

ERM-GC Model Solutions

Spring 2022

1. Learning Objectives:

6. The candidate will understand the concept of economic capital, risk measures in capital assessment and techniques to allocate the cost of risks within business units.

Learning Outcomes:

- (6a) Demonstrate a conceptual understanding of economic measures of value and capital requirements (e.g., EVA, embedded value, economic capital, regulatory measures, and accounting measures) and their uses in decision-making processes
- (6b) Apply risk measures and demonstrate how to use them in value and capital assessment
- (6c) Propose techniques of attributing the “cost” of risk/capital/hedge strategies to business units in order to gauge performance (e.g. returns on marginal capital)
- (6d) Demonstrate the ability to develop a capital model for a hypothetical organization

Sources:

ERM-106-12: Economic Capital – Practical Considerations – Milliman

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

Commentary on Question:

This question tests candidates' ability to understand capital models, aggregation of risks, attributing capital, and how they are used in capital assessments.

Solution:

- (a)
 - (i) Identify and describe four of Acme's *key* stakeholders.
 - (ii) Outline the RC considerations of each key stakeholder, reflecting Acme's recent experience.

1. Continued

Commentary on Question:

This part asked candidates to identify and describe four key stakeholders. Most candidates did well on this part. Key stakeholders getting full credit included: Shareholders; Management; Policyholders; Regulators; Ratings Agencies; Employees; Board of Directors; Other Insurers; Lenders. Credit was given for the first four. Those closely related, i.e., Management and Employees was counted as only one key stakeholders. If more than four were listed, only the first four were graded. Candidates should tie to COVID experience.

(i)

Shareholders – Interested in returning a good return on invested capital. Not interested in extremes beyond ruin.

Management – Risk loadings in pricing, assessing performance, allocating capital.

Policyholders – Most interested in extreme events that threaten ability to pay claims.

Regulators – Interested in extreme events. Will want to see COVID impacts.

(ii)

Shareholders – would want small RC, but higher distributable earnings.

Management – Accurate RC as possible, to determine performance of each BU managers.

Policyholders – Would want a large RC, offering more protection.

Regulators – Would want a large RC, to protect against further COVID losses.

(b) Acme's management is considering a restructure, whereby some BUs would be divided and a new BU added. The proposed structure is described as follows:

- A is divided into two, unequal parts
- L is divided into two, identical parts
- P is unchanged
- N is the new business unit, which is considered risk-free.

The proposed new capital allocation is as follows:

BU	RC
A ₁	95
A ₂	4
L ₁	30
L ₂	20
P	15
N	5

1. Continued

Assess whether the new allocation satisfies the requirements of a Coherent Capital Allocation methodology by comparing the proposed RC allocation to the existing allocation.

Commentary on Question:

Most candidates did well on this part. Candidates needed to state that this does not meet the requirements of a Coherent Capital Allocation method, and explain why using the three properties.

A Coherent Capital Allocation method must satisfy:

No Undercut – a sub-portfolio’s allocation should be no more than its standalone capital requirement. This is satisfied since $A1+A2 \leq 100$; $L1+L2 \leq 50$

Symmetry – If the risk of two sub-portfolios is the same, the allocation should be the same. This is not satisfied since L1 and L2 are said to be identical, but have unequal capital.

Risk-free allocation – capital allocated to a risk-free BU should be zero. Not satisfied, as N is allocated 5.

This new allocation does NOT satisfy the requirements of a Coherent Capital Allocation method.

- (c)
- (i) Demonstrate that the amount by which total capital can be reduced with diversification is 24.58. Assume that the risks are normally distributed.
 - (ii) Calculate the amount of RC for each BU using the Pro Rata (linear) approach. Show all work.
 - (iii) Calculate the amount of RC for each BU using the Discrete Marginal Contribution approach. Show all work.
 - (iv) Recommend either the Pro Rata or the Discrete Marginal Contribution method of allocation for Acme. Justify your answer.

Commentary on Question:

Candidates did very well on parts (i) and (ii). Some did not know the formula for (iii). Candidates received full credit on (iv) if they explained the difference between the two methods, made a recommendation, and explained why this was a better method for Acme in particular.

1. Continued

Parts (i), (ii), and (iii) in Excel spreadsheet.

(iv)

I recommend the discrete marginal contribution approach for Acme. While the Pro Rata method is simpler, it is not as accurate at taking into account diversification benefits. Since management wants to reduce EC by taking into account correlations between business units, the Discrete Marginal Contributions approach would be more helpful in achieving that goal.

2. Learning Objectives:

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.

Learning Outcomes:

- (3b) Demonstrate organization-wide risk aggregation techniques that illustrate the concept of risk diversification by incorporating the use of correlation.
- (3d) Demonstrate the use of scenario analysis and stress testing in the measurement of current and emerging risks.
- (3e) Demonstrate the importance of the tails of distributions, tail correlations, and low frequency / high severity events, and the use of extreme value theory to analyze these situations.
- (4b) Analyze quantitative financial and non-financial data using appropriate statistical methods to assist in quantifying risk.

Sources:

ERM-142-20: Data Quality is the Biggest Challenge by Moody

ERM-120-14: IAA Note on Stress Testing and Scenario Analysis (pp. 1-6 and 14-17 and 19-25)

ERM-139-20: Quantitative Enterprise Risk Management by Mary Hardy, Chapter 7: Copulas

Commentary on Question:

This question assessed the ability of the candidate to apply rules and best practices to a real-world problem involving model design, data quality and stress testing. Candidates were tested on their ability to evaluate materiality of issues and use provided information as well as judgement to justify appropriate solutions. Most candidates scored well on parts (a) and (c), although most candidates did not receive full credit since they failed to consistently justify their responses. Most candidates scored poorly on part (b) as they appeared unfamiliar with Moody's Data Quality Practices.

2. Continued

Solution:

(a) The first objective of the external review is to assess the VaR model's design. Addison describes the methodology, data and assumptions as follows:

- The model uses parameters based on one year of historical market data as inputs to calculate VaR
- The calculation employs a Monte Carlo simulation and assumes that changes in risk factors follow a well-defined distribution, e.g., normal distribution or t-distribution
- To determine aggregated VaR, the model assumes correlations between the risk factors and a t-copula to incorporate increased correlation in the tail of the combined distribution
- The correlation assumptions are based on recent data and they have been backtested.

Critique the model design.

Commentary on Question:

Candidates generally scored well on this question although few received full credit. Several candidates failed to comment on all pieces of the model design in their critiques or they failed to explain/justify why a component was deemed appropriate or inappropriate.

- A common deficiency in calibration of distribution parameters is using a time-period of insufficient length to capture a representative range of conditions. One year of historical market data will therefore be insufficient and inappropriate for Addison's VaR calculations since most individual years will not include a wide range of conditions. Several years of data should be incorporated into the calibration to capture tail-type events if the focus of the analysis is on VaR.
- Monte Carlo design is appropriate for simulating investment returns since it is flexible and can capture complex non-linear relationships between variables. It may not always be the best methodology however, since even though it may show potentially disastrous results in the tail, it may not focus attention on the effect of the scenario to properly assess investment risk. Addison should ensure that her team can understand what is driving VaR results from the model and that the drivers align with the risk sources of interest for the Board. Also, Monte Carlo model designs can be resource intensive and require technical expertise. Addison should evaluate whether her team can appropriately maintain the model with their current resources.

