

Exam RETRPIRM

Date: Friday, May 3, 2024

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, β_1 can be typed as beta_1 (and ^ used to indicate a superscript).

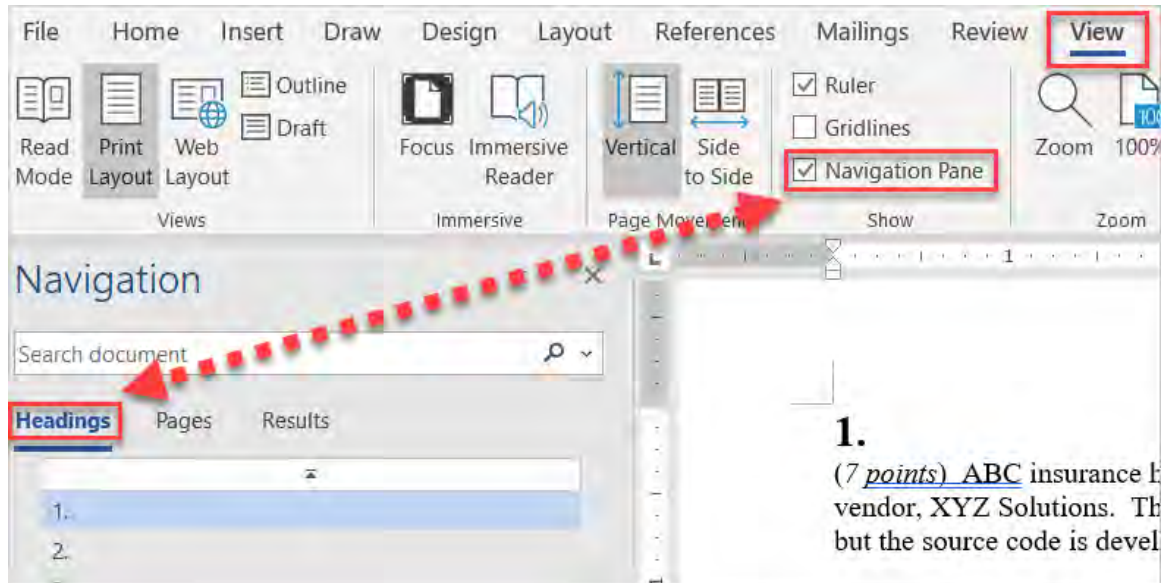
b) In the Excel document formulas should be entered. Performing calculations on scratch paper or with a calculator and then entering the answer in the cell will not earn full credit. Formatting of cells or rounding is not required for credit.

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.

(7 points) You are the actuary for a defined benefit pension plan with the following projected benefit payments. You are also given the yield curve.

Time	Yield Curve	Benefit Payments	Time	Yield Curve	Benefit Payments	Time	Yield Curve	Benefit Payments
1	1.50%	967,095	26	1.75%	871,622	51	3.00%	955,005
2	1.50%	994,926	27	1.75%	827,808	52	3.00%	915,916
3	1.50%	870,820	28	1.75%	959,335	53	3.00%	803,525
4	1.50%	984,790	29	1.75%	809,492	54	3.00%	973,959
5	1.55%	919,110	30	1.80%	838,542	55	3.00%	939,004
6	1.60%	890,197	31	1.90%	916,880	56	3.25%	967,848
7	1.60%	904,429	32	2.00%	818,693	57	3.25%	884,740
8	1.60%	942,606	33	2.00%	967,286	58	3.25%	963,081
9	1.60%	877,937	34	2.00%	825,890	59	3.25%	860,740
10	1.62%	992,304	35	2.00%	830,582	60	3.25%	897,475
11	1.62%	865,967	36	2.25%	834,384	61	3.50%	811,559
12	1.62%	951,575	37	2.25%	820,906	62	3.50%	933,811
13	1.65%	906,064	38	2.25%	900,586	63	3.50%	936,642
14	1.65%	851,085	39	2.25%	885,231	64	3.50%	979,822
15	1.65%	861,298	40	2.50%	952,161	65	3.50%	874,361
16	1.65%	921,309	41	2.60%	905,709	66	3.50%	883,417
17	1.70%	854,977	42	2.75%	894,265	67	3.50%	958,052
18	1.70%	991,782	43	2.75%	940,201	68	3.50%	819,937
19	1.70%	917,077	44	2.75%	875,739	69	3.50%	861,836
20	1.75%	856,812	45	2.75%	975,753	70	3.50%	805,696
21	1.75%	956,826	46	2.75%	824,537	71	3.50%	995,377
22	1.75%	883,498	47	2.75%	809,369	72	3.50%	957,163
23	1.75%	987,016	48	2.75%	854,715	73	3.50%	830,089
24	1.75%	941,036	49	2.75%	899,690	74	3.50%	944,436
25	1.75%	820,739	50	2.75%	938,714	75	3.50%	860,574

- (a) (2 points) Calculate the duration of the liabilities of the pension plan.

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

1. Continued

You are given the liability impact for the following shifts in the yield curve:

	D1	D2	D3	Liability Impact
Shift 1	+100bps	+50bps	0	-\$528,000
Shift 2	+75bps	-75bps	0	+\$792,000

- (i) The market value of the pension plan's fixed income investment is \$8,800,000.
 - (ii) The effective duration of the fixed income investment is equal to the effective duration of the liabilities.
 - (iii) The pension plan is fully immunized against shifts in the yield curve.
- (b) (3 points) Calculate key-rate durations D1, D2 and D3 for the fixed income investment.

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

- (c) (2 points) Describe the challenges associated with a cash flow matching strategy.

