
SOCIETY OF ACTUARIES
QFI Investment Risk Management Exam

Exam QFIIRM

Date: Thursday, May 1, 2014

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) Madison Bank owns a portfolio that tracks S&P 500 very closely. The portfolio returns are assumed to be normally distributed with expected annual return (μ) of 13.5% and standard deviation (σ) of 24.4%. The 20 worst daily returns on S&P 500 during the past calendar year are shown below in descending order of magnitude.

Rank	Daily Return(%)	Rank	Daily Return(%)
1	-5.75	11	-3.15
2	-5.33	12	-2.91
3	-5.01	13	-2.80
4	-4.81	14	-2.68
5	-4.57	15	-2.56
6	-4.33	16	-2.44
7	-4.10	17	-2.32
8	-3.86	18	-2.20
9	-3.62	19	-2.08
10	-3.39	20	-1.97

Assuming there are 250 trading days in a year and the portfolio value is \$100 million:

- (a) (2 points) Calculate the 5% daily VaR using the following:
- (i) (1 point) Historical Method.
 - (ii) (1 point) Analytical Method.
- (b) (1 point) Explain which VaR method (Historical, Analytical or Monte Carlo Simulation) is the least appropriate for the following situation:
- (i) (0.5 points) Fat tailed distributions.
 - (ii) (0.5 points) A small company with limited computing resources.

1. Continued

Madison bank has approached your consulting firm because they are considering adding a hedge to one of their portfolios and wants you to analyze this decision using a coherent risk measure. You generated 1000 simulations using the Monte Carlo Approach. The tables below show the worst ten simulations of losses with and without the hedge.

Portfolio without the Hedge		Portfolio with the Hedge	
Simulation	Losses (\$mm)	Simulation	Losses (\$mm)
425	0	595	0
827	0	628	0
479	0	932	5
72	0	936	8
308	10	708	13
76	17	372	21
965	20	630	26
100	20	798	26
787	50	787	32
68	65	68	32

- (c) (2 points) Calculate the Incremental VaR and Incremental CTE for the portfolio at the 99.7th percentile level when the hedge is incorporated.
- (d) (2 points) Recommend whether to add the hedge to the portfolio based only on the information in part (c).

2. (6 points) You work in the Enterprise Risk Management Department of ABC Investments, Inc. Your firm has been through a tough financial period and is beginning to return to more solid financial footing. Senior management is keen on improving profitability.

A hedge fund has invited ABC Investments to invest in their fund. You have been instructed to construct an operational due diligence template for reviewing the hedge fund investment opportunity.

- (a) (2 points) Describe four key items you want to include in the template and explain why you want to focus on them.

In addition to reviewing the hedge fund opportunity, ABC Investments have just hired Salvador Salamander to develop a new investment product. To perform risk evaluation, a set of complex models has been developed by Mr. Salamander's team. They believe their models can account for any real world contingency.

- (b) (1 point) Critique Mr. Salamander's approach to evaluating risk.

Mr. Salamander proposes the following bonus package for his team and himself:

- Bonuses should be paid quarterly based on the most recent quarter's result.
- Bonuses should be paid on a pro rata basis to the entire team totaling to 20% of the fund return if positive.

- (c) (2 points) Evaluate the proposed bonus structure.

Considering that the product is complex and only a few specialists will understand it, Mr. Salamander recommends that the financial reporting and trading should both be done by his team.

- (d) (1 point) Assess Mr. Salamander's recommendation.

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- 3.** (11 points) You are the Chief Risk Officer of a large insurance company. After several years of high profile failures and crises in financial institutions, the Board has asked you to review the firm's risk management framework. You decide to spend a day discussing the various aspects of risk management within the firm.

9:00 am: Meeting with your staff on systemic risk:

- (a) (1 point) Define systemic risk.
- (b) (2 points) Identify two types of systemic risk and explain why they are classified as systemic risks.

10:00 am: Meeting with your staff on Enterprise Risk Management:

Your firm manages a portfolio of equity derivatives used to hedge the firm's equity indexed annuity block. The portfolio consists of index call options that are purchased from several investment banks.

- (c) (2 points) Outline the steps of an Enterprise Risk Management framework and describe how it can be applied to manage the risk associated with the equity indexed annuity block.

11:00 am: Discussion with the firm's trading desk staff:

The investment policy of your firm requires daily posting of collateral based on mark-to-market on all derivatives transactions.

- (d) (1 point) Explain the risk that is addressed by daily collateral posting.

The firm currently holds a long position of a one-year forward contract on 1000 shares of a non-dividend paying stock established at a forward price of \$107. The contract is three months into its term. The spot price is \$110 and the risk-free rate is 3.25%. The previous day's collateral held by the firm was \$4,000.

