

Exam QFIPM

Date: Friday, October 27, 2023

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This examination has 13 questions numbered 1 through 13 with a total of 70 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.

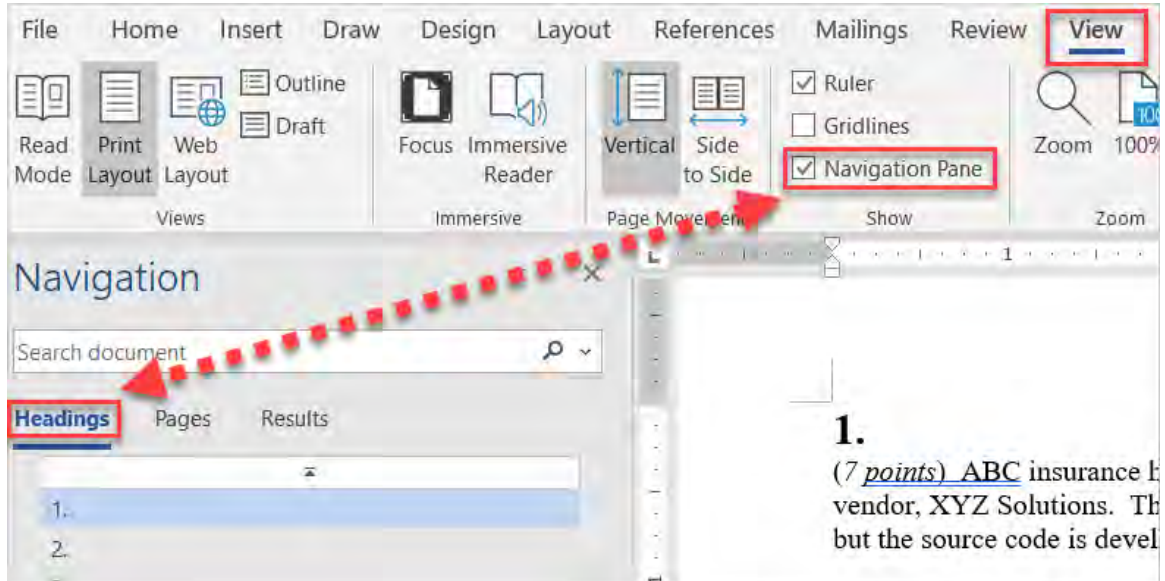
Written-Answer Instructions

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. Prior to uploading your Word and Excel files, each file should be saved and renamed with your five-digit candidate number in the filename.
4. The Word and Excel files that contain your answers must be uploaded before time expires.

Navigation Instructions

Open the Navigation Pane to jump to questions.

Press Ctrl+F, or click View > Navigation Pane:



1.

(4 points) You are an investment actuary at insurance company ABC. Your team is considering venture capital (VC) investments.

- (a) (1 point) Explain why venture capitalists are not passive investors.

ANSWER:

Your company has committed \$50 million to a venture fund. The fund has a management fee of 2% and an incentive fee of 20%. During the first year of the investment, the venture capitalist invested \$30 million in a start-up company which generated profits of \$6 million.

- (b) (1 point) Calculate the total compensation the venture capitalist will receive at the end of the first year.

ANSWER:

After the first year, the venture capitalist considers two investment options, both requiring a \$50 million investment:

Option 1 generates a 5% profit with 90% probability and a 5% loss with 10% probability

Option 2 generates a 50% profit with 20% probability and a 20% loss with 80% probability

- (c) (1.5 points)

- (i) (1 point) Assess which option is more likely to be chosen by the venture capitalist.

ANSWER:

- (ii) (0.5 points) Assess whether the venture capitalist's selection benefits ABC or is optimal for ABC.

ANSWER:

1. Continued

- (d) *(0.5 point)* Recommend covenants that ABC should include in the venture capital partnership agreements given the answer to part (c).

ANSWER:

2.

