SOCIETY OF ACTUARIES

Life ALM and Modeling

Exam ILALAM

Date: Friday, May 2, 2025

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This examination has 6 questions numbered 1 through 6 with a total of 60 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 document as directed within each question. Graders will only look at work in the indicated file.

   a) In the Word document, answers should be entered in the box marked ANSWER within each question. 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 X^2 can be typed as x^2.

   b) In the Excel document formulas should be entered. For example, X = component1 + component2. 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.

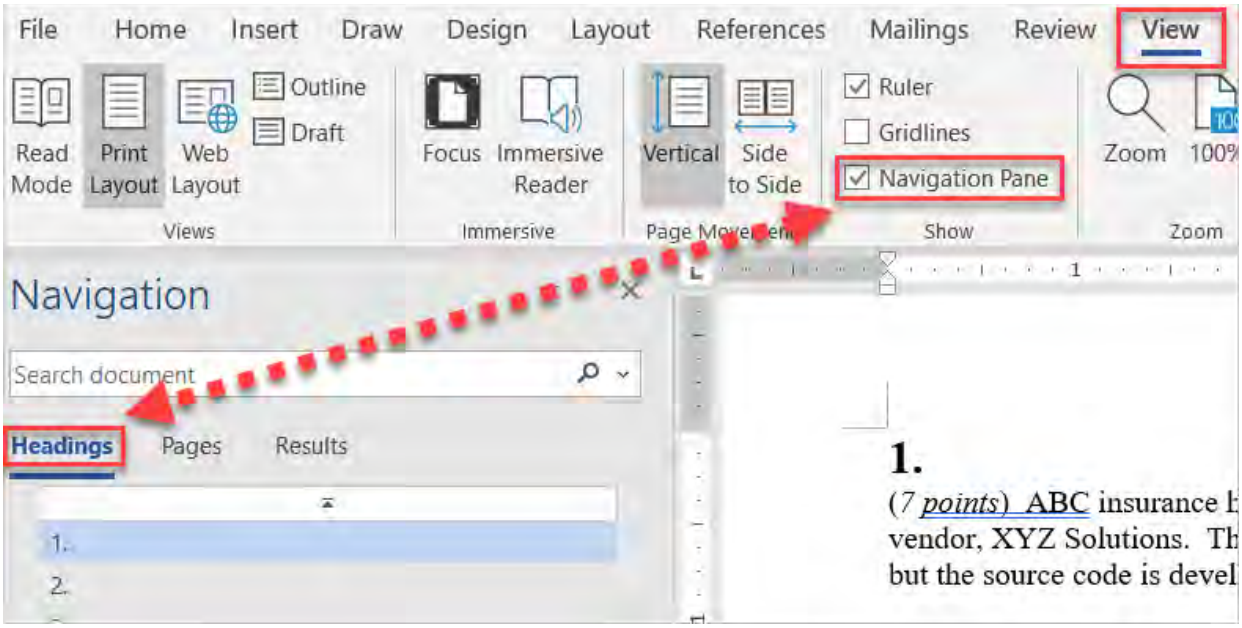
3. Prior to uploading your Word and Excel files, each file should be saved and renamed with your unique candidate number in the filename. To maintain anonymity, please refrain from using your name and instead use your candidate number.

4. The Word and Excel documents 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.

(*11 points*) Your company is looking to improve its long-term care (LTC) modeling, changing from claim cost projections to a first principles basis.

(a) (*2 points*) Critique the following statements.

A. *A model is considered a first principles model only if it breaks down all major assumptions into component pieces.*

ANSWER:

B. *When moving from claim cost to first principles, the main challenge is developing the active and disabled mortality.*

ANSWER:

(b) (*4 points*) Critique the following approaches used for developing first principles mortality and lapse assumptions for an LTC model.

A. *Developing healthy life and disabled life mortality assumptions independently is the best approach.*

ANSWER:

B. *A disadvantage of developing healthy life mortality assumptions and backing into implied disabled life mortality assumptions is that it may not produce results that have a reasonable relationship to the total life mortality assumption.*

ANSWER:

1. Continued

C. *An advantage of developing disabled life mortality assumptions and backing into implied healthy life mortality assumptions is that the approach captures each attribute that impacts a policyholder's transition from healthy to disabled status, i.e., incident, utilization, and continuation characteristics. Therefore, if this approach is used, these captured attributes should be preserved.*

ANSWER:

D. *Given companies generally have a much higher volume of active life data compared to disabled life data, the inability of accurately classifying a termination as a death is limited to a disabled life mortality study.*

ANSWER:

Your company develops healthy life lapse assumptions directly from experience using the GAM-94 mortality table adjusted in aggregate to fit historic experience – i.e., an aggregate mortality scalar has been applied such that total expected deaths are consistent with total actual deaths.

(c) (*1 point*) Describe one advantage and one disadvantage of this approach.

