

# Exam QFIPM

**Date:** Friday, April 29, 2022

## INSTRUCTIONS TO CANDIDATES

### General Instructions

1. This examination has 17 questions numbered 1 through 17 with a total of 100 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.

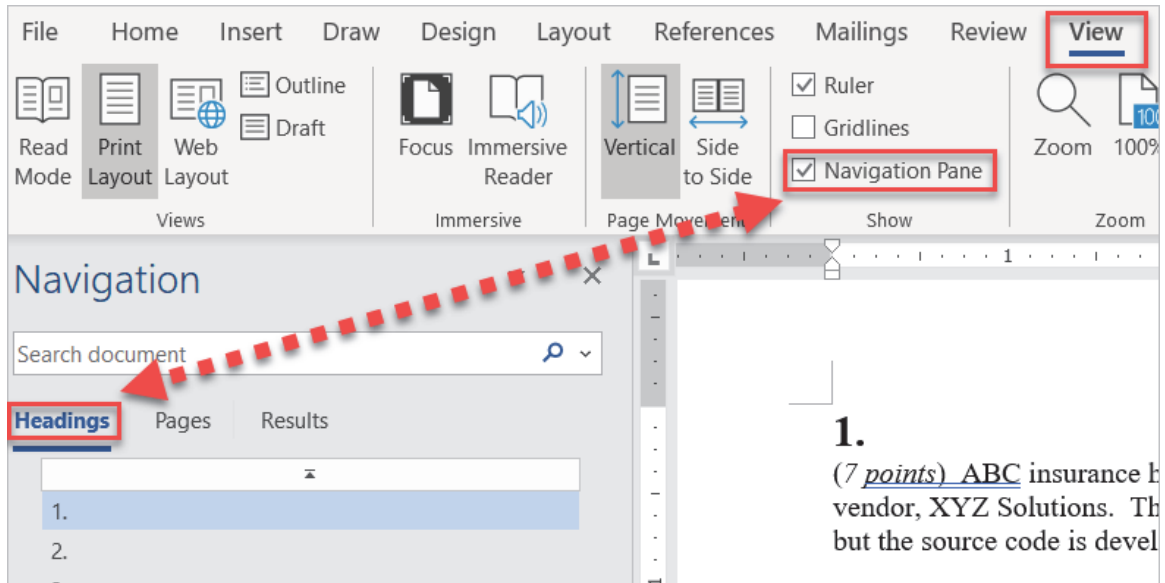
### Written-Answer Instructions

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,  $\beta_1$  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.

(6 points) XYZ Insurance has recently created an ALM team to help manage economic risks for its traditional life insurance block of business. Your manager informs you that the block is comprised entirely of whole life insurance policies issued to young lives and is currently backed by a portfolio consisting of a mix of corporate and government bonds.

Senior management is concerned with the level of risk exposure for this block of business.

- (a) (1 point) Describe two ALM-related risks that this block of business is exposed to.

ANSWER:

Your team is investigating different asset strategies for managing this block of business. Senior management has mentioned that, since the liabilities have a long duration, they are concerned about interest rate exposure, particularly at the long-term end of the yield curve. The team is currently investigating two strategies:

- X. Immunization
- Y. Interest Rate Swap Overlay

- (b) (2 points) Assess the appropriateness of each strategy with regards to addressing senior management's concerns.

ANSWER:

Due to the low interest rate environment, senior management is concerned about asset yields and is investigating ways to improve the performance of the block. Your team is investigating the addition of equities to the portfolio, implemented using a carve out strategy.

- (c) (1.5 points) Propose a carve out strategy for this block of business.