2. Continued

- A normal/t-distribution for changes in risk factors may not be appropriate for market risks that can be more right-tailed. Addison's team should consider other distributions and determine the best fit for the market behavior the team is trying to model.
 - The use of a t-Copula is appropriate for addressing the lack of sufficiently heavy tails in the probability distributions used. However, although the associated correlation assumptions may introduce heavier tails, there is always the possibility that they don't capture sufficient tail risk. Also, using a copula will require even more expertise since calibration can be complex and explaining the use of a copula may be difficult for the Board to understand. Addison should ensure her team has sufficient understanding and resources to calibrate the copula and provide necessary explanations.
 - Basing correlation on recent data only, could be inappropriate, depending on whether or not recent relationships are reflective of the investment risk Addison's team is trying to model.
 - Back-testing however, is one appropriate tool for validating the correlation assumptions being used. After backtesting is conducted, the team will have to use their judgement to determine if recent data should continue to be used or if more historical data should be added. As Addison's team reports model results, caution should always be suggested as history is not always a predictor or future results.
- (b) The company has an internal requirement to follow Moody's Data Quality practices.
- (i) Describe the most critical step in the Moody's recommended seven-step quality process that is not being followed. Justify your response.
 - (ii) Describe the two most critical data quality rules applicable to this data. Justify your response.

Commentary on Question:

Candidates generally scored poorly on this part of the question because they did not appear to recall Moody's seven-step quality process or Moody's data quality rules. Several candidates incorrectly referenced EIOPA Data Quality Requirements from the same reading. Also, both subparts asked the candidate to describe the most critical steps. Partial credit was awarded for listing other steps/rules that were critical (but not the most critical), but only if sufficient justification was provided. In order to get full points in both subparts, justification of "most critical" needed to tie back to the issues listed and describe how the recommended step / data quality rule addressed the issue.

2. Continued

- (i) The most critical step they are failing to follow in Moody's seven-step data quality process is step 4, Data Standardization. Data standardization involves execution of a series of data quality checks and rules against the monthly data being appended. Best practice is to execute the data quality rules within the repository. In this case, Addison's team needs to check the format and quality of the data every time an update is made and implement a rule to ensure that it is consistent with previous data the team has stored in their repository. Currently, the monthly change in the formats of the reported data is likely leading to the large VaR fluctuations observed from month to month. Data standardization will address the issue.
- (ii) The two most critical data quality rules that apply to Addison's monthly data are Range Constraints and Set-Membership Constraints.
 - Range constraints will set minimum or maximum allowable values for the data based on typical ranges for the data type. In this case, negative expected returns are showing up in the data. The range should be restricted to exclude negative values to address this problem. Addison's team should also make note of any negative data points and investigate the issue.
 - Set-Membership constraints will ensure values for a column come from a set of discrete values or codes. In this case, the rule is already being used for the risk type field, but the set of discrete values needs to be updated to include the 4th risk factor. Once the set-membership constraint is updated, the issue will be addressed.
- (c) Addison has decided to begin with a sensitivity analysis where there is a 5% decline in the equity markets. She would use the resulting impact to the investment portfolio to enhance the reporting to the Board.
 - (i) Critique Addison's decision.

You tell Addison that other scenario types should also be considered. Addison returns with the following scenarios:

- Single Factor Scenario – an unexpected spike in claims that requires the liquidation of 10% of the investment portfolio at current market prices
- Multi-Factor Stress Scenario – a 1-year recession that depresses the market value of equities in the portfolio, results in defaults in their bond portfolio and drives inflation resulting in increased claim costs and a slight dip in business volume late in the year

2. Continued

- Multi-Factor Multi-Period Stress Scenario – a severe, 2-year market downturn that increases the severity of the Multi-Factor Stress Scenario. Additionally, the scenario reflects a significant reduction to investment income and business volumes in year 2.
- (ii) Evaluate each scenario type given the Board’s needs and Addison’s available resources.
- (iii) Recommend the most appropriate scenario type based on your analysis in part (ii). Justify your response.

Commentary on Question:

Candidates generally scored well on part (c). Most candidates received partial credit for subpart (i), but few received full credit since their critique of Addison’s decision didn’t tie back to all of the Board’s requests. Several candidates received close to full credit for subpart (ii). Responses commonly fell short in consistently addressing all three components of the Board’s requests for each scenario type. Candidates received full credit for subpart (iii) if their response included sufficient justification and it was consistent with subpart (ii). Responses for subpart (iii) were not contingent on answering subpart (ii) and candidates could receive full credit for subpart (iii) even if their response for subpart (ii) was incorrect or incomplete.

- (i) The Board has expressed a desire to better understand specific conditions that could result in tail losses and whether there would be any associated long-term impacts to their business. Addison is proposing the use of a single factor sensitivity test. Typically, Single Factor Sensitivity tests are low in complexity which makes them efficient for both time and resources and this is a positive for Addison since she appears to have limited resources. However:
- Single factor sensitivity tests are typically low in explanatory power
 - A 5% drop in equities is not a severe stress scenario, as evidenced by recent events
 - Equities are not the main asset of the company

Based on the above, the sensitivity test Addison has proposed will not enhance the reporting to the Board. To address the Board’s needs, she should also incorporate a drop in the investment grade bond values as well as increased defaults to show something that can threaten the company’s financial stability. She should also consider a sustained shock to interest rates that could affect the company’s business plan, to reflect potential long-term impacts.

2. Continued

- (ii) Each scenario type should be evaluated based on its ability to:
- Assess tail risk
 - Incorporate stresses on multiple variables to address the investment portfolio and business impacts
 - Evaluate these impacts sustained over an extended time-period since business impacts may take longer to materialize.

Once Addison has assessed the ability of each scenario type to address the Board's needs, she should also reflect on her current resources and the level of sophistication necessary to evaluate the scenarios.

Single Factor Scenario – Generally, these scenarios are used for medium stresses and are low in explanatory power. Although this scenario will help the company evaluate liquidity risk, it does not represent a tail scenario for investment risk. It also fails to capture any long-term business impacts. It will not address the Board's needs. It is a straightforward scenario however, and Addison's team should have sufficient resources and the sophistication necessary to implement the scenario.

Multi Factor Stress Scenario – Generally, these scenarios are high in explanatory power and consider multiple risk factors. A recession that incorporates equity losses and bond defaults appropriately represents a tail scenario. The scenario also incorporates business impacts through increased claim costs and reduced business volume, but they are only short term as it specifies 1 year. This scenario does a better job of addressing the Board's needs, but doesn't satisfy all of the requirements. Relative to the single factor scenario, the multi factor scenario will require more resources and sophistication to evaluate. This is likely manageable for Addison's team, but may begin to be a strain on their resources.

Multi Factor Multi Period Stress Scenario – These scenarios are typically highest in explanatory power and consider multiple risk factors over extended time periods. This scenario clearly addresses all of the Board's concerns. Relative to the other scenarios considered, the multi factor multi stress scenario will likely require significant resources and sophistication to evaluate. This will be difficult for Addison's team to manage.

2. Continued

- (iii) Based on the analysis in part (ii), I would recommend the Multi Factor Stress Scenario. It goes further than the Single Factor Scenario in addressing the Board's needs and understanding. It will also require considerably less resources than the Multi Factor Multi Stress Scenario. Although my recommendation doesn't address all of the Board's concerns it's appropriately balanced with Addison's current resources and level of sophistication, making it the best solution in the short term.

3. 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.
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.
6. The candidate will understand the concept of economic capital, risk measures in capital assessment and techniques to allocate the cost of risks within business units.

