

Exam QFIPM

AFTERNOON SESSION

Date: Wednesday, April 29, 2020

Time: 1:30 p.m. – 3:45 p.m.

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This afternoon session consists of 7 questions numbered 10 through 16 for a total of 40 points. 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 morning or afternoon session for Exam QFIPM.
6. Be sure your written-answer envelope is signed because if it is not, your examination will not be graded.

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****BEGINNING OF EXAMINATION****

Afternoon Session
Beginning with Question 10

- 10.** (6 points) You are given the following data for an investment portfolio and its associated benchmark:

Sector	Portfolio Weight (%)	Benchmark Weight (%)	Portfolio Return (%)	Benchmark Return (%)
Energy	35%	30%	2.70%	3.00%
Financial	25%	20%	6.00%	4.00%
Consumer Durables	5%	10%	A	-2%
Technology	35%	40%	3%	B

The mandate of the investment portfolio is to only invest in opportunities within the United States.

Your associate has calculated the allocation/selection return as -0.015%. He has also mentioned that the portfolio benchmark return is 2.3%. You are required to complete his attribution analysis.

- (a) (2.5 points) Calculate the values A & B above.
- (b) (2 points) Calculate the total value-added return by showing the pure sector allocation and within sector allocation/selection components.

The following asset classes have been suggested as new elements to incorporate in the portfolio benchmark:

- A REIT index
- MSCI EAFE

- (c) (1.5 points) Critique the above suggestions.

11. (5 points) Insurance company WIC is developing a new individual variable annuity product with a guaranteed lifetime withdrawal benefit (GLWB). Some of the product specifications are:

- I. Initial premium = \$10,000
- II. Free withdrawal amount = 10% of account value
- III. Benefit Base = Maximum of 5% roll up and annual ratchet up to 5 years until first withdrawal, whichever occurs first and annual thereafter
- IV. Charge as percent of benefit base = 50 basis points
- V. Maximum benefit percent = 5% for life at ages 55-65 and 6% thereafter

To determine the expected cost of the GLWB product, the WIC pricing team performed the base run using the following:

- Long-term pricing assumptions (100% of an Aggregate Mortality Table, Lapse Rate by Policy Year, and a Dynamic Lapse Factor);
- 1,000 risk-neutrals scenarios;
- Fund allocation of 65% Equity/35% Bonds.

The pricing team also performed sensitivity testing. Results of the base run and the sensitivity testing are summarized below:

Run	Sensitivity Test Difference From Base	Weighted- average GLWB Cost (basis points)
Base		50.0
Less scenarios	500 scenarios	45.5
More scenarios	1500 scenarios	49.5
Aggressive Growth Fund Allocation	75% Equity/25% Bonds	55.2
Conservative Growth Fund Allocation	50% Equity/50% Bonds	33.9
Lower mortality	30% of Aggregate Mortality Table	84.3
Increase Lapse Rate by Year	120% of Base Lapse Assumption	43.1
Decreased Dynamic Lapse Factor	Max (10%, Base Dynamic Factor – 12.5%)	54.2

WIC is exploring reinsurance and/or a hedging program on this product

11. Continued

- (a) (2 points) Propose risk mitigation techniques for three key risk drivers behind the GLWB product.

To improve run time efficiency for future pricing exercises it has been suggested to use 500 scenarios.

- (b) (1 point) Critique the suggestion of using 500 scenarios for calculating the cost of the GLWB.
- (c) (2 points) Propose four modifications to the pricing and/or product design to reduce the risk exposure of the embedded guarantee of the GLWB product.

- 12.** (5 points) You are building an asset-value model that is of mixed-Bernoulli type, where default of an asset is determined by comparing the asset value at one-year horizon with some critical threshold. Assume that the log-return process of the asset value is of the form

$$r_i = \sqrt{\rho} * Y + \sqrt{1-\rho} * Z_i \quad (i = 1, \dots, m),$$

Where r_i , Y , and Z_i are standard normal variables, and $Z_i, \dots, Z_m$ are independent of each other and also independent of Y . The factor Y is common to all m assets. Under these assumptions, we have

$$p_i(Y) = N \left[\frac{N^{-1}(p_i) - \sqrt{\rho} * Y}{\sqrt{1-\rho}} \right]$$

Where p_i is the unconditional one-year default probability of asset i and N is the standard normal CDF.