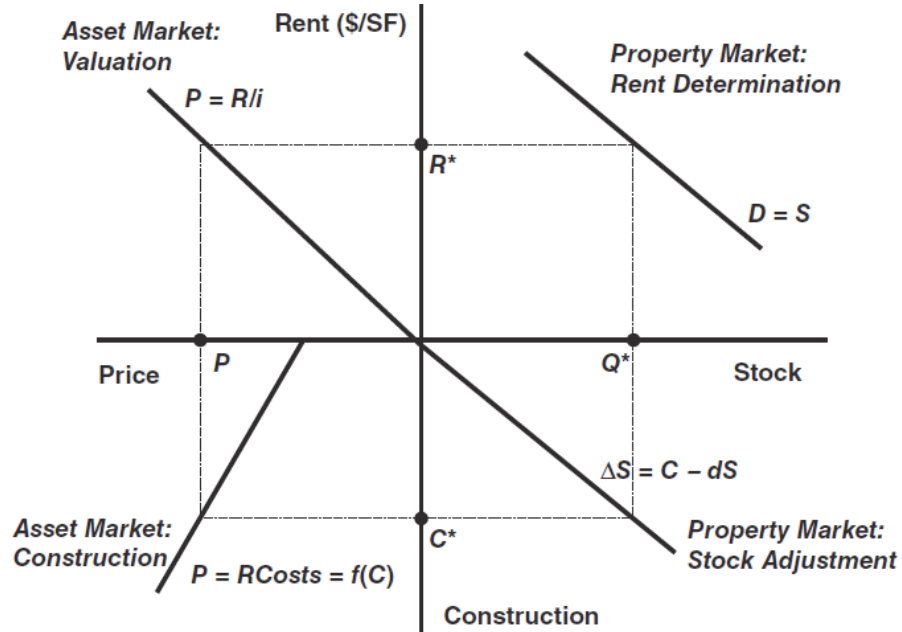
ANSWER:

- (d) (1.5 points) Critique the decision to add equity to the portfolio.

ANSWER:

**2.**

(6 points) The ABCD Pension Fund portfolio owns a real estate holding in a local market currently experiencing expanding economic activity. It is evaluating the sale of this property.



Using the Four-Quadrant model:

- (a) (1.5 points) Explain how increased economic activity drives rent in the short term.

ANSWER:

- (b) (1.5 points) Explain how increased economic activity drives construction activity and rent in the intermediate term.

ANSWER:

## 2. Continued

A semiconductor fabrication company is seeking to build a campus that would in part be comprised of a facility currently owned by ABCD.

- (c) (1 point) Explain investment value (IV) considerations for different investors and developers in a given geographic area.

ANSWER:

Let IV be the investment value of the property for the semiconductor company. Consider the following scenarios:

- (i) Scenario 1: IV is much greater than market value (MV). To assemble the properties for an industrial campus, the potential buyer has larger plans than is possible for this single property, and thus a higher IV than the general MV of this specific property.
  - (ii) Scenario 2: IV is much less than MV. Selling specific properties, including the one owned by the pension plan, is more valuable than one large commercial space.
  - (iii) Scenario 3: IV roughly equals MV, within transaction costs.
- (d) (2 points) Propose a negotiating strategy for ABCD to sell the property to the semiconductor company for more than the general market price for each of the scenarios above.

ANSWER:

### 3.

(6 points) You are an investment actuary at XYZ insurance company responsible for performance and attribution calculations for XYZ's annuity surplus portfolio.

You are provided with the following information regarding XYZ's annuity surplus portfolio:

- On January 1, the market value of the surplus portfolio is \$115M.
- On February 1, the reserve strengthened and \$10M of cash is transferred from the surplus portfolio to the liability-backing portfolio. The market value of the surplus portfolio is \$110M after the cash transfer.
- On April 1, dividends and coupons totaling \$5M is paid from investments in the surplus portfolio.
- On May 1, \$10M of cash in the surplus portfolio is invested back into fixed income assets already in the portfolio. The total market value of the portfolio after the reinvestment is \$120M.

Assuming an equal number of days in each month.

- (a) (1 point) Calculate the time-weighted rate of return of the surplus portfolio from January 1 to May 1.

ANSWER:
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### 3. Continued

You are provided with the following information on the surplus portfolio as of December 31.

