

Exam ERM

Date: Thursday, May 2, 2024

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. Questions 1, 2, and 6 pertain to the Case Study.

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.

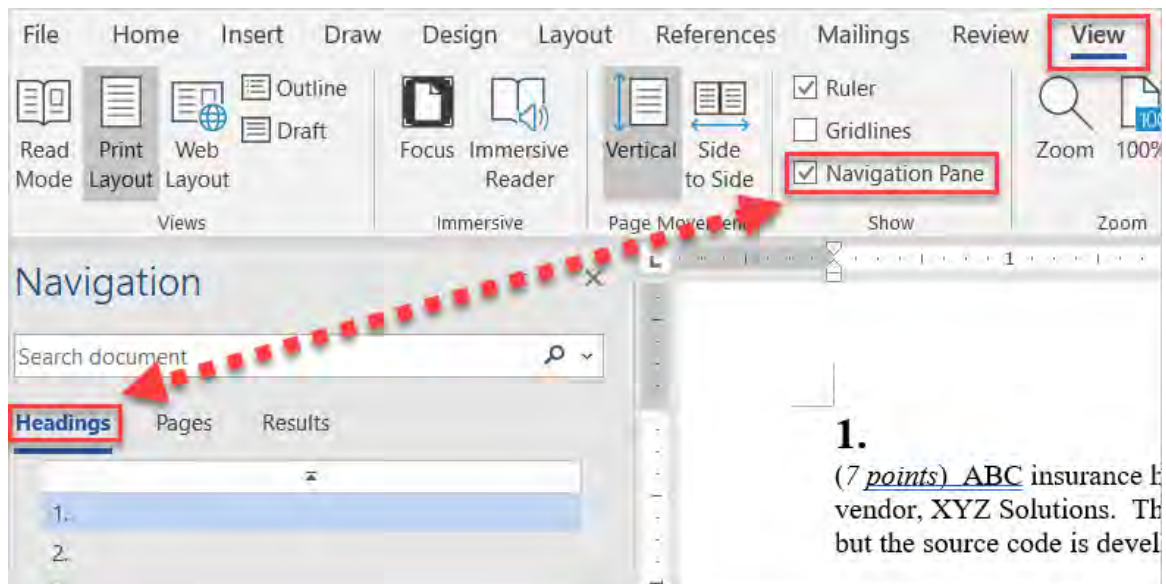
Written-Answer Instructions

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.
 - c) For each question part requiring an answer in Excel, (1) clearly identify the inputs to the calculations, (2) show the necessary interim calculations, adding rows and / or columns, if necessary, and (3) enter the final answer in some or all of the cells highlighted in yellow, as applicable in each circumstance. These cells should contain formulas with links to other calculations in the worksheet. Minimize the use of hard-coded figures and maximize the number of interim steps in the calculations that would demonstrate your line of thinking.
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 the five-minute upload period expires.

Navigation Instructions

Open the Navigation Pane to jump to questions.

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



CASE STUDY INSTRUCTIONS

The case study will be used as a basis for some examination questions. Be sure to answer the question asked by referring to the case study. For example, when asked for advantages of a particular plan design to a company referenced in the case study, your response should be limited to that company. Other advantages should not be listed, as they are extraneous to the question and will result in no additional credit. Further, if they conflict with the applicable advantages, no credit will be given.

*Questions 1, 2 and 6 pertain to the Case Study.
Each question should be answered independently.*

1.

(10 points) You are a consultant at Caerus who has been hired by the CRO of SeaLux to assist with a risk analysis for SeaLux's Board of Directors. The Board is concerned about emerging risks and wishes to avoid any unpleasant surprises.

Refer to Section 1.8 of the Case Study

- (a) (2 points) Describe two key opportunities and two key threats to include in a SWOT analysis of SeaLux.

ANSWER:

- (b) (3 points) As part of your analysis you meet with senior officers of SeaLux to get their thoughts on emerging risks facing the company. The CFO expresses concern about exchange rate risk because SeaLux wants to expand in markets such as China and Southeast Asia where it currently has low penetration. Meanwhile, the Chief Technology Officer (CTO) is concerned with cyber attacks if SeaLux expands in these markets.

- (i) Critique whether interviewing senior officers is an effective technique to identify the emerging risks facing SeaLux.

ANSWER:

- (ii) Assess whether the risks identified by the CFO and CTO are emerging risks for SeaLux.

ANSWER:

1. Continued

- (c) (5 points) You are preparing a presentation to the Board on the most important emerging risks for SeaLux. They have asked you to present one risk from the five Industry Key Risks listed in Section 1.8 of the Case Study, and one risk not on that list. The CRO has asked you to choose risks that are both highly material to SeaLux and good examples of emerging risks.
- (i) Recommend which of the five Industry Key Risks you will present to the Board. Justify why your recommendation fits both criteria.

ANSWER:

- (ii) Recommend one risk not listed in the five Industry Key Risks to present to the Board. Justify why your recommendation fits both criteria.

ANSWER:

**Questions 1, 2 and 6 pertain to the Case Study.
Each question should be answered independently.**

2.