- (a) (0.5 points) Interpret the meaning of factor Y in your model.
- (b) (0.5 points) Describe how the conditional default probability $p_i(Y)$ depends on Y .

You have two sets of historical default data, labelled Set A and Set B, which you could use to test your model. One of the datasets is sourced from a diverse portfolio of corporate loans, while the other is from a retail banking portfolio. You determined that Set A has an average one-year default probability of 0.30% and asset correlation of 40%. Similarly, Set B has an average one-year default probability of 0.45% and asset correlation of 5%. You would like to determine on which dataset your model would be expected to perform best.

12. Continued

- (c) (1 point) Choose the best statement from the four options below and explain your choice:
- (i) Set A corresponds to the portfolio of corporate loans and is expected to perform best
 - (ii) Set B corresponds to the portfolio of corporate loans and is expected to perform best
 - (iii) Set A corresponds to the retail banking portfolio and is expected to perform best
 - (iv) Set B corresponds to the retail banking portfolio and is expected to perform best

Your model uses the Gaussian copula to incorporate the multivariate dependence structure. You now decide to test the impact of changing the Gaussian copula into a t-copula, transforming the asset value log-returns as

$$r'_i = \sqrt{n/W} * r_i,$$

where $W \sim \chi^2(n)$ is independent of Y and $Z_1, \dots, Z_m$.

- (d) (2 points) Prove that the conditional default probability is now given by

$$p_i(Y, W) = N \left[\frac{\sqrt{W/n} * F_n^{-1}(p_i) - \sqrt{\rho} * Y}{\sqrt{1-\rho}} \right]$$

where F_n is the t-distribution function with n degrees of freedom.

One of the key parameters in your model that needs to be estimated is the asset correlation coefficient ρ .

- (e) (1 point) Describe the difficulty in estimating ρ from market data and how CreditMetrics handles this problem.

13. (5 points) You are a fixed income professional at an investment firm and are evaluating several upcoming leveraged loan deals. Two of the deals you are reviewing are:

- SEA Corp with a BBB rating that is trying to raise 200 million, and
- TMX Corp with a BB rating that is trying to raise 150 million.

(a) (1 point) Describe the factors that might cause both deals to execute at the same spread.

You then review a price sheet of defaulted unsecured corporate bonds and defaulted leveraged loans. You notice that all the unsecured corporate bonds are listed at higher prices relative to par than the leveraged loans. Your manager has asked whether or not you agree with the accuracy of the price sheet and to justify your response.

(b) (1.5 points) Outline your answer to your manager.

Subsequently, you are talking to your team that manages the corporate bond portfolio for AAA Life Insurance. AAA Life called to let your team know that they would be completing the sale of a large real estate holding in a week and would like the proceeds to be invested in their corporate bond portfolio.

AAA Life also stated that they would like the portfolio to hold as little cash as possible at all times due to the impact this has on the total return. Your team expresses the following to you during a strategy meeting:

- One team member is concerned about how to rebalance the portfolio without cash
- Another team member believes that the proceeds from the real estate sale must be reinvested very quickly.
- A third team member points out that they have considered Treasury futures and over-the-counter (OTC) swaps but they are concerned about a variety of risks with those choices.

Your team needs direction that both recommends a solution and demonstrates how that solution addresses each of your team members' stated concerns and observations. You have scheduled another meeting with your team to make the recommendation and describe how it addresses the points made at the first strategy meeting.

(c) (2.5 points) Outline your discussion with the team.

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- 14.** (7 points) You, as the investment officer of your company, are reviewing the company's investment policy and found that your CFO made the following statement:

"...we are still debating whether integrating environmental, social, and governance (ESG) criteria into our investment process is a good strategy. We believe that any specific environment and social factor is just one component of the overall investment decision, along with financial analysis, valuation, and macroeconomic factors. We would therefore not want any blanket exclusions or prohibitions as that can hurt financial return."