Asset Class	Benchmark	Portfolio Weight	Target Weight	Asset Class Performance	Benchmark Performance
Fixed Income	Barclays U.S. Bond Index	50%	45%	7.5%	4.5%
Equity	S&P 500 Index	30%	40%	10.0%	9.0%
Real Estate	MSCI U.S. REIT Index	20%	15%	5.0%	6.0%

(b) (2 points)

- (i) (0.5 points) Calculate the overall portfolio return and overall benchmark return.

ANSWER:

- (ii) (1.5 points) Calculate the active asset class allocation return and active security selection return, assuming interaction returns are folded within security selection.

ANSWER:

### 3. Continued

You are also provided with the following information on the liability-backing portfolio as of December 31.

Fixed income returns are attributed into the following factors:

- Carry: return arising from the passage of time
- Interest rates: return arising from changes in interest rates
- Credit spreads: return arising from changes in credit spreads

Sector	Weight		Portfolio Return			Benchmark Return		
	Portfolio	Benchmark	Carry	Interest Rates	Credit Spreads	Carry	Interest Rates	Credit Spreads
Government	15%	30%	1.5%	-1.0%	-	1.0%	-1.2%	-
Corporate	85%	70%	3.0%	-1.5%	2.5%	2.5%	-1.5%	2.7%

The portfolio aims to meet the following objectives:

- The liability-backing portfolio has a focus on book yield and the portfolio yield should exceed that of the benchmark.
- The liability-backing portfolio should be less sensitive to credit spreads than the benchmark.

(c) (2 points) Assess the performance of the portfolio in meeting its objectives.

ANSWER:

XYZ is also looking to implement a framework for the liability-backing portfolio where the portfolio is not marked-to-market with respect to changes in the yield curve.

Assume that interaction returns are folded into security selection.

(d) (1 point) Calculate the active sector allocation return and active security selection return under the new framework.

ANSWER:



**4.**

(7 points) You are asked to help your company's senior management understand two liquidity measures: Liquidity Cost Score (LCS) and Trade Efficiency Score (TES).

(a) (2 points) Compare LCS and TES.

ANSWER:
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#### 4. Continued

An investment-banking firm recently published a new version of its LCS model as shown below. The sign of each coefficient in this new version remains the same as in the original version.

Regression of LCS on Bond Attributes: Quoted IG and HY bonds

Dependent Variable: LCS (%)		
Observation Period: 2018 – 2020		
Explanatory Variable	Coefficient	t-statistics
Monthly Trading Volume (\$million)	0.002	-18.4
Issue Size (\$million)		-20.3
Age (Years)	-0.002	16.9
DTS		182.2
Intercept		5.8
Monthly Dummies?	Yes	
Number of Observations:	26,370	
Adjusted R <sup>2</sup>	0.75	

As of 31 December 2020, Bond A, B, C and D were in your company's asset portfolio as shown below.

Bond	Par value held by ABC Life (\$million)	Trader Quoted?	Benchmark Bond?	Monthly Trading Volume (\$million)	Issue Size (\$million)	Age (Years)	DTS	OASD	Bid Price	Ask Price	Bid Spread (bps)	Ask Spread (bps)
A	10	Yes	Yes	85	30	1.0	51.7	12.5		92.4	465	440
B	9	Yes	No	13	70	3.0	20.0	5.8	93.6	95.6		
C	4	No	No	6	20	10.0	39.6	10.4				
D	6	No	No	1	20	5.0	40.0	10.6				

The non-benchmark adjustment factor = 1.2. The non-quoted adjustment factor = 1.3.

(b) (3 points) Construct a ranking of the LCS's of bonds A, B, C, and D.

ANSWER:
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#### 4. Continued

- (c) (1 point) Approximate the proceeds from selling Bond A.

ANSWER:

The option adjusted spread of your company's asset portfolio widened over the last year.

- (d) (1 point) Explain two possible scenarios for the widened option adjusted spreads.

