



Exam QFIIRM

Date: Tuesday, October 30, 2018

Time: 2:00 p.m. – 4:15 p.m.

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This examination has a total of 40 points.

This exam consists of 5 questions, numbered 1 through 5.

The points for each question are indicated at the beginning of the question.
2. Failure to stop writing after time is called will result in the disqualification of your answers or further disciplinary action.
3. 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 on the exam booklet.

Written-Answer Instructions

1. Write your candidate number at the top of each sheet. Your name must not appear.
2. Write on only one side of a sheet. Start each question on a fresh sheet. On each sheet, write the number of the question that you are answering. Do not answer more than one question on a single sheet.
3. The answer should be confined to the question as set.
4. When you are asked to calculate, show all your work including any applicable formulas. When you are asked to recommend, provide proper justification supporting your recommendation.
5. When you finish, insert all your written-answer sheets into the Essay Answer Envelope. Be sure to hand in all your answer sheets because they cannot be accepted later. Seal the envelope and write your candidate number in the space provided on the outside of the envelope. Check the appropriate box to indicate Exam QFIIRM.
6. Be sure your written-answer envelope is signed because if it is not, your examination will not be graded.

Tournez le cahier d'examen pour la version française.

Recognized by the Canadian Institute of Actuaries.

****BEGINNING OF EXAMINATION****

1. (7 points) A portfolio consists of stocks A and B and has a market value of \$200 million. You and your colleague are discussing various methodologies for calculating VaR on the portfolio.

- The expected monthly return on stock A is 0.85% with monthly standard deviation of 3.20%
- The expected monthly return on stock B is 0.95% with monthly standard deviation of 5.26%
- The stocks are equally weighted in the portfolio
- The correlation between the two stocks is 0.35

(a) (1 point) Calculate the 5% weekly VaR for this portfolio using the variance-covariance approach.

Your colleague decides to estimate 5% weekly VaR using the Monte Carlo approach. 100 random outcomes are generated and the worst 10 are given below (in millions of dollars).

Rank	100th	99th	98th	97th	96th	95th	94th	93th	92th	91th
Profits	-5.391	-5.385	-5.291	-5.107	-5.1	-5.049	-4.997	-4.983	-4.977	-4.955

(b) (0.5 points) Calculate the 5% weekly VaR using the Monte Carlo approach.

(c) (1 point) Compare and contrast the Monte Carlo and variance-covariance approaches to computing VaR.

Your manager notes that the projected 5% weekly VaR is \$6.10 million. Backtesting indicates that the weekly portfolio losses in excess of \$6.10 million do indeed occur about twice a year. However, when losses occur, they are more than double the VaR estimate. Your manager is concerned about the utility of VaR as a risk measure and suggests the following alternatives:

1. CTE
2. Stress Testing
3. Copula

(d) (2 points) Recommend a more appropriate measure of the tail risk from the list above. Justify your choice.

1. Continued

Adding to your manager's concern, your colleague makes the following statement, "over the past two years, losses were tracked and my review found that in year 1, there were five instances in which the 5% weekly VaR was exceeded. In the second year, there were zero instances in which the 5% weekly VaR was exceeded. I don't think VaR is a reliable risk measure."

(e) (1 point) Critique your colleague's statement.

You decided to enhance the VaR estimate by providing a 95% confidence interval on the 5% weekly VaR. More backtesting indicated that the weekly VaR fell outside of the confidence interval three times during the 50 trials.

(f) (1.5 points)

- (i) Explain the reasonableness of the backtesting results.
- (ii) Recommend two improvements to estimate VaR.

2. (9 points) Company ABC is a soda manufacturer that was founded 10 years ago by the Xander family. Through the family's creativity and strong management, ABC has had great success in the beverage industry and recently gone public. Albert Xander, one of the founders, continues to serve as the CEO of ABC. You have been hired as a consultant to assist with creating strong governance and Enterprise Risk Management (ERM) for the newly public firm.

Your first project is to establish ABC's board structure. The Xander family is interested in having ongoing membership on the board and its committees.

- (a) (2 points) Explain three restrictions you would impose on the Xander family's participation on the board and its committees to facilitate effective board governance.

Your colleague makes the following suggestions regarding board structure and board membership criteria:

1. "Since board members serve as monitors for the shareholders, I would say the more the merrier. Consequently we should have a board with at least 15 members."
2. "A certain level of board turnover is healthy so we should have limits on board terms. I would recommend limiting board terms to 1 year."
3. "As ABC is in the beverage business, we should focus on having outside directors knowledgeable in beverage marketing and business development."
4. "Directors who currently have 3 or more directorships at other companies should not be eligible to be a board member at ABC."

