SOCIETY OF ACTUARIES

Portfolio Management

Exam INV 101

Date: Friday, November 21, 2025

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This examination has 8 questions numbered 1 through 8 with a total of 50 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.

3. Each question part or subpart should be answered either in the Excel document or the paper provided as directed. Graders will only look at the work as indicated.

4. In the Excel 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).

5. Prior to uploading your Word and Excel files, each file should be saved and renamed with your unique candidate number in the filename. To maintain anonymity, please refrain from using your name and instead use your candidate number.

6. The Excel file that contain your answers must be uploaded before the five-minute upload period expires.

Written-Answer Instructions

1. Write your candidate number at the top of each sheet. Your name must not appear.

2. Write on only one side of a sheet. Start each question on a fresh sheet. On each sheet, write the number of the question that you are answering. Do not answer more than one question on a single sheet.

3. The answer should be confined to the question as set.

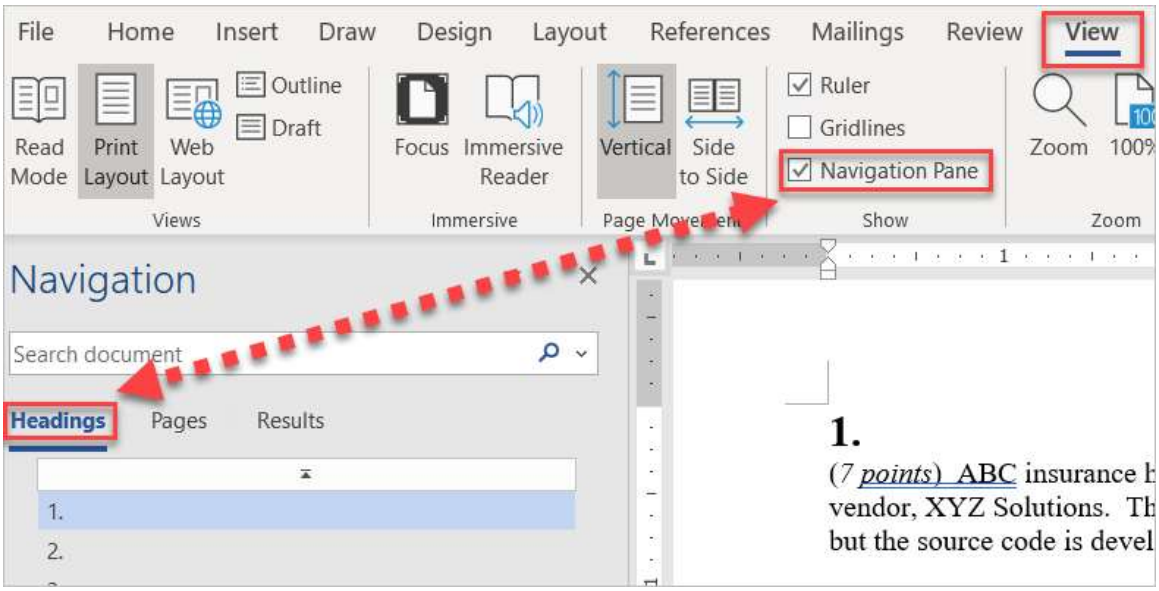
4. When you are asked to calculate, show all your work including any applicable formulas. When you are asked to recommend, provide proper justification supporting your recommendation.

5. When you finish, hand in all your written-answer sheets to the Prometric center staff. Be sure to hand in all your answer sheets because they cannot be accepted later.

Navigation Instructions

Open the Navigation Pane to jump to questions.

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



1.

(*8 points*) You are an investment actuary of ABC Life. You were presented with a table of newly-issued securities shown below.

Security Category	Description	Coupon Rate	Market Price (per $100 par value)
	10-year U. S. Treasury Bond	4.00%	100
A	Agency RMBS pass-throughs	5.00%	100
B	10-year non-callable bond issued by PQR company	5.00%	100
C	Non-callable zero-coupon bonds issued by the same PQR company as in (B) with maturity ranges for every month between 1 month to 10 years (i.e 120 total bonds)	0.00%	Each bond is priced to yield 5% bond-equivalent yield

(a) (*1 point*) Contrast the risks associated with investing in category A, B, or C against U.S. Treasury bonds in the above table.