ANSWER:

## 5.

(8 points) Insurance company, XYZ, plans to make an investment in private equity (PE).

You are developing a benchmark for the investment.

- (a) (1 point) Explain the four main purposes of a benchmark.

ANSWER:

Your manager wants you to develop PE benchmarks using desirable benchmark properties according to the Bailey criteria.

- (b) (2 points) Explain the difficulties meeting four of the properties when developing PE benchmarks.

ANSWER:

XYZ's investment department provides the following simulated distribution of two funds. Year 6 values are terminal NAVs.

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
PE Fund 1	-100	-500	+200	-1000	-400	+800	+2000
PE Fund 2	-800	-500	-1000	-200	+500	+1500	+2000

- (c) (2 points)

- (i) (1.5 points) Compare the performance of the two funds by IRR and TVPI.  
(ii) (0.5 points) Explain the key difference between IRR and TVPI.

*The response for this part is to be provided in the Excel document*

## 5. Continued

After some research, you decide to use a public equity index as the benchmark. The historical index values are summarized in the table below. Also, it is proposed to use the public market equivalent (PME) method for benchmarking purpose.

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Public Equity Index	5962	4625	3064	3558	3821	4715	5542

- (d) (0.5 points) Explain how PME works and why it is critical in performance benchmarking.

ANSWER:

- (e) (2.5 points) Recommend the PE fund that has a higher excess IRR compared to the benchmark, answer this part in Excel.

*The response for this part is to be provided in the Excel document*

**6.**

(6 points) You are reviewing the investment portfolio of XYZ life insurance company, whose liabilities consist primarily of defined benefit pension obligations and whole life insurance policies.

- (a) (1 point) Describe four ways in which insurers may take excessive risks that could impact investment decisions.

ANSWER:

- (b) (1 point) Describe three measures used to examine the performance of an investment taking its risk into account.

ANSWER:

XYZ is planning to add a position in a new fund to its well-diversified equity portfolio for its pension plan. Two funds are being considered (A) and (B).

	A	B
Risk-free Rate	3%	
Fund Return	10%	12%
Std Dev of Fund Return	5%	7%
Systematic Risk	1.25	1.75

- (c) (2 points)

- (i) (1.5 points) Calculate the Sharpe ratio and Treynor ratio for each fund.

ANSWER:

- (ii) (0.5 points) Recommend which fund to invest in based on your results from part (c) i).

ANSWER:

## 6. Continued

Your assistant has made the following suggestions to mitigate the negative effects of the low interest rate environment:

- We should reposition our portfolio such that 50% is allocated to infrastructure investments to increase returns.
- We should invest in emerging market sovereign debt, which is foreign risk-free debt, due to the high return relative to our Treasury yields.
- We can consider increasing our target allocation in equities to earn a higher return.

(d) (2 points)

- (i) Explain why a prolonged low interest rate environment poses additional risk.

ANSWER:

- (ii) Critique your assistant's suggestions.

ANSWER:

## 7.

(5 points) You are an associate actuary at ABC, a large multi-national insurance company founded in 1992 that offers a wide selection of life and annuity products to consumers. Where ABC is domiciled, they are currently required to use locked in rates for contract valuation.

During a recent meeting, a coworker mentioned they had heard about upcoming changes to the International Financial Reporting Standards (IFRS).

- (a) (2 points) Describe five of the improvements that IFRS 17 makes to existing insurance accounting practices.

ANSWER:

Your coworker expresses some skepticism of the new reporting standard. He claims that IFRS 4 was satisfactory and that this just sounds like more paperwork. He also says that the current economic environment hasn't changed enough since ABC's founding to justify the new standard.

- (b) (1 point) Assess your coworker's comment on changes to the economic environment and how IFRS 17 could improve ABC's understanding of their liabilities.