(5 points) You work at a global investment company and you are analyzing a short-selling hedge fund. An existing client invested in this short-selling fund as well as a traditional market index fund in the years 20XX and 20YY, respectively. Coincidentally, the client achieved the same return in both years.

You are given the following:

Year of Investment	Amount Invested in the Market Index Fund (\$m)	Amount Invested in the Short-selling Hedge Fund (\$m)	Risk-free Interest Rate	Market Return
20XX	\$3	\$5	3.2%	8%
20YY	\$8	\$12	4.0%	10%

You ignore any idiosyncratic risk associated with the returns of the fund in 20XX and 20YY. The market index fund has a beta of 1 and you assume the beta of the short-selling hedge fund is constant over time.

(a) (2 points) Calculate the beta of the short-selling hedge fund,.

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

Three investors are interested in investing in hedge funds.

Investor A:

- Believes there is currently a bull market
- Wants to minimize idiosyncratic risk
- Wants to minimize event risk
- Is comfortable with the use of leverage but not interested in seeking arbitrage opportunities for specific securities
- Wants international exposure but doesn't want to pay high fees

2. Continued

Investor B:

- Believes the current market is neither in a bull or bear state
- Has a strong view on the direction of one sector of the stock market due to his extensive research
- Also has a directional view on a few individual, healthy stocks within this sector
- Is not seeking exposure internationally

Investor C:

- Believes there is currently a bear market
- Wants to minimize credit risk
- Is comfortable with alpha risk but not beta risk
- Wants to rely on returns from fund manager skill
- Is not supportive of regression analysis

(b) (3 points) Recommend the most suitable hedge fund strategy for each investor.

ANSWER:

3.

(5 points) You are the chief investment officer for a defined-benefit pension plan. Recently, the plan's Board members asked you to help them understand the three *super* asset classes below.

- Capital assets
- Assets that can be used as economic inputs
- Assets that are a store of value

(a) (1 point) Define each of the above *super* asset classes, including an asset example for each class in your answer.

ANSWER:

(b) (1 point) Explain the sources of risk premium that allow venture capital investors to earn returns in excess of public market investors.

ANSWER:

(c) (1 point) Describe the common legal structures of typical U.S. private equity funds and their implications for defined benefit pension plan investments.

ANSWER:

3. Continued

You are looking at the following allocations for your plan's assets. The primary considerations of the asset portfolio are:

- Generate an expected return of at least 4.5%
- Minimize exposure to equity risk

	Portfolio A		Portfolio B	
	Allocation	Expected Return	Allocation	Expected Return
Government Bonds	20%	3.5%	20%	3.5%
Corporate Bonds (Investment Grade)	80%	5.0%	60%	5.0%
Distressed Debt			20%	7.0%
Sharpe Ratio	0.7		0.9	

(d) (2 points) Recommend which portfolio to use.

ANSWER:

4.

(6 points) You are the chief investment officer for a pension fund in Country A, where the pension plan is tax-exempt. You are considering commercial real estate for the pension fund investment portfolio.

Your team has prepared the following information for you on property:

- The property is available for sale for \$10,810,532.
- The property's expected pre-tax annual Net Operating Income (NOI) is given below. All NOIs are assumed to occur at the end of the year. The cash flow projection is illustrated below:

Year	1	2	3	4	5	6	7	8	9	10
Pre-tax NOI	700,000	710,500	721,158	731,975	742,954	754,099	765,410	776,891	788,545	800,373

Your team is aware that a marginal investor is also interested in buying the property. Your team makes the following assumptions about both investors, the pension fund and the marginal investor:

- Both investors plan to sell the property at the end of year 10.
- The property's selling price is expected to be \$11,000,000 at the end of year 10.
- Both investors will take out a \$8,000,000 loan to finance the property purchase under the provisions below:
 - The loan's annual interest rate is 6.75%.
 - The loan's annual interest amount is due at the end of each year, assuming the loan is taken at the beginning of the year (at the time of property purchase).
 - Annual loan principal repayment is \$30,000 per year, also due at the end of each year.

Any outstanding loan principal is to be repaid when the property is sold.

