

Exam QFIIRM

Date: Friday, October 30, 2020

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This examination has 6 questions numbered 1 through 6 with a total of 40 points.

The points for each question are indicated at the beginning of the question.

2. While every attempt is made to avoid defective questions, sometimes they do occur. If you believe a question is defective, the supervisor or proctor cannot give you any guidance beyond the instructions provided in this document.

Written-Answer Instructions

1. Each question part or subpart should be answered either in the Word document or the Excel file as directed. Graders will only look at work in the indicated file.
 - a) In the Word document, answers should be entered in the box marked ANSWER. The box will expand as lines of text are added. There is no need to use special characters or subscripts (though they may be used). For example, β_1 can be typed as beta_1 (and ^ used to indicate a superscript).
 - b) In the Excel document formulas should be entered. Performing calculations on scratch paper or with a calculator and then entering the answer in the cell will not earn full credit. Formatting of cells or rounding is not required for credit.
 - c) Individual exams may provide additional directions that apply throughout the exam or to individual items.
2. The answer should be confined to the question as set.
3. The Word and Excel files that contain your answers must be uploaded before time expires.

Recognized by the Canadian Institute of Actuaries.

1. (7 points) You are a consultant for small insurance company, SLC, in the United States. To align with industry best practices, the Board has decided to form a risk management committee at SLC.

(a) (1 point) List four responsibilities for the new risk committee.

ANSWER:

The Board asks you to review candidates for the new risk committee.

- John is a seasoned director at SLC, and has helped the company establish a variety of longstanding processes.
- Jane has been at SLC for one year. She has served on risk committees of a number of consulting firms, for a total of 10 years.
- Al has been at SLC for over 15 years, has worked for John, and is responsible for maintaining the underwriting processes.
- Beth has been at SLC for 5 years, working in different departments. She has just passed her final actuarial exam.

(b) (2.5 points)

(i) List four qualifications for members of an effective risk committee.

ANSWER:

(ii) Assess each candidate's qualifications.

ANSWER:

(iii) Recommend the two most qualified individuals.

ANSWER:

1. Continued

After SLC has formed its risk management committee, you are asked to assist the company in developing its risk management framework. The committee has identified the following risk categories and risk reports:

Risk Categories

- Market Risk
- Underwriting Risk
- Credit Risk
- Operational Risk

Risk Reports

1. Internal audit results
2. Value at risk
3. Sales of new life insurance products
4. Enterprise-wide risk report

- (c) (1 point) Identify the most appropriate risk category for each risk report.

ANSWER:

1. Continued

You are asked to review the risk management framework, which has the following components:

- The company favors regulatory prescription in setting risk tolerances and limits, as this will promote transparency and consistency.
- Major lines of business within the company should meet monthly to discuss issues and developments related to the risk appetite metrics.
- The process of assessing risk on a qualitative basis should be independent of the process of assessing risk on a quantitative basis.
- Experience studies are updated annually with additional resources that can provide updates as needed, to manage the pricing risk.

(d) (2.5 points)

(i) Critique each component.

ANSWER:

(ii) Recommend any changes to the components above.

ANSWER:

2. (8 points) Bob is an individual investor who has recently acquired an inheritance of USD 2,500,000. Bob identifies two attractive equity indices, Index Y and Index Z. The performance of the indices can be approximated by normal distributions. Bob is actively employed and focused on maximizing his investment return relative to risk taken.

(a) (0.5 points) Describe an efficient frontier in the context of portfolio management.

ANSWER:

Bob's initial investment is outlined in the table below:

Table 1: Initial Investment:

	Index Y	Index Z
Return	10%	7%
Volatility	15%	12%
Investment (USD)	1,250,000	1,250,000
Correlation (Index Y, Index Z)	0.3	
Time Horizon	1 year	

(b) (3 points)

(i) Calculate the marginal VaR for each index at a 95% confidence level.

The response for this part is to be provided in the Excel spreadsheet.

(ii) Explain which index carries more marginal risk.

The response for this part is to be provided in the Excel spreadsheet.

(iii) Recommend directionally how to reach the optimal portfolio.

The response for this part is to be provided in the Excel spreadsheet.

2. Continued

After three years, Bob has decided to retire. He is now concerned with minimizing risk and meeting income needs. His investment after the three years is illustrated below:

Table 2: Investment after Year 3:

	Index Y	Index Z
Return	10%	7%
Volatility	20%	15%
Investment (USD)	1,500,000	1,300,000
Correlation (Index Y, Index Z)	0.3	

- (c) (1 point) Calculate the probability that Bob's portfolio declines in value over the next year.

The response for this part is to be provided in the Excel spreadsheet.