ANSWER:

At the meeting, your supervisor asks for your insight on how IFRS 17 might impact ABC's overall balance sheet. She is particularly interested in the following cases:

- Short-term insurance contracts where liabilities for incurred claims are not discounted.
  - Long-term insurance contracts where the historical rate is higher than the current rate.
  - Risk margins that are higher than the risk adjustment in IFRS 17.
- (c) (1 point) Describe the expected impact of IFRS 17 on insurance contract liabilities for each of the above cases.

ANSWER:



## 7. Continued

ABC is adopting IFRS 9 in conjunction with IFRS 17. ABC's assets are as follows:

- 90% Debt instruments
  - 10% Derivatives
- (d) (*1 point*) Assess which measurement bases for financial assets under IFRS 9 are appropriate for ABC.

ANSWER:
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## 8.

(5 points) PQR has decided to begin selling Guaranteed Investment Contracts (GIC). To make their GIC more attractive to investors, PQR is planning to add a put feature, where contract owners can demand full payoff of the GIC within 7 days if the company's credit rating is downgraded by one notch. Historically, the company has maintained high credit ratings, typically A+.

The sale plan is \$10 billion in the first year. Below is the proposed asset allocation to support the sales.

Types of Assets	Total (in Billions)
Secured funded assets	\$6.4
Liquid unencumbered assets	\$2.0
Illiquid unencumbered assets	\$1.6

Liquidity Profile (estimated time to sell)	Total (in Billions)
Within 1 week	\$0.7
Within 2 weeks	\$0.6
Within 1 month	\$0.4
Longer than 1 month	\$0.3

- (a) (2 points) Describe the liquidity risk associated with this GIC.

ANSWER:

- (b) (2 points) Propose measures to manage the liquidity risk above.

ANSWER:

## 8. Continued

PQR has obtained lines of credit from several banks, with 80% of the total credit limit is from bank S. You have noticed that S has been issuing preferred stock as well as large amounts of subordinated debt during last two years. Below are the liquidity ratios of bank S for the last 4 quarters.

	1Q	2Q	3Q	4Q
Liquidity Ratio	116	111	106	101

- (c) (1 point) Recommend whether PQR should continue with the current credit line.

ANSWER:
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## 9.

(6 points) You are an actuary working for a pension consulting company. Your client, ABC, is a large and mature sugar company. ABC has a long history of operation, with stable income historically. ABC has established a registered defined benefit pension fund for all their employees. All pensions are paid in local currency, which is not US Dollars. You are asked to establish the investment policy statement for the pension fund with the following demographics:

- Half of the workforce are experienced sugar farmers with an average age of 55 years.
- The other half are very young and in good health.
- The average age of all of the plan participants is 39 years old.
- The average liability duration of the plan is 20 years.

Due to the recent shift in dietary recommendations, sugar demand has been dropping globally and the company's income has been slowly declining. The pension fund for ABC is currently funded at 100% with a historical fund return of 6.5%. In ABC's jurisdiction, investment income for registered pension funds is tax-exempt.

- (a) (2 points) List eight typical elements of an investment policy statement.

ANSWER:

- (b) (2 points) Describe the return objectives and liquidity requirements of the ABC pension plan

ANSWER:

In order to try and earn a high return for the pension fund, ABC's retirement policy committee has suggested investing in a new asset class, BitCoin, which has been recently created and is actively traded in US Dollars, to fund the pension liability.

- (c) (2 points) Evaluate whether the proposal fulfills four standard investment constraints.

ANSWER:

## 10.

(5 points) You have been asked to build a credit risk model for a portfolio of 100 mortgages.

You are given the following assumptions:

- The mortgages are not independent of each other
- The mortgages all have a similar risk of default

(a) (1 point) Describe a key shortcoming of the binomial and Poisson independent-default setting models, and how the mixture models address this shortcoming.

ANSWER:

You first decide to model defaults using a binomial-mixture model where the default probability

$p(Z) = \exp(Z)$ , where  $Z$  is normally distributed with mean  $\mu = \ln(1/20)$  and variance  $\sigma^2 = \ln(9)$ , so that  $E[p(Z)] = \exp(\mu + \sigma^2/2)$ .  $\text{Var}(p(Z)) = (\exp(\sigma^2) - 1) \times \exp(2\mu + \sigma^2)$ .

