ERM-GC Model Solutions
Spring 2015

1. **Learning Objectives:**
4.   The candidate will understand the approaches for managing risks and how an entity makes decisions about appropriate techniques.

Learning Outcomes:
 (4b)   Demonstrate means for transferring risk to a third party, and estimate the costs and benefits of doing so.

Sources:
ERM 114-13: Introduction to Reinsurance, Rudolpho Wehrhahn (excluding all Annexes)

Commentary on Question:
The goal of the question is to test knowledge of reinsurance options. The candidate was expected to identify management considerations for selecting an appropriate reinsurance option.

Solution:
(a)   Explain how reinsurance could be used to address Myers' breach in risk limits.

Commentary on Question:
Full credit was awarded for responses that described the benefits of reinsurance specifically to address the concern given in the question.   Credit was not given for features or benefits of reinsurance that would not address the breach in risk limits, although these were often included in candidate responses. While many candidate responses included the central point regarding risk transfer (point 1 below), fewer included points 2 and 3.

1.   Reinsurance is a risk management tool used to transfer risk from the insurer to the reinsurer.

2.   Meyers could use reinsurance to transfer
   • Exposures in excess of its concentration limits by ceding a portion of all policies covering a defined risk (surplus reinsurance), or
   • Losses in excess of its concentration limits by using excess of loss reinsurance.

1. Continued

3. Use of reinsurance allows the insurer to participate in a larger diversity of risks using the same working capital by keeping a smaller portion of each risk. The reduction in concentration risk may diminish the volatility of annual results.

(b) Compare and contrast surplus reinsurance with excess of loss reinsurance.

Commentary on Question:
A large number of candidates did not clearly identify the differences between the two forms of insurance.

Compare:
Both are risk management tools that transfer risk to the reinsurer. The capacity is the maximum amount that is reinsured.

Contrast:
- Excess of loss only covers losses in excess of priority so that small claims are not reinsured.
- Surplus reinsurance is quota share reinsurance that assigns or cedes a portion of each claim. Small claims are reinsured. The retention is the amount of sum insured retained by the insurer (for sum insured amounts ≤ retention plus capacity).

(c) Calculate Myers' retained claim for the following scenarios. Show your work.

Commentary on Question:
Many candidates struggled with the surplus reinsurance calculations. In surplus reinsurance, the quota share reinsured is determined based on the sum insured. Then that quota share is ceded for each claim, regardless of claim size. Full credit answers generally included both a table and supporting calculations, although full credit was given for correct calculations with the retention amounts clearly indicated regardless of whether a table was included.

Retained Agreement I – Surplus Reinsurance:
A) Since the sum insured = $100 and retention = $60, the quota share ceded equals [1 – (retention/sum insured)] = [1 – (60/100)] = 40%. The capacity limit does not come into play. Alternatively, the retained share is (retention/sum insured) = (60/100) = 60%. So, the $20 claim is 60% retained. **Retention = 20 x 0.60 = $12**.
B) Sum insured = $300. Sum insured minus retention = $300 – 60 = 240 = capacity. Therefore, retained share = 60/300 = 20%. The $200 claim is 20% retained. **Retention = 200 x 0.20 = $40**.

1. **Continued**

Retained Agreement II – Excess of Loss Reinsurance:
A) Since the $20 claim is less than the $50 priority, it is **fully retained**.
B) The $200 claim is in excess of the $50 priority, so it is reinsured up to the $100 capacity. Ceded amount = Min [(claim – priority), capacity] = Min[(200-50), 100] = Min[150,100] = $100.
Retention = $200 – 100 = $100.

Scenario	Sum Insured	Claim	Retained Claim I	Retained Claim II
A	$100	$20	**$12**	**$20**
B	$300	$200	**$40**	**$100**

(d)   Outline the considerations that would factor into making a recommendation between the two reinsurance options.

Commentary on Question:
Any three of the following considerations resulted in full credit.

- Counterparty risk of each reinsurer (credit ratings, probability of default)
- The risk-return trade-off or the cost of each option
- The impact on the risk measures of each option, or how well each addresses the risk limit breach
- Regulatory issues such as whether reserve or capital credit would be allowed
- The level of risk sharing of each option
- The duration or renewability of each option
- The ease of doing business and/or existing relationship with the reinsurers
- Tax issues

2. **Learning Objectives:**
1. 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 the approaches for managing risks and how an entity makes decisions about appropriate techniques.

