**Enterprise Risk Management –
Individual Life & Annuities Extension**

Exam ERM-ILA

Date: Wednesday, November 3, 2021

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This examination has 8 questions numbered 1 through 8 with a total of 80 points.

   The points for each question are indicated at the beginning of the question. Questions 1 and 5 pertain to the Case Study and questions 7 and 8 pertain to the Case Study and/or extension readings.

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.
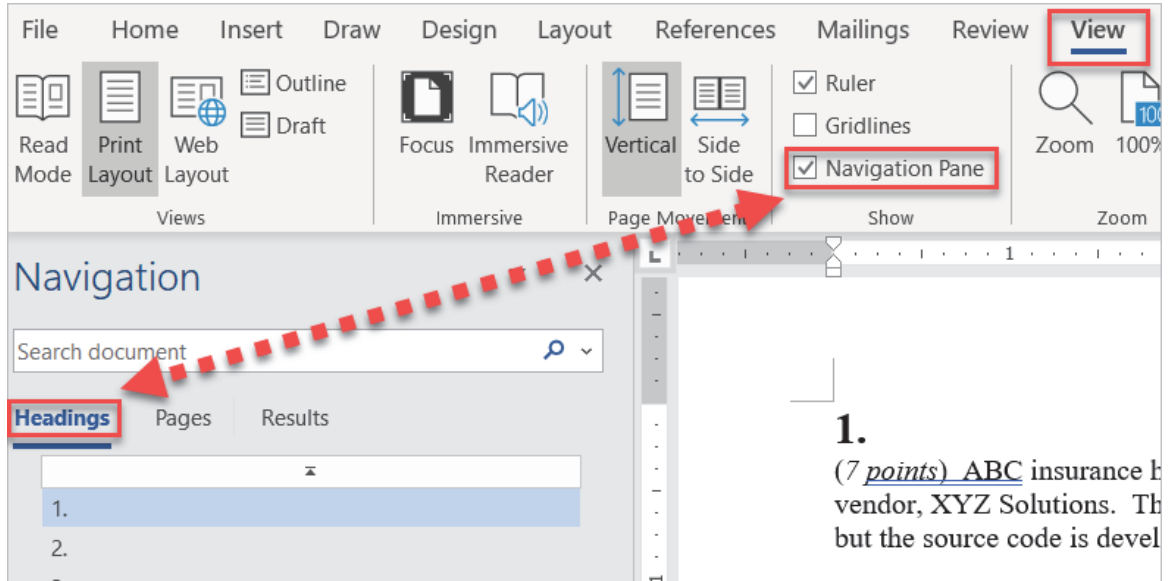
Written-Answer Instructions

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) 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 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.

Recognized by the Canadian Institute of Actuaries.

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.

1.

(*12 points*) Refer to section 1.5 of the Case Study.

(a)   (*3 points*) Big Ben considers improving its operational risk analysis by implementing one of the following:

1. Using five years of Big Ben's operational failure frequency and loss severity data, which is collected internally.
2. Using five years of Big Ben's internal data combined with industry data.
3. Using stress testing and scenario analysis.

(i)   Evaluate each of the three approaches.

ANSWER:

(ii)   Recommend the most appropriate approach for Big Ben. Justify your response.

ANSWER:

1. Continued

(b)   (*3 points*) Big Ben is considering acquiring an online life insurance company.

Taylor, an actuarial student, suggests that Big Ben implement the following in its new Liquidity Assessment Program if Big Ben undertakes the acquisition:

1. Reflect the correlation between financial markets and insurance risks
2. Measure liquidity risk using liquidity ratio and excess/deficit of liquidity
3. Assess liquidity using 10 unique stress scenarios

(i)   Describe the key drivers of liquidity risk for Big Ben.

ANSWER:

(ii)   Compare the liquidity risk profile between a life insurance company and Big Ben.

ANSWER:

(iii)   Critique Taylor's suggestion.