(b) (1 point) Calculate the following:

(i) Expected number of defaults for the portfolio

ANSWER:

(ii) Covariance of the default indicators for any two issuers

ANSWER:

## 10. Continued

After further research, you decide to model defaults using the Poisson-Gamma approach. The key idea of the Poisson-mixture approach is to randomize the arrival intensity and, indirectly, the default probability. You assume that  $\lambda_n \equiv \lambda(S)$ , where  $S$  follows a gamma distribution  $S \sim \Gamma(2,4)$ , with mean  $\mu = 0.5$  and variance  $\sigma^2=0.125$ , so that  $E(p(S)) = E(S)$ .

- (c) (1 point) Explain one advantage of mixing the Poisson model with another distribution, such as the Gamma distribution.

ANSWER:

- (d) (2 points)

- (i) Calculate the probability that there are exactly 2 defaults for the portfolio.

ANSWER:

- (ii) Calculate the default correlation  $\rho_D$  for any two issuers using the quick and dirty calibration method described in the Bolder reading (assuming  $p(S)=S$ ).

ANSWER:

## 11.

(7 points) This question is concerned with allocation of commodity investments into a portfolio consisting of equity and fixed income assets. One benefit of allocating part of your portfolio to commodities is hedging against inflation.

- (a) (0.5 points) Explain two reasons why commodities serve as an inflation hedge during a rapidly expanding economy.

ANSWER:

- (b) (1.5 points) Describe how each of the following characteristics can weaken the well-documented inflation hedging property of commodities:

- (i) High volatility of energy commodities

ANSWER:

- (ii) High storability of industrial metals

ANSWER:

- (iii) High price sensitivity of agricultural commodities to factors other than inflation

ANSWER:

## 11. Continued

Your preferred approach is to gain pure commodity exposure in a cost-effective way.

(c) (1.5 points) Explain why each of the following alternative investment vehicles may not be suitable for your portfolio.

(i) Direct physical ownership

ANSWER:

(ii) Public commodity-based equity

ANSWER:

(iii) Bonds issued by commodity firms

ANSWER:

Your colleague tells you to avoid agricultural commodities. His analysis shows that the returns over the last five years are comparable to those of government bonds but with significantly higher volatility. He quotes Hotelling theory to back up his statement, concluding that agricultural commodity investments will always result in negative Sharpe ratios over the long term.

(d) (2 points) Critique your colleague's argument.

ANSWER:

In addition to spot returns, collateral return and roll yield are the two other sources of returns on commodity future contracts.

(e) (1.5 points) Describe how collateral return and roll yield could contribute to enhanced returns compared to direct investments.

ANSWER:



## 12.

(6 points) You are evaluating a lump sum pension payment currently worth \$100, that will be made in 34 years. The payment is indexed to inflation, which is assumed to be 1% per year. Your portfolio consists of a zero-coupon bond with a fixed notional of \$120 maturing in 30 years. The discount rate for pension and bond payments is 5%.

- (a) (1 point) Calculate the funding ratio.

ANSWER:

- (b) (1 point) Identify key risk factors that can adversely affect the funding ratio.

ANSWER:

You decide to sell the bond and invest 70% of the proceeds into equity, while the remaining 30% is held back as cash. You use this cash as collateral to enter into a 34-year interest rate swap, receiving 5% in exchange for a variable rate of interest.

- (c) (0.5 points) Identify advantages of using swaps instead of bonds.

ANSWER:

- (d) (1 point) Calculate the Liability Driven Investment (LDI) leverage, defined as the value of liabilities as a percentage of LDI assets value.

ANSWER:

## 12. Continued

Assume that one year has passed. Equity dropped by 10% over the year, and the inflation expectation and discount rate are revised to 1.5% and 5.5%, respectively. The LDI leverage has now increased to 575%.