(8 points) Caerus Consulting is supporting the introduction of a Term with Accelerated Underwriting (TAU) product at SLIC. The product will rely on an External Consumer Data and Information Source (ECDIS) to provide a risk score based on personal credit for each applicant. This risk score will supplement responses to medical questions answered in a digital application.

Refer to Section 3.2 and Section 4.5 of the Case Study.

(a) (4 points)

- (i) Describe one operational risk associated with designing the TAU product that SLIC should now consider when evaluating the overall risk of its Term product portfolio.

ANSWER:

- (ii) Explain one approach to mitigate the risk described in part (i). Justify your response using details from the Case Study.

ANSWER:

William Xu's November 15th, 2022, memorandum discusses whether death benefit limits and reinsurance arrangements are needed for TAU. Refer to Section 4.5 of the Case Study.

- (iii) Critique the recommendations in Xu's memorandum, considering SLIC's existing Term products and reinsurance.

ANSWER:

2. Continued

- (b) (4 points) A state where SLIC is licensed has proposed a new ECDIS regulation as part of Environmental, Social and Governance issues, designed to protect consumers from potential bias and misinformation in underwriting algorithms used by insurance companies.

The following is an excerpt from the regulation:

“External Consumer Data and Information Source” or “ECDIS” means any data or information source used by a life insurer to supplement or supplant traditional underwriting factors or to establish lifestyle indicators that are used in insurance practices. This term includes credit scores, social media habits, purchasing habits, home ownership, educational attainment, licensures, civil judgments, court records or occupation that does not have a direct relationship to mortality, morbidity or longevity risk, and any insurance risk scores derived by the insurer or third-party from the above list or similar data and/or information source.

Life insurers that use ECDIS as well as any algorithms and/or predictive models incorporating ECDIS must establish a governance framework that facilitates and supports policies, procedures, and systems designed to determine whether the ECDIS are credible in all material respects and that their use in any insurance practice does not result in unfair discrimination.”

- (i) Evaluate how SLIC can address this underwriting regulation in its existing risk policies. Justify your response using details from the Case Study.

ANSWER:

- (ii) Propose how SLIC can stay aware of similar regulations going forward.

ANSWER:

3.

(10 points) You are an analyst at MOK, a large life insurance and annuity company, working on its Economic Capital model. MOK models the following risks on a standalone basis and calculates diversified required Economic Capital at 99.5% using a variance-covariance approach.

MOK Standalone Risk Types
Interest Rate Risk
Credit Risk
Lapse Risk
Mortality Risk
Operational Risk

MOK management is considering the use of copulas to calculate diversified Economic Capital, and initially wants to limit testing scope to aggregating two risks.

Standalone cumulative distribution functions for potential losses (in '000s) for each risk are shown in the tab "Q3 – Standalone CDFs" of the Excel spreadsheet.

(a) (3 points)

- (i) Explain two key challenges MOK would face implementing a copula model for aggregating risks.

ANSWER:

- (ii) Recommend which two risk types should be selected to test the new copula aggregation method based on the provided standalone CDFs. Justify your selection.

ANSWER:

3. Continued

- (b) (7 points) Management has decided that you should focus on Interest Rate Risk and Lapse Risk, regardless of what was chosen in a(ii). You have decided to use the following Gaussian copula function to aggregate the selected risks.

$$Z(p, q) = a \times \Phi_{-1}(p) + \sqrt{1 - a^2} \times \Phi_{-1}(q)$$

Assume that $a = 0.75$. Refer to the tab “Q3.b” of the Excel spreadsheet.

- (i) Calculate diversified Interest Rate and Lapse Risk at the 99.5th percentile by applying the Gaussian copula for provided independent uniform draws p and q .

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

- (ii) Calculate the correlation parameter ρ that would lead to an equivalent diversified Interest Rate and Lapse Risk at the 99.5th percentile using the variance-covariance aggregation method.

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

- (iii) Compare your results from part (ii) with the implied overall distribution correlation using the copula.

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

4.

(12 points) You are an actuary reporting to the CRO at DEF Life Insurance Company. During the last year two significant changes have taken place:

- DEF has started a new policyholder wellness program. Policyholders can connect their fitness trackers to DEF's mobile wellness app and are rewarded when they meet exercise targets.
- DEF has adopted a new HR policy allowing all employees to work remotely from wherever they choose, including internationally.

Prior to the past year the company experienced on average fewer than one cyber security incident per year. However, in the last year DEF has experienced at least one cyber security incident per month. Recent cyber security incidents have had various causes, including employees clicking on links in phishing emails and hacker attacks through the wellness app used by policyholders.

(a) (3 points) The CRO is concerned about the growing risks from cyber security threats and asked you to review three proposed Key Risk Indicators (KRI):

- I. Number of attempted phishing attacks at DEF
- II. Average amount of time for DEF's cyber security team to identify a cyber security incident
- III. Number of insurance industry data breaches

Critique each of the three proposed KRIs.

ANSWER:

4. Continued

- (b) (5 points) You would like to better understand how the KRIs relate to actual losses from cyber incidents at DEF.

The loss amount due to cyber incidents is based on total expenses incurred per month for investigation and resolution of cyber incidents.

