

Exam ERM

Date: Thursday, October 31, 2024

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This examination has 4 questions numbered 1 through 4 with a total of 60 points.

The points for each question are indicated at the beginning of the question. Questions 3 and 4 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.

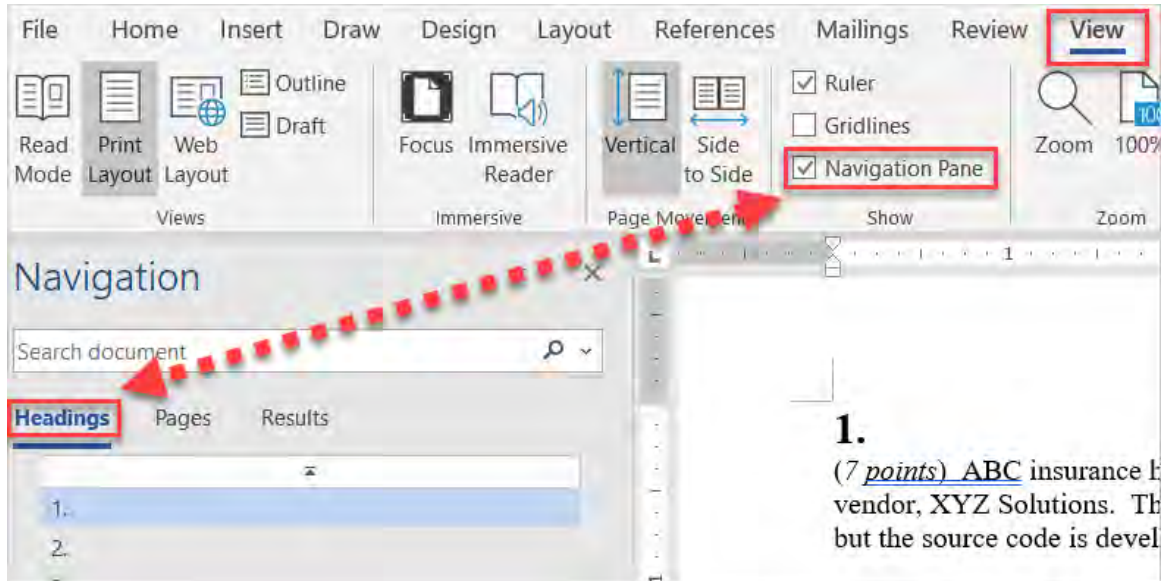
Written-Answer Instructions

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 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 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.

1.

(15 points) You are an actuary at ABC Health (ABC), a small health insurer that has recently become more aware of the financial risks associated with the emergence of gene-cell therapy. Claims associated with these therapies are both rare and extremely expensive, with a single claim able to significantly impact ABC's financial results.

(a) (3 points) ABC has only experienced a small number of claims related to gene-cell therapy and is considering the use of external data to supplement internal data.

(i) Explain the advantages of using external data in this situation.

ANSWER:

You are evaluating the following three aggregation methods for combining external claim frequency data with internal data:

- Using external data directly
- Scaling external data using a scaling algorithm
- Applying a proportionality factor to external data

(ii) Explain the pros and cons of each aggregation method.

ANSWER:

1. Continued

- (b) (2 points) Your intern Alvin has combined external data with ABC's internal data. You ask him to consider using block maxima models to model extreme losses related to gene-cell therapy.

Alvin has made the following comments about distributions associated with block maxima models, where ξ is the shape parameter:

- “The Fréchet distribution is the Generalized Extreme Value (GEV) distribution with $\xi < 0$. It is fat-tailed distribution for use in managing extreme risks in finance and insurance.
- The Gumbel distribution has $\xi > 0$. It is bounded and would not be recommended in this scenario.
- The Weibull distribution is the GEV with $\xi = 0$. This distribution has no upper bound and would be suitable in this case for large losses.”

Evaluate the accuracy of each of Alvin's comments. Justify your response.

ANSWER:

- (c) (3 points) Alvin has selected a distribution and provided estimates for the scale parameters μ and θ , and the shape parameter ξ for two different scenarios. One scenario uses a 12-month block size, and the other scenario uses a 24-month block size. The standard error of each parameter is in parentheses.

- Block size of 12 months: $\mu = 124.5$ (20), $\theta = 10.3$ (2.4), $\xi = 0.850$ (0.012)
- Block size of 24 months: $\mu = 150.3$ (18.8), $\theta = 9.3$ (1.4), $\xi = 0.943$ (0.543)

- (i) Identify which of the above three distributions is most appropriate for each scenario given the parameter estimates. Justify your response.