- (e) (1 point) Calculate the new funding ratio.

ANSWER:

- (f) (1.5 points) Evaluate the situation (increase in leverage / decrease in funding ratio) and potential courses of action for the fund manager.

ANSWER:

### 13.

(6 points) You are part of a team managing a fixed income portfolio backing long duration life insurance liabilities of ZZZ Life Insurance. The team is looking at ways to increase the overall yield of the portfolio using fixed income securities.

- (a) (1 point) Identify four advantages of private debt over high yield bonds.

ANSWER:

To illustrate to the team the different characteristics of high yield bonds you compare a pay-in-kind (PIK) note that has an equity clawback to a bond with a bullet structure.

- (b) (1.5 points) Compare and contrast the cash flows for a PIK note with an equity clawback and a bond with a bullet structure.

ANSWER:

The investment team has secured a loan using just a few of its higher quality industrial bonds as collateral. The collateral is marked to market once per month and must cover the amount of the loan outstanding plus a margin of 10%. If the collateral is insufficient, additional bonds are posted as collateral until the loan outstanding plus 10% is reached.

A rating agency recently informed the team that any additional posting of collateral for this loan could result in a downgrade of ZZZ Life Insurance. Additionally, over the past few weeks there has been a significant increase in merger and leveraged buyout activity in the industrial sector.

- (c) (1.5 points) Explain the event risk the team is concerned about due to this recent increase in merger and buyout activity with regards to the rating of ZZZ Life Insurance.

ANSWER:

### 13. Continued

You have been reading through the indentures of the industrial bonds pledged as collateral

- (d) (2 points) Explain two covenants that may appear in the indentures that would make you less concerned about the recent increase in merger and buyout activity.

ANSWER:
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## 14.

(5 points) BYR bakery enters into a supply agreement with SLR, a small, recently-established producer of organic flour. The agreement specifies that BYR will buy 1,000 kg of organic flour from SLR each month for a term of three years. BYR will pay \$1,000 per month, 30 days before delivery.

- (a) (0.5 point) Describe the credit risk present in this agreement.

ANSWER:

- (b) (2 points) Describe the four parameters of credit risk for each of the parties.

ANSWER:

After two years, the market for organic flour has evolved and the following deals are available on the market:

- 1 year at \$1,500 per month payable on delivery
- 2 years at \$1,700 per month payable on delivery
- 3 years at \$1,400 per month payable on delivery

The unsecured borrowing rate for each party after two years is 3% (compounded annually).

- (c) (1 point) Describe the steps to calculate the supply agreement's mark-to-market value after two years.

ANSWER:

## 14. Continued

Your colleague proposes to use the agreement's mark-to-market value as a measure of the credit risk.

(d) (1.5 points)

(i) (0.5 points) Critique this proposal

ANSWER:

(ii) (1 point) Propose a more appropriate measure for the credit risk.

ANSWER:

## 15.

(5 points) You are reviewing the credit risk of a portfolio of 1,000 corporate bonds from various companies, with a total value of \$1,000,000.

- (a) (1 point) State a formula defining the default loss random variable in terms of the exposure at default and recovery rate of each bond, giving definitions for each term in the formula.

ANSWER:

To start, you make some simplifying assumptions:

- the credit risks of the bonds are independent,
- each bond has a homogenous exposure of \$1000 and default probability of 2%, and
- the recovery rate is zero.

- (b) (1 point) Calculate the variance of the default loss defined in part (a).

ANSWER:

You decide to calculate a VaR using a normal approximation to the binomial distribution.

- (c) (1 point) Calculate the approximate 95th percentile VaR of the default loss.

ANSWER:

## 15. Continued

You review the credit risk report of the portfolio and note the following statements:

- A. Credit risk management is solely concerned with managing the magnitude of the expected default loss.
  - B. Where possible, the real world probability of default is estimated by looking at market price data, which add additional conservatism.
  - C. We have chosen to use a structural model over a reduced-form model – its ability to model the reason for default leads to a superior fit.
  - D. Model parameters can be easily calculated analytically using the method of maximum likelihood.
- (d) (2 points) Critique each of the statements above.

