
SOCIETY OF ACTUARIES
QFI Investment Risk Management Exam

Exam QFIIRM

Date: Friday, May 6, 2016
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.

****BEGINNING OF EXAMINATION****

1. (7 points) You are an investment actuary in a start-up, multi-line insurance company. Your manager has asked you to participate in a discussion about VaR. He has broken up the definition of VaR into the following 4 statements below:

- (i) VaR is an accurate measure of a loss.
- (ii) VaR captures a firm's potential losses with a certain probability.
- (iii) VaR captures a firm's potential losses during a certain period of time.
- (iv) VaR captures a firm's potential losses under any market condition.

(a) (2 points) Identify and explain if each statement on VaR is correct.

You have been asked to analyze a possible reinsurance arrangement in which your company is considering ceding a portion of the risk. You have been provided the following details:

- 1. Based on a historical VaR calculation, the 30-day VaR(95) is \$30 million.
- 2. You are considering 4 possible reinsurance arrangements:

Arrangement	Loss Coverage	Deductible	Reinsurance Premium
A	\$20 million	\$6 million	\$4 million
B	\$24 million	\$6 million	\$5 million
C	\$40 million	\$5 million	\$7 million
D	\$100 million	\$5 million	\$15 million

(b) (2 points)

- (i) Calculate the VaR(95) after reinsurance under each arrangement.
- (ii) Recommend a reinsurance arrangement based on the calculation in (i).

1. Continued

A colleague has provided you with the following ranked loss simulations out of 100 simulations:

Scen No.	Losses
95	\$30 million
96	\$40 million
97	\$65 million
98	\$100 million
99	\$175 million
100	\$180 million

- (c) (2 points)
- (i) Calculate the 95% CTE (before reinsurance).
 - (ii) Recommend a reinsurance arrangement based on the calculation in (i).
- (d) (1 point) Explain any difference in your recommendation in b(ii) and c(ii).

2. (11 points) ABC Hospital, a large public company, has a pension plan covering its employees. ABC is in the process of updating its governing principles for the pension fund, as well as reviewing the pension's Board structure. ABC acknowledges the importance of defining an investment policy framework for the pension plan, which should include clearly defined responsibilities and accountabilities.

(a) (0.5 points) List four other key elements that should be defined in an investment policy framework.

As a part of this review ABC is looking to perform a stakeholder impact analysis.

(b) (2.5 points)

- (i) Identify four key stakeholder segments to be considered in the framework and the interests and concerns of each segment.
- (ii) Describe two examples of the agency problem among the stakeholders identified in (i).

ABC is looking to set up the Board of Directors for the pension fund. One prominent doctor at the hospital proposes including doctors from various practices across the hospital on the Board of Directors.

(c) (2 points) Assess the doctor's proposal.

The Investment Policy is stated below:

“The pension fund is to be overseen by the fund's Board of Directors. Board members must be elected according to ABC's procedures. They should meet regularly and report to the key stakeholders as important changes happen, at least once every few years. The fund should not invest more than 30% in risky assets, and this should be monitored at least monthly as asset mix changes. In addition costs should be kept low especially through investment management fees.”

(d) (1.5 points) Recommend six improvements or additions to the Investment Policy.

Following a recent financial crisis, ABC has concerns over funding pressures related to their pension fund. To minimize future risk, ABC has focused on four areas: Strategic Asset Allocation, Liquidity, Quantitative Methodologies, and Sharing knowledge with stakeholders.

(e) (2 points) Explain how these areas may assist in turmoil markets.

2. Continued

LMN Investment Management has managed ABC's pension assets for the past few years. LMN's portfolio manager has been known to occasionally skim profits from accounts he manages as his performance reward. In addition, he smoothes losses to help minimize concerns during poor performance.

- (f) (2.5 points)
- (i) Identify the unethical behaviors present at LMN and explain four potential drivers of these unethical behaviors.
 - (ii) Recommend two ways to promote the consideration of ethical issues at LMN.

- 3.** (6 points) You are a consulting actuary for a small European investment firm XYZ which fared poorly during the 2007-2010 Global Financial Crisis.

The CEO is concerned about how the regulatory environment could affect his firm.

- (a) (0.5 points) Define regulatory risk.
- (b) (1.5 points) Explain the role regulations played in the 2007-2010 Global Financial Crisis.

The CEO is seeking to increase each fund's return while limiting liquidity risk.

- (c) (1.5 points) Describe the limitations of each of the following in measuring liquidity risk.
 - (i) Bid-ask spread
 - (ii) Transaction volume
 - (iii) Illiquidity ratio, which measures the price impact per \$1 million traded in a day
- (d) (1 point) Explain how liquidity risk played a role in the evolution of the 2007-2010 Global Financial Crisis.

The CEO is concerned about XYZ's compensation structure. One of the company's funds is overseen by two fund managers who each manage half of the assets. The fund charges a 1% incentive fee on any positive returns generated. The company pays each fund manager 0.5% of any positive gains they achieve.

- (e) (0.5 points) Identify the risk that the fund's compensation structure creates.
- (f) (1 point) Propose a solution to manage this risk.

THIS PAGE INTENTIONALLY LEFT BLANK

4. (9 points) You work for a large financial conglomerate ABC. The company has two major business units: Life insurance and investments. Recently, the Chief Risk Officer (CRO) was concerned with the company's credit risk exposure.

(a) (1 point) Explain why credit risk is difficult to analyze.