Learning Outcomes:
(1a) Explain risk concepts and be able to apply risk definitions to different entities.

(4e) Develop an appropriate choice of a risk mitigation strategy for a given situation (e.g., reinsurance, derivatives, financial contracting), which balances benefits with inherent costs, including exposure to credit risk, basis risk, moral hazard and other risks.

Sources:
Financial Enterprise Risk Management, Sweeting, 2011
- Ch. 7 Definitions of Risk
- Ch. 16 Responses to Risk

Commentary on Question:
This question was designed to test a candidate's understanding of a variety of risks applied to specific situations, as well as how to mitigate those risks.

For sub-part (i) of each section, candidates needed to adequately describe the main risk within the context of the situation in order to receive full credit. For sub-part (ii) of each section, candidates needed to have two well-explained mitigation strategies in order to receive full credit.

For sub-part (ii), particularly in parts (a) and (b), some candidates suggested mitigation strategies that essentially involved not making the proposed change. Such responses received minimal credit, as the point of the question was how to manage the risk, given that the change was occurring.

Overall, candidates did well on this question.

Solution:
(a)
(i) Describe the main risk that would be introduced by the simplified underwriting product.

(ii) Propose strategies to manage the risk identified.

2. **Continued**

(i) **Adverse selection** is the main risk introduced. It arises as a result of information asymmetry. In this situation, due to limited underwriting, the individual knows considerably more about his health than the insurance company.

Healthy individuals will likely choose to purchase traditional term products, because they will receive lower premium rates. Unhealthy individuals will gravitate towards the simplified issue product, since a medical examination is not required.

(ii) **Risk transfer** – Calusa could enter into a YRT or Coinsurance arrangement. This would transfer mortality risk to the reinsurer and give Calusa time to develop mortality experience for the simplified issue product.

Risk reduction - Calusa could limit the sales of the simplified issue product, in order to reduce the mortality exposure until Calusa becomes comfortable with the mortality experience of the new product.

(b)

(i) Describe the main risk that would be introduced by the COLA feature.

(ii) Propose strategies to manage the risk identified.

2. **Continued**

      (i)   **Interest Rate Risk** – The COLA rider introduces indirect interest rate risk to Calusa. Calusa is now obligated to make inflation-linked payments to purchasers of this rider. The result is that Calusa no longer knows the amount of the payments it is obligated to make in the future.

      (ii)   **Cash Flow Matching** - Calusa can invest in bonds which have coupon payments and redemption amounts that are tied to the Consumer Price Index (e.g., TIPS). By carefully implementing this strategy, Calusa can closely match its future asset and liability cash flows.

            Swaps - Interest rate swaps could be purchased. Calusa would agree to pay a fixed interest rate, in exchange for floating interest rate payments, linked to the CPI. Swaps would have to be entered into at various durations, in order to mimic the liability cash flows.

(c)

      (i)   Describe the main risk associated with Calusa's personnel practices.

      (ii)   Propose strategies to manage the risk identified.

Commentary on Question:
Candidates generally did well on this portion of the question.
- *For sub-part (i), many terms were used to name the risk. It was not important to get the correct term; candidates could still receive full credit using a different term than "People risk" but adequately explaining the risk.*
- *For sub-part (ii), the solution shown is an example of a good answer; many other valid answers were given, which also received credit.*

      (i)   **People risk** - People risk can encompass a variety of things, and it starts with the risk that the wrong people are employed. Employees in the claims department need proper training and skills to ensure claims are processed accurately and efficiently.

            High turnover in the P&C division could also lead to:
- Loss of intellectual capital
- Increased recruitment and training costs
- Decreased morale of remaining employees
- Low customer satisfaction if errors occur

      (ii)   **Hire the right employees** - Employees need to have the appropriate skills to work in the claims department.
- Employ a quality human resources department to find people with the right skills

2. **Continued**

- Implement training procedures for new and temporary employees
- Professional temporary employment agencies could be used to identify quality candidates

Retain the right employees
- Review performance on a regular basis to identify high performing and poor performing employees
- Provide competitive pay and working conditions
- Provide advancement opportunities

(d)

    (i)   Describe a significant risk associated with the new claims administration system.