ANSWER:

1. Continued

(c)   (*3 points*) Big Ben is evaluating its approach to managing its cyber risk given its strategy of creating a one-stop shop interface for its globally mobile clientele and its possibility of acquiring an online insurance company. Big Ben notes that cyber risk is gaining more attention given its increasing incidence rate and impact.

Big Ben's current cyber risk management framework includes:

- Hiring people with cyber risk expertise and providing training to employees
- Setting cyber risk limit using key risk indicators
- Real-time monitoring of internal, communication system, and social media data.

Taylor made the following suggestions:

- Big Ben should leverage its current infrastructure and available technologies. No new technology investment to address cyber risk should be made
- Big Ben should develop a contingency plan to cover additional financial losses that might occur
- No cyber risk insurance is necessary.

Evaluate Taylor's suggestions.

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ANSWER:

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1.   Continued

(d)   (*3 points*) Big Ben has hired Caerus to evaluate whether it should acquire an online life insurance company.

    (i)   Explain how the liquidity risk, operational risk, and cyber risk profiles might be impacted if Big Ben acquires an online insurance company.

ANSWER:

    (ii)   Recommend whether Big Ben should consider acquiring an online life insurance company based on your response to part (i). Justify your response.

ANSWER:

2.

(*8 points*) PIC is a small regional insurance company that has been selling traditional life insurance and annuity products for the past two decades. The company recently added variable annuity (VA) products to its portfolio and implemented a hedging strategy to manage risk exposures from this block of business.

Considering the VA products have a different risk profile, PIC is reviewing its existing models and risk management tools to ensure risks associated with these products are well understood, monitored, and managed.

You are an actuary working in the ERM department. The existing Economic Capital model uses a one-year 99% VaR based on scenarios from historical experience.

(a)   (*3 points*) PIC considers implementing an Economic Scenario Generator (ESG) to enhance its risk management capabilities. Your colleague Hunter commented, "since the purpose of using ESG is to manage risk, it is more appropriate to develop real-world scenarios".

   (i)   Describe three business uses demonstrating that an ESG could add value to PIC.

   ANSWER:

   (ii)   Critique Hunter's comment.

   ANSWER:

2. **Continued**

(b)   (*5 points*) An Excel-based ESG model developed and used by the Investment
Office (IO) may be leveraged for risk management purpose.

The primary use of the IO's ESG is to generate interest rate paths for PIC's fixed
income assets, which constitute 93% of PIC's investment portfolio. This real-
word scenario generator derives the term structure of interest rates using a
Vasicek model with parameters calibrated to historical treasury rates from 1980 to
2019 using a regression approach.

You note the following modeling choices made as part of the parameterization
process:

- Outliers are eliminated to generate a steady-state level
- The underlying dynamics of interest rates are described using a long-
  term mean and standard deviation
- The recovery path from initial condition to a steady-state level is
  calibrated to be consistent with historical experience. Due to long run-
  time, recalibration of parameters and assumptions is performed
  annually.

(i)   Assess the limitations of this ESG model for PIC based on the features of
a comprehensive ESG.

ANSWER:

(ii)   Describe two sources of parameter risk in the current interest rate
parameterization process.

ANSWER:

(iii)   Evaluate the appropriateness of this model for each of the three business
uses you identified in part (a)(i).

ANSWER:

3.

(*14 points*) LifeCo is a life insurance company with two blocks of business:

- Participating Whole Life with guaranteed cash value
  - o This block is closed to new business
  - o Average attained age of policyholders is 70
  - o 100% of fund investment experience is passed to policyholders via dividends
  - o There is no more room to pass adverse experience to policyholders. Shareholders are absorbing 100% of those impacts

- Traditional Universal Life
  - o Death benefit amount is equal to the face amount elected at inception plus the fund value
  - o Premiums are flexible
  - o Minimum credited rate is 3.0%.

LifeCo's management is interested in incorporating an Economic Capital (EC) framework. The EC balance is calculated as of December 31, 2019.