ABC's life insurance business includes the following:

- A legacy universal life block of business covered by a reinsurance deal with XYZ Re.
- A variable annuity block of business with a guaranteed minimum withdrawal benefit rider, which uses derivatives to hedge the tail risk.
- An investment division to manage invested assets backing these liabilities.

(b) (1 point) Identify three examples of credit risk based on the list above.

(c) (1.5 points) Describe three strategies for how ABC can manage its credit risk in its life insurance business.

The CRO is now turning his attention to market risk. ABC's investment arm is split into two divisions: Domestic and International. The table below shows a summary of the funds in each division along with their current allocated risk budgets, expressed in terms of permitted daily VaRs.

Division	Domestic			International		
Fund	Small Cap	Large Cap	Total Domestic	Value	Emerging Markets	Total International
Assets Under Management (\$M)	100	100	200	50	50	100
Risk Budget (\$M)	10	5	13	10	5	11

(d) (1 point) Compare the correlations of the funds within each division.

(e) (1.5 points) Explain how each of the following ideas contribute to a well-conceived risk budget framework.

- (i) Scenario analysis limits
- (ii) Position concentration limits
- (iii) Liquidity limits

4. Continued

ABC is moving to a new risk budgeting approach using expected information ratios. An analyst has prepared the following table that summarizes the actual and optimal risk allocations based on tracking error. Unfortunately, one of the values in the table is unreadable.

- (f) (2 points) Calculate the optimal risk allocation for the International Value fund. Assume all correlations between funds are zero.

Fund	Risk Allocation (bps)		Information Ratio	
	Actual	Optimal	Expected	Implied
Domestic Small Cap	65	72	0.35	0.31
Domestic Large Cap	89	103	0.50	0.42
International Value	142	Illegible	0.59	0.67
Emerging Markets	97	93	0.45	0.46

Your colleague makes the following comment:

“The implied information ratios indicate areas where risk is being overspent or underspent and thus provide a useful monitoring tool. Based on the table, risk is being overspent for Domestic Small Cap, Domestic Large Cap and Emerging Markets.”

- (g) (1 point) Critique the above statement.

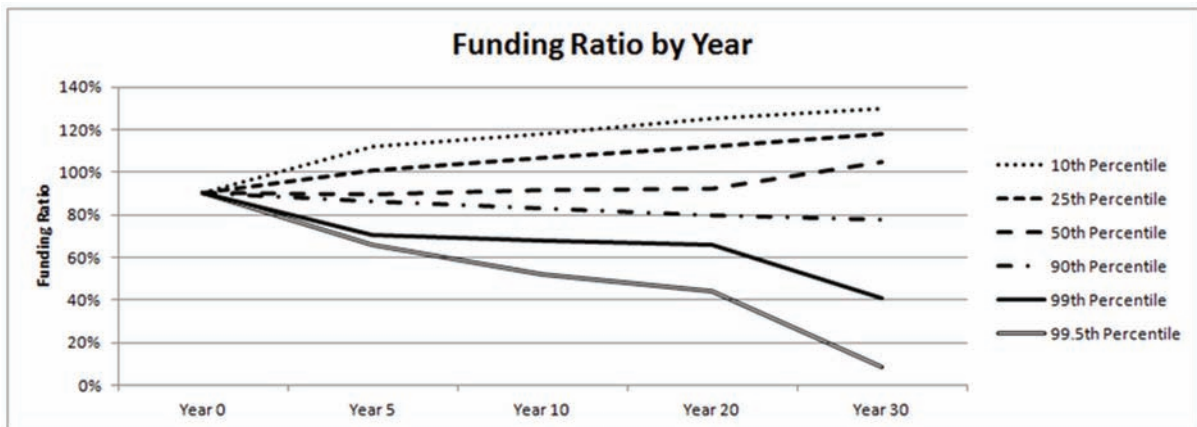
5. (7 points) Morris was just hired at the ABC Investment Management Company as the Chief Investment Officer. ABC mainly manages corporate pension liabilities on behalf of plan sponsors. The plan liability has the following features:

- Mandatory retirement age is 65
- Pension benefits are based on employee’s final year salary
- Pension benefits are adjusted based on an inflation index
- ABC uses the Society of Actuaries Mortality Table developed in 1906
- Average duration of the pension liability is 10 years
- The investment allocation is as follows:

Asset Class	% Allocation	Weighted Average Life (Years)
Corporate Bonds	20%	25
Private Equity	30%	N/A
Commercial Mortgage Loans	25%	5
Real Estate	25%	N/A

(a) (1.5 points) Describe three risks that are exhibited in this plan.

Morris generated 1000 simulations of the future funding ratios of the pension plan. He proposed using the VaR(99) to measure the funding risk of this portfolio at year 10.



5. Continued

(b) (3 points) Based on the graph above:

(i) Critique the use of VaR(99) in measuring the tail risk of this portfolio.

Morris recommends the following alternative risk measures to analyze the tail risk of the pension fund:

- Omega
- Expected Shortfall
- Worst Case Expectation
- Standard Deviation

(ii) Identify and explain the two least appropriate risk measures to quantify the tail risk.

Morris came up with the following additional suggestions to improve ABC's tracking error methodology for the pension portfolio:

- Portfolio managers will be replaced if they have 3 consecutive months of poor performance.
- Portfolio managers will use S&P 500 Index as a benchmark for all tracking error calculations sent to the client.
- Tracking error models will not be released until they are adequately backtested.
- At least 40% of backtesting observations in tracking-error forecasts should fall within 2 standard deviation for the model to be used.

(c) (2.5 points) Critique each guideline above.

****END OF EXAMINATION****

USE THIS PAGE FOR YOUR SCRATCH WORK