Learning Outcomes:

- (1b) Demonstrate an understanding of the perspectives of regulators, rating agencies, stock analysts, auditors and company stakeholders and how they evaluate the risks and the risk management of an organization.
- (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.
- (3e) Demonstrate the importance of the tails of distributions, tail correlations, and low frequency / high severity events, and the use of extreme value theory to analyze these situations.
- (4c) Analyze risks that are not easily quantifiable, such as liquidity, operational, and environmental risks.
- (6a) Demonstrate a conceptual understanding of economic measures of value and capital requirements (e.g., EVA, embedded value, economic capital, regulatory measures, and accounting measures) and their uses in decision-making processes

Sources:

ERM-106-12: Economic Capital-Practical Considerations-Milliman

ERM-120-14: IAA Note on Stress Testing and Scenario Analysis

3. Continued

ERM-137-20: ORSA and the Regulator by AAA

ERM-138-20: Quantitative Enterprise Risk Management by Mary Hardy, Chapter 6: Extreme Value Theories

SOA Monograph: A New Approach to Managing Operational Risk, Ch. 8

Commentary on Question:

This question tests a candidate's understanding of the ORSA report, specifically as it relates to Lyon from the Case Study. The Candidate is expected to know details on Operational Risk, and the candidate should be able to do an Extreme Value Theory analysis. The question used Describe for Comprehension assessment and used Evaluate, Explain or Justify for Analysis or Knowledge Utilization assessments. In a Fellowship level exam, the Candidate is expected to spend more effort in their explanations, drawing on the curriculum while using specific references to Lyon from the Case Study.

Solution:

(a) The following feedback was provided by the regulator:

“A key weakness of Lyon’s approach to the group capital assessment of the enterprise in the ORSA is the lack of group-level analysis.”

Explain the issue raised by the regulator using two relevant examples from the Case Study.

Commentary on Question:

Candidates did reasonably well on this part, explicitly and appropriately referencing the Case Study with examples and sufficiently providing possible issues.

From page 48 of the Case Study:

“Excerpt from the Capital Assessment section of Lyon’s ORSA Report: Lyon determines its capital requirements based on the economic capital process that is already in place within its subsidiary companies.”

The concern here is the lack of consistency across the company, on how risks are calculated and aggregated. This demonstrates an ERM program that is not mature.

3. Continued

From page 49 of the Case Study:

“The acceptance of risk is the primary responsibility of the subsidiary. Risk is first identified, measured and managed at the subsidiary entity level. Diversification across risk types is calculated at the subsidiary level. Risk aggregation to the corporate level is the sum of all subsidiary-level risks by risk category.

Lyon is ignoring intra-group creation of capital and contagion risks, such as reputational or strategic risk, or missing risk diversification benefits.

- (b) Another key issue raised was that Lyon’s Corporate capital quantification for credit risk is not modeled, even though credit risk is a key risk for the enterprise.

A consultant was hired to develop loss scenarios on the Corporate asset portfolio. He produced the following results.

Percentile	Loss (in 000s) at end of year
75%	\$5,450
90%	\$9,681
95%	\$14,368
98%	\$17,725

Evaluate the reasonableness of Lyon’s Corporate Economic Capital value for Credit Risk given these scenario results.

Commentary on Question:

Candidates were expected to evaluate critically Lyon’s Corporate Credit Risk value from the Case Study or the scenario results in relation to that specific value. In some cases, candidates either referenced the wrong value and/or the wrong units or failed to make a substantial evaluation.

From the financials in section 2.11, Lyon’s Corporate Credit Risk EC is \$18.58 million, developed by a simple factor-based approach. The scenarios provided show a potentially fat-tailed distribution with significant recession-level results (90-95%ile) and 98%ile that’s nearly \$18 million already.

Given credit risk is a concern of the group as well as the subsidiaries, Lyon should develop a consistent modeling approach across the enterprise. This would replace the factor-based approach for the Corporate Credit EC and would provide a better view of how much of the \$178 million available EC is excess capital.

3. Continued

- (c) Senior management has requested that the Corporate Risk Committee develop improvements to the ORSA for next year's submission.
 - (i) Explain how stress and scenario testing can improve Lyon's ERM framework and ORSA reporting.
 - (ii) Describe two items that regulators will consider when evaluating stress testing in the ORSA report.

Commentary on Question:

Candidates generally did well on this part, though answers should have been more specific to Lyon in part (i).

- (i) Scenario and Stress Testing evaluates the strength of the business by subjecting it to varying combinations of economic, liquidity, operational, reputational conditions with differing degrees of severity. Lyon is in the process of developing an aggregate risk appetite statement which could be informed by enterprise-wide stress and scenario testing.

Linking risk drivers to actual historical events, for example, a recession or pandemic, can be helpful in improving senior management and board understanding of risks and then they can develop mitigating strategies.

- (ii) Regulators want to understand the severity of the stresses, including how the scenarios and stresses were calibrated, including any model and assumption validations. They would also like to see reverse stress tests or "break the bank" scenarios.

Regulators want to know the completeness of stress testing, such that it includes risks material to the enterprise and considers combined risks and interrelationships among risks.

3. Continued

- (d) Senior management has requested several enhancements to the group capital assessment and scenario/stress testing. The first recommendation is to develop an Operational Risk provision for the enterprise.
- (i) Describe two quantitative approaches to modeling Operational Risk that would be appropriate for Lyon.
- (ii) Explain the considerations of the following as they relate to data used in modeling Operational Risk:
- Internal vs External data
 - Hard vs Soft data.

For calculating Operational Risk capital, a colleague suggests using a Generalized Pareto Distribution with a threshold at \$1 million, the calibrated shape parameter at 0.80 and the calibrated scale parameter at 0.5.

$$Q_a = d + \frac{b}{k} \left(\left(\frac{S_x(d)}{1-a} \right)^k - 1 \right)$$

There are a total of 500 loss values collected across the businesses. You are provided the following table showing the top 30 largest losses, in millions of dollars.

12.33	8.71	6.74	4.41	4.20
3.31	2.97	2.65	2.58	2.40
2.29	2.21	2.12	1.89	1.76
1.35	1.34	1.28	1.27	1.25
1.15	1.13	1.10	1.07	1.05
0.99	0.97	0.96	0.92	0.91

- (iii) Calculate the 99th percentile of operational losses using the GPD. Show all work.
- (iv) Evaluate the result from (iii) and discuss how it relates to the economic capital held by Lyon. Justify your answer using information from the Case Study.

3. Continued

Commentary on Question:

Candidates did generally well with the shorter describe and calculate parts, but explanations and evaluations were limited. Some candidates choose to calculate the 99%ile using a different technique than the GPD requested or miscalculated the value, but if the explanations in part d(iv) were reasonable relative to the value in d(iii), credit was still given for that part.

(i)

- Simple add-on model where the factor can be derived from costs at a certain confidence level with a certain degree of correlation would be easy to implement at Lyon.
- Monte Carlo Frequency/Severity simulation using stochastic scenarios developed from historical data and expert judgement would be better but take more time to develop and run.