- (e) (1 point) Calculate the collateral movement between the firm and the counterparty.

2:00 pm: Meeting with the firm's Chief Financial Officer on risk budgeting:

- (f) (2 points) Compare and contrast risk allocation versus asset allocation in the context of risk budgeting.

3. Continued

Your firm has a policy of risk budgeting for acceptable levels of risks for its various portfolio managers. The table below shows the allocated funds, a permitted level of daily risk (expressed in terms of dollar amounts of value at risk, VaR) and the quarterly profits for two of its portfolio managers. The firm has allocated funds to Foreign Exchange and Fixed Income desks believing that their activities are only weakly correlated. In reality, the two portfolios are engaged in activities that are highly correlated.

Portfolio	Allocated Funds	Permitted Daily VaR	Profit
Foreign Exchange	\$200 M	\$5 M	\$50 M
Fixed Income	\$400 M	\$10 M	\$60 M

- (g) (1 point) Assess the overall impact on the risk of the firm given the firm's view of correlation between the two portfolios.
- (h) (1 point) Recommend changes to the allocation of the funds given your assessment in (g).

4. (9 points) Fred S. Anderson is CEO of Widgets ‘R Us, a publicly-traded company. The firm just announced a record year in sales of high-quality widgets, which are very popular among young adults. The CEO is happy to see share prices increase as stock options are a significant component of his executive compensation package.

(a) (1.5 points) Describe the interests of the following stakeholders with respect to the company’s current profitability and profit growth:

(i) Stockholders

(ii) CEO

(iii) Customers

(b) (2 points) Explain whether each of the following relationships involves a principal-agent conflict.

(i) CEO – Stockholders

(ii) Bondholders – Stockholders

(iii) Senior Management – mid level managers

Recently earnings have been falling short of expectations. The CEO has asked his senior management team to “do whatever it takes” to cut expenses. Otto Mann, the Chief Operations Officer, is considering outsourcing the manufacturing of widgets to Gorgoroth. Gorgoroth is a developing country that is known for being a low cost production platform with non-existent workplace and environmental regulations. This has permitted firms operating in the country to avoid investing in safe working conditions, to bypass basic waste management and to pay below-market wages. Focusing on the economics Otto advocates outsourcing manufacturing to Gorgoroth based on its low production costs and easy compliance requirements.

(c) (1.5 points) Identify the unethical behavior(s) present if Widgets ‘R Us were to proceed with the outsourcing and explain what may be causing Otto to ignore ethical considerations.

(d) (2 points) Recommend 4 ways to promote the consideration of ethical issues when making business decisions for Widget ‘R Us.

4. Continued

One year later, the company struggles to innovate in a market saturated with widget competitors. Stockholders have become dissatisfied with the company's performance and are concerned that governance mechanisms have been inadequate. They hire you as a consultant to assess the company's governance structure. You decide to focus on the board structure.

Board Structure

- The board has 12 members:
 - The CEO is the chairman of the board.
 - 4 internal directors, who are part of the senior management team.
 - 7 external directors, who were personally nominated by the CEO.
 - The Audit Committee is comprised of 2 internal directors and 2 external directors.
 - The Compensation Committee is comprised of 1 internal director and 3 external directors.
- (e) (2 points) Critique the current board structure and recommend changes that would improve the effectiveness of Widgets 'R Us' Board in governing the company.

5. (7 points) Susan Ross is an actuary at Kruger Consulting and is responsible for credit loss modeling. Her model considers two risk factors. She has determined the marginal distributions of these risk factors and the linear correlation coefficient.

(a) (1 point) List 4 problems of linear correlation as a dependency measure.

Susan makes the following statements:

- “I have enough information to determine the joint distribution between the two risk factors.”
- “I’ll be able to determine tail dependence from the correlation coefficient.”
- “If the distribution between risk factors is known to be an elliptical distribution, a correlation matrix is an appropriate way to summarize the dependence structure of the two risks.”

(b) (2 points) Critique each statement.

Susan has been asked to develop an enterprise risk modeling solution for a client. Her model will incorporate several classes of risk, each of which is a function of several factors. The client has provided a table summarizing their desired specifications for each risk class:

Client Risk Class Specifications

Risk Class	Marginal Distribution of Risk Factor	Complexity	Additional Consideration
Operational	Lognormal	High	Marginal conditional probabilities needed
Mortality	Multivariate t	Low	Value at risk needed
Equity	Lognormal	Low	Very heavy tailed multivariate

Susan is aware of three options for modeling the dependence structure between risk factors:

- Linear Correlation
- Rank Correlation
- Copula

(c) (4 points) Propose an approach to modeling the dependency structure of each risk class.

****END OF EXAMINATION****

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