ANSWER:

The projected liability cash flows from one of your company's product portfolios are given in the Excel sheet. These cash flows are non-interest sensitive. Your company's investment guideline is to closely match asset/liability cash flows for this product portfolio.

(b) (*1 point*) Explain which of the four categories of securities in the table is most suitable to support the liability based on the investment guideline.

ANSWER:

You are provided the following information about the agency RMBS pass-throughs:

- The underlying mortgages are newly issued 30-year loans with 5.00% interest rate and total loan balance of $30 million.
- The pre-payment implied in the market price = 210% PSA

(c) (*2 points*) Calculate the projected total cash flows due to the investor in each month using 210% PSA for the agency RMBS pass-throughs.

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

1. Continued

Assume that all the underlying mortgages in the agency RMBS pass-throughs were gathered by a bank as collateral to create a CMO deal with three sequential tranches.

Agency CMO deal with three sequential tranches	Tranche Coupon Rate
Tranche 1, allocated with 27% of the deal's notional	5.00%
Tranche 2, allocated with 30% of the deal's notional	5.00%
Tranche 3, allocated with 43% of the deal's notional	5.00%

(d) (*2 points*) Calculate the projected cash flows of Tranche 2 due to the investor each month.

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

After comparing the projected cash flows between liability and Tranche 2 from part (d), your assistant proposed:

> "Rather than buying the bond (or bonds) that was identified in part (b), the company can buy $4.5 million notional Tranche 2 security because such purchase also meets the investment guideline to support the liability"

(e) (*2 points*) Critique your assistant's proposal.

ANSWER:

2.

(*6 points*) Company ABC is a risk-averse, long-term investor. You are examining an investment opportunity for Company ABC to purchase Property X.

You are given three assessments on investment values for Property X:

Company	Investment Value (millions)
ABC	$200
DEF	$125
HIJ	$75

(a) (*1 point*) Justify why Company ABC should purchase Property X.

ANSWER:

Company ABC's CEO heard that REITs are an attractive alternative to directly purchasing private property, while still getting real estate exposure. The CEO would like you to assess REIT Y.

You are given the following information on REIT Y:

Outstanding Shares	$10,000
Value of Properties	$1,500,000
Liabilities (Debt)	$1,400,000
Share Price	$15

(b) (*1 point*) Calculate REIT Y's Net Asset Value and differential relative to its share price.

ANSWER:

(c) (*1 point*) Describe three reasons why a differential valuation might exist between the REIT and private property market.

ANSWER:

2. Continued

Company ABC's CEO states, *"REIT Y's share price has been trending upwards all year. We should get in on the momentum and invest in REIT Y"*

(d) (*1 point*) Evaluate the CEO's statement.

ANSWER:

Company ABC's CEO would also like you to consider REIT Z as an alternative option.

You are provided with data on REIT Y and Z:

Average OCC	
REIT Y	15%
REIT Z	5%

Company ABC's CEO states, *"REIT Y is a better growth investment because the real estate market is competitive, and REIT Y can afford to purchase new properties while REIT Z cannot."*

(e) (*1 point*) Evaluate the CEO's statement.

ANSWER:

(f) (*1 point*) Recommend in which of the above REITs company ABC should invest.

ANSWER:

3.

(*6 points*) You are a financial advisor for high net worth clients. Below is the economic profile for one of your clients:

- He owns a taxable stock portfolio of $500,000
- He has a mortgage loan of $2,000,000 on his primary residence, which is currently valued at $3,000,000
- He has an expected pension payout that will be starting in 15 years with a current present value of $1,200,000
- He plans to fund a college education trust for his two children in three years, with a current present value requirement of $600,000
- His other estimated future expected consumption expenditures have a current present value of $1,500,000
- He expects to receive a taxable inheritance within ten years, with an estimated current present value of $700,000

You use this information to construct his economic balance sheet.

(a) (*1 point*) Explain how the concept of an economic balance sheet differs from a traditional balance sheet, including providing one item that only appears on an economic balance sheet.