Refer to the accompanying Excel file for the tabs mentioned.

(a)   (*7 points*) The following information is provided for each of the key risks identified:

- Credit
  - o You are given the following regarding LifeCo's Fixed Income assets portfolio. Default and recovery rates are estimated from S&P historical data from 1981 to 2004. Assume asset ratings do not change.

Exposure ($ thousand)	Rating	Annual Default Rates			Recovery Rate
		Year			
		1	2	3	
10,000	AAA	0.01	0.03	0.08	85%
5,000	AA	0.04	0.13	0.15	75%
7,500	A	0.08	0.15	0.20	60%
5,000	BBB	0.11	0.20	0.26	50%

  - o EC for credit risk is set as 120% of the expected credit loss over 3 years

3. Continued

- Mortality
  - EC for mortality risk has been estimated using the RBC framework

- Interest Rate
  - The liability discount curve is generated using the Ho-Lee model where:
    - $\Delta R_t = A_t \Delta t + E_t$ where E_t is normally distributed with mean 0 and standard deviation 2.0%
    - E_t simulated values are derived from a U(0,1) distribution and are shown in the tab 'Q3 (a)(ii) Interest Rate'
    - A_t is calibrated using bond prices shown in the tab 'Q3 (a)(ii) Interest Rate'
    - The initial rate for calibration R_0 is 3.0%.

  - EC for interest rate risk is calculated as the present value of the shocked cashflows less the present values of the base cashflows, where the present value of the shocked cashflows is determined by reducing the resulting discount curve by 0.5% in all years. Liability cashflow projections for 30 years are available from the valuation models in the tab 'Q3 (a)(ii) Interest Rate'.

(i) Evaluate LifeCo's approach to modeling EC for the three identified key risks.

ANSWER:

(ii) Calculate credit risk EC and interest rate risk EC. Show all work.

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

(iii) Explain how you would incorporate lapse risk and reinvestment risk into LifeCo's EC framework.

ANSWER:

3. Continued

(b)   (*4 points*) LifeCo's EC requirement for mortality has been estimated as $1.5 million.

The following correlation matrix has been provided and is based on publicly available historical market data.

	Correlation Matrix		
	Credit	**Mortality**	**Interest Rate**
Credit	1.00	0.03	0.30
Mortality	0.03	1.00	0.01
Interest Rate	0.30	0.01	1.00

(i)   Calculate LifeCo's aggregate EC using the given correlation matrix. Show all work.

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

(ii)   Compare and contrast the following aggregation methods as they pertain to LifeCo:

- Correlation
- Copula.

ANSWER:

(iii)   Describe the considerations for using copulas to aggregate risks in an EC framework.

ANSWER:

3. Continued

(c)   (*3 points*) LifeCo's management wants to assess adverse effects of the COVID-19 pandemic on its EC position as of December 31, 2020.

Management suggests using the following scenario and the correlation matrix provided in part (b):

Risk	Outcome
Credit	10% decrease in recovery rates (e.g. from 70% to 60%)
Mortality	5% increase in liability claim payments for all durations
Interest rate	10 bps decrease in base discount rates for all years

(i)   Recalculate the total required EC under the pandemic scenario. Show all work.

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

(ii) Critique LifeCo's management's suggestion.

ANSWER:

4.

(*8 points*) QPT is an insurer specializing in individual whole life insurance, term life insurance, and individual deferred annuities. You have been asked to evaluate a specific investment portfolio backing a block of deferred annuities and to make recommendations on how QPT can enhance their risk management for the block.

(a)   (*2 points*)

   (i)   Describe two primary benefits of having a well-defined risk appetite framework for key organizational risks.

ANSWER:

   (ii)   Explain how risk appetite can be reflected in each of the following:

   - Asset Allocation
   - New Business Budgeting
   - Performance Measurement.

