the contribution of each risk

Monte Carlo simulations can help identify extreme events.

Backtesting

Looking at other metrics could be a way to ensure that results are consistent across models.

Purchase vendor best-in-class model

Communication with the portfolio manager is the best place to start.

4. Learning Objectives:

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

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.

(2f) Examine examples of risk management failure.

Sources:

Sweeting, Chapter 20: Case Studies

Haslett 33, Risk Management Programs

"Financial Enterprise Risk Management" by Sweeting Ch. 8 "Risk Identification"

"The Top 10 Operational Risks: A Survival Guide for Investment Management Firms and Hedge Funds" by Miller and Lawton Ch. 3

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Describe how risk culture in each of the two cases contributed to their respective failures.

Commentary on Question:

Candidates needed to provide 3 correct responses for each case to receive full credit. Many candidates either did not read the cases or misunderstood what led to their respective failures.

Barings:

- Lax oversight
- Few questions asked by management for why profits were so high from a supposedly low-risk arbitrage strategy
- Compensation was key incentive that drove the rogue trader to take excessive risk

4. Continued

Equitable Life
- Arrogant superiority within the management
- Held an isolated position in the insurance industry
- Concentrated key roles in having appointed actuary also serve as CEO
- Took excessive risk without realizing it

(b) Explain how these axioms could have helped prevent the failures in each case study.

Commentary on Question:
Candidates were only generally only able to produce 1 or 2 explanations and thus received partial credit.

Barings:
- 2 – question what losses the straddle could have caused
- 3 – might have eliminated the two reporting lines
- 4 – policies could have exposed this early
- 5 – anticipate market disaster

Equitable Life
- 1 – more robust models could have shown a bigger decline in rates
- 2 – Are we doing things other companies aren't?
- 3 – would have prevented CEO and appointed actuary from being the same person
- 4 – could have caught that policyholders should have been notified of the new class
- 5 – ask what if interest rates fall to zero?

(c) Recommend the most appropriate technique to assess this risk.

Commentary on Question:
Candidates were generally able to describe the techniques but were not always able to recommend the correct approach.

- Pilot survey – Useful as a preliminary survey. In this case, we have already identified the risk and are looking for a more detailed risk assessment. The other two techniques should be more appropriate for risk assessment (not just identification)

4. Continued

- Gap Analysis – Assesses desired and actual levels of risk exposure, demonstrating risk gap at the company. Involves some level of risk assessment, but for inflation risk it might be more helpful to survey acknowledged experts (as used in the Delphi Technique). Also Gap Analysis is not as flexible as other techniques

- Delphi Technique – Continual surveying of experts until there is consensus. Allows much more flexibility than surveys otherwise might in order to make best use of expert knowledge. Time is also taken to properly analyze the results rather than just aggregating answers. This is the most appropriate due to the expertise and analysis required to assess inflation risk.

- All surveys have similar weaknesses including: responses heavily influenced by the way questions are asked; generally require multiple choice approach, which limits responses; free text responses are difficult to analyze; introduction of bias unless some sort of weighting is applied to responses.

(d)

(i) Identify any potential operational risks uncovered by the consultant.

(ii) Critique the consultant's conclusions.

(iii) Recommend to the firm 4 corrective actions that could be taken to mitigate the operational risks you identified in part (i).

Commentary on Question:
Candidates did not perform well on this question. Many candidates critiqued the company itself instead of critiquing the consultant's conclusions. Many candidates were not able to provide correct operational risk mitigation actions.

(i) Key-person risk and workflow documentation risk

(ii) Key Person Risk (Excerpt 1)
- "The firm contains many small, highly specialized operational teams to handle specific asset classes, investment strategies and clients. We note that this allows management to place their best people in particularly challenging areas." - Nothing particularly wrong with this statement.
- "Additionally, clients like to hear that the firm has teams dedicated to their fund." This statement sounds correct, but it would not bode well for the firm if the dedicated team left the company.

4. Continued

- "Further, there are numerous, irreplaceable specialists within the firm, assuming either sole responsibility for a function or client relationship. We view this as an advantage as it sends a signal of expertise to clients. Additionally, having an individual responsible for maintaining the relationship with clients helps build continuity and rapport between the firm and the clients." The consultant notes several observations in Excerpt 1 that depict key person risk (e.g. many small, highly specialized operational teams, irreplaceable specialists with sole responsibility for either a function or client relationship), but fails to see the danger
- The consultant incorrectly concludes that the current operational set up (that is striken with key person risk) as sending a signal of expertise to clients and is a great way to build continuity and rapport with clients.