Bob would like to minimize the risk of his portfolio by selling his position from either Index Y or Index Z for cash. He is considering the following measures to determine from which index he should withdraw funds:

- Incremental VaR (1 year, 95%)
- Component VaR (1 year, 95%)
- Expected return

- (d) (3.5 points)

- (i) Identify the measure most suitable for Bob's situation.

The response for this part is to be provided in the Excel spreadsheet.

- (ii) Calculate the measure chosen in i) for both positions in the portfolio based on Table 2.

The response for this part is to be provided in the Excel spreadsheet.

- (iii) Recommend which index to reduce his position from based on your results.

The response for this part is to be provided in the Excel spreadsheet.

3. (6 points) You are an actuarial student studying the following three case studies.

- Korean Air Flight 801
- Equitable Life Insurance
- Bernard Madoff

You are considering the following five of the “Top Ten” operational risks:

- Amalgamated Assignments
- Complacency
- Handoffs
- Reading the Fine Print
- Reconciliation Gaps

(a) (1 point) Describe each of the above operational risks.

ANSWER:

(b) (2 points)

(i) Identify the one operational risk most relevant to all three case studies.

ANSWER:

(ii) Explain how this particular risk was present in each of the three case studies.

ANSWER:

(iii) Describe how a best practices enterprise risk management system would have addressed this risk for each case study.

ANSWER:

3. Continued

(c) (2 points)

- (i) Identify one “Top Ten” operational risk that is most relevant to the Korean Air Flight 801 case study but not the other two case studies.

ANSWER:

- (ii) Identify one “Top Ten” operational risk that is most relevant to the Bernard Madoff case study but not the other two case studies.

ANSWER:

The risks identified in parts (b) and (c) are inserted into the table below as [Operational Risk 1], [Operational Risk 2], and [Operational Risk 3] in some order. Each case study is represented by a column in the table with ✓-marks indicating the most relevant “Top Ten” operational risks present in the case study.

	[Case Study A]	[Case Study B]	[Case Study C]
[Operational Risk 1]		✓	
[Operational Risk 2]	✓	✓	✓
[Operational Risk 3]	✓		
Amalgamated Assignments	✓		✓

- (d) (1 point) Identify which of the three case studies best corresponds to each of Case Study A, Case Study B, and Case Study C in the table.

It is not necessary to create a table; a list identifying the case study belonging to each of A, B, and C is sufficient.

ANSWER:

Please note that for the purposes of this question, exact notation is not required. For example, F_1 will be considered the same as F_1 and F^1 will be considered the same as F^1 .

4. (7 points) You are an analyst in the investment department of a large insurance company. You wish to simulate a collateralized debt obligation (CDO) after calibrating your copula to fit market prices.

(a) (2 points)

(i) Describe the steps necessary to simulate a loss distribution given random variables X_1, X_2, \dots, X_n with distributions F_1, F_2, \dots, F_n , and a copula $C(u_1, \dots, u_n)$.

ANSWER:

(ii) Compare and contrast the use of rank correlation and linear correlation for copula calibration.

ANSWER:

4. Continued

The company is considering purchasing two CDOs – CDO A and CDO B. You have been asked to assess their risks.

CDO A contains 100 equally-weighted, investment-grade issuers. You are given the market prices for the three tranches. Using the one-factor Gaussian copula model, you calculate the correlation needed to replicate the market prices for each tranche, as shown:

Seniority	Correlation
Equity	20%
Mezzanine	18%
Senior	25%

Your coworker reviews your results and states:

1. The underlying default dependence structure is not a function of tranche seniority.
 2. The correlations should be identical for all tranches.
- (b) (1 point) Critique your coworker's statements.

ANSWER:

4. Continued

CDO B contains 20 equally-weighted issuers. Historical data indicates that this CDO has the following properties:

- Asymmetric default risk, as the issuers are clustered around certain locales/industries
- High tail dependence between the bond issuers

To model defaults on a tranche from this CDO, you are considering the following copulas:

1. Gaussian Copula
2. Student- t Copula
3. Gumbel Copula

- (c) (1.5 points) Assess the appropriateness of each copula to quantify the risks of this CDO.

ANSWER:

Your manager is concerned with risks similar to those faced by public firms in the 2008 Financial Crisis and has asked you to perform a broader scenario-based risk analysis.

- (d) (0.5 points) Describe one advantage and one disadvantage of evaluating risks using scenario-based aggregation.

ANSWER:

4. Continued

The company has set the following objectives should a similar financial crisis occur:

- Limit the exposure to loss from credit defaults
- Maintain sufficient liquidity to be able to act on potential acquisition opportunities during a crisis

You are developing actions that can be taken to meet the above objectives. In doing so, you take note that your firm has a substantial long position in mezzanine tranches.

You are considering the following potential actions:

1. Sell protection on super-senior tranches instead of mezzanine tranches
2. Reduce the allocation in CDOs and purchase treasuries
3. Purchase credit default swaps (CDS) for hedging

- (e) *(1.5 points)* Assess the effectiveness of each action in meeting the company's objectives.