ANSWER:

4. Continued

(b) (*4 points*) The details of the entire three-asset portfolio you have been asked to evaluate are given below. The CRO wants to evaluate risk metrics for monitoring the block and suggests that a 95% VaR may be an appropriate threshold.

Asset	Yield	Exposure ($ million)	Default Probability (1 year)	Recovery Rate
A	4%	$20	6%	40%
B	6%	$50	3%	60%
C	8%	$30	10%	10%

(i) Calculate, net of recovery, the expected loss and the variance over a one-year time horizon. Show all work.

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

(ii) Calculate the 95% VaR using the results from (i) assuming that portfolio losses are normally distributed. Show all work.

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

(iii) Determine the empirical 95% VaR based on the distribution of potential portfolio losses calculated in (i). Justify your response.

ANSWER:

(iv) Describe one key shortcoming for each metric calculated in (ii) and (iii) that should be considered when selecting an appropriate risk measure for QPT's risk appetite statement.

ANSWER:

4. **Continued**

(c)   (*2 points*) QPT's CRO is planning a discussion with the internal audit department regarding risk assessment on credit risk in an inherent risk control matrix.

  (i)   Identify and describe three *key* questions that should be considered during the risk assessment phase.

  ANSWER:

  (ii)   Recommend the most effective action to mitigate the credit risk for the portfolio in part (b). Justify your response.

  ANSWER:

5.

(*14 points*) The CFO of Energetix wants to develop a comprehensive ERM framework at the company and has reached out to Caerus for advice on how to start.

You are an actuary at Caerus, assigned to the Energetix account. Your manager has outlined a report recommending an ERM framework. She has asked you to draft content for some of the sections, listed below.

      I.   The Three Lines of Defense
      II.   Risk Identification
      III.   Emerging Risks
      IV.   Strategic Risk

Refer to section 1.9 of the Case Study.

(a)   (*3 points*) For Section I - The Three Lines of Defense:

     (i)   Summarize the function of the 2nd line of defense.

> ANSWER:

     (ii)   The CFO of Energetix has proposed that the new ERM team should report to the Manager, Engineering.

              Assess this proposal.

> ANSWER:

(b)   (*3 points*) For Section II - Risk Identification:

Propose four risk identification tools and/or techniques for Energetix and explain how Energetix could use them.

> ANSWER:

5.   **Continued**

    (c)   (*4 points*) For Section III - Emerging Risks:

        (i)   Explain how Energetix is exposed to cyber risk.

> ANSWER:

        (ii)   Identify four risk management strategies for cyber risk for Energetix.

> ANSWER:

        (iii)   Identify two emerging risks, other than cyber risk, faced by Energetix. Justify why they are emerging risks.

> ANSWER:

        (iv)   Propose a methodology for monitoring early warning signals for each of the two risks identified in part (iii).

> ANSWER:

    (d)   (*4 points*) For Section IV - Strategic Risk:

        (i)   The CFO has noted that climate-related damage to facilities and distribution channels may lead to service disruptions.

                Provide three additional examples of how climate risk may impact the strategic planning for Energetix.

> ANSWER:

        (ii)   Assess which of the three categories of climate risk (physical, transition or legal and reputation) is the most impactful on Energetix.

> ANSWER:

6.

(*4 points*) ABC Life is an insurance company selling universal life (UL) and annuity policies.

(a) (*2 points*) The company has taken the following risk mitigation steps:

- Moved from entering into over-the-counter swaps to using exchange-traded interest rate futures
- Signed new YRT treaties to cede death claims of UL policies to a reinsurance company
- Implemented a data analytics system to help detect claim fraud.

(i) Identify the risks being addressed in each step shown above.

ANSWER:

(ii) Identify the category of risk response for each risk mitigation.

ANSWER:

(iii) Explain what risks are created by taking each mitigation step.

ANSWER:

(b) (*2 points*) ABC Life has a wholly owned captive for its UL business. It is considering other risk transfer options because it believes the captive is too resource intensive.