ANSWER:

2.

(6 points)

- (a) (1 point) Compare and contrast the calculation of market liability and budget liability from the financial economics perspective for the following two assumptions:
- (i) Default rate
 - (ii) Discount rate

ANSWER:

- (b) (5 points) Compare and contrast the calculation of market liability and budget liability from the financial economics perspective for the following:
- (i) Interest rate risk
 - (ii) Credit risk
 - (iii) The pursuit of alpha

ANSWER:

3.

(7 points) You are the actuary for Company ABC's defined benefit pension plan. Company ABC recently made the decision to terminate the plan within 5 years. The primary objective of Company ABC is to minimize the cost of plan termination by ensuring that the plan is fully funded before termination occurs.

You are given:

Plan type	Closed and frozen
Funded status	86%
Asset allocation	60% equity / 40% bonds
Bond duration	7.2 years
Liability duration	9.8 years

- (a) (2 points) Describe the benefits of implementing a glide path liability-driven investment (LDI) strategy.

ANSWER:

- (b) (5 points) Recommend one of the following LDI strategies considering Company ABC's primary objective.

Justify your recommendation.

	Option 1	Option 2
Initial asset allocation	No immediate change	35% Equity / 65% Bonds
Triggers	Interest rate level (long term bond index) increases by 0.50%	Funded status improves by 2%
Monitoring frequency	Quarterly	Monthly
% of equity replaced with bonds when a trigger is reached	15%	5%
Duration of bonds added to the portfolio	14.9 years	7.2 years
End state objective	Hedge ratio = 100%	Funded status = 100%

ANSWER:

4.

(9 points)

- (a) (2 points) List the four main objectives of performance measurement tools.

ANSWER:

- (b) (3 points) Identify the strengths and weaknesses of using risk-adjusted return ratios for performance measurement.

ANSWER:

You are given the following information on three portfolios:

Portfolio 1				Portfolio 2				Portfolio 3			
		MV0	750			MV0	225	Beginning of year MV		1000	
CF1	100	MV1	975	CF1	50	MV1	320	CF1	100	MV1	1140
CF2	75	MV2	1000	CF2	-60	MV2	260	CF2	-40	MV2	1250
CF3	100	MV3	1000					CF3	225	MV3	1480
CF4	50	MV4	1225					CF4	80	MV4	1370
								CF5	-50	MV5	1290
								CF6	100	MV6	1400
								CF7	-30	MV7	1390
								CF8	0	MV8	1500
								CF9	100	MV9	1625
								CF10	250	MV10	1750
								CF11	300	MV11	1875
								CF12	0	MV12	2000
								End of year MV		2045	

Portfolio 1	Cash flows (CF) & market values (MV) are quarterly at the end of the quarter
Portfolio 2	Cash flows & market values are semi-annual at the end of the period
Portfolio 3	Cash flows & market values are monthly, mid-month

Market values shown are inclusive of cash flows at the valuation date.

- (c) (3 points) Calculate the dollar-weighted and time-weighted rates of return for each of the three portfolios.

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

4. Continued

- (d) *(1 point)* Calculate the Sharpe Ratio for portfolios 1 and 2 assuming a risk-free rate of 2.50% and using the time-weighted return calculated in c) above.

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

5.

(5 points)

- (a) (3 points) Describe the considerations when defining a public pension plan's objectives for the purpose of establishing a risk management framework.

ANSWER:

- (b) (2 points) Describe the factors that contribute to distortions in the feedback loop for public pension plans.

ANSWER:

6.

(6 points) Company XYZ is a large petroleum firm that has recently hired you, a pension actuary, to review the investment practices in their two defined benefit pension plans for their Division A and Division B employees, respectively.

	Division A	Division B
Plan type	Closed	Open
Plan participants	30% actives and 70% retirees	70% actives and 30% retirees
Plan assets	\$850 Million	\$600 Million
Plan liabilities	\$700 Million	\$800 Million

You are given the following excerpt of the Statement of Investment Policies and Procedures (SIPP) applicable for both Division A and Division B plans.

Investment objectives	<ul style="list-style-type: none"> Minimize sponsor contributions and funding volatility on a company level Improve balance sheet and income statement of Company XYZ
Investment strategies	<ul style="list-style-type: none"> Diversify investments by investing in stocks, bonds, and alternative investments Invest a proportion of stocks and bonds into the petroleum industry Invest in residential and commercial real estate through the purchase of exchange traded funds Invest in long-short style hedge funds to generate additional return Duration match bonds on an aggregate company level
Plan administrator	Company XYZ
Plan assets	Division A: 75% bonds, 5% hedge funds, 15% in Company W stock, 5% cash and equivalents Division B: 70% stocks, 9% hedge funds, 15% in Company W stock, 5% real estate, 1% cash and equivalents
Investments	<ul style="list-style-type: none"> Use investment manager Alpha for bond investments and investment manager Beta for stock investments, due to having the lowest fees in these respective asset classes Invest in hedge fund X for its long-short strategy Invest in multiple exchange traded funds for real estate
Rebalancing	Rebalance on an annual basis to ensure the asset allocation percentages do not exceed minimum and maximum allowed allocations
Monitoring	Annual investment performance review by Company XYZ internal finance department

6. Continued

- (a) (4 points) Critique the elements provided above of Company XYZ's SIPP.

ANSWER:

Company XYZ is considering hiring an outsourced chief investment officer (OCIO) for both Division A and Division B plans.

- (b) (2 points) Describe the advantages and disadvantages of the above consideration.

ANSWER:

****END OF EXAMINATION****