

# Exam RETRPIRM

**Date:** Friday, October 30, 2020

## INSTRUCTIONS TO CANDIDATES

### General Instructions

1. This examination has 6 questions numbered 1 through 6 with a total of 40 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.
2. The answer should be confined to the question as set.
3. The Word and Excel files that contain your answers must be uploaded before time expires.

*Recognized by the Canadian Institute of Actuaries.*

1. (6 points) Company XYZ sponsors a defined benefit pension plan and is reviewing its liability-driven investment strategy.

You are given:

	Value	Effective duration	Key rate durations				
			D1	D2	D3	D4	D5
Total plan liabilities	\$28,000,000	17	1.7	X	3.4	Y	5.2

You are also given the following:

An increase of 100 basis points in key rate D2 and an increase of 50 basis points in key rate D3 combine to result in an \$1,200,000 decrease in liabilities.

- (a) (2 points) Calculate the key rate durations D2 and D4.

Show all work.

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

- (b) (2 points) Calculate the effect of the following yield curve shifts on the liabilities

	Shift in yield				
	D1	D2	D3	D4	D5
Shift 1	-0.10%	-0.05%	0.00%	0.00%	+0.15%
Shift 2	0.00%	+0.15%	+0.15%	+0.05%	0.00%

Show all work.

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

- (c) (2 points) Compare and contrast investing in the following fixed income portfolios for the purpose of implementing an LDI strategy for XYZ pension plan:

- (i) A portfolio matching the effective duration; and  
(ii) A portfolio matching the key rate durations

ANSWER:

**2.** (6 points) You are the actuary for a defined benefit pension plan whose sponsor is considering replacing the plan's allocation to public equity with an allocation to private equity and real estate.

(a) (2 points) Describe six additional risks that the pension plan would be exposed to.

ANSWER:

(b) (4 points) Describe ways investment managers can mitigate the risks described in part (a).

ANSWER:

**3.** (8 points)

(a) (1 point) Describe how to measure the following items from a financial economics perspective.

(i) Market Value of Assets; and

(ii) Liabilities

ANSWER:
---------

You are a shareholder of Company XYZ. You are given the following:

	Description			
	Assets (\$)	Pension Portfolio Allocation of Company XYZ's Pension Plan (%)	Tax Rates	Expected Return
Total Portfolio	\$10M			
Company XYZ			35%	
Desired Equities	\$5M	60%	15%	7%
Desired Bonds	\$5M	40%	40%	3%
Gross Pension Assets	\$0.5M			

Notes:

- Total portfolio assets represent your portfolio and include gross pension assets.
- Gross pension assets represent your indirect holdings through the corporate pension plan
- Desired equities and bonds represent your target asset mix

### 3. Continued

Company XYZ shifts the asset allocation of the pension plan to a 100% bond portfolio. You change your direct holdings to return to your desired allocation to equities and bonds.

- (b) (6 points) Calculate the impact of the new portfolio on your after-tax returns by filing out the tables in Excel.

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

**Table 1: Your Portfolio Return (Pension Plan: 60/40 Portfolio)**

Pension Plan: 60% Equity / 40% Bonds	Your Holdings	Pre-tax Income	Personal Tax	After-tax Income
<b>Indirect holdings through corporate pension plan</b>				
Equity				
Bond				
Total indirect holdings				
<b>Your direct holdings</b>				
Equity				
Bond				
Total direct holdings				
Total portfolio				

### 3. Continued

**Table 2: Your Portfolio Return (Pension Plan: 100% Bond Portfolio)**

<b>Pension Plan: 100% Bonds</b>	<b>Your Holdings</b>	<b>Pre-tax Income</b>	<b>Personal Tax</b>	<b>After-tax Income</b>
<b>Indirect holdings through corporate pension plan</b>				
Equity	0	0		
Bond				
Total indirect holdings				
<b>Your direct holdings</b>				
Equity				
Bond				
Total direct holdings				
Total portfolio				

- (c) (1 point) Explain why shifting the pension plan's asset allocation to bonds represents an arbitrage opportunity.

ANSWER:

**4.** (8 points)

- (a) (2 point) Describe the risks associated with investing in fixed income.

ANSWER:

- (b) (3 points) Describe methods that active managers use to mitigate the risks described in (a).

ANSWER:

Company XYZ is evaluating a new fixed income strategy for the XYZ Pension Plan. The Company's goal is to use active management of the fixed income portfolio to minimize interest rate risk while achieving a higher return than the benchmark.

Company XYZ's investment advisors have proposed two portfolios:

<b>Constraints</b>	<b>Benchmark</b>	<b>Portfolio A</b>	<b>Portfolio B</b>
Duration	15 years	+/- .5 years of the benchmark	No constraint
Minimum credit quality	AA	AA	B, no more than 25% high yield corporate
Target Allocation (permitted deviation)	60% Government/ 40% Corporate	50% Government/ 50% Corporate (10% deviation)	20% Government/ 80% Other (20% deviation)
Mortgage Backed Security Sector	None	Not allowed	Up to 15%
Foreign bonds	None	10-20%	Not allowed
Allow currency forward contracts	No	Yes	No

- (c) (3 points) Compare and contrast each constraint of Portfolio A versus Portfolio B for addressing Company XYZ's goal.

ANSWER:

- 5.** (5 points) You are the actuary for XYZ Company which sponsors a frozen defined benefit pension plan.

You are given:

Assets	\$100 million
Liabilities	\$125 million
Asset Mix	60% Equity / 40% Bonds
Bond duration	7.7 Years
Interest Rate Hedge Ratio	16.43%

- (a) (2 points) Calculate the impact on the funded ratio of a 20 basis point reduction in both the fixed income yields and the liability discount rate.

Show all work.

ANSWER:
---------

The plan sponsor would like to reduce the volatility of the funded ratio without reducing the expected return of the investment strategy.

- (b) (3 points) Describe potential changes to the investment strategy that achieve the plan sponsor's objective.

ANSWER:
---------



**6.** (7 points)

(a) (4 points) Explain how each of the following addresses risks for defined benefit pension plans:

- (i) Prudent person rules;
- (ii) Minimum funding regulations;
- (iii) Guarantee funds; and
- (iv) Accounting standards.

ANSWER:

(b) (3 points) Explain how each of the following addresses risks for defined contribution pension plans:

- (i) Prudent person rules;
- (ii) Limits on fees charged to plan members; and
- (iii) Incentives to annuitize.

ANSWER:

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