ERM Model Solutions
Spring 2024

1. Learning Objectives:

1. The candidate will understand the ERM framework and process and be able to apply them to organizations.

2. The candidate will understand the types of risks faced by an entity and be able to identify and analyze these risks.

Learning Outcomes:

(1d) Assess the overall risk exposure arising from an organization's current and emerging risks.

(2b) Discuss risk taxonomy, including an awareness of how individual risks might be categorized in different ways.

(2c) Identify and analyze specific risks faced by an organization, including but not limited to: financial, environmental, operational, legal, reputational and strategic risks.

Sources:

Financial Enterprise Risk Management, Sweeting, 2017, Ch. 8 Risk Identification

ERM 107-12: Strategic Risk Management Practice, Anderson and Schroder, 2010 Ch. 7 Strategic Risk Analysis

ERM-133-19: Emerging Risks and Enterprise Risk Management (pp. 2-6)

Commentary on Question:

Overall, candidates did well on this question. Most candidates struggled with the part c(ii).

Solution:

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

Commentary on Question:

*Most candidate did well on this question. Only **key** opportunities and threats specific to SeaLux received full credit. Reasonable opportunities and threats specific to SeaLux received partial credit. Strengths and weaknesses didn't receive credit.*

1. Continued

Opportunities:
1. Large markets with low penetration rates in numerous countries where SeaLux already an established presence.
2. Asian market, where economic growth has raised discretionary income levels, fueling an increasing demand for travel.

Threats:
1. Increases in fuel prices.
2. COVID impact travel trends..

(b) 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.

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

Commentary on Question:
Most candidate did well on this question. At least two distinct statements were required to receive full credit and the alternative answers were accepted. In order to receive full credit for part (ii) candidates needed to provide justification to whether the risk is emerging risk for SeaLux specifically.

(i) This is an effective supplemental technique. All the interviews were carried out by the same person, which ensured consistent treatment.
It can be a time-consuming approach, however meeting only with senior officers ensure reasonable time spent on this exercise.
Framing of the questions is important part of the interviews, however, concentrating only on the emerging risk made the interview focused and made it easier to frame the questions.

(ii) Exchange Rate Risk is not an emerging risk for SeaLux. As the company operates in Australia, Europe and Asia, SeaLux already and has significant exposure to exchange rate risk. Additionally, Exchange Rate Risk doesn't have the characteristics of the emerging risk:
- It is not hard to communication as SeaLux management is familiar with the risk.

1. Continued

- It is not hard to assign ownership as CFO owns that risk.
- There is no lack of consensus around the exchange risk.

Cyber risk is an emerging risk for SeaLux. Even though it's one of the main industry risks, it has a high level of uncertainty, where both frequency and potential impact are hard to assess. Cyber risk has the secondary impact on the company reputation that can have a large impact, but it's hard to quantify.

(c) 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.

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

Commentary on Question:
Most candidates did reasonably well on part (i), but struggled with part (ii). Responses discussing world events, weather/natural disasters and ability to recruit, with the strong justification, received full credit, while other two risks received partial credit if a good argument was provided. Some candidates recommended a risk from the five Industry Key Risks as a response to part (ii), which resulted in no credit.

(i) I recommend presenting "World events impacting the ability to travel" to the Board. This is a key risk for SeaLux. The risk covers the pandemic-related events as well as political instability, new laws and regulations (for example gambling laws) and natural disasters. This is a good example of an emerging risk since there is a high level of uncertainty around these events and it's difficult to assess the potential impacts on the company. It's difficult to assign the ownership for the risk, as there is no one person or workgroup that "owns" each risk as they cover multiple events and can significantly impact all stakeholders. The events are also wildly unpredictable, for example COVID's impact resulting in a global travel ban.

1. Continued

(ii) Shifting demographic patterns and its impact on cruise lines. For example - the younger generation's preference for other modes of travel. While it is known that demographic patterns, such as age and ethnicity are evolving, the impact on the cruise line business is highly uncertain.

2. Learning Objectives:

1. The candidate will understand the ERM framework and process and be able to apply them to organizations.

2. The candidate will understand the types of risks faced by an entity and be able to identify and analyze these risks.

5. The candidate will understand the approaches for managing risks and how an entity makes decisions about appropriate techniques.

Learning Outcomes:

(1a) Recommend an appropriate framework for an organization's enterprise risk management and an acceptable governance structure.

(2c) Identify and analyze specific risks faced by an organization, including but not limited to: financial, environmental, operational, legal, reputational and strategic risks.