(i) Compare and contrast traditional reinsurance, securitization and use of a captive.

ANSWER:

(ii) Describe the advantages of each option for ABC Life.

ANSWER:

7.

(*11 points*) After reviewing the March 1, 2021 memo from the Life Pricing Team (Case Study Section 4.9), George Lyon wants to know more about how policyholder behavior might impact SLICs risk profile.

(a)   (*1 point*) Explain the two primary risks a secondary guarantee introduces to a UL product.

> ANSWER:

(b)   (*3 points*) Per the March 1, 2021 memo, SLIC has experienced a significant increase in the percentage of limited-pay policies for the Protector Plus product. Explain how this could impact SLIC's risk profile.

> ANSWER:

(c)   (*3 points*) One of SLICs key competitors, XYZ, has a European parent company that is subject to Solvency II.

XYZ has been caught up in a regulatory scandal regarding inadequate reserves, leading to a credit downgrade and a "run on the bank" of policyholders surrendering their policies. Tomas Lyon, CEO, is concerned about how this could impact SLICs book of business and if they will see a "run on the bank" as well.

(i)   Compare and contrast how surrender risk is captured in US RBC and Solvency II.

> ANSWER:

(ii)   Explain the likely impacts to SLIC's business of the XYZ scandal.

> ANSWER:

7. Continued

(d)   (*2 points*) Consider the following sources of liquidity for a policyholder who needs cash.

A. Surrender life insurance policy
B. Use policy loan
C. Withdraw from bank savings account
D. Stop paying insurance premiums

For each source:

(i)   Evaluate its liquidity, including an explanation of the disadvantages to the policyholder of using that source.

ANSWER:

(ii)   Assess the impact on surrenders for SLIC if the policyholder used that source.

ANSWER:

(e)   (*2 points*) Max Hawke, Chief Investment Officer, forwards a table of risk measures of the Protector Plus product as modeled by a consulting firm assuming a $1,000,000 account value.

Measure	Value	Shock
Rho	102,876	0.50% decrease in interest rates
Vega	8,836	0.50% increase in volatility of interest rates

Interpret SLIC's liability risk exposure based on these values.

ANSWER:

8.

(*9 points*) Odette Bird, SVP Variable Annuity, has been in conversations with Danielle Wolf, Chief Marketing Officer, regarding the VA Plus product as mentioned in Odette's April 6, 2020 memo in Section 4.9 of the Case Study.

Odette has asked you to assist in the risk assessment for the product.

(a)   (*1 point*) Explain how the risk profile of VA Plus with GMDB would differ from the risk profile of SLIC's existing VA with GMDB with respect to:

(i)   Policyholder behavior

ANSWER:

(ii)   Hedging

ANSWER:

(b)   (*3 points*) Propose two product features that could be implemented for VA Plus to reduce each of the risks explained in (a). Justify your responses.

(i)   Policyholder behavior

ANSWER:

(ii)   Hedging

ANSWER:

8. Continued

(c) (*4 points*) Due to competing priorities, the ERM team does not have time to implement VA Plus into their economic capital models by the time the product would be launched. The ERM team has developed a simplified spreadsheet model to calculate an initial estimate of the cost of the GMDB guarantee. You have been asked to review the calculation to support their simplified model.

ERM has supplied you with the first ten years of projections for a single scenario of the simplified model and the following assumptions:

- All investments are in the separate account
- Projections of account value have been provided using the lapse and mortality rates provided in the Excel workbook
- The GMDB charge of 0.50% is assessed against beginning-of-year account value
- The GMDB benefit is based on the beginning-of-year account value
- Present values are discounted at 4% per annum
- All cash flows occur at the end of the year

Calculate the guarantee cost for this scenario. Provide your answer by completing the table provided in the Excel workbook.

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

(d) (*1 point*) Explain one improvement that can be made to the simplified model to more accurately capture the risks involved with the product.

ANSWER:

END OF EXAMINATION