- (b) (2.5 points)

- (i) Assess each statement.
- (ii) Recommend improvements where applicable.

You acknowledge that effective governance requires knowing the interests of different stakeholders at ABC such as stockholders and customers.

- (c) (2 points) Develop a stakeholder impact analysis on stockholders and customers.

2. Continued

You now turn your attention to ERM as well as the role of the central risk function and how it interacts with the rest of ABC.

(d) *(1 point)* List the steps of an effective ERM system.

Your colleague has identified the following interaction models for the central risk function:

1. Offence and Defense Model
2. Policy and Policing Model
3. Partnership Model

(e) *(1.5 points)* Explain the potential shortcomings of each interaction model.

3. (8 points) You are an analyst on the risk management team at XYZ, an investment firm that uses derivatives to reduce risk in one of its funds. Your team recently reviewed the firm's operational risks.

(a) (0.5 points) List five of the top ten operational risks according to Miller.

Susan, another member of your team, made some operational risk entries in a risk register. She made the following observations about XYZ's derivative trading operations:

1. The trading desk forwards trade confirmations to investment operations.
2. New employees are given workflow documentation to assist with onboarding.
3. The derivative trading system is kept up-to-date with the latest software releases from the vendor and the information is passed to many other downstream systems in the company.
4. There is a specialized team for each derivative instrument.

(b) (1.5 points)

- (i) Evaluate each statement in terms of operational risk management.
- (ii) Recommend one improvement for each deficiency identified in part (i).

XYZ's interest in cataloging its risks grows as it observes a competitor undergo bad publicity where the competitor misled prospective investors with its investment performance metrics.

(c) (0.5 points) Identify the type of unethical behavior displayed by XYZ's competitor.

(d) (1 point) Describe four possible causes for this unethical behavior.

3. Continued

XYZ asks you to review its own practices for determining the data it shows prospective investors. You compile the following list:

1. The fund and benchmark returns are provided to clients.
2. The fund manager and key investment team members are identified in communications to clients.
3. The historical period chosen for calculating the fund's return is from year N-5 to year N.

Year	N-7	N-6	N-5	N-4	N-3	N-2	N-1	N
Fund Net Asset Value (NAV)	100	93	90	97	109	100	95	123

(e) (1.5 points)

- (i) Evaluate each of XYZ's practices described above.
- (ii) Recommend one improvement for each deficiency identified in part (i).

XYZ's fund offers investors 100% participation in the growth of the stock for company ABC and guarantees the investor will not lose money by the end of Year 2. Susan worked with David, the fund manager, to create a new risk register entry for this fund as shown below:

Item Number	Category	Entry
1	Risk Identifier	Same as David's other funds
2	Risk category	Non-operational risk
3	Likelihood of risk	Low
4	Current status of risk	Within tolerance
5	Scenarios where risk is likely to occur	Economic recession or poor performance of ABC
6	Risk response implemented	Purchase options
7	Frequency of review	Every 3 years
8	Risk owner	Susan

(f) (3 points)

- (i) Critique Susan's risk register entry for the fund.
- (ii) Recommend improvements for the deficiencies identified in (i).
- (iii) Identify six additional pieces of information that should be present in this entry.

4. (9 points) You are an asset manager at ABC Asset Management. ABC is one of the most highly regarded asset management firms in the nation for its attention to customer needs and risk management over recent years.

(a) (1 point) Describe the four ingredients for an effective risk management group.

In your first risk management meeting with your client, they define their risk objective to be 75 basis points (bps) annual tracking error on the Barclays Capital Municipal Bond Index. With an investment horizon of 10 years, you use the ABC ex-ante tracking error model to determine the optimal allocation. The risk attribution from your model is shown below.

ABC Ex-Ante Model Results

Asset Class	Relative Weight	Effective Duration Contribution	Spread Duration Contribution	Interest Rate Marginal Contribution	Spread Marginal Contribution	Total Marginal Contribution to Risk
Treasury Securities	-1%	0.11	0.00	0.41	0.00	0.41
MBS	+1%	-0.01	-0.03	-0.05	-0.03	
Industrial Bonds	+4%	0.03	0.35	0.08	0.43	
Net Assets	0%	X	Y			Z

(b) (2 points)

- (i) Calculate X and Y in the table above and interpret your results.
- (ii) Calculate Z and explain its attribution among risk factors by asset class.
- (iii) Explain whether the projected results meet your client's risk objective.