(ii)

- Internal vs External data:
Internal data can be collected directly by the company and reflect pertinent losses. However, there might not be adequate internal data to model and analyze operational risks in the tail. Therefore, external data should be used to supplement the data. However, external data needs to be reasonably unbiased, reflect similar operations of Lyon and is scaled to a level comparable to Lyon.
- Hard vs. Soft data:
Hard data is collected intentionally on a prospective basis for short period of time and produces far more data points than soft data. For example, hard data would represent the day-to-day operational failures that tend to be high frequency but low severity. However, hard data does not capture tail events and therefore is not appropriate to use alone. Soft data collects fewer events looking back over time, but does capture extreme events, and it is the most appropriate to use when modeling/incorporating tail events. When modeling operational risks, it will be critical to include the low severity, high frequency events captured in soft data.

(iii)

$S_x(d) = 25/500 = 0.05; \geq 95\%$, so EVT appropriate

$d=1.0$, and $k = 0.80$ and $b = 0.5$ (given)

$1 + (.5/.8)((0.05/.01)^{.8-1}) = \2.64 Million

3. Continued

(iv)

Based on the result, we expect that losses from a 1-in-100 Operational event to be greater than \$2.64M. The result is between 10%-20% of Lyon's \$18M Corporate EC, but that's only for Credit Risk and is too small if intended to be the Ops EC for the whole enterprise. This internal data from the businesses could be supplemented with external or soft data to reflect larger potential losses and then re-parameterize the GPD.

4. 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.
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.
6. The candidate will understand the concept of economic capital, risk measures in capital assessment and techniques to allocate the cost of risks within business units.

Learning Outcomes:

- (1c) Demonstrate how to articulate an organization's risk appetite, desired risk profile, quantified risk tolerances, risk philosophy and risk objectives.
- (2c) Identify and analyze specific risks faced by an organization, including but not limited to: financial, environmental, operational, legal, reputational and strategic risks.
- (4a) Determine risk exposures using common risk measures (e.g., VaR and TVaR) and compare the properties and limitations of such measures.
- (4c) Analyze risks that are not easily quantifiable, such as liquidity, operational, and environmental risks.
- (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).
- (5i) Choose appropriate techniques to measure, model and manage various financial and non-financial risks faced by an organization.
- (6a) Demonstrate a conceptual understanding of economic measures of value and capital requirements (e.g., EVA, embedded value, economic capital, regulatory measures, and accounting measures) and their uses in decision-making processes

4. Continued

Sources:

ERM-136-20: Managing Liquidity Risk: Industry practices and recommendations for CROs (excluding section 4)

ERM-134-19: Group Insurance Chapter 39 Risk Based Capital Formulas

Value-at- Risk, Third Edition, The New Benchmark for Managing Financial Risk, Jorion Ch. 13 Liquidity Risk (excluding section 13.4)

Commentary on Question:

This question was trying to test candidates knowledge of liquidity risk. The question included two calculations, both involving asset liquidity measures and the resulting impact on the financials of the company. Related subparts required an understanding of the results of the calculations as they related to liquidity considerations.

Parts of the question not related to the calculations required knowledge of liquidity risk frameworks and potential areas of risk. Candidates who scored higher on these parts tended to provide answers in the context of the liquidity risks specifically facing a health insurance company.

Solution:

- (a) In considering which asset to sell, the CIO asks you if any of the four assets have breached the individual asset liquidity limit. Assume a normal distribution and critical value of 1.645.
- (i) Determine which, if any, of the individual assets have breached the asset liquidity limit. Show all work.
- (ii) Recommend which asset to sell based on the results in (i). Justify your response.

Commentary on Question:

Subpart (i)

Many candidates received full credit on these calculations and the interpretation of the results. Those that didn't tended to have errors in the LVAR formulas, or did not demonstrate an understanding of the breach limits (i.e. ratios above 35%).

Subpart (ii)

Candidates typically received either full credit or no credit here, which correlated highly with correct interpretation of the individual asset liquidity limits and whether or not assets were in breach of those limits.

4. Continued

- (i) Refer to Excel for calculation solutions.
- (ii) Both the BB Corporate bond and the B corporate bond have breached the individual asset equity limit. The BB Corporate bond should be sold, as its ratio (37.6%) exceeds the 35% limit by more than the B Corporate bond's ratio (35.5%).
- (b) Question statement.
ABC uses the NAIC Health RBC formula when calculating the RBC ratio. The following table shows book values and average post-tax RBC factors by risk category used by ABC to calculate its RBC ratio.

RBC Category	Book Value	Average post-tax RBC Factor
H0	1,299	0.030
H1	23,612	0.022
H2	32,000	0.044
H3	12,478	0.032
H4	2,220	0.050

Total Adjusted Capital (TAC) = 5,527

- (i) Describe what RBC is intended to measure.
- (ii) Assume that cash held on the balance sheet has a 0% RBC factor.

Analyze the impact on the company's RBC ratio of selling each individual asset from part (a). Show all work.
- (iii) Discuss whether your analysis performed in part (ii) has changed your prior recommendation to the CIO on which asset to sell. Justify your response.

Commentary on Question:

Subpart (i)

Many candidates received either no credit or nearly full credit. Those who did not receive credit failed to mention that RBC is a regulatory tool that can lead to regulatory action, and not a standalone tool to measure the competitiveness or financial solvency of an insurance company.

4. Continued

Subpart (ii)

The large majority of candidates received less half of the available points here, as many struggled with the correct calculations. Many candidates correctly identified the formula for Health RBC, but most candidates did not correctly update the HI factors or the Total Adjusted Capital figures to reflect the asset sales.

Subpart (iii)

Most candidates received little to no credit here, as the responses were based on incorrect calculations in the prior sub-question. Responses that did receive credit justified those responses with a correct interpretation of the impact to RBC ratios, even if their corresponding calculations were not fully correct.

- (i) RBC is a standard regulatory formula that represents the minimum capital requirement for insurers, and is used to determine when a regulator must take action against an insurer, up to and including taking control. RBC is not the amount of capital that an insurer would want to hold to meet growth or competitive objectives.
 - (ii) Refer to Excel for calculation solutions.
 - (iii) Based on the impact to the RBC ratios, the B Corporate bond should be sold. While the LVAR/VAR ratio for the BB Corporate bond is higher, selling the BB bond decreases the RBC ratio from 345.0% to 344.7%. Conversely, selling the B bond increases the RBC ratio to 345.5%.
- (c) The CIO wants to review the company's liquidity contingency plan.
- (i) Outline the main components of a well-designed liquidity contingency plan as part of a broader liquidity risk framework.
 - (ii) Explain how a catastrophic event could impact the liquidity needs of ABC.
 - (iii) Identify three factors, other than a catastrophic event, that could impact the level of ABC's available liquidity.

Commentary on Question:

Subpart (i)

Many candidates did not identify components of a liquidity contingency plan (e.g. having a pre-defined list of liquidity contingency resources) and instead listed examples of liquidity contingency resources. A full listing all of the elements below was not required for full credit, but at least some demonstration of knowledge of these elements resulted in credit.

4. Continued

Subpart (ii)

The large majority of candidates received at least some credit on this part. Almost all candidates received credit for recognizing that a catastrophic event would lead to an increase in claims, but many failed to identify any potential impacts beyond that. This question was specifically testing candidates understanding of liquidity needs, and not liquidity resources.

Subpart (iii)

Many candidates received at least half of the potential credit on this question, though a large number received none. Those that received less credit failed to identify factors that could affect the available liquidity of a health insurance company, and instead provided responses that were not applicable to ABC.