    (ii)   Propose strategies to manage the risk identified.

Commentary on Question:
Candidates generally did well on this portion of the question. This portion of the question was intentionally worded differently, asking candidates to describe "a significant risk" instead of "the main risk". Therefore, alternative answers could receive full credit, but most candidates answered similarly to the solution below.

    (i)   **Technology Risk**
- An internet-based claims system hosted on third party servers exposes Calusa to unintended loss or disclosure of confidential information
- Remote access also increases security risks
- Loss of confidential data could damage Calusa's reputation
- By using a third party administrator Calusa has to rely on a resource it does not control

    (ii)   **Keep security up to date** - Security patches should be implemented as soon as they are available in order to minimize potential loss of confidential information. Calusa should take appropriate measures to restrict access to the internet-based claims system, such as weekly password resets.

           Back up data regularly – Back up servers daily and store backup data at another site. These measures are needed to minimize losses if data becomes corrupt. Claims will be being entered into the system every day, so it is important to back up data frequently**.**

3. **Learning Objectives:**
1. The candidate will understand the types of risks faced by an entity and be able to identify and analyze these risks.

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

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

Learning Outcomes:
(1a) Explain risk concepts and be able to apply risk definitions to different entities.

(1c) Identify and assess the potential impact of risks faced by an entity, including but not limited to market risk, currency risk, credit risk, counterparty risk, spread risk, liquidity risk, interest rate risk, equity risk, hazard/insurance risk, inflationary risk, environmental risk, pricing risk, product risk, operational risk, project risk and strategic risk.

(2d) Apply and analyze scenario and stress testing in the risk measurement process.

(3d) Analyze risks that are not easily quantifiable, such as operational and liquidity risks.

Sources:
Financial Enterprise Risk Management, Sweeting, 2011, Ch. 7 Definitions of Risk

Value-at- Risk: The New Benchmark for Managing Financial Risk, Jorion, 3rd Edition
- Ch. 13 Liquidity Risk
- Ch. 14 Stress Testing

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

ERM-117-14: AAA Practice Note: Insurance Enterprise Risk Management Practices

Commentary on Question:
This question asked candidates to assess risks in a non-traditional situation and to consider strategic decision-making from both a quantitative and qualitative standpoint.

Some candidates experienced difficulty in applying the risk concepts outside an insurance-company or other financial-services setting. They may have understood the material they had read but could not take the next step to identify the principles in an unfamiliar context. This was the biggest differentiator between candidates who did well on this question and those who did not.

3. **Continued**

Solution:
(a)   Describe the following risks to Dr. Dan as they apply to Option I:

      (i)   Liquidity Risk

      (ii)   Counterparty Risk

      (iii)   Operational Risk

      (iv)   Professional Liability Risk (Legal obligations arising out of a professional's errors, negligent acts, or omissions during the course of the practice of his or her craft)

Commentary on Question:
The candidate had to make the connection between the types of risk and Dr. Dan's actual situation. Credit was not given for definitions or descriptions of the types of risk unless the corresponding example in the given scenario was specified. The answers shown in parts (a), (b), and (c) for Liquidity risk focus on Funding risk, but credit was also given for Asset risk if it was related to appropriate examples that were specific to the scenario.

Operational risk is the most relevant risk in these scenarios, so more credit was available for responses dealing with that risk than for the others.

The answers provided are more complete than required for full credit.

      (i)   Liquidity Risk:
          Uncertain cash flow and volume of business:
          The timetable for development of the geographical area and likely increases in volume of business are very unpredictable. Can he manage the cash flow until the business is big enough to provide more dependable income?

      (ii)   Counterparty Risk:
          Problem with clients paying their bills – the clients are Dr. Dan's counterparty.

3. **Continued**

        (iii)   Operational Risk:
- People risk
  - He does not manage his employees effectively
  - Small town location, lack of employee benefits make it harder to find good employees (size of his business does not support paying more)
  - High risk that accidents will happen to animals or that an employee does something wrong
- Crime risk, data risk, reputational risk
  - Could also result from substandard procedures and processes
- Business continuity risk
  - He does not have a back-up veterinarian
- Technology, regulatory
  - He does not have any resources providing him support in responding to new regulations
  - Running a one-man hospital gives him limited time -- keeping up on regulations may not be a priority

        (iv)   Professional Liability Risk

Lack of a more formal approach to hospital management is likely to result in serious errors made by employees. Although he has insurance, serious claims could result in greatly increased premiums or being deemed an uninsurable risk.