ANSWER:

(d) (*4 points*) You are given a set of experience study data in the Excel spreadsheet.

(i) Calculate the following for each policy year:

- Number of implied lapses
- Mortality rate
- Lapse rate

(ii) Identify issue(s) with the calculated lapse rate.

(iii) Recommend a solution for the identified issue(s).

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

2.

(*8 points*)

(a) (*1 points*) List advantages and disadvantages of using an existing actuarial model to develop a model for a new product.

ANSWER:

(b) (*4 points*) You are given a set of model output in the Excel spreadsheet.

(i) Perform static validation based on the information provided in the table. Show all work.

(ii) Describe the steps of analyzing static validation results.

(iii) Identify which product and/or metric needs to be investigated based on the static validation results. Justify your answer.

(iv) Propose an investigation approach to identify any potential issues.

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

2. Continued

You are considering investing in one of two portfolios:

	Portfolio A	**Portfolio B**
Total tracking error volatility (TEV)	13.6	22.3
Systemic TEV	9.8	14.1
Interest-Rate Duration	7.2	5.3
Option-Adjusted Spread (bp)	152	189
# of Securities	35	72

- Target spread of 150-200 bps above the Moody's Corporate Bond index
- Risk budget of 25bps/month
- Liabilities have a duration of 5.5

(c) (*1 point*) Calculate the idiosyncratic tracking error volatility for each portfolio. Show all work.

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

(d) (*2 points*) Recommend which portfolio your company should invest in. Justify your answer.

ANSWER:

3.

(*10 points*)

(a) (*4 points*) Critique the following statements related to asset adequacy and capital planning.

A. *For products that are not exposed to interest rate risk, insurers are not providing an embedded option to the policyholders.*

ANSWER:

B. *We have detailed data of good quality on our historical investment returns. We can set the credited interest rate equal to the average historical investment return minus a margin.*

ANSWER:

C. *A gross premiums valuation (GPV) test is appropriate for a level-premium term life product to assess its asset adequacy and duration mismatch in the portfolio.*

ANSWER:

D. *The risk capital needed by an insurance company depends on the riskiness of its asset / liability position. Therefore, the goal of asset & liability management is to remove asset / liability risk as much as possible.*

ANSWER:

3. Continued

You are planning to issue a 12-month variable annuity (VA) policy with the following features:

- A Guaranteed Minimum Maturity Benefit equal to 110% of initial account value
- A Guaranteed Minimum Death Benefit equal to 110% of initial account value
- An annual Management Fee of 1.5% deducted at the beginning of each month
- Fund growth is linked to an equity index

You are given the following assumptions:

Initial Account Value	100,000
Mortality Rate (monthly)	0.15%
Discount Rate	0%

Your economic scenario generator produced a simulation of equity index prices. They are provided in the Excel spreadsheet.

(b) (*3 points*) Calculate the present value of the guaranteed minimum benefits for a single policy at issue. Show all work.

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

3. Continued

ASOP 22, Statement of Opinion based on Asset Adequacy Analysis… defines "moderately adverse conditions" as conditions that include one or more unfavorable, but not extreme, event(s) that have a reasonable probability of occurring during the testing period.

Your colleague proposed three moderately adverse scenarios to use for asset adequacy testing (AAT) of the VA product described in part (b).

(c) (*3 points*) Critique the use of each scenario in the context of AAT.

(i) 50% reduction in equity performance.

ANSWER:

(ii) 3% mortality increase for all projection periods after a recent increase in mortality due to a pandemic.

ANSWER:

(iii) A standalone shock of 2% reduction in interest rate, while current interest is 3%.

ANSWER:

4.

(*11 points*) You are developing an economic scenario generator (ESG).

(a) (*6 points*) Critique each of the following statements:

A. *According to Jensen's inequality, a single scenario representing the average market condition is used in pricing and valuation of VA.*

ANSWER:

B. *Feynman-Kac theorem prohibits the use of risk neutral scenarios that are not mean reverting because such scenarios do not look real.*

ANSWER:

C. *Real world and risk neutral scenarios are selected based on different use cases. Since economic capital focuses on extreme tail events which may not exist in real life, risk neutral scenarios are always used. For strategic asset allocations, real world scenarios are used since cash flow pricing is not the primary consideration.*

ANSWER:

D. *Risk neutral scenarios must always be used directly for calculating market prices.*

ANSWER:

E. *In order to improve the efficiency of the ESG calibration process, the cascade structure is used.*

ANSWER:

F. *Management decides to perform deterministic stress testing using a scenario generated by the ESG.*

ANSWER:

4. Continued

For a VA with GMAB, you are given the following.