- (i) The main components of a liquidity contingency plan include:
- procedures to detect a potential liquidity stress event using early warning indicators
 - a pre-defined list of contingency resources in the case of a stress event
 - procedures and governance to activate the contingency plan
 - procedures and governance to decide when to implement the appropriate response to a liquidity stress event, and monitor the implementation
 - the process for internal and external communication
 - the process to periodically test and update the plan
- (ii) Catastrophic events trigger an increase of insurance payment obligations, leading to large unexpected liquidity needs or payment requirements within a short time. Catastrophic events may also trigger drastic changes in consumer behavior such as mass lapses, or could result in the downgrade of assets, making them ineligible for collateral posting.
- (iii) Other factors that could impact the level of ABC's available liquidity include:
- A reduction in the market value of assets
 - Limited access to external and internal funding
 - Reduced funding from business operations (e.g. lower than expected inflow of premium income from new business)

5. Learning Objectives:

3. The candidate will understand the concepts of risk modeling and be able to evaluate and understand the importance of risk models.
5. The candidate will understand the approaches for managing risks and how an entity makes decisions about appropriate techniques.

Learning Outcomes:

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

ERM-144-20: IAA Risk Book - Chapter 13: Asset Liability Management Techniques and Practices for Insurance Companies (LO 5)

ERM-112-12: Revisiting the Role of Insurance Company ALM within a Risk Management Framework (LO 5)

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

Commentary on Question:

Commentary listed underneath question component.

Solution:

- (a) During your initial meeting with the company, Magenta Rock's CFO, Juan, states: "I believe we spend too much time worrying about the duration gap between our assets and liabilities. Given that Magenta Rock reports its financials on a book value basis, the primary focus of the ALCO should be to minimize absolute risk from asset volatility and minimize accounting volatility."

Evaluate the assertions made by Juan.

5. Continued

Commentary on Question:

Candidates scored reasonably well on this question, however, several only addressed one of the CFO's assertions, rather than both as the question required.

While book value and accounting volatility are important considerations, they are more related to a short-term view for regulatory and reporting purposes. Economic value should also be considered as it takes a long-term view on growth and profitability for the company.

The fact that the effective duration of liabilities is much longer than that of the assets may result in significant problems with funding risk especially in times of economic downturn with adverse interest rate changes. With liabilities having higher durations, the company will need to continually search for and roll new assets into its portfolio. When market stressed environments, it may be difficult or impossible to both find assets with sufficient duration as well as having to sell existing assets at depressed prices in order to meet cash outflow obligations.

- (b) At a follow-up meeting, the ALCO expresses concerns regarding the current low interest rate environment and the volatility of the economic surplus. The ALCO suggests immunizing Magenta Rock's portfolio.
- (i) Describe two ways in which Magenta Rock would still be exposed to interest rate risk even if the portfolio is immunized using effective duration.
- (ii) Recommend a strategic asset allocation framework that would help increase Magenta Rock's portfolio yield while still addressing its concerns of surplus volatility. Justify your response.

Commentary on Question:

Part 5b(i) was a fairly easy question. Many candidates received full credit. Part 5b(ii) was more difficult, with few candidates receiving full credit. On part 5b(ii), several candidates presented a generic SAA framework without addressing the stated concern of surplus volatility. Several candidates also suggested specific investments rather than answering the question which called for a framework.

b(i)

- Immunizing may work effectively only for small change of interest rate. If the volatility of interest rate is large, it may still face the risk.
- Sometimes it may be hard to find assets with long enough duration to fulfill the immunizing in the actual market. So, it may still face the interest rate risk in future.

5. Continued

b(ii)

Magenta Rock should constrain surplus volatility but relax the duration matching requirement. The surplus volatility will help to ensure assets are consistently sufficiently above liabilities. Relaxing the duration constraint will allow Magenta rock to seek higher yields through potentially riskier equity or alternative investment vehicles.

Note that Magenta could also look for assets with higher times to maturity which, in an upwards yield sloping environment would yield higher returns and would actually help with duration matching given the liability portfolio's long duration.

- (c) To further test the impact of the current interest rate environment, an ALCO member suggests that the following scenario test should be conducted:

A 50 basis point parallel drop in the risk-free rates for one year followed by an additional 10 basis point drop for each of the next four years.

- (i) Assess how Magenta Rock's ALM profile would be impacted under the stress test circumstances.
- (ii) Recommend one additional method Magenta Rock could use to measure interest rate risk to complement the scenario testing. Justify your recommendation.

Commentary on Question:

Candidates scored reasonably well on both parts of 5(c)

c(i)

- On the asset side, the asset value will increase due to lowered yield curve, but it will suffer from reinvestment risks from any bonds maturing in the near future
- On the liability side, the liability value will increase and the magnitude will be more than the increase in asset because of the longer liability maturity.
- Magenta Rock will have a difficult time in funding the guaranteed minimum return on the fixed annuity business. In addition, it will face liquidity challenge in funding the withdrawal from the annuity business

c(ii)

Magenta Rock could use stochastic modelling to measure interest risk rate. Stochastic modelling makes use of ESG to generate a random process of financial variables in concern, interest rates in our case. It allows a wide range of scenarios to be modelled, providing a distribution of possible loss of Magenta Rock. This could better reflect the interest rate tail risk due to extreme market conditions.

5. Continued

- (d) During your review of ALCO's practices, you notice that credit risk was overlooked when analyzing future asset cash flows.

Describe how Magenta Rock could incorporate its credit risk exposure into the projected asset cash flows.

Commentary on Question:

Candidates scored reasonably well on 5(d)

A credit migration model can be used to model probability of default, exposure, and loss given default to incorporate credit risk exposure into the projected asset cash flows.

- (e) You suggest to the ALCO that the volatility of the liability cash flows could be minimized using risk transfer methods or derivatives.

Explain how each of the following methods could be used to minimize the volatility of Magenta Rock's liability cash flows:

- Reinsurance
- Interest rate swap

Commentary on Question:

Part 5(e) was fairly easy for candidates and many received full credit.

Using stop loss reinsurance for Magenta Rock's life product would transfer claims liability to a reinsurer after a specified threshold. This would put a cap on Magenta Rock's claims liability, resulting in less volatile liability cash flows.

Magenta Rock could use an interest rate swap to receive fixed interest rate payments in exchange for variable rates. This will help stabilize the annuity interest rate needs, resulting in less volatility in liability cash flows.

6. Learning Objectives:

1. The candidate will understand the ERM framework and process and be able to apply them to organizations.
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.
- (1c) Demonstrate how to articulate an organization's risk appetite, desired risk profile, quantified risk tolerances, risk philosophy and risk objectives.
- (5c) Demonstrate the use of controls for retained and residual risks.

Sources:

ERM-119-14: Aggregation of risks and Allocation of Capital (Sections 4-7 Excluding 6.3) (LO 1)

ERM-143-20: Internal Controls Toolkit, Doxey, Ch. 1, pp. 11-17 & 27-35 (LO 5)

ERM-702-12: IAA Note on ERM for Capital and Solvency Purposes in the Insurance Industry, Pages 9–38 (LO 1)

Risk Appetite: Linkage with Strategic Planning Report (LO 1)

Exploring The Black Box: Working with inherent and residual risk (LO 5)

Commentary on Question:

Overall candidates did not perform well on this question. Parts (b) and (c) respectively scored the fewest grading points.

Solution:

- (a) Big Ben is committed to maintaining a strong capital base to support the risk associated with its business.

Describe one residual risk and one inherent risk that apply to Big Ben. Justify your response.

Commentary on Question:

Residual risk is the risk that remains after taking into account all mitigating actions that can reasonably be taken in order to manage the risk. Liquidity risk is a residual risk that Big Ben still faces even after implementation of an ALM strategy.