(5b) Demonstrate application of the following responses to risk, including consideration of their costs and benefits: avoidance, acceptance, reduction without transfer, and transfer to a third party.

(5h) Demonstrate possible risk management strategies for non-financial risks.

Sources:

Financial Enterprise Risk Management, Sweeting, 2017 Ch. 16 Responses to Risk (LO 2)

PSI ESG Underwriting Guide For Life & Health Insurance': Managing environmental, social and governance risks in life & health insurance business (LO 2)

SOA Monograph- A New Approach to Managing Operational Risk -Chapter 8 (LO 2)

Financial Enterprise Risk Management, Sweeting, 2017 Ch. 16 Responses to Risk (LO 5)

ERM 107-12: Strategic Risk Management Practice, Anderson and Schroder, 2010 Ch. 7 Strategic Risk Analysis (LO 5)

SOA Monograph- A New Approach to Managing Operational Risk -Chapter 8 (LO 1)

Commentary on Question:

This question is testing candidates' knowledge of Operational, Social, and Underwriting risk, as well as regulations governing the use of consumer personal data.

2. Continued

Solution:

(a)

(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.

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

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.

Commentary on Question:
Most candidates received at least partial credit for this part. Technology Risk, People Risk, and Model Risk were all acceptable answers, as were other risks that could be considered as Operational. Candidates needed to describe the risk, including tying to SLIC, for full credit.

(i) Model risk – a new product needs new models, how established is SLIC's model governance? Can we use an existing model or would a new one need to be built? Accuracy in model output and avoiding model bias are both key.

Commentary on Question:
Most candidates received at least partial credit. Full credit was given to an answer that addressed the risk in part a)i) and was a plausible response.

(ii) SLIC could outsource the modeling to a consultant or reinsurer, building confidence at SLIC to where this work would move in-house at some point. This would also create a smoother roll-out, where risk of model errors is reduced.

Commentary on Question:
Most candidates received partial credit. Candidates were expected to address and explain at least two valid points that closely relate to the case study.

2. Continued

(iii) From Xu's email: "I expect our underwriting system to be robust, and as such, do not expect to have to limit the death benefit requested. However, to be safe, we may want to find a reinsurance partner to cover the excess of our desired retention level." This is not appropriate because in reality there are different levels of underwriting depending upon the size of the policy – SLIC should cap the death benefit given the limited UW information being gathered… higher face needs more UW up front.

Considering the Reinsurance / risk transfer: Simplified issue has quota share, multiple reinsurers who may each react to AUW differently. Full UW has one reinsurer above retention, likely has a say in pricing / rates and the UW done. For AUW, might want reinsurer input on UW / pricing given its new venture for SLIC, Or could argue the proportional reinsurance will allow selling more to help diversify the risk of any one policy if simplified issue reinsurers would be amenable to any additional UW being done depending upon reinsurance allowance for the additional acquisition expense.

(b) 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."

2. Continued

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

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

Commentary on Question:
Most candidates did not receive full credit for this part. Candidates needed to show an understanding of SLIC's current ERM framework, as well as where changes needed to be made.

(i) Policies for Credit, Market, Liquidity and Operational but seem to be focused only on investments. No Insurance policy or Reinsurance policy? SLIC doesn't model any Insurance or Ops risks. Could develop new policies.

Might wish to develop a unique ESG governance policy framework or similar structure which details roles, responsibilities and processes. This can allow a well-defined approach (e.g. using the Responsibility Assignment Metric – RACI methodology), but there might be a greater effort needed to develop guidance and subsequent internal implementation

Integrating ESG risks into the existing risk framework of organizations is common, sometimes within reputation and investment risk policies.

Commentary on Question:
Most candidates did well on this part. Full credit was awarded to candidates who proposed and explained at least two options.

(ii) SLIC could either set up an in-house regulatory / compliance department or build out Legal or Risk departments to cover.

SLIC could continue using CAERUS consulting who is already focused on the industryregulations and responses of other insurers.

3. Learning Objectives:

3. The candidate will understand the concepts of risk modeling and be able to evaluate and understand the importance of risk models.

Learning Outcomes:

(3b) Demonstrate organization-wide risk aggregation techniques that illustrate the concept of risk diversification by incorporating the use of correlation.

(3c) Evaluate and select appropriate copulas as part of the process of modelling multivariate risks.

(3g) Evaluate and select appropriate models to handle diverse risks, including models that use a stochastic approach.