4. Continued

Additional information is given below based on country A's tax law which the marginal investor is subject to:

- The interest payment on a property loan is tax deductible.
- The tax rate is 25% for all income and capital gains, where the capital gain tax is paid on the difference between the sales price and the purchase price.
- The property's land value, currently estimated to be \$3,000,000, is not depreciable.
- The marginal investor has the option to claim the depreciation expenses of the property's structure value for income tax filing.
- If annual depreciation expense is claimed:
 - The straight-line depreciation method over 50 years must be used.
 - The sum of claimed depreciation expenses is subject to a 35% tax at the time of the property sale (known as the recapture tax).

To prepare a competitive bid, your team at the pension fund considers two scenarios to analyze the potential purchase by the marginal investor:

- a. The marginal investor claims annual depreciation expenses.
- b. The marginal investor does not claim annual depreciation expenses.

- (a) (3 points) Calculate total tax payment in each of the next 10 years for the marginal investor under the two scenarios.

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

- (b) (1.5 points) Calculate the after-tax IRR for the marginal investor under the two scenarios.

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

- (c) (1.5 points) Calculate the maximum price the pension fund should be willing to pay for this property considering the marginal investor's IRR.

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

5.

(6 points) You are working as a credit risk analyst for Company X, a large manufacturing company with significant credit exposure to Company Y, a raw goods producer. You have recently been assigned to work on a project with the Credit Portfolio Management (CPM) team.

- (a) (1 point) Explain the two key activities in an active CPM strategy (as defined in Bouteille).

ANSWER:

Your manager has told you that Company Y's financial strength could be significantly threatened by large amounts of rainfall in the continental United States.

- (b) (1.5 points) Recommend an active CPM strategy to manage the risk that Company Y defaults on its obligations to Company X.

ANSWER:

Your manager makes the following statements about CPM:

- I. Credit Risk Assessment and CPM are essentially the same discipline, requiring the exact same skill set and providing similar insights into a company's credit risk position. Both areas focus on analyzing individual transactions rather than the portfolio at-large.
- II. Advances in liquidity and analytical tools have led to evolution of the CPM process. In particular, it has become more difficult in the last 20 years to buy/sell exposures to execute rebalancing transactions, which has turned CPM into a purely academic exercise.
- III. Basic CPM can and should be viewed as the absolute minimum amount of activities that should be performed by any firm exposed to credit risk. It does not require sophisticated modelling in order to add value to an enterprise.

- (c) (2 points) Critique each statement.

ANSWER:

5. Continued

To hedge your exposure to Company Y, Company X had entered into a 10-year Credit Default Swap (CDS) prior to you joining the team, concluded at 1.00% per annum.

5 years later, you observe the following comparable CDS trades in the marketplace:

<u>Tenor (Years)</u>	<u>Rate (Per Annum)</u>
5	1.20%
10	1.50%

Your colleague observes that the same 10-year CDS is trading at 1.50% per annum and claims that the Mark-to-Market (MTM) value of the CDS is 0.50% per annum.

(d) (1.5 points) Explain whether or not your colleague's claim is correct.

ANSWER:

6.

(4 points) ORD is a small sized US regional bank with deposits totaling \$10 billion. ORD funds its time deposit (e.g Certificate of Deposit) and demand deposit (e.g. checking account) liabilities with long-term loans and securities. ORD also has fee income that roughly offsets the operating expenses.

- A \$10 million endowment fund has been set up to manage a large donation made by a not-for-profit organization.
- The goal of the endowment is to provide perpetual funding to a charitable organization in the US, while maintaining the fund's long-term purchasing power.
- The spending rate of the endowment is 4.2% of its assets which are to cover the organization's expenses, which trend with the larger economy's inflation.
- In addition, the endowment has annual investment management expenses equal to 3% of assets annually.

(a) (3 points) Compare the approach of Bank ORD and the endowment fund to managing three of the following:

- (i) Liquidity risk
- (ii) Tax concerns
- (iii) Return objectives
- (iv) Time horizon

ANSWER:

6. Continued

The donor is a believer in the success of ESG policies, and has stipulated that the endowment be a signatory to the Principles of Responsible Investing which has six principles.