Workflow Documentation Risk

- "In review of the firm's formal documentation of processes, procedures and workflows, we find the firm to be significantly deficient. For the majority of the firm, documentation is absent or severely outdated." - This assessment of the firm's workflow documentation is accurate given the observation
- "The firm likely experiences significant duplication of work efforts and management cannot ensure operational controls are in place. " - This is a reasonable consequence
- "Additionally, we expect the firm will have difficulties in training new employees and is severely at risk of being unable to perform critical functions if it were to experience significant employee turnover or a disaster. This is a serious issue that requires immediate attention from the firm. " - The consultant's conclusion is on target. There would be difficulty in ensuring continuity if there was significant employee turnover without proper documentation.
- The key person risk is exacerbated in light of the lack of documentation. It makes it harder to find and train a replacement that can quickly take on a vacated role of concentrated importance.

(iii)

- Effective cross-training
- Avoid overly concentrated roles – share critical responsibilities / client relationships between more than 1 employee.
- Mandatory two week vacation without access to email or the office
- Key-life insurance
- Effective and continuous documentation of key processes and procedures (solves both risks)
- Managers must ensure staff actually follow documentation

4. Continued

- Documentation should be available online and available in the event of a disaster

5. Learning Objectives:

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

Learning Outcomes:

(1a) Compare the interest of key stakeholders.

(1b) Explain principal versus agent conflict.

(1d) Describe governance mechanisms that attempt to address these conflicts.

(1e) Understand the importance of an organizations culture in effectuating governance.

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

Sources:

Integrated Risk Management, Doherty Chapter 7: Why is Risk Costly to Firms?

Commentary on Question:

The question provided candidates with an opportunity to assess manager agency issues in a business situation and identify possible alternative compensation structures

Solution:

(a) Describe two features of a country's tax code that could create the convexity referenced in the statement above

Commentary on Question:

This was a fairly straightforward recall item. Most candidates generally did well

Non linearity of tax schedule

Deductions for items such as depreciation and loss carrybacks

(b) Illustrate how convexity in the tax function can cause the expected value of taxes to be affected by risk.

Commentary on Question:

Candidates generally did well in this section. Many candidates provided a graphical illustration rather than a verbal description. Both the illustration and a verbal response were accepted.

Given convexity, it means that for the same amount of expected taxable income, expected tax is higher for a more dispersed distribution. Higher volatility will give a more dispersed distribution of taxable income, which increases the expected tax payment.

In contrast, hedging can reduce expected tax payment

5. Continued

"The attraction of shareholders to high risk investments always leads to 'asset substitution'. 'Asset substitution' involves the firm raising debt and promising to undertake a low-risk project. After securing the funds, it then substitutes a high risk investment causing a wealth transfer from bondholders to shareholders."

(c) Assess the above statement

Commentary on Question:
Most candidates failed to address that the 1st part of the statement is not always true

The 2nd part of the statement is correct. The first part of the statement could happen but does not always happen

(d) Describe the measures that could be taken by bondholders to mitigate the situation.

Commentary on Question:
Candidates generally did not do well on this section. Very few were able connect the situation to the potential bondholder actions

Bondholder will push up the credit spread as the riskiness is raised. This will impact the bond price and the attractiveness of the bond. It will increase the cost of debt for the company

(e) Describe an alternative situation that could also arise from the asymmetry in the payoff to the shareholders and the bondholders.

Commentary on Question:
Most candidates identified underinvestment, but, few provided additional explanations

Another situation is "Underinvestment" when a firm is likely for forgo positive NPV projects, due to other risks of the firm

Shareholders are likely to pass positive NPV projects as they pay the full cost of the project but may benefit only under certain circumstances

The greater the risk the more likely that underinvestment will occur

If the firm can lower the risk, it can make bonds more attractive & thereby lower the cost of the firm's debt

"One way to incent managers of a company to hedge risks, and thus add value, is to compensate them with a company stock-options plan."

5. Continued

(f) Assess the above statement

Commentary on Question:
Most candidates provided only a limited responses rather than in integrated response.

Managers are likely to take decisions that serve their own interest

Managers are more likely to hedge certain risks when they have a self interest in the value of the firm

Whether stock options add to manager's wealth depends on the strike price

Several studies have shown that hedging risks usually lowers the value of stock options, hence, managers with stock options tend not to hedge

(g) Describe an alternative compensation scheme that would better incent managers to hedge company risks

Commentary on Question:
Most candidates were able to identify an appropriate program

Stock ownership plans
or
"incentive compensation" or performance-related compensation"

In both plans, managers are likely to hedge risks because managers will reduce their own risk and keep efficiency gains from the hedges