Month	Loss amount due to cyber incidents (dollars)	KRI 1: Number of attempted phishing attacks	KRI 2: Average time to log a cybersecurity incident (mins)	KRI 3: Number of insurance industry data breaches
January	33,000	7	80	11
February	18,000	5	35	1
March	51,000	18	8	5
April	100,000	22	29	7
May	27,000	8	18	0

- (i) Calculate Kendall's Tau for each of the three KRIs compared to loss amounts. Show your work.

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

- (ii) Analyze the reasonableness of the results from part (i).

ANSWER:

- (c) (4 points) The CRO has asked you to recommend a KRI to be included in the monthly "Key Risk Dashboard" shared with executives throughout the company.

- (i) Recommend one of the three proposed KRIs to be included in the "Key Risk Dashboard". Justify why you would include your chosen metric over the other two.

ANSWER:

- (ii) Propose a new KRI to supplement your recommendation in part (i) by covering its weaknesses. Justify your proposal.

ANSWER:

5.

(11 points) XYZ is an insurance company that sells life and annuity products. You have been hired as a consultant by XYZ to help enhance the asset allocation framework to achieve risk-return optimization. The first step in the process is to conduct a thorough investment risk assessment to identify and prioritize the organization's key asset-related risks.

XYZ has historically invested in bonds, mortgages, and equities. Its current asset holdings are summarized below:

Asset Categories	Percentage
Long-term Bonds	35%
Short-term Bonds	5%
Domestic Stocks	20%
Foreign Stocks	10%
Mortgages	30%
Total	100%

(a) (4 points)

You have identified three key risks related to XYZ's asset portfolio: Credit risk, Market risk, and Disintermediation risk.

(i) Explain the relevance of each of these key risks for XYZ.

ANSWER:

(ii) Recommend an appropriate risk management approach for each of the three key risks. Justify your response.

ANSWER:

With interest rates rising rapidly in the previous year and equity markets being extremely volatile, XYZ's senior management team is concerned about certain asset-related risks.

(iii) Identify which of the three key risks XYZ should monitor more closely in the environment described above. Justify your response.

ANSWER:

5. Continued

- (b) (7 points) XYZ is evaluating its bond portfolio to determine if its current holdings align with its investment goals.

XYZ's goals:

- Less than 0.5% of the portfolio expected to default over the next year
- Expected annualized return of portfolio at time 0 greater than 5.0%
- VaR(95) of expected capital charge for bond portfolio less than 2.5% at the end of year 1

Below are the three initial portfolio options that XYZ is considering.

Bond Ratings	Portfolio 1	Portfolio 2	Portfolio 3
AAA	10.0%	10.0%	2.5%
AA	15.0%	25.0%	2.5%
A	25.0%	30.0%	5.0%
BBB	30.0%	25.0%	65.0%
BB	15.0%	5.0%	15.0%
B	5.0%	5.0%	10.0%
CCC	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%

You were able to obtain a credit rating migration matrix from a well-known rating agency – the transition probabilities are given in the “Q5.b.i” tab of the Excel spreadsheet.

In addition, Capital Charge Risk Factors by rating and 100 1-year simulations of each portfolio are given in the “Q5.b.ii” tab of the Excel spreadsheet.

- (i) Calculate the expected 1-Year default rate and expected annualized return at time 0 for each of the portfolios shown above.

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

- (ii) Calculate the VaR(95) expected capital charge for each bond portfolio at the end of year 1 using the 100 simulations provided in the “Q5.b.ii” tab of the Excel spreadsheet.

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

- (iii) Recommend which portfolio allocation should be adopted. Justify your response.

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

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6.

(9 points) SLIC is considering revising its investment strategy for the Single Premium Immediate Annuity (SPIA) block to increase its allocation to higher yielding assets. Refer to Section 3.2 of the Case Study.

In the most recent SLIC Risk Management Committee meeting, the VP of ALM recommended that the revised investment strategy also be used to support the Universal Life (UL) block.

You are on the Risk Management Committee and have concerns about liquidity risk.

- (a) (2 points) Describe how the revised investment strategy might impact SLIC's liquidity risk.

ANSWER:

- (b) (3 points) William King, a director in the ERM department, made the following comments on liquidity risk:

“Unlike banks, liquidity risk is minimal for life insurance companies like SLIC. There haven't been any failures of life insurance companies caused by liquidity issues. SLIC has long-duration liabilities and predictable policyholder behavior. We hold sufficient liquid assets and would not need to liquidate these new assets to pay benefits. In fact, liquidity risk is usually a consequence of inappropriate management of other risks. If we manage other risks properly, we shouldn't be worried about liquidity risk.”

Critique William King's comments.

ANSWER:

6. Continued

- (c) *(4 points)* The SLIC Risk Management Committee approved applying the revised investment strategy to both SPIA and UL blocks. However, the Committee wants to enhance SLIC's current liquidity risk management framework. Refer to SLIC's current Liquidity Risk Policy described in Section 3.2 of the Case Study.

Recommend ways to enhance the liquidity risk management framework.

ANSWER:

****END OF EXAMINATION****