- (a) (1 point) Critique the CFO position on integrating the ESG criteria in the investment policy.

You are searching for asset managers to support your investments.

- (b) (1 point) List four characteristics, qualitative or quantitative, that you will use in evaluating various asset managers.

You have narrowed down your search to two asset managers, A and B. Asset manager A specializes in long-only funds, and asset manager B specializes in long-short funds.

- (c) (1 point) Compare long-only, long-short, and market neutral long-short funds.

The two managers follow distinct investment styles as below:

Asset Manager	Expected Active Return	Expected Tracking Risk
A	0.5%	1%
B	2.5%	4%

You have an active risk budget between 1% and 2.5% and have come up to these three asset manager mix options:

Mix Option	1	2	3
Asset manager A	80%	60%	40%
Asset manager B	20%	40%	60%
Active Risk	0.0113	0.0171	0.0243

- (d) (1.5 points) Determine the best asset manager mix among the three options above, using the Information Ratio as the criteria.

14. Continued

Your company has become bullish in its overall market view and desires to increase its active return. It has revised its active risk budget to 2.0%. Because of these changes, you have found asset manager C (who specializes in long-only funds and has a distinct investment style) to replace asset manager B. The expected active returns of managers A and C are uncorrelated.

Asset Manager	Expected Active Return	Expected Tracking Risk
C	4.0%	5%

- (e) (2.5 points) Determine the optimal manager mix between asset manager A and C using the Information Ratio as the criteria.

- 15.** (6 points) Country QFI economic environment is one of volatile and rapidly moving markets that are experiencing unusual dynamics (such as talk of negative interest rates and swap spread). Expectations of higher long-term interest rates have not materialized even though the Central Bank has raised the overnight rate 5 times in the last three years. This environment has pension plans looking for opportunities to de-risk.

You are a completion manager for a mid-sized pension plan with liabilities that have a very long duration. The plan is currently underfunded and is seeking a more customized liability hedge. The plan has recently closed to new members.

- (a) (1 point) Identify catalysts for pension plans to de-risk as a result of the economic environment in QFI.
- (b) (2 points) Explain three of the typical risk factors to consider when constructing a completion portfolio for a pension plan.

Given the underfunded status, the plan sponsor would like to pursue an investment strategy that will achieve the following:

- a higher rate of return to help reduce the funding gap;
 - lower volatility of funded status;
 - maintain the current equity allocation.
- (c) (2 points) Recommend a strategy that might help the plan build a completion portfolio that meets the sponsor's goals.
- (d) (1 point) Discuss the risks of the proposed strategy.

- 16.** (6 points) You work for a public sector pension fund, where three fund managers are managing the fund assets. Their portfolio statistics can be found below:

	Asset Under Management (Millions)	Expected Active Return relative to the firm's benchmark	Expected Tracking Risk
Manager A	500	0%	0%
Manager B	300	1%	2%
Manager C	200	2.5%	11%

Based on the above,

- (a) (1 point) Identify the investment approach of each manager and your firm's investment strategy and justify your answers.

Manager C uses the XYZ Index as his benchmark, which had an annual return of 7%. In the meanwhile, your firm uses the ABC Index as the benchmark, which had an annual return of 4%.

- (b) (1 point) Calculate manager C's "true" active return and "misfit" active return.

Manager C claimed that since his active return of 2.5% is positive, he was doing a good job.

- (c) (1 point) Critique his comment.

The future liability of the pension fund depends on future inflation and economic growth. Traditionally, fund managers will rebalance their portfolio between bonds and stocks based on the correlation and volatility assumptions.

- (d) (1.5 points) Describe why this traditional approach may be flawed through interpreting the relationships between: inflation, growth, stocks, and bonds.

You recommend the pension fund to adapt the All Weather Approach.

- (e) (1.5 points) Explain why your recommended approach could circumvent the flaws of the traditional approach.

****END OF EXAMINATION****
Afternoon Session

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