Sources:

ERM-101-12: Measurement and Modeling of Dependencies in Economic Capital (Ch 3-5)

ERM-119-14: Aggregation of risks and Allocation of Capital (Sections 4-7 Excluding 6.3)

Quantitative Enterprise Risk Management by Mary Hardy, Chapter 6: Copulas

Value-at- Risk, Third Edition, The New Benchmark for Managing Financial Risk, Jorion Ch. 7 Portfolio Risk: Analytical Methods

Commentary on Question:

The goal of question was for candidates to demonstrate knowledge and application of copulas as a diversification methodology, compare to variance-covariance approach, and consider how to incorporate copula insights in practice.

Solution:

(a)

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

(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.

Commentary on Question:

(i) Candidates were able to identify two challenges, but most couldn't explain the challenges earning them limited points. To get full points, candidates had to provide challenges with implementing a copula, not just choosing a copula.

3. Continued

(ii) *Many candidates incorrectly mentioned Mortality or Operational Risk which cannot be modeled in a way that a copula can be used. Candidates needed to justify their selection, reflecting an understanding of the risk that could be brought into the copula to receive full points.*

(i) One challenge is that copulas are computationally intensive, especially with the number and types of risks ABC includes in the model.

A second challenge is that copulas are less transparent and intuitive to executives when compared to other aggregation methods (variance-covariance). This may result in more difficult communication and additional hurdles prior to enterprise-wide acceptance.

(ii) Interest Rate and Lapse Risk would be appropriate to model using copula since their CDFs demonstrate that the two risks exhibit tail dependence. When interest rates are high, lapses are more likely to be high as policyholders will want to put their money in current yields. When rates are low, lapses will tend be lower.

(b) 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.

(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.

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

Commentary on Question:

(i) *Most candidates were able to do most if not all of this part earning a significant number of points.*

(ii) *Few candidates were able to provide the correct formula. Full points were given if the correct formula was provided even if part (i) was not done correctly.*

3. Continued

(iii) *Although many candidates were able to provide the correct formula for this part, few earned full points on the discussion of the comparison. Many candidates based their discussion solely on the results when the results were incorrect, instead of reflecting on what the results mean.*

(i) Column E Inverted Normal Dist Values
Column F Inverted Normal Dist Values
Column G Joint Distribution using Copula
Column H revised q'
Column I simulated IR Risk Value
Column J simulated Lapse Risk Value

99.5th Percentile Interest Rate = 399 (Cell N17)
99.5th Percentile Lapse Rate = 141 (Cell N18)
99.5th Percentile of Aggregate Risk = 486 (Cell N19)

(ii) Per Jorion Chapter 7: VaR(Port) = sqrt(VaR(A)^2 + VaR(B)^2 - 2*VaR(A)*VaR(B)*rho)
486 = sqrt (399^2 + 141^2 + 2*399*141*rho)
rho = 0.5076 (note actual solution is 0.50 due to individual VaRs not being rounded)

(iii) Implied correlation across distribution using copula is 0.39, lower, but close to, the solved-for correlation of 0.5. The solved-for correlation being close to the implied distribution is due to the fact that the copula used is Gaussian, which does not assume tail correlation.

There is also a very low probability of truly extreme events occurring for both Lapse Risk and Interest Rate Risk. It's possible that running only 1000 scenarios is not sufficient for capturing the potential tail dynamics of the two risks.

4. Learning Objectives:

1. The candidate will understand the ERM framework and process and be able to apply them to organizations.

4. The candidate will understand how the risks faced by an entity can be quantified and the use of metrics to measure risk.

Learning Outcomes:

(1d) Assess the overall risk exposure arising from an organization's current and emerging risks.

(4c) Analyze risks that are not easily quantifiable, such as liquidity, operational, and environmental risks.

Sources:

ERM-151-22: Developing Key Risk Indicators to Strengthen Enterprise Risk

Embedding Cyber Risk in Risk Management: An Insurer's Perspective By Kailan Shang (pp.12 -15 of Cybersecurity: Impact on Insurance Business and Operations)

ERM-101-12: Measurement and Modeling of Dependencies in Economic Capital (Ch 3-5)

Commentary on Question:

Commentary listed underneath question component.

Solution:

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.

4. Continued

(a) 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.

Commentary on Question:
Candidates should consider both strengths and weaknesses when forming a critique.

Some candidates addressed the proposed KRI's by listing aspects of a good KRI from the source. The best critiques explained how these aspects made the proposed KRI's better (or worse) at predicting changes in the risk environment.