6. Continued

Inherent risk is a function of exposure and impact, not considering any mitigation factors. Regulatory risk is an inherent risk that Big Ben faces regardless of the mitigation actions they put in place.

- (b) Big Ben is implementing the Model Governance framework.
 - (i) Define the three major types of internal controls.
 - (ii) Provide an example of an internal control used by Big Ben in the Model Governance framework, for each type you identified in part (i).

Commentary on Question:

Many candidates did not correctly identify the three major types of controls for part (i). Candidates also did not focus their examples for part (ii) to the Model Governance framework as requested in the question.

Part (i):

The three major types of internal controls include:

1. **Preventive** controls are designed to keep errors from occurring.
2. **Detective** controls are designed to identify errors that may have already occurred.
3. **Corrective** controls are designed to correct errors that have identified (or detected).

Part (ii):

1. Preventive example: Big Ben required that high risk models be validated on a strict 3-year rotation schedule through a centralized model validation group.
2. Detective example: Big Ben requires that models that are not subject to validation be reviewed by an independent analyst (e.g. someone who was not the model developer) who is familiar with the model's topic and purpose.
3. Corrective example: The formal model validation exercise will require a report with a pass or fail grade, regardless of the findings. If the model fails, a remediation plan will need to be created by the model developer and executed in a timely manner.

6. Continued

- (c) Big Ben is formalizing its risk appetite framework.
- (i) Describe the three increasingly detailed levels of a risk appetite framework.
 - (ii) Provide two examples of risk appetite that Big Ben already utilizes or is considering. Justify your response.
 - (iii) Provide two examples of risk tolerances that Big Ben already utilizes or is considering. Justify your response.

Commentary on Question:

Many candidates were unable to identify the detailed levels of the risk appetite framework in part (i) even though 2 of the 3 levels were given in parts (ii) and (iii). For examples provided in parts (ii) and (iii), the candidate was given credit for justification as either a risk appetite or risk tolerance, but not both.

Part (i):

1. **Enterprise Risk Tolerance** – the aggregate amount of risk the company is willing to take.
2. **Risk Appetite** – enterprise risk tolerance needs to be allocated to a risk appetite for specific risk categories and business activities.
3. **Risk Limit** – the most granular level used for business operation. A risk limit translates enterprise risk tolerance and risk appetite for each category into risk-monitoring measures.

Part (ii):

Example 1: Big Ben uses internal models to determine its required economic capital based on VaR. The quantile used for the VaR calculation is 99.5% over a one-year horizon.

Example 2: Big Ben requires that each line of business maintain an Internal Capital Adequacy Ratio of 140%.

Part (iii):

Example 1: To manage liquidity risk, the contractual maturities of assets and liabilities are monitored, and the duration mismatch is not allowed to exceed a specific tolerance.

Example 2: To manage interest rate risk, Big Ben will monitor the sensitivity of assets and liabilities to changes in interest rates. The Board wants to be able to withstand a 200bp parallel shift in the yield curve.

7. 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:

- (1e) Propose ERM solutions or strategies that effectively manage risk under different real (case study) and hypothetical situations facing financial and non-financial organizations.
- (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.
- (5i) Choose appropriate techniques to measure, model and manage various financial and non-financial risks faced by an organization.

Sources:

ERM-824-21: Strategic Crisis Management: A Basis for Renewal and Crisis Prevention (GC)

ERM-831-22 Managing 21st Century Political Risk (GC)

Commentary on Question:

To earn full credit, it was necessary that the candidates be familiar with the two sources referenced above. Part (a)(i) and part (b) required knowing certain lists of risks that were in the readings. No points were taken away for part (a)(ii) if candidates had the wrong list in part (i) but then used that list and came up with reasonable examples for part (ii). As a result, candidates generally did well on part (a)(ii). Part (b) was where candidates struggled the most, either because they did not know the list of risks being referenced or because they failed to follow the question's instructions and justify their answers.

7. Continued

Parts (c) and (d) required extrapolation from the readings rather than memorization. Candidates did well on part (c), but tended to be too brief or too broad on part (d).

Solution:

- (a)
- (i) Describe three megatrends that are transforming the landscape for political risks in the 21st century.
 - (ii) Describe a scenario, for each megatrend, that could impact SeaLux Cruise Lines.

Commentary on Question:

Candidates generally did well on this question. Part (i) required a list of the three megatrends as found in the reading AND a description of that megatrend in the candidate's words for full credit. Part (ii) required candidates to tie their examples back to SeaLux in particular for full credit. Most candidates did an excellent job of this.

A number of candidates used an example revolving around climate change and alternative fuel sources for the political environment risk in part (ii). Full credit was given for such answers.

(i)

Rise of Technology/Social Media: This trend can be described as an increase in the use of technology globally. Inherent in this is increased social media which allows for like-minded people to come together more easily and perpetuate their causes and beliefs

Vastly Changing Political Environment Since the Cold War: The state of geopolitics is constantly changing since the end of the cold war. There are rising states, declining states, new world powers, etc. Geopolitics are as intertwined and dynamic as they've ever been.

Significant Changes to the Supply Chain: The supply chain has become a lot leaner. Supply chains for a given company can extend all over the world and disruptions to business don't have to stem from events at home anymore, they can now arise from events across the globe.

(ii)

Technology/Social Media: Someone with social media influence (a celebrity) gets really bad service on a SeaLux Cruise and tweets about it – hundreds of thousands of people see the tweet and out of fandom/support choose to promote a different cruise line or propogate anti-SeaLux media.

7. Continued

Changing Political Environment: As tensions between Russia and the rest of the world ratchet up, SeaLux may be faced with decisions to eliminate ports on their Arctic cruises or restrict travel by individuals being sanctioned. They may need to reconsider fuel sources and costs impacted by a boycott of Russian oil.

Supply Chain: SeaLux is planning to add three new ships in the next five years. If parts of those ships are made in another country, and a natural disaster strikes that country, SeaLux will be exposed to damage, loss, and production delays. This would mean that SeaLux, a company headquartered in Seattle, Washington, could be directly affected by a natural disaster occurring halfway around the world.

- (b) Classify each of the cruise industry key risks in Section 1.10 of the Case Study into one of the seven types of major crisis families. Justify your answer.

Commentary on Question:

Many candidates did not know the seven types of major crisis families from the reading. They are Economic, Informational, Physical, Human Resources, Reputational, Psychopathic Acts, and Natural Disasters.

Other candidates failed to justify their responses and did not receive full points for that reason. There was no need to reiterate the key risks from the case study in the response as is shown below, as long as it was clear to the grader which one was being referenced in each part of the answer.

Other answers were acceptable if well justified, such as increase in fuel prices being an economic risk instead of physical.

World events impacting the ability or desire of people to travel

The economic risk category includes events such as market crises, so if the ability or desire of people to travel is reduced due to increasing unemployment in an economic depression or financial crisis, this would be an economic risk.

Weather conditions natural disasters, or other incidents affecting cruise ships and/or passengers

This would be in the natural disaster risk category. For example, a tornado or hurricane could drastically damage the cruise ships that are operating in the Caribbean. Damage to ports could even prevent SeaLux from being able to go forward with adding two new destinations in the Caribbean as planned.

Technology risks, including breaches in data security, disruptions to information technology operations, and failure to keep pace with developments in technology

The informational risk category includes data breaches or a loss of important or confidential client information, such as may result from a cyberattack.