ANSWER:

(b) (*1.5 points*) Calculate the economic net worth for your client.

ANSWER:

You have also conducted a detailed interview with your client and developed an assessment of his risk preference. You have determined his utility function to be $U_m = E(R_m) - 0.5\lambda\sigma^2_m$. You estimated his risk aversion coefficient λ to be 3. You have put together three potential portfolios with their expected return and risk.

Asset Allocation	Expected Return $E(R_m)$	Forecasted Standard Deviation of Return σ_m
A	0.12	0.25
B	0.08	0.20
C	0.05	0.12

3. Continued

(c) (*1.5 points*) Recommend the most appropriate asset allocation using mean-variance optimization.

ANSWER:

You are drafting an investment policy statement for your client.

(d) (*2 points*) Describe two key constraints that would impact your client's asset allocation.

ANSWER:

4.

(*5 points*) You work as an ALM actuary at ABC Life (ABC) and are looking to adjust the fixed-income (FI) portfolio used to back ABC's pension risk transfer (PRT) liabilities (i.e., group annuity). More specifically, your goal is to enhance the yield earned on the portfolio (without taking on too much risk) using the following instruments that reference the 3-month SOFR:

- Long term, inverse floaters
- Long term, receive fixed interest-rate swaps (IRS)

(a) (*1 point*) Indentify two similarities and two differences between the instruments.

ANSWER:

(b) (*1 point*) Explain how both instruments can be used to enhance the yield on the FI portfolio.

ANSWER:

Your manager notes that the PRT business is very sporadic. When a deal does occur, a large sum of cash is received by the investment manager, and they will want to get it invested as quickly as possible since cash yields are low. Thus, your manager is considering using passive bond ETFs to better manage the transaction.

(c) (*1 point*) Explain how a passive bond ETF can accomplish this.

ANSWER:

The senior management team at ABC wants to increase the profitability of the PRT business by diversifying the block's asset portfolio to incorporate equities. Currently, they're looking to re-allocate 20% of the FI portfolio to apply a new factor-based strategy and they've asked you to lead the portfolio's construction.

(d) (*2 points*) Justify appropriate risk factors used in the factor-based strategy.

ANSWER:

5.

(*5 points*) You work as an investment consultant. YUP Mutual (YUP), one of your clients, is asking for your help in updating their investment mandate. Below is background information on YUP:

- It's a mutual life insurance company that was established 5 years ago
- It mainly sells whole life insurance products to young urban professionals
- It's currently managing $100M in assets split 50/50 between equities (EQ) and fixed-income (FI)
- Its EQ portfolio is currently being managed with a passive investment strategy through an asset manager
- The following are the unit values of the EQ portfolio (net of MER (i.e., management expense ratio), withdrawals, and deposits) and its benchmark's index level over the last 5 years:

Year	0	1	2	3	4	5
Benchmark Level	2,823.81	2,704.10	3,225.52	3,714.24	4,515.55	4,076.60
Portfolio UV ($)	35.56	32.53	38.98	44.87	55.00	50.00

(a) (*1.5 points*) Calculate the EQ portfolio's 5-year annualized tracking error.

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

The CIO at YUP was quite surprised by the EQ portfolio's tracking error.

(b) (*1 point*) Describe three factors that may be driving the tracking error.

ANSWER:

YUP is really interested in exploring active management strategies for their EQ portfolio as part of their update. The CIO at YUP has heard a lot about activist strategies and wants to learn more about how they could unlock value for their investors.

(c) (*1 point*) Explain how activist funds could manipulate a target firm's balance sheet to unlock value for their investors.

ANSWER:

5. Continued

YUP's CIO believes that it may be worth the effort to start an in-house activist strategy fund as part of the EQ portfolio.

(d) (*1.5 points*) Evaluate whether it's appropriate for YUP to allocate a portion of the EQ portfolio to an in-house activist strategy fund.

ANSWER:

6.

(*8 points*) You supervise an investment fund managed by Manager A. You are doing the year-end evaluation of the performance of Manager A. Manager A adopts the Brinson-Fachler model.

(a) (*1.5 points*)

(i) (*0.75 points*) Describe the issue that occurs in the Brinson-Hood-Beebower Model when the benchmark return outperforms the benchmark.