4. Continued

Before running the ex-ante model with an adjusted portfolio, you reviewed empirical data and calculated the correlation matrix below:

Asset Class	Treasury Securities (Rate)	Mortgage Backed Securities (MBS) (Spread)	Industrial Bonds (Spread)
Annual Standard Deviation (bps)	78	27	18
<i>Correlations</i>			
Treasury Securities	1.00	-0.15	-0.39
MBS	-0.15	1.00	0.20
Industrial Bonds	-0.39	0.20	1.00

You developed three independent portfolio adjustments below:

1. Moderate reallocation from Treasury Securities to MBS.
2. Slight reallocation from Industrial Bonds to Treasury Securities.
3. Significant reallocation from Industrial Bonds to Treasury Securities.

(c) (2.5 points)

- (i) Describe the expected impact on tracking error for each adjustment.
- (ii) Recommend one adjustment to best satisfy the risk objective.

Before entering into the agreement, your client asks to see how the adjusted portfolio will perform in a 1 in 250 year market crash.

(d) (1 point) Describe two reasons why tracking error should not be used as a standalone risk metric to address your client's market crash request.

Question 4 continued on next page.

4. Continued

You address your client's request by developing two stress tests described below. The adjusted portfolio is then analyzed under both tests.

Stress Test (Time Period)	Description
2008 Financial Crisis Replication (6 months)	Interest rates fall steadily, markets decline rapidly, spreads widen and the real estate market collapses
Prolonged Recession (2 Years)	Interest rates fall, market drops 5% in one week and slowly declines thereafter. Situation continues for two years before recovery begins.

Stress Test Results

Stress Test	Spreads: P/L Effect (%)	Interest Rates: P/L Effect (%)	Change in Portfolio during Period as a Multiple of its Standard Deviation	Probability of Event (%)
2008 Financial Crisis	-5	-16	2.8	0.25
Prolonged Recession	4	-6	1.2	1.00

(e) (1.5 points)

- (i) Interpret the stress test results.
- (ii) Determine which test better addresses your client's request.

To build trust between ABC and its clients, you are meeting with your client to explain how your firm does not condone reporting misleading performance results.

- (f) (1 point) Identify two ways that you could hypothetically use to improve reported results for the client.

THIS PAGE INTENTIONALLY LEFT BLANK

5. (7 points) You are providing risk management advice to ABC, a large financial conglomerate.

The company is considering entering into a 10-year interest rate swap with an investment bank on a notional of \$525 million.

- The bank will pay ABC annually a fixed rate of 4% for 10 years.
- ABC will pay the bank annually a fixed rate of 2% for the first year, and thereafter, a rate defined by:

$$r_c - 5\% + 1\% \times \max\left(\frac{100 \times Y_5}{2\%} - P_{30}, 0\right)$$

Where:

- r_c is the rate of ABC's own corporate bonds, which is currently at 5%.
- Y_5 is the 5-year Treasury yield at year one ($t = 1$).
- P_{30} is the price of the 30-year Treasury bond issued today at $t = 1$.
(For example, if the price rose by 15% in 1 year, P_{30} would equal 115.)
- The Treasury yield (Y_5) and price (P_{30}) in the formula are not known at issue ($t = 0$), but will be known after 1 year and locked in for the remainder of the contract.
- The current 5-year Treasury Yield is 1.5%.

You acknowledge that ABC will be exposed to interest rate risk especially if rates rise, but suspect that other risks are present.

- (a) (0.5 points) Describe two financial risks (other than interest rate risk) to which ABC is exposed.
- (b) (0.5 points) Describe two nonfinancial risks to which ABC is exposed.

You run a stress test on the above swap. In your projection, you make the following assumptions at $t = 1$ year:

- A parallel shift of 150bps upwards is applied to the Treasury yield curve.
 - The price of the 30-year Treasury bond issued today decreases by 20%.
 - The rate on ABC's corporate bonds remains at 5%.
- (c) (1.5 points) Calculate the potential loss over the remaining 9 years.

5. Continued

After reviewing the projected losses in the stress test, your colleague, Ted, remarked that entering this swap has troubling similarities to the Space Shuttle Challenger failure.

- (d) (1.5 points) Describe two key drivers of the Space Shuttle Challenger failure that also apply to entering the proposed swap.

To get a more complete picture of the risks to which ABC is exposed, you begin the process of risk identification. Ted suggests using brainstorming, interviews or the Delphi Technique to identify risks.

- (e) (1.5 points) Explain the advantages and disadvantages of Ted's suggested risk identification techniques.

From real life risk management failures you are aware of the dangers associated with the naïve use of derivatives and have decided to review ABC's derivative strategies:

1. The company has recently invested in leveraged inverse floating rate notes, which have been highly profitable in the current low rate environment.
2. The company last year issued 15-year forward contracts on corn, and hedges the positions using three-month OTC futures contracts.

- (f) (1.5 points) Explain how ABC is exposed to risk in each derivative strategy.

****END OF EXAMINATION****

USE THIS PAGE FOR YOUR SCRATCH WORK