7. Continued

Ability to recruit, develop and retain qualified shipboard personnel

The human resources risk category could include loss of key employees or a high turnover rate of qualified shipboard personnel due to perceived low pay or poor treatment.

Increases in fuel prices, changes in the types of fuel consumed, and availability of fuel supply

The physical risk category includes things such as a loss of suppliers or a disruption at an operating plant. If SeaLux's fuel suppliers in Asia are affected by a Russian boycott of oil, this could be considered a physical risk.

- (c) Identify the relevant stakeholders SeaLux should address in its communication plan. Explain why they are relevant.

Commentary on Question:

Most answers that received full credit listed a minimum of three stakeholders, most commonly the three given below. Some candidates listed government bodies/regulators or travel agents, and if well-justified, could earn full credit for those answers as well.

Shareholders: Increased customer complaints could lead to a decrease in customers, and therefore revenue and perhaps profits. Shareholders are concerned with the profitability of their investments, so they will want to know what is being done to rectify this issue.

Employees: Shipboard personnel need to be informed of what the policies are to ensure there is no confusion on what they need to be mandating and policing on board. Marketing and those responsible for customer communication need to be informed so they can ensure there is no confusion or conflict of information. For example, it would be confusing for travelers if a COVID section on SeaLux's website said one thing, but the packing list said another.

Customers: The customers have already complained about the changing mask policies, so they are a primary party who needs to see relevant communication on the matter. Customers need to be addressed in such a way that they feel heard and valued by SeaLux, but also have no more confusion about the mask policy and the reasons for it.

- (d) Recommend actions SeaLux could take to enhance the crisis management plan to reflect Asian customers as emergent stakeholders.

7. Continued

Commentary on Question:

Many candidates were too brief in their responses to this question to obtain full credit. This question did require extrapolation from the reading, both to identify what would enhance a crisis management plan and to tie it back specifically to SeaLux/cruise line concerns. Some candidates were too broad in their answers and discussed more general considerations in expanding in the Asian market, such as developing marketing plans, rather than keeping their answer related to crisis management.

SeaLux should enhance their crisis scenario planning by considering additional risks they may be exposed to if they expand in the Asian market. For example, areas like Thailand may be more prone to typhoons and tsunamis than the Caribbean. SeaLux should add these environmental risks into their contingency plan. They should also consider political risks associated with these areas. For example, China may be more likely to impose travel bans quickly in the event of a pandemic than the US, leading to people stranded on ships or at foreign ports. Perhaps most importantly, SeaLux should consider hiring leadership familiar with the Asian market and the Asian stakeholder that can lead crisis communication efforts.

8. Learning Objectives:

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.
6. The candidate will understand the concept of economic capital, risk measures in capital assessment and techniques to allocate the cost of risks within business units.

Learning Outcomes:

- (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.
- (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).
- (6a) Demonstrate a conceptual understanding of economic measures of value and capital requirements (e.g., EVA, embedded value, economic capital, regulatory measures, and accounting measures) and their uses in decision-making processes
- (6b) Apply risk measures and demonstrate how to use them in value and capital assessment

Sources:

ERM-812-15: Valuation for Mergers and Acquisitions, Ch. 1 (GC)

Malz Chapter 12 Section 3.1: Defining Leverage Risk (GC)

ERM-819-19: Exchange Rate Risk Measurement and Management (GC)

ERM-136-20: Managing Liquidity Risk: Industry practices and recommendations for CROs (excluding section 4) (LO 2)

8. Continued

Commentary on Question:

Candidates struggled with this calculation-heavy question. Key items many candidates did not understand included:

- *That capital required to support a purchase could be estimated using capital ratios (e.g., calculate ratio of capital to total liabilities (or assets) before the transaction. Calculate expected liabilities (or assets) after the transaction. Solve for the additional capital needed to keep the original ratio constant.)*
- *How the purchase price of the block entered into the calculation (by decreasing the amount of assets received in the transaction and thereby increasing the necessary capital)*
- *How to “translate” the leverage formula that uses assets, debt, and equity into line items on an insurance company’s financial statement (assets = assets; debt = liabilities; equity = surplus or capital)*
- *Thinking through how the proposed purchase would affect assets, liabilities, and surplus in order to calculate leverage after the transaction*
- *Understanding the concepts of “cost of debt service” and “hurdle rate”*

Candidates performed much better on the parts of the question that did not involve calculations.

Very few candidates used the excel file to write out any part of their thought process. However, candidates that did so were often able to earn partial credit for having some correct ideas, even if their answer was not correct.

Solution:

(a)

- (i) Assume the capital needs of AnnCo’s products are proportional to the capital needs of SLIC’s other products.

Estimate the total capital required to acquire AnnCo and maintain SLIC’s targeted surplus ratios after the acquisition of AnnCo. (Use SLIC’s balance sheet as shown in section 3.4.) Show your work.

- (ii) Lyon is considering borrowing the necessary capital and contributing it to SLIC.

Describe the factors Lyon management should consider in determining whether to increase debt to finance this investment.

8. Continued

Commentary on Question:

Very few candidates understood that the capital needed to support an annuity block would be proportional to the size of the block in terms of assets or liabilities. Many candidates attempted to relate the capital requirement to the purchase price alone. Full credit was given to candidates who recognized the need for a ratio to assets or liabilities and applied one, even if the numerator or denominator did not match those below (for example, adjusting the required surplus capital down to reflect the difference between the "target" RBC of 350% and the current RBC of 405%, or using general account only liabilities for the denominator.) Extensive partial credit was given for explaining the calculation, as in the first paragraph of part (i) below, even in the absence of a completed calculation.

Part (ii) required only two considerations if well described. A number of candidates lost points because they focused exclusively on whether AnnCo should be purchased at all, rather than focusing on whether debt should be used for the transaction as the question asked.

(i)

In the absence of detailed information, capital needs can be estimated as a function of assets or reserves. We know the ratio of capital to liabilities today for SLIC, and we know how much the liabilities would increase if AnnCo was purchased. Therefore, we can estimate the capital required to support the purchase of AnnCo as follows:

Total reserves associated with AnnCo are approximately \$1.4B according to section 2.10 of the case study. The current SLIC capital and surplus to liability ratio is approximately 8.5% ($509,788/6,017,538$) according to section 3.4 of the case study. To keep the capital and surplus to liability ratio the same if \$1.4B is added to the liabilities means an additional $8.5\% * \$1.4B$ or \$118.604M of capital and surplus, for a total of \$628.392M of capital and surplus.

Finally, the purchase price of \$75,000,000 should be added to get the amount of investment required to make this purchase without affecting SLIC's capital ratios. The total additional capital needed is therefore \$193.6M.

(ii)

Some considerations Lyon should take into account before increasing their debt for this transaction:

- Debt reduces liquidity, as the debt service must be paid out of cashflows. If the cost of paying the debt reduces SLIC or Lyon's income to unacceptable levels, the company's risk of default or downgrade increases.
- If Lyon can invest the capital they are borrowing and earn their desired hurdle rate even after accounting for the cost of paying the debt, borrowing is reasonable.

8. Continued

- Debt creates an after-tax benefit compared to equity financing.
- Lyon should consider this additional borrowing in light of the debt they already hold. For example, if Lyon had significant debt obligations already, they should be less inclined to increase their debt to finance the investment. In fact, Kelly's rating agency report indicates just the opposite: Lyon's long-term debt is minimal in their view and Kelly even suggested Lyon evaluate their capital structure to see if additional leverage may result in a more optimal structure.