1. We will incorporate ESG issues into investment analysis and decision-making.
 2. We will be active owners and incorporate ESG issues into our ownership policies and practices.
 3. We will seek appropriate disclosure on ESG issues by the entities in which we invest.
 4. We will promote acceptance and implementation of the Principles within the investment industry
 5. We will work together to enhance our effectiveness in implementing the Principles
 6. We will each report on our activities and progress towards implementing the Principles
- (b) (*1 point*) Describe two actions to incorporate ESG for any two of the principles above (four actions in total).

ANSWER:

7.

(6 points) Your firm has been hired to evaluate the investment strategies of two clients.

Client 1 is a small property and casualty company with mostly auto claims, all payable within the next two years. Management is confident that future premium levels can be set without marketplace consequences to support future expected claim costs. They are also looking to re-evaluate both how they manage investment to fund the claim costs and the fully indexed fixed income portion of the surplus.

Client 2 is a medium sized insurance company that has been buying fixed payments pensions and recently started making bids for blocks of business with benefits tied to CPI. Typically, they receive cash or liquid high quality bonds to take on these liabilities. They are reviewing the current investment strategies in order to determine if any investment strategy changes are necessary.

You are preparing a ranking of different asset classes to address the inflation concerns of these two clients, ensuring that the liability profile of each client is considered.

(a) (2 points) Justify a ranking, from best (1) to worst (3), for each of the two clients separately for the following asset classes:

- Nominal Bonds
- Commodities
- Materials Equity

ANSWER:

Your colleague has suggested using US market REITS as a better asset class to hedge inflation as compared to Materials Equity. They have noticed that theory suggests that REITS would be good hedge against rising inflation due to liquidity risk of investing in property. They are asking your expertise in doing some additional research about the empirical evidence.

(b) (0.5 points) Explain how the empirical evidence of REITs compares to the theory that REITS are a good inflation hedge.

ANSWER:

(c) (0.5 points) Assess whether REITs would be a better inflation hedge than Materials Equity.

ANSWER:

7. Continued

Client 2 is considering moving to a cash-flow matching dedication strategy.

- (d) (1 point) Describe two concerns that the portfolio managers might have, in applying a dedication strategy.

ANSWER:

For Client 1, the current strategy for the fixed income part of the surplus is using a pure bond index matching strategy. The client strongly believes that both interest rates and defaults will rise over the next two years.

- (e) (0.5 points) Explain how an active strategy could be used for Client 1.

ANSWER:

Ultimately you decide that your team is not in good position to monitor a fully active strategy and choose to use an Enhanced Indexing approach instead.

- (f) (1.5 points) Describe three additional ways that the Enhanced Indexing strategy can enhance the portfolio return.

ANSWER:

8.

(5 points) You are an investment actuary at ABC Insurance Company, reviewing an investment portfolio, P_0 (with return R_0) recommended by your predecessor. You are given the following information:

Portfolio P_0 information

- Expected return for P_0 is 10%
- Standard deviation of return is 0.16

Other information

- ABC's risk aversion scale, R_A is 4

ABC's targeted risk objective criteria

- Targeted expected utility is 5%, using the generic formula $U_m = E(R_m) - 0.5R_A(\sigma_m)^2$
- Targeted safety-first ratio is 0.4 with a corresponding minimal return level of 4%

(a) (2 points)

- (i) (1.5 points) Calculate the minimum expected return required to satisfy the risk objectives.

ANSWER:

- (ii) (0.5 points) Explain how ABC's risk objectives would be impacted if ABC's risk tolerance increased.

ANSWER:

You are constructing a new portfolio consisting of equities, real estate, and bonds; however, your colleague does not understand why real estate is treated as a separate asset class.

- (b) (1 point) Explain how real estate meets two of the criteria of being categorized as a separate asset class.