ANSWER:

- (ii) Explain the tradeoff between using either the 12-month or 24-month block sizes.

ANSWER:

1. Continued

- (d) (3 points) Alvin has gathered a sample of 200 losses using the combined data set shown in the tab “Q1.d” of the Excel spreadsheet. He plans to use the following formulation of the generalized Pareto distribution (GPD) to calculate tail risk metrics.

$$Q_\alpha = d + \frac{\beta}{\xi} \left(\left(\frac{S_x(d)}{1 - \alpha} \right)^\xi - 1 \right)$$

- (i) Recommend an appropriate threshold to use to indicate extreme tail events for gene-cell therapy claims given the sample data set. Justify your response.

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

- (ii) Calculate the 95th, 99th, and 99.9th percentiles of the loss distribution using the GPD with the parameters as shown in the tab “Q1.d” of the Excel spreadsheet. Show your work.

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

- (e) (4 points)

- (i) Explain why VaR and TVaR are not appropriate risk measures for this situation.

ANSWER:

- (ii) Recommend which method – block maxima or GPD – is more appropriate for modeling large losses due to gene-therapy claims. Justify your response.

ANSWER:

2.

(17 points) GRD, a U.S. manufacturer of educational-themed toys, has seen surging sales and is considering becoming a publicly traded company. The company utilizes a factory in Country X, whose currency is ELI, for manufacture of cost-effective parts and import of completed parts for assembly and sale in the U.S. Historically, GRD's relationship with the factory has been strong, with GRD receiving on-time deliveries despite occasional factory shutdowns due to social unrest or political events.

Over the past several years, Country X's economy has been volatile, but the trade relationship between Country X and the U.S. has been stable. As GRD approaches its initial public offering, it is required to disclose its risk management program. You are a risk consultant who has been hired to assess the effectiveness of GRD's risk management program.

(a) (4 points)

(i) Describe the three types of exchange rate risk as they apply to GRD.

ANSWER:

(ii) Assess whether each type of risk described in (i) is low, medium, or high for GRD. Justify your answer.

ANSWER:

Jon Doe, the CFO of GRD, states the following:

“While we lack a formal exchange rate risk management program, we've been actively monitoring the fluctuations of the ELI against the US Dollar (USD). Historically, we've mitigated potential risk by using currency forwards when anticipating a stronger ELI. This approach has been successful in the past and we expect it to continue working in the future. Considering the ELI has been consistently weakening since the pandemic, the exchange rate risk is a positive risk for us. We've got this under our control and don't need to spend any more time on this risk.”

(b) (3 points) Critique Jon Doe's statements on exchange rate risk management.

ANSWER:

2. Continued

(c) (8 points) GRD does not have expertise in investing and hedging. You have been helping the company design its hedging strategies and explore hedging instruments in both OTC and exchange-traded markets. GRD is considering the following alternatives for its hedging strategy.

- Currency (call) options
- Currency futures

(i) Assess the suitability of each alternative for mitigating exchange rate transaction risk including any risk implications. Justify your response.

ANSWER:

GRD has decided to further consider currency (call) options as an alternative to forwards (as noted by Jon Doe) and would now like to examine cash flows and potential benefits. There is an upcoming payment of 1 million ELI in three months.

As of today, the prevailing spot exchange rate stands at \$1.26 per ELI.

You have two choices for hedging:

- An over-the-counter three-month currency forward contract with a predetermined forward rate of \$1.30 per ELI. There are no transaction costs.
- An exchange-traded three-month currency call option on ELI with a strike price of \$1.28 per ELI. The premium for the call option is \$0.012 per ELI.

You are given:

- The interest rate in the U.S. is 2.5% per annum.
- The interest rate in Country X is 1.75% per annum.
- It is forecasted that the exchange rate will increase to at least \$1.30 per ELI in three months.

This information is shown in tab “Q2.c.ii” of the Excel spreadsheet.

(ii) Calculate the dollar costs in three months for each of the two hedge choices assuming the forecast is correct. Show your work.

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

2. Continued

- (iii) Recommend which hedging choice best meets the needs of the company. Justify your answer.

ANSWER:

You are asked to perform a sensitivity analysis on the exchange rate which would impact the choice of hedging instrument.

- (iv) Calculate the breakeven exchange rate in three months such that the dollar costs in three months of the currency forward and currency option are equal. Refer to tab “Q2.c.iv” of the Excel spreadsheet. Show your work.