KRI 1 will have reliable & consistent data to track, is easy to understand, and can serve as early warning of increased cyber threat. It is also related to a root cause of recent cyber incidents. However, KRI 1 doesn't capture risk from the wellness app. It also does not capture the success rate of those attacks so it provides no information about DEF cyber risk preparedness.

KRI 2 is specific to DEF, will have reliable and consistent data to track, is easy to understand, and captures all types of cyber risk. However, even though KRI 2 captures all types of cyber risk, it lacks relevant historical perspective because of recent significant changes in cyber risk exposure from the new wellness program and the new HR policy allowing remote employees.

KRI 3 will capture general industry exposure to cyber risk which could serve as an early warning signal. KRI 3 would also capture wellness app risk if other companies in industry also have a product. However, KRI 3 relies on industry data which might not be a good indicator for DEF's cyber risk, possible lag in reporting, and monitoring frequency might not be high enough to be useful.

(b) 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.

4. Continued

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.

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

Commentary on Question:
Most candidates calculated Kendall's Tau correctly. Using a mathematically equivalent formula could earn full credit.

Please see the excel workbook for the model solution to b(i).

KRI 1 is the most positively correlated with losses. This is reasonable because KRI 1 is an internal measure of security incidents. Phishing attacks could have directly led to losses, so its high correlation is not surprising.

KRI 2 is loosely negatively correlated with losses. This is reasonable because KRI 2 is more of a measure of internal team efficiency. Discovering a cyber security incident quickly might not lead to lower losses. Alternatively, there might be a delay in logging an incident if it is deemed immaterial/not urgent.

KRI 3 is somewhat positively correlated with losses. A positive correlation is reasonable because an industry environment that has more attacks could reasonably be expected to impact DEF as well. The weaker positive correlation for KRI 3 compared to KRI 1 is also reasonable due to KRI 3 being an external measure.

(c) 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.

4. Continued

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

Commentary on Question:
Part c(i): Any of the 3 KRI's could have been recommended with proper justification. Candidates were not able to gain full credit without also addressing why they did not recommend each of the other two.

Part c(ii): Candidates that used DEF's specific circumstances described in the question stem generally performed better than candidates that did not.

(i)
I recommend KRI 3. It provides early warning indication by using an external measure that includes companies that would likely be targeted in the same way because they are in the same industry. This early warning indication allows DEF to raise awareness potentially address deficiencies before DEF has been targeted specifically.

KRI 1 only deals with phishing attacks and doesn't address DEF's concerns regarding the wellness app.

KRI 2 is not well correlated with losses according to Kendall's Tau calculation, and is also impacted by the quality and quantity of the employees logging cybersecurity incidents.

(ii)
KRI 3 is a good measure in that it is looking at the overall insurance industry, but it could be difficult to get the data to analyze, there could be a lag reporting due to the time needed to aggregate the data, and may be too narrow focused if other companies have more conservate work from home policies.

I recommend tracking the number of DEF cyber security incidents, split by region. This data is much easier and faster to obtain because it is internal data, it covers multiple types of cyber security incidents, and evaluating by region allows DEF insight into the cyber risk impact of their HR policy.

5. **Learning Objectives:**

2. The candidate will understand the types of risks faced by an entity and be able to identify and analyze these risks.

3. The candidate will understand the concepts of risk modeling and be able to evaluate and understand the importance of risk models.

4. The candidate will understand how the risks faced by an entity can be quantified and the use of metrics to measure risk.

5. The candidate will understand the approaches for managing risks and how an entity makes decisions about appropriate techniques.

Learning Outcomes:

(2a) Describe different definitions and concepts of risk.

(2c) Identify and analyze specific risks faced by an organization, including but not limited to: financial, environmental, operational, legal, reputational and strategic risks.

(3d) Demonstrate the use of scenario analysis and stress testing in the measurement of current and emerging risks.

(4a) Determine risk exposures using common risk measures (e.g., VaR and TVaR) and compare the properties and limitations of such measures.

(5b) Demonstrate application of the following responses to risk, including consideration of their costs and benefits: avoidance, acceptance, reduction without transfer, and transfer to a third party.

(5e) Determine an appropriate choice of mitigation strategy for a given situation, which balances benefits with inherent costs (including exposure to moral hazard, credit, basis and other risks).

(5f) Demonstrate the use of tools and techniques for identifying and managing credit and counterparty risk.