Initial Premium (collected at start of year)	$500,000
M&E Fees (collected at start of year)	2.0% of Fund Value
Rider Fee (collected at start of year)	2.0% of Fund Value
Initial Expense (incurred at start of year)	5.0% of Initial Premium
Annual Maintenance Expense (incurred at start of year)	$300
Guarantee (paid at maturity)	120% of Initial Premium
Term (years)	30
Annual Decrement Rate (at end of year)	5.0%
Annual Fund Return (at end of year)	6.0%
Implied Market Volatility of Fund Return	10.0%
Annual Risk-free rate	5.0%

(b) (*4 points*) Calculate the price of the GMAB using Black-Scholes formula. Show all work.

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

(c) (*1 point*) Discuss two key challenges when setting the implied market volatility assumption for option pricing.

ANSWER:

5.

(*10 points*) Your company has a block of fixed deferred annuities (FDA) with the following benefits:

- A fixed credited rate declared annually
- A guaranteed minimum credited rate
- Surrender option of account value less a surrender charge
- Option to deposit additional premium
- Accumulation period of 10 to 20 years

(a) (*1 point*) Explain how this product design exposes the company to investment risk.

ANSWER:

(b) (*1 point*) Describe two embedded options inherent in this product design.

ANSWER:

(c) (*2 points*) Discuss the impact of a significant increase in interest rates on the profitability of this product from the perspective of both the liability and the supporting asset portfolio. Assume the supporting asset portfolio is fully invested in fixed income.

ANSWER:

5. Continued

You are reviewing the investment strategy for the FDA. Given resource and budget constraints you have decided to adopt a passive management strategy and manage the asset portfolio against one of the following bond market indices.

Index X:	a long-term corporate high-yield bond index that includes debt issues rated below Baa
Index Y:	a medium-to-long-term corporate bond index with investment-grade debt issues
Index Z:	a short-term corporate bond index with investment-grade debt

(d) (*2 points*)

(i) Select the most suitable benchmark index. Justify your answer.

ANSWER:

(ii) Recommend either a pure bond indexing strategy or an enhanced indexing strategy. Justify your answer.

ANSWER:

The risk team determined the following key-rate durations for the FDA.

Term (Years)	Duration
0.25	0.02
1	0.20
3	0.35
5	0.55
10	0.70
15	3.00

(e) (*2 points*) Construct a portfolio of zero coupon bonds to match the key-rate durations. Assume a portfolio value of 100,000. Show all work.

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

5. Continued

You are reviewing how your investment portfolio is tracking against the benchmark index. 10-months of data is provided in the Excel spreadsheet.

(f) (*2 points*) Calculate the tracking risk of your asset portfolio against the benchmark index. Show all work.

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

6.

(*10 points*) Your company has the three products with the following features:

- **Universal Life (UL)**
  - Closed to new sales
  - 5% minimum crediting rate guarantee
  - Average life expectancy longer than 30-years

- **Term Insurance**
  - Closed to new sales
  - 20-year term with an average of 10-years remaining

- **Fixed Indexed Annuity (FIA)**
  - Open to new business
  - 5-year contracts
  - Includes a market value adjustment

Assets supporting the three products are managed in a single portfolio.

(a) (*1 point*) Critique the company's decision to use a single asset portfolio.

ANSWER:

(b) (*2 points*) Assess the liquidity risk inherent in the three products assuming a significant increase in interest rates.

ANSWER:

6. Continued

You a considering a relaunch of the UL product including a 5% account value bonus if the policyholder persists for 3 years. The ALM team has presented three portfolios to help support this new feature:

	Portfolio A	**Portfolio B**	**Portfolio C**
Expected Return	4%	10%	7%
Standard Deviation of Return	2%	20%	10%

You are given the following information:

- Expected face amount to be sold is 10,000,000
- Initial capital is 12,000,000
- The Risk Aversion factor is 6
- Assume there are no lapses in the first 3 years

(c) (*3 points*)

(i) Calculate the utility for each portfolio to support the persistency bonus. Show all work.

(ii) Calculate Roy's safety-first criterion for each portfolio. Show all work.

(iii) Recommend which portfolio the ALM team should use to support the persistency bonus feature. Justify your response.

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

6 Continued

You hope to improve the yield on the asset portfolio and are exploring alternative high-yield assets.

(d) (*4 points*) Critique the following statements:

A. *A below investment grade bond will have higher interest rate sensitivity compared to an investment grade bond with equal face value and term structure.*

ANSWER:

B. *Collateralized Loan Obligations (CLOs) often offer more predictable cashflows compared to other types of collateralized securities.*

ANSWER:

C. *CLOs can be used to meet various levels of credit risk taking through a tranche structure giving companies the flexibility to target certain levels of yield based on credit risk appetite.*

ANSWER:

D. *Including CLOs in a portfolio will provide a hedge against inflation, particularly if they are floating rate.*

ANSWER:

E. *To avoid taking on higher credit or liquidity risk, a CLO investment strategy should focus on middle market rather than broadly syndicated CLOs.*

ANSWER:

****END OF EXAMINATION****