ANSWER:

8. Continued

You identify corner portfolios CP1 and CP2, and your team proposes two other portfolios P1 and P2.

	Equities	Real Estate	Bonds
CP1	100%	-	-
CP2	33.4%	66.6%	-
P1	50%	50%	-
P2	-	25%	75%

- (c) (1 point) Explain whether P1 and P2 could potentially be corner portfolios.

ANSWER:

You want to explore using Monte Carlo simulation in asset allocating process as the portfolio back Universal Life liabilities.

- (d) (1 point) Explain why using Monte Carlo simulation in the asset allocating process would be beneficial to ABC.

ANSWER:

9.

(4 points) You have recently joined the credit risk management team of a fast growing medium sized life and annuity insurance company.

- (a) (1 point) Compare and contrast credit default swaps (CDS) and credit insurance.

ANSWER:

You notice that the company's exposure to IJK Corporation has exceeded the current limit and you decide to use CDS to manage the exposure. A five-year CDS on IJK Corporation is currently quoted with a coupon of 100bp and points upfront of -3.0.

- (b) (1 point) Calculate spread of this CDS (ignore the time value of money).

ANSWER:

Your company bought a \$100M CDS. Two years later, IJK Corporation CDS spread has widened by 60bps.

- (c) (1 point) Calculate the Mark To Market (MTM) value of this CDS (ignore the time value of money).

ANSWER:

Given the exposure to IJK Corporation has decreased naturally, your company is looking to reduce the CDS position and realize a MTM gain. At the same time, your CFO is concerned about increasing counterparty exposure.

- (d) (1 point) Recommend an approach to realize the profit on the CDS taking into account the CFO's concern.

ANSWER:

10.

(8 points) You are an actuary working in the ALM area of an insurance company.

Your manager asks you to consider the following statements with respect to ALM strategy for your company:

- (i) If ABC wishes to take high levels of risk, the efficient frontier may provide useful insights into portfolios that optimize surplus risk
- (ii) The duration of an asset cannot exceed its time to maturity
- (iii) Modified Duration can be used to compare the relative sensitivity of two bonds to parallel changes in the yield curve

(a) (1.5 points) Critique each of your manager's statements.

ANSWER:

You receive an up-front premium of \$74M for a single, fixed liability cash flow of \$100M due ten years from now.

Your available investment universe consists only of zero-coupon government bonds.

You plan to invest the premium in the following two government bonds, with proportions determined so as to match the dollar duration of the liability.

All rates are annualized and continuously compounded. There are no transaction costs or other expenses.

Bond	Term (yrs)
A	5
B	30

Initial yields for government bonds are given as follows:

Term (yrs)	Yield
5	3.25%
10	3.50%
15	3.75%
20	4.00%
25	4.25%
30	4.50%

10. Continued

- (b) (0.5 points) Calculate the initial dollar duration of the liability.

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

- (c) (0.5 points) Calculate the initial dollar safety margin.

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

- (d) (1.5 points) Calculate the initial investment in each of Bond A and Bond B that will dollar duration-match the liability.

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

Immediately after the bonds have been purchased, bond yields have changed to the following:

Term (years)	Yield
5	2.75%
10	3.10%
15	3.45%
20	3.80%
25	4.15%
30	4.50%

- (e) (1.5 points) Calculate the new positions in each bond that will restore the dollar duration-matching.

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

- (f) (0.5 points) Calculate the new dollar safety margin.

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

10. Continued

You are following a contingent immunization strategy, whereby you would immunize the portfolio with a bond which exactly matches the liability cash flow if the dollar safety margin falls to zero.

You are concerned about the risk that 10-year rates could decrease, with no change to the 5-year and 30-year rates.

- (g) (1 point) Approximate the further decrease in 10-year rates that would require immediate immunization of the portfolio (no change to the 5-year and 30-year rates).

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

You are considering including Monte Carlo simulation as an additional tool in your ALM program.

- (h) (1 point) Describe the advantages of adding Monte Carlo simulation to your ALM program.

ANSWER:

11.