Sources:

Value-at- Risk, Third Edition, The New Benchmark for Managing Financial Risk, Jorion Ch. 18 Credit Risk Management (excluding Appendices)

Risk Appetite: Linkage with Strategic Planning Report

ERM-135-20: Risk Management and the Rating Process for Insurance Companies by A.M. Best

5. Continued

Financial Enterprise Risk Management, Sweeting, 2017 Ch. 16 Responses to Risk

Commentary on Question:
This question was testing candidates' understanding of asset-related risks and potential risk management techniques. The question also tests the candidates' ability to calculate VaR on risk-return metrics. Candidates did generally better on the calculations in part (b) than the explanations in part (a) and struggled in particular with demonstrating understanding of disintermediation risk.

Solution:
(a)

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

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

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

Commentary on Question:
Responses relative to credit risk were mostly strong, and full credit on part (ii) was given for responses including CDS / credit insurance, diversification or reinsurance. A common response was to invest only in high quality assets / highly-rated counterparties. Partial credit was given for this because it does reduce XYZ's credit risk but would severely limit the achievable return on the asset portfolio.

For market risk, candidates needed to identify at least 2 components in part (i). Many candidates responded relative to equity levels/XYZ's stocks only, ignoring interest rates, etc. Similar to credit risk, full credit was given on part (ii) for any plausible method of risk reduction, transfer or acceptance.

For disintermediation, many candidates struggled to demonstrate that they understood the definition. For those that were successful on part (i), it was common on part (ii) to recommend product design features to dis-incentivize lapse. Since the stem of the question addresses risk on the asset portfolio, candidates needed to provide risk management techniques relative to the assets for full credit.

For part (iii), substantial credit was given for responses recommending any of the 3 options provided the candidate gave appropriate explanation tying it to the economic conditions mentioned and the implication for XYZ's asset portfolio.

5. Continued

(i) Credit risk is the risk that a counterparty could default or a security could be downgraded resulting in a decrease in value. Credit risk applies to the short-term and long-term bonds and mortgages in XYZ's portfolio.

Market risk includes equity, interest rate and foreign currency exchange rate risks which can impact the value of the asset portfolio. For XYZ, equity risk applies to the domestic and foreign stocks, interest rate risk applies to the bonds and mortgages and exchange rate risk applies to the foreign stocks.

Disintermediation risk is the risk that interest rates rise resulting in elevated lapses as policyholders shift to products offering higher crediting rates, potentially driving a need to sell assets which have decreased in value with the risk in rates. This is relevant to XYZ because they sell life and annuity products and hold 70% of assets (bonds + mortgages) in fixed income.

(ii) Credit risk can be managed by purchasing credit insurance and/or by diversifying across sectors and issuers.

Market risk can be managed by hedging if desired, but this could significantly reduce the return of the asset portfolio; alternatively XYZ may choose to accept market risk up to a defined appetite.

Disintermediation risk can be managed by holding assets in the portfolio that are liquid and not exposed to rising interest rates. XYZ has significant allocation to stocks which could be sold to cover higher than expected lapses if rates rise.

(iii) Given rates have risen rapidly, XYZ should monitor disintermediation risk which could cause policyholders to lapse, driving the need to sell assets at lower values. XYZ should also monitor market risk since the rise in rates likely reduced the value of the bonds and mortgages and the equity market volatility is likely impacting the stocks in the portfolio.

(b)

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

(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.

5. Continued

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

Commentary on Question:
Most candidates did well on this part. There were a couple of common mistakes with the calculations.

On part (i) a common mistake in calculating the expected annualized return at time 0 was attempting to adjust for defaults by multiplying the expected return for each initial rating by (1-probability of default in 1 year). This is incorrect because the expected rate of return already reflects the probability of default. Partial credit was given, and this mistake does not impact the values relative to XYZ's goals in part (iii).

On part (ii) a common mistake in calculating the VaR was to use the Percentile.excl function in Excel which produces the VaR exclusive of the first and last values. Full credit was given despite this if the calculation was otherwise correct.

On part (iii) substantial credit was given for recommendations consistent with the values that candidates calculated in parts (i) and (ii) relative to XYZ's goals, even if the values were incorrect. To receive full credit, candidates needed to correctly identify that Portfolio #2 comes the closest to meeting XYZ's goals and also acknowledge that the expected return was slightly below the 5% that XYZ desired.

(i) Refer to Excel template for solution.

(ii) Refer to Excel template for solution.

(iii) Refer to Excel template for solution.