ANSWER:

- (f) *(0.5 points)* Recommend the most appropriate action.

ANSWER:

- 5.** (6 points) You have been hired by a group of shareholders of Flying High, which provides jets to airline companies. Flying High, under the recommendation of the head engineer, is rushing to develop a new jetliner as it seeks an edge in the competitive jet production market.

Flying High has one major competitor, Soaring Air, which recently launched an updated jetliner. Flying High produces all of its jets in Country X but is headquartered in Country Y. Country X features low labor and capital costs but has recently seen some political unrest.

- (a) (1 point) Identify and describe four risks faced by Flying High.

ANSWER:

The team developing the jetliner consists of only engineers. The head engineer receives a large bonus for each new product that is cleared for production. He recently recommended bypassing the required internal safety review, which often takes a year to complete, because the jet is based on a current product. Other engineers endorsed the decision because it was consistent with precedent set by the head engineer.

- (b) (1 point)

- (i) Identify and describe two sources of conduct risk.

ANSWER:

- (ii) Recommend an approach to mitigating each conduct risk.

ANSWER:

5. Continued

The company's current ERM process consists of the following practices:

1. The ERM team consists of only the CEO and CFO and periodically issues reports to the board.
2. Risk management is solely the responsibility of the ERM team.
3. The company's risk policy manual specifies bringing all concerns to the ERM team but does not specify philosophy or measurable outcomes.

(c) (2 points)

- (i) Critique the ERM process of Flying High.

ANSWER:

- (ii) Recommend five actions to enhance the ERM process of the firm.

ANSWER:

The most recent shareholder meeting led to the following observations:

- The board consists of 10 current and former executives in the airline industry.
- A majority of members of the board serve on several other boards, which include companies that do business with Flying High.
- The board meets twice a year, and the CEO is generally present.

(d) (1 point) Recommend four improvements to the board structure.

ANSWER:

5. Continued

The board is considering an accounting-based bonus for the CEO, which will be based on how Flying High's performance compares to one of the following benchmarks:

1. Flying High's prior year's performance plus 5%
 2. Performance of the best performing competitor in the airline industry for the current year
 3. Average performance of competitors in the airline industry for the current year
 4. Flying High's average performance over the last three years
- (e) (1 point) Recommend the most appropriate benchmark.

ANSWER:

6. (6 points) You are a risk manager for a large insurer that specializes in products that guarantee a fixed interest rate. Your organization wants to improve the risk identification process for market risks.

(a) (1 point) Describe four modes of viewing the environment that can be used to identify market risks.

ANSWER:

Historically, market risk management has been directly handled by the asset manager, who describes to you their risk management practices:

1. The team uses a floating rate bond index as a benchmark for portfolios backing the firm's liabilities.
2. Risk limits are set based on the standard deviation of returns relative to the benchmark.
3. The manager invests in illiquid assets that have no observable market prices, so the team values these assets using a model that was developed internally.
4. A new employee, who recently graduated from a top university, develops the model and approves the valuations.
5. The team ensures that the regulatory capital required on their investments does not exceed a certain percentage of the company's total available capital.

(b) (2.5 points)

(i) Critique each practice.

ANSWER:

(ii) Recommend one improvement for each flawed practice.

ANSWER:

6. Continued

Your risk management team plays a key role in the company's asset allocation process. To evaluate two proposed asset allocation strategies, your market risk analyst puts together the following return scenarios. The risk-free rate is 0%.

Expected Returns		
	Economic Scenario	
Investment Strategy	<i>Strong Economy</i>	<i>Weak Economy</i>
<i>Overweight Credit Risk</i>	10%	2%
<i>Underweight Credit Risk</i>	5%	4%
Scenario Likelihood	40%	60%

(c) (1.5 points) Show all work by typing out the calculation.

(i) Calculate the Sharpe ratio for each strategy.

ANSWER:

(ii) Recommend one of these strategies.

ANSWER:

6. Continued

After getting your recommendation, the portfolio manager puts together an asset allocation with the following exposures and regulatory capital requirements:

Current Asset Allocation			
	Portfolio Exposure (\$M)	Required Capital Factor	Total Required Capital (\$M)
	A	B	C = A x B
Treasuries	10	0%	0.0
Investment Grade Bonds	80	1%	0.8
High Yield Bonds	10	10%	1
Total	100		1.8

The firm's risk limit states that required capital cannot exceed \$2M. Your credit analyst estimates that 10% of Investment Grade bonds will be downgraded to High Yield next year.

(d) (1 point) Show all work by typing out the calculation.

(i) Calculate the new regulatory capital requirement under this scenario.

ANSWER:

(ii) Recommend any necessary changes to the asset allocation.

ANSWER:

****END OF EXAMINATION****