(5 points) You are an actuary working for XYZ Bank which specializes in providing commercial real estate mortgages in the U.S.

- (a) (1 point) Identify the differences in characteristics between commercial and residential real estate mortgage (excluding the property type).

ANSWER:

In an effort to attract more investors, XYZ Bank securitizes their commercial real estate mortgages into a Commercial Mortgage-Backed Security (CMBS) with a simplified structure of three tranches:

- Tranche A is the senior tranche with 20% credit support
- Tranche B is the subordinate tranche
- Tranche X is the interest-only tranche

The CMBS consists of 100 individual commercial mortgages of a loan value of \$5M each. Based on historical experiences, these individual commercial mortgages have a default rate of 1% over the lifetime of the loan. They are assumed to be independent from each other. Once defaulted, XYZ Bank expects to recover only 50% of the loan value.

- (b) (1.5 points) Describe the credit quality of Tranches A and B relative to the underlying mortgages.

ANSWER:

In the past year, interest rates in the U.S. increased rapidly from near zero to near 5%.

- (c) (1.5 points) Describe the risk factors to the investors in XYZ's CMBS under the current economic environment.

ANSWER:

- (d) (1 point) Recommend changes in future CMBS issues to mitigate the risks.

ANSWER:

12.

(5 points) A pension fund, currently invested in traditional bonds is looking to improve the investment returns using high-yield bonds or as debt holders of a Collateralized Loan Obligation (CLO). These investments have increased in popularity on the buy-side because institutional investors are seeking higher yields.

- (a) (1 point) Describe two additional reasons for this increase in popularity.

ANSWER:

- (b) (2 points) Describe the cash flow structures of the following instruments and how they impact the issuer and the pension plan:

- (i) Deferred interest bonds

ANSWER:

- (ii) Step-up bonds

ANSWER:

- (iii) Payment-in-kind bonds

ANSWER:

- (iv) CLOs

ANSWER:

As an investor considering that high-yield bonds may provide higher yield, the financial risk profile of the company is an important determinant.

The risk manager mentions that an investment into senior debt of a CLO with the same yield as that of a high-yield bond appears more attractive, when considering diversification, risk appetite and liquidity in the case of default.

- (c) (1 point) Justify the risk manager's statement.

ANSWER:

12. Continued

A member of the board states that CLOs have a high risk of bankruptcy.

- (d) (1 point) Critique this statement.

ANSWER:

13.

(7 points) You oversee two portfolio managers:

- Manager 1 employs an analyst who does research and provides recommendations.
- Manager 2 looks for active gains to beat the market.

You wish to identify appropriate benchmarks and performance evaluation metrics for each of the managers.

- (a) (1 point) List four properties of a valid benchmark for performance evaluation.

ANSWER:

- (b) (1 point) Describe how to construct a custom security-based benchmark.

ANSWER:

You are given the following information for Manager 1's portfolio:

	Benchmark		Portfolio	
Economic Sectors	Weight	Return	Weight	Return
Basic Materials	60%	10%	40%	11%
Energy	40%	12%	60%	12%
Total Benchmark return =		10.80%		

- (c) (3 points) Assess the portfolio performance using the following attribution breakdowns:

- (i) Pure selection allocation
- (ii) Allocation/selection interaction
- (iii) Within-sector selection
- (iv) Total value added

ANSWER:

13. Continued

You are given the following information for Manager 2's portfolio:

	Average over Evaluation Period
Portfolio return	11%
Market index return	10%
Risk-free rate	2%

Estimated portfolio beta relative to market index = 0.5

(d) (1 point) Calculate the following performance metrics for this portfolio:

(i) Jensen's alpha

ANSWER:

(ii) Treynor ratio

ANSWER:

You are considering the following performance evaluation options:

- Compare the manager's performance against the median manager return from a database of other account returns in similar institutions.
- Calculate a risk-adjusted performance metric to compare the manager's performance against the market using the CAPM model.

(e) (1 point) Assess these two performance evaluation options.

ANSWER:

****END OF EXAMINATION****