6. **Learning Objectives:**

1. The candidate will understand the ERM framework and process and be able to apply them to organizations.

2. The candidate will understand the types of risks faced by an entity and be able to identify and analyze these risks.

5. The candidate will understand the approaches for managing risks and how an entity makes decisions about appropriate techniques.

Learning Outcomes:

(1a) Recommend an appropriate framework for an organization's enterprise risk management and an acceptable governance structure.

(1e) Propose ERM solutions or strategies that effectively manage risk under different real (case study) and hypothetical situations facing financial and non-financial organizations.

(2c) Identify and analyze specific risks faced by an organization, including but not limited to: financial, environmental, operational, legal, reputational and strategic risks.

(5c) Demonstrate the use of controls for retained and residual risks.

(5g) Analyze how ALM and other risk management principles can be used to establish investment policy and strategy, including asset allocation.

(5i) Choose appropriate techniques to measure, model and manage various financial and non-financial risks faced by an organization.

Sources:

Value-at- Risk, Third Edition, The New Benchmark for Managing Financial Risk

ERM-144-20: IAA Risk Book - Chapter 13: Asset Liability Management Techniques and Practices for Insurance Companies

ERM-136-20: Managing Liquidity Risk: Industry practices and recommendations for CROs

Financial Enterprise Risk Management, Sweeting, 2017

6. Continued

Commentary on Question:
This question tests candidates understanding of liquidity risk as it relates to different products and investment strategies, as well as understanding of a risk management framework. Several candidates confused liquidity risk with credit risk in parts (a) and (c). In part (b), many candidates only commented on incorrect statements made by William King, and were awarded part marks.

Solution:

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

Commentary on Question:
This question asks about liquidity risk within the context of the case study. Most candidates were able to identify and justify that the changes increased liquidity risk. Stronger candidates commented on the suitability of UL and SPIA sharing the same investment strategy.

The revised SPIA investment strategy includes alternative assets, emerging market equity, and derivatives. Adding these assets to SLIC's portfolio increases the company's liquidity risk. Alternative assets have thin markets and uncertain market values, making them difficult to liquidate quickly, and adds uncertainty to liquidation value. Additionally, derivatives have margin requirements, and margin calls will increase SLIC's liquidity needs.

SLIC may face further liquidity risk by applying the revised SPIA investment strategy to UL. Unlike SPIA, SLIC's UL products include a surrender benefit. As a result, UL is exposed to policyholder behavior, which may cause unexpected liquidity needs.

(b) 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.

6. Continued

Commentary on Question:
Many candidates struggled on this part. In a critique question, candidate should consider the entire statement, both accurate and inaccurate parts. Correct answers are not limited to the model solution below.

William King is correct that liquidity risk is lower for life insurance companies than for banks, but it's incorrect to say that liquidity risk is minimal for life insurers. It's also true that managing other risks can mitigate liquidity risk, but that won't eliminate liquidity risk and it should still be monitored.

It's not correct to say that SLIC has predictable policyholder behavior. Stressed market conditions or rising interest rates may lead to an unexpected increase in lapses, which may stress SLIC's liquidity position. Although SLIC holds sufficient liquid assets in normal market conditions, asset values fall in a stressed market scenario, which may lead to the need to liquidate additional assets to pay for claims.

(c) 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.

Commentary on Question:
This question assesses candidates understanding of a strong risk management framework. To receive full marks, candidates are expected to provide several different recommendations to improve SLIC's current liquidity risk management framework. Many candidates provided multiple unique scenarios to improve stress testing. This was treated as one recommendation and awarded part marks.

1. Create a liquidity risk appetite statement. The current liquidity risk policy only requires that SLC holds sufficient assets to meet cash demands in a unique liquidity stress-test scenario. The policy should be enhanced to include a clear risk appetite statement and more formal targets.

2. Create Key Risk Indicators for liquidity risk, such as a liquidity coverage ratio, which are regularly monitored (IE monthly). If pre-specified soft or hard thresholds are breached, senior management and the Risk Management Committees should be notified.

6. Continued

3. Improve liquidity risk modeling. SLIC's liquidity scenario stress test is limited to an idiosyncratic reputational liquidity crisis. Additional scenarios should be tested which capture other liquidity risk drivers, such as catastrophic events, changes in policyholder behavior, or adverse financial market conditions.

4. Create a liquidity contingency plan which outlines actions to take in stressed scenario. The company should assess all available sources of liquidity, in order of availability. The plan should identify order of execution of liquidity sources, and should be stress tested to account for different scenarios.