ANSWER:

(ii) (*0.75 points*) Describe the improvement made by the Brinson-Fachler model that addresses this issue.

ANSWER:

			Manager A	
	Benchmark Weight	Benchmark Return	Fund Weight	Fund Return
Fixed Income	50%	X	25%	3%
Equity	40%	W	Z	6%
REIT	10%	8%	Y	R

You are given the table above, as well as the information below:

- The interaction return for Equity is -0.1%.
- The selection return for Equity is -0.2%.
- The allocation return for Fixed Income is 0.35%.
- Fund return is 5.7%.

(b) (*1.5 points*) Calculate X, W, Z, Y, and R.

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

6. Continued

(c) (*2 points*) Calculate manager A's performance attribution.

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

(d) (*1.5 points*) Analyze manager A's performance based on his performance attribution results obtained in (c).

ANSWER:

To further the analysis, risk attribution is incorporated to obtain performance appraisal metrics. You are given the following information for Manager A and, a potential job candidate, Manager B.

	Manager A	Manager B
Risk-Free Rate	1.5%	
Target Rate of Return	4.0%	0.25%
Fund Return	5.7%	7%
Standard Deviation	10%	11.93%
Semi-Standard Deviation	2.5%	6.7%
Systematic Risk	1.06	1.37

(e) (*1.5 points*) Recommend a manager based on Sharpe ratio, Treynor ratio and Sortino ratio.

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

7.

(*5 points*)

(a) (*1 point*) Define Gross Exposure, Net Exposure, and Adjusted Exposure.

ANSWER:

(b) (*1 point*) List the two-step process of determining default probabilities.

ANSWER:

(c) (*1 point*) Describe three reasons for the nationally recognized statistical ratings organizations (NRSROs) being regulated by the Securities and Exchange Commission (SEC).

ANSWER:

(d) (*2 points*) Describe the S&P global ratings corporate criteria framework.

ANSWER:

8.

(*7 points*) You are a credit risk analyst at XYZ Financial Services. You are asked to model losses due to defaults on a bond portfolio consisting of 1,000 obligors. The default probability of each obligor is 1%.

Let D_N be the number of defaults within the portfolio.

(a) (*1 point*) Calculate $E[D_N]$ and $Var[D_N]$ using the binomial independent-default model.

ANSWER:

Your colleague, Jane, believes that the model used in Part (a) is not an ideal choice for modelling the default risk of this portfolio. She suggests that the assumption of default independence is not realistic.

(b) (*1 point*) Identify two additional shortcomings of the model in Part (a) besides the assumption of default independence.

ANSWER:

To account for potential default correlations, you decide to apply a mixture-binomial model as described in "Credit Risk Modelling" by Bolder. You make the following assumptions:

1. The latent variable Z follows a beta distribution $B(\alpha, \beta)$ with $\alpha = 0.2$ and $\beta = 19.8$.
2. The default probability is given by $p(Z) = Z$.

(c) (*2 points*) Calculate $Var[D_N]$ using the mixture-binomial model.

ANSWER:

8. Continued

Jane further suggests that you should also consider a one-factor Gaussian threshold model to evaluate the portfolio's credit risk. She suggests the following model for the standardized asset return for obligor n:

$$y_n = \sqrt{20\%}\, G + \sqrt{80\%}\, \epsilon_n,$$

where each obligor defaults if $y_n \leq c$, where $c = \Phi^{-1}(0.01)$ is chosen so that the unconditional probability of default is 1%. Here, $G \sim N(0,1)$ is the common economic factor, and $\epsilon \sim N(0,1)$ is idiosyncratic.

Jane is concerned about the conditional default probabilities of an obligor under the scenario of a severe downturn, where G = −2.33.

(d) (*1.5 points*) Calculate the "Z-score" that would be required in determining the conditional probability of y_n when G = −2.33. (You do not have to calculate the probability.)

ANSWER:

Your manager claims that the t-distribution model is better than the one-factor Gaussian threshold model, because the t-distribution has heavier tails.

(e) (*1.5 points*) Critique your manager's claim.

ANSWER:

END OF EXAMINATION*