(b)

- (i) Describe the three types of exchange rate risk.
- (ii) Identify which risk in part (i) applies to this financing transaction. Justify your answer.
- (iii) Explain whether or not Lyon should hedge these new currency exposures if it uses this source of capital. Justify your answer.

Commentary on Question:

Many candidates knew the three risks from the reading for part (i) and earned full credit, as very few candidates failed to correctly describe them if they knew their names. Economic risk had the broadest array of definitions. Although the source describes it as "revenue from selling products in a foreign currency or expenses from paying for inputs in foreign currency", full credit was also given to the numerous responses that described it as risk to the present value of future cash flows from adverse exchange rate movements.

A correct answer to part (ii) relied on the justification. If points were taken away in part (i) because the candidate didn't know the three risks, but then took a risk they described in part (i) and was able to justify why it applied in part (ii) they could still get full credit. Part (iii) asked for a recommendation and a justification. Simply listing pros and cons was insufficient for full credit if a recommendation was not made. Most full credit answers included two justifications for the recommendation.

(i)

Transaction: cash flow risk associated with transactional accounts (a change in the exchange rate affecting the value of a contract). Pertains to movement in the exchange rate before known, short run cash flows are received.

Translation: balance sheet risk (rolling up subs that are in one currency to parents that are in another). Pertains to movements in exchange rates impacting the balance sheet valuation of assets and liabilities.

8. Continued

Economic: impact on revenues and expenses (revenue from selling products in foreign currency or expenses from paying for inputs in foreign currency).

Alternatively, pertains to the way in which exchange rates impact the present value of future cash flows.

(ii)

- Transaction risk is cash flow risk. The debt service is in euros and SLIC and Lyon's revenues are in dollars. The dollar amount of payments to service the debt will vary with the euro-dollar exchange rate.

Alternatively:

- Translation risk is balance sheet risk. A firm's debt profile – the currency and maturity composition of a firm's debt – determines the susceptibility of its net equity and earnings to exchange rate changes. Since the debt liability is in euros, but SLIC and Lyon report their financials in dollars, they are exposed to translation risk depending on the euro-dollar exchange rate on the date of the financial reports.

(iii)

Lyon should hedge the exchange rate risk for the following reasons:

- Lyon (and SLIC) should not view this as a potential opportunity to lower the cost of the debt service by hoping for a favorable exchange rate change at the risk of an unfavorable one, assuming the hedging is affordable.
- Even though the movements of exchange rates can be either good or bad for Lyon, hedging the risk can provide a more predictable liability on the balance sheet as well as provide for a more stabilized future cash outflow.

Alternatively:

Lyon should not hedge the exchange rate risk for the following reasons:

- Lyon already has a subsidiary in Helios that conducts business and reports financials in Euros. They may be able to hedge this risk naturally through their global companies in the form of dividends from one to the other, making hedging this loan with derivative instruments unnecessary. (This assumes we are looking at the transaction from Lyon's POV and not the specific companies themselves.)
- The cost to hedge, assumed to be 75 bps on a 3% interest loan, may be high. If Lyon calculates the cost of hedging the exchange rate risk to be higher than the cost of additional capital they might need to absorb the volatility and uncertainty that would result from leaving the exchange risk unhedged, they should not hedge the risk.

8. Continued

- (c)
- (i) Calculate the leverage ratio before and after the proposed transaction. Show your work.
 - (ii) Calculate the cost to service the debt for the proposed transaction inclusive of the cost of hedging. Show your work.
 - (iii) Recommend whether Lyon should proceed with the acquisition supported by the debt financing. Justify your response.

Commentary on Question:

- (i) *Most candidates knew the leverage formula, but struggled with how to translate an insurance company's financial statement into the categories of "debt", "equity" and "assets". Candidates who had trouble with part (a)(i) also did not understand how purchasing AnnCo would affect debt, equity, and assets in order to adequately calculate the after-transaction leverage ratio.*
 - (ii) *Candidates earned full credit if they understood that the debt service cost is the repayment of the loan plus the cost of hedging and generally knew how to go about calculating that. Very few candidates understood the concept of debt service cost.*
 - (iii) *Either recommendation (proceed or not proceed) were acceptable if well-justified and if the recommendation aligned with the calculations made in previous sections. Candidates were expected to use the information on the desired hurdle rate to help with the recommendation.*
- (i) Malz (the author of the relevant source material) defines the leverage ratio as A / E or $1 + D / E$. It also footnotes that an alternative definition is simply D / E . (A = assets, D = Debt, E = Equity)

Lyon's consolidated financials show that debt = liabilities = \$10.612B, equity = surplus = \$3.666B, and assets = debt + equity = \$14.278B

Therefore, leverage before the transaction is $14.278 / 3.666 = 3.894$

The transaction will add 1.4B to the liabilities for a total of 12.011B and 193.6M to surplus (see part(a)(i) calculation) for a total of 3.859B. The assets increase by 1.4B + 193.6M to 15.871B.

The new leverage ratio after the transaction is $15.871 / 3.859 = 4.112$

8. Continued

- (ii) The debt service cost refers to the payments Lyon has to make on the money they borrow, plus the cost of hedging those payments.

If Lyon borrows \$193,604,000 (the answer to part (a)(i)) at 3% interest, with principal being amortized over 10 years, using the excel PMT function gives $PMT(3\%, 10 \text{ periods}, PV 193,604,000) = \$22,696,295$ as an annual cost. Per the question stem, hedging will add an additional 0.75% of that value, for a total cost of \$22,866,517 annually.

Alternatively, since the question didn't specify the type of amortization, calculating the first year of debt service using straight line amortization is also acceptable. That would give $3\% \times 193,604,000 + 19,360,400 = 25,168,520$ before hedging and $1.0075 \times 25,168,520 = \$25,357,284$ with hedging.

- (iii) The decision to proceed with debt financing for this transaction should take into account whether the payment of the debt service costs would create an unsustainable burden on SLIC, since the question stem clarifies that SLIC is expected to cover those costs via dividends to Lyon.

SLIC's 2021 net income is \$44,080,000, which is ~2X the annual debt service cost. SLIC may struggle to cover those costs in a crisis environment that has a significant impact on earnings. Lyon should be aware of this and be ready to accommodate a lower dividend from SLIC if necessary.

Lyon should also consider not just whether SLIC could pay the debt, but also whether the transaction would result in increased revenues sufficient to both pay the debt and create a reasonable return on the additional capital.

The hurdle rate refers to the expected return on invested capital. If we assume a target cost of capital of $10\% \times \$193.6\text{M}$ (the capital borrowed) we'd want to see additional earnings of \$19.4M from this block. We also need our earnings to cover the hedging costs plus interest we are having to pay to borrow that capital. In year 1, those costs are 3.75% of 193.6M, or \$7.3M. Add that in, and the target additional annual earnings are $19.4 + 7.3 = \$26.6\text{M}$. Using a \$1.4B block as a denominator, the necessary earned spread to reach this target is 1.9%. This is a reasonable earned spread assumption in today's markets, although it doesn't account for revenue from the \$1B MYGA block that might be needed to support the unprofitable SPDA block. If the purchase price of that legacy business could be adjusted to reflect the expected future profitability, AnnCo looks like a reasonable purchase.

8. Continued

In summary, I recommend Lyon proceed with the purchase of AnnCo subject to an analysis of the expected losses from the SPDA block.