

# Exam RETRPIRM

**Date:** Friday, May 5, 2023

## 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.

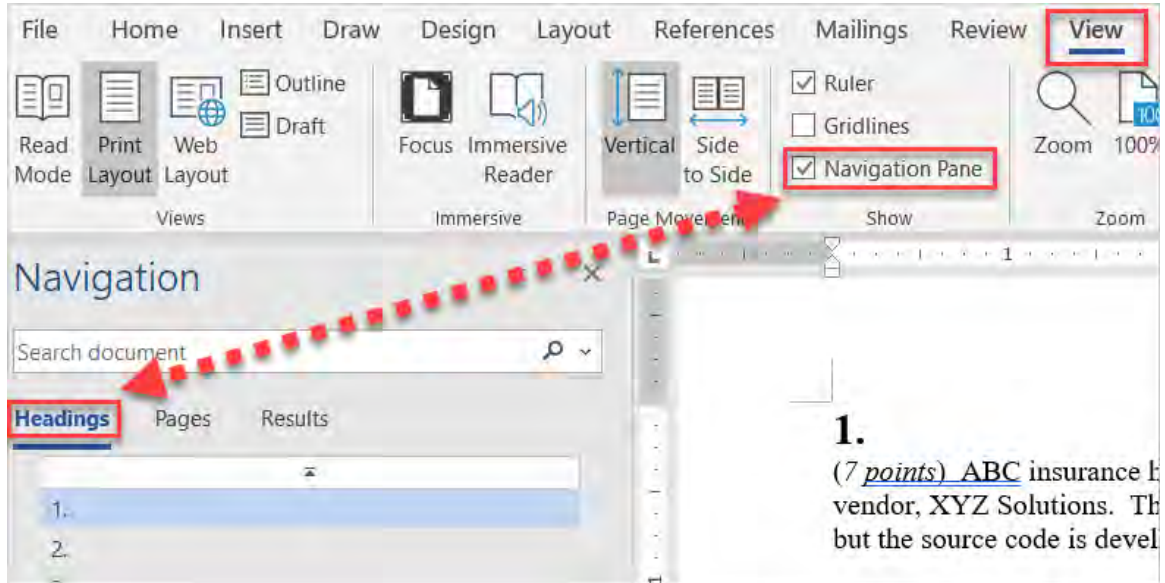
### Written-Answer Instructions

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. 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)

- (a) (4 points) Describe desirable features for target date fund design.

ANSWER:

- (b) (2 points) Describe diversification solutions that address the following risks in target date funds:

- (i) Growth risk
- (ii) Inflation risk
- (iii) Market risk

ANSWER:

## 2.

(7 points)

- (a) (2 point) Compare and contrast effective duration and key rate durations.

ANSWER:

You are given the following information on three different types of securities:

	Key rate durations by year							Initial price
	1	5	10	15	20	25	30	
Security 1	0.05	0.4	1.3	1.8	1.4	1.2	3.0	104
Security 2	0.2	-0.5	-0.3	X	-25.0	-20.0	-40.0	3
Security 3	0.2	0.7	0.5	0.8	1.1	0.4	0.2	120

- (b) (1 point) Calculate the price of Security 1 after a 10-basis point increase in the 30-year key rate.

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

- (c) (2 points) The price for Security 2 is 3.2 after the following shift:

- 15-basis point decrease in the 15-year key rate; and
- 10-basis point decrease in the 30-year key rate.

Calculate the effective duration of Security 2.

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

## 2. Continued

(d) (2 points) You are given the following steepening shift for Security 3:

- 10-basis point decrease in the 5-year key rate;
- 20-basis point increase in the 15-year key rate; and
- 30-basis point increase in the 25-year key rate.

Calculate the level (parallel) interest rate shift that is equivalent to the steepening shift given above.

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

### 3.

(6 points) You are given the following portfolio information:

Asset Class	Asset allocation of the portfolio	Expected return	Standard deviation of return
Long bonds	35%	3%	6%
Domestic equity	30%	7%	8%
International equity	30%	6%	10%
Private equity	3%	10%	15%
Cash	2%	0%	0%

Correlation	Long bonds	Domestic equity	International equity	Private equity	Cash
Long bonds	1	-0.2	-0.3	0	0
Domestic equity	-0.2	1	0.6	0	0
International equity	-0.3	0.6	1	0	0
Private equity	0	0	0	1	0
Cash	0	0	0	0	1

The standard deviation of the portfolio is 0.04713.

(a) (3 points) Calculate the marginal contribution to portfolio risk of:

- (i) Long bonds
- (ii) Domestic equities
- (iii) International equities

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

The investor sells one unit of domestic equity.

(b) (1 points) Calculate how many units of long bonds the investor must purchase to retain the same level of risk in the portfolio as before the sale of domestic equity.

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

(c) (2 points) Calculate the change in the portfolio expected excess return.

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

**4.**

(9 points) You are given the following about Company ABC's frozen defined benefit pension plan:

	Active members	Terminated vested members	Retired members	Total
Number	1,500	1,000	5,000	7,500
Plan termination liabilities	\$30,000,000	\$10,000,000	\$150,000,000	\$190,000,000
Liability duration (years)	20	18	12	

You are also given:

Fixed income assets	\$80,000,000
Equity assets	\$100,000,000
Hedge ratio	43%
Duration of fixed income assets	14

## 4. Continued

Company ABC's CFO is considering the following de-risking options:

- (i) Adopting a glide path that will have an allocation of 100% in liability-hedging assets when the plan is 100% funded on a termination basis.
- (ii) Purchasing an annuity buy-out for retired members and keeping the current asset allocation for the remaining assets.
- (iii) Purchasing an annuity buy-in for retired members and adopting a glide path for the remaining assets that will have an allocation of 100% in liability-hedging assets when the plan is 100% funded on a termination basis.

Compare and contrast how the following economic event would have affected the three de-risking options:

- A 200-basis point increase in interest rates; and
- A 25% drop in equity markets.

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



**5.**

*(8 points)*

- (a) *(4 points)* Describe four considerations in establishing a risk budget for public sector defined benefit pension plans.

ANSWER:

- (b) *(4 points)* Describe four strategies that could be implemented to address contribution and funded status risk in a public sector defined pension plan.

ANSWER:

**6.**

*(4 points)*

- (a) *(2 points)* Compare and contrast the principles of financial economics and the actuarial standards of practice applicable to pension plans.

ANSWER:

- (b) *(2 points)* Compare and contrast the accounting standards for public pension plans and private pension plans using the principles of financial economics.

ANSWER:

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