ANSWER:
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## 16.

(5 points) You manage a portfolio of bonds to support a group of liabilities.

- Liabilities in the next three years have payments of \$1 million annually at the end of each year.
- The liabilities are supported by 3 bonds that pay coupons at the end of each year that were just purchased.
- All bonds are also readily available for additional purchase at par.

Bonds	Par Value (\$ in millions)	Coupon
30 years	10	3.50%
20 years	4	3.25%
3 years	1	1.00%

To support this liability, you are required to use cashflow matching using the principal and coupon payments of the above bonds.

- (a) (1.5 points) Calculate the unfunded liability position of your matching strategy at the end of each of years 1-3 for the liabilities and the supporting assets.

ANSWER:

Assume excess cash at the end of the period is allowed.

- (b) (1 point) Calculate the minimum value of bonds to purchase to fully cashflow match the liabilities.

ANSWER:

- (c) (0.5 points) Evaluate if cashflow matching is an appropriate method for these liabilities.

ANSWER:

## 16. Continued

Other liabilities are backed by bonds in another asset portfolio as shown below.

	PV of Position (\$ in Million)	Duration
Assets	550	8
Liabilities	540	12

- (d) (1 point) Calculate the amount of assets above that you will need to purchase to immunize this net asset/liability position.

ANSWER:

Alternatively, interest rate futures can be purchased to immunize the net position from interest rate risk. Bond A is used to settle the futures contract as it is the Cheapest-to-Deliver:

	Duration	Market Value of Bond (\$ in millions)	Conversion Factor
Bond A	7	10	1.2

- (e) (0.5 points) Calculate the number of full future contracts that would be needed to be bought or sold to successfully immunize the net position.

ANSWER:

The portfolio manager would like to decrease the duration of the asset to 6 to support another, shorter, set of liabilities,

- (f) (0.5 points) Calculate the number of full future contracts that would need to be bought or sold to achieve this.

ANSWER:

## 17.

(6 points) You work for the Asset & Liability Management (ALM) department for an insurance company. Your job is to design strategies to purchase various assets to back insurance liabilities. Based on the calculation from the actuaries, the duration for the liability is approximately 15 years. Your team member has the following comment:

Since the liability has a duration of 15 years, we can duration-match the liability by purchasing a Mortgage Backed Security (MBS) which uses 15 year fixed-term mortgages as the underlying asset. Since the mortgage rate is locked in at issue for fixed rate mortgages, as long as we can purchase MBS with the right interest rate, we can eliminate the interest rate risk.

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

ANSWER:

Your colleague assembled the following analysis on the price vs interest rate of a Fixed-Maturity Bond and a MBS, but he forgot to label the securities.

Interest Rate	2.5%	3%	3.5%	4%	4.5%	5%	5.5%
Security A	106	104	102	100	98	96	94
Security B	104	103	101.5	100	97.5	95	93

- (b) (1.5 points) Describe the characteristics of Securities A and B to identify which is the Fixed-Maturity Bond and which is the MBS.

ANSWER:

Your firm is considering investing in a pool of mortgages with a weighted average coupon (WAC) of 5%.

There is a difference between the WAC and the pool's coupon rate.

- (c) (1.5 points) Explain three sources for the difference between the WAC and a pool's coupon rate.

ANSWER:

## 17. Continued

You were also given the underwriting information on two MBS pools. The information below are pool averages:

	MBS A	MBS B
Credit Score	760	700
Loan-to-Value Ratio	80%	85%
Debt-to-Income Ratio	30%	40%

(d) (2 points)

- (i) (1.5 points) Explain how this information could be used to determine the credit risk of MBS.

ANSWER:

- (ii) (0.5 points) Identify which pool has a higher likelihood of default.

ANSWER:

**\*\*END OF EXAMINATION\*\***