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

- (d) (2 points) As you continue your review, you note that there have been more instances where political issues have caused disruptions than you were originally led to believe. You recommended to GRD management that it add political risk to its risk taxonomy. Katie, a director of Risk Management at GRD, disagrees with your recommendation. In her email, she states:

“We believe the company's exposure to political risk in Country X is minimal and doesn't necessitate active management. Here's our reasoning:

- *Limited Ownership: We don't directly own the factory, minimizing direct risk from disruptions.*
- *Non-Sensitive Goods: The imported components are not subject to heightened regulatory scrutiny due to their nature.*
- *Past Performance: The factory has maintained deliveries despite previous political events in Country X.”*

Critique Katie’s statement on political risk.

ANSWER:

*Questions 3 and 4 pertain to the Case Study.
Each question should be answered independently.*

3.

(13 points) You are the Deputy CRO for Pryde. Pryde currently uses a Co-CTE approach to allocate capital to its two business units and a RAROC approach for compensation. You have been asked to assist with risk budgeting and performance measurement.

Refer to Section 4.5 of the Case Study.

(a) (7 points)

- (i) Compute the capital allocated to each business unit using Pryde's current approach and the projected 2024 data provided in the tab "Q3 - 30k CapitalSim Scenarios" of the Excel spreadsheet. Refer to tab "Q3.a.i" of the Excel spreadsheet. Show your work.

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

You decide to evaluate alternative capital allocation methods.

- (ii) Calculate the allocated capital following the Proportional and the Co-VaR allocation methods based on the VaR(99.6) and using the projected 2024 data provided in the tab "Q3 - 30k CapitalSim Scenarios" of the Excel spreadsheet. Refer to tab "Q3.a.ii" in the Excel spreadsheet. Show your work.

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

- (iii) Recommend a change to Pryde's current methodology. Justify your answer.

ANSWER:

3. Continued

- (b) (6 points) Pryde uses RAROC to reward appropriate risk-taking behaviors in its compensation structure for business unit leaders.

Pryde's net income by line of business was as follows (000's):

	2022	2023
Commercial Multiple Peril	77,184	20,696
Workers Compensation	6,179	6,716
Total Net Income	83,363	27,412

- (i) Compute the retrospective RAROC for Pryde's two lines of business for 2022 and 2023. Use Pryde's current approach for calculating economic capital (EC) and assume the EC is constant throughout each year. Refer to tab "Q3.b.i of the Excel spreadsheet. Show your work.

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

The Commercial Multiple Peril business unit leader asserts that the RAROC-based compensation structure is unfair, but the Workers Compensation business unit leader disagrees.

- (ii) Explain each business unit leader's reasoning.

ANSWER:

- (iii) Recommend a change to address fairness for both business unit leaders. Justify your recommendation.

ANSWER:

*Questions 3 and 4 pertain to the Case Study.
Each question should be answered independently.*

4.

(15 points) You are an actuary working for SLIC.

SLIC has recently hired a new CRO who is interested in managing mortality and longevity risks more proactively. She has requested you to review the metrics included in the Risk Management Committee's quarterly KRI dashboard. The quarterly dashboard currently includes:

- Loss Ratio
- New sales dollars, count, and growth rate
- Count of claims ceded to SLIC's reinsurer

Refer to Sections 3.2 and 4.5 of the Case Study.

(a) (5 points)

- (i) Identify one element of good KRIs that is present in the quarterly dashboard's metrics. Justify your response.

ANSWER:

- (ii) Identify one element of good KRIs that is missing from the quarterly dashboard's metrics. Justify your response.

ANSWER:

- (iii) Recommend three specific ways that SLIC could benefit from including more effective KRIs. Justify your recommendation.

ANSWER:

4. Continued

- (b) (7 points) The new CRO is particularly concerned about the impact of Environmental, Social, and Governance (“ESG”) risks on the organization’s key risks. Refer to tab “Q4.b” in the Excel spreadsheet.
- (i) Identify three ESG risks that could be significant to the financial results of SLIC’s life and annuity blocks.

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

- (ii) Evaluate the anticipated risk impact and likelihood of each identified risk with regard to SLIC’s life and annuity blocks by placing it on the likelihood/severity table in the Excel spreadsheet.

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

- (iii) Justify each identified risk’s placement on the likelihood/severity table.

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

- (c) (3 points) Recommend a KRI to monitor for each ESG risk from part (b). Justify your recommendation using the characteristics of good KRIs.

ANSWER:

****END OF EXAMINATION****