(b)   Explain how the risks described in (a) change if Dr. Dan elects to pursue Option II.

Commentary on Question:
There had to be a logical connection between the type of risk and the scenario. Emphasis should be on what changes between the scenarios.

        (i)   Liquidity Risk: Dr. Dan's cash flow is his salary, which doesn't depend upon business volume; therefore, it's much more predictable.

        (ii)   Counterparty Risk: Dr. Dan's income does not depend on the financial arrangements between his employer and the clients. The risk is minimized if he is careful in choosing a financially-stable employer who can be expected to pay Dr. Dan's salary as expected.

        (iii)   Operational Risk: Dr. Dan is not responsible for hiring & firing other employees, or for training them, although since they assist him, he is directly affected by the quality of their work.

3. **Continued**

Crime risk & data risk are essentially nonexistent for him since he does not own the hospital.

Reputational risk affects primarily his employer, although his own professional reputation could suffer if his employer is not well-thought-of.

Technology risk affects primarily his employer

Regulatory risk affects his employer with respect to the hospital itself and its owner, but Dr. Dan is still responsible for complying with regulations affecting the practice of his profession.

(iv) Professional Liability Risk: Dr. Dan's risk is minimized because he can concentrate on doing what he does best. He will not have to split his attention between managing a hospital and practicing medicine.

(c) Explain how the risks described in (a) change if Dr. Dan elects to pursue Option III.

Commentary on Question:
There had to be a logical connection between the type of risk and the scenario. Emphasis should be on what changes between the scenarios.

(i) Liquidity Risk: Cash flow should be more predictable due to MegaPet's established business model and the high-traffic location.

(ii) Counterparty Risk: Risk from clients is minimized because Dr. Dan has to follow MegaPet's policy of charging up front. However, MegaPet is now a counterparty – MegaPet holds a considerable amount of Dr. Dan's money; if it goes under, he may have trouble recovering his money.

(iii) Operational Risk: More subject to standardized procedures:
The corporate office monitors management reports generated by hospital admin system.
Standardized responses to regulatory risk and technology risk.

More corporate oversight to help minimize crime and people risk.

Better benefits attract better people, minimizing data risk.

Reputational risk is not so much dependent upon him as an individual; however, he is subject to the effects of unfavorable publicity concerning MegaPet.

3. **Continued**

       (iv)   Professional Liability Risk: Higher-quality management practices and employees make this lower-risk than for Option 1.

(d)

       (i)   Explain why, in the strategic risk management field, scenario analysis is adopted as a qualitative analytical tool, rather than as a quantitative tool.

       (ii)   Identify three qualitative factors that could influence Dr. Dan's choice among the three options.

Commentary on Question:
In part (i) for full credit two points needed to be made: insufficient data, and ignoring insights about the external environment due to being distracted by numbers. In part (ii) any reasonable qualitative factors that could influence Dr. Dan's choice were accepted.

       (i)   It is often difficult to estimate many of the strategic risks due to insufficient data. The statistical models backing the quantification of scenarios build on rather restrictive assumptions, such as no regime shifts, stable correlations and the absence of complex probabilistic or "fat-tailed" behaviors. There is a strong tendency for people to focus on numbers at the expense of more important qualitative aspects, such as the value of insights uncovered in the process of investigating the nature of the external environment. Scenarios can help to make blind spots visible and uncover areas where further knowledge and insight are needed.

       (ii)   How the population of the area will grow and thus be able to support a larger top line

             Operational risk in Option I because Dr. Dan's income depends to a great extent on employees who are not very well supervised

             There are so many moving parts to the business in Option I that it is not reasonable to expect that Dr. Dan can manage them well, in addition to practicing his profession

             Dr. Dan's hospital is only beginning to break even; there is no guarantee that that will continue. He already lacks capital. Can he survive?

(e)   Outline the guidance you will offer Dr. Dan as he chooses among the three options.

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3. **Continued**

Commentary on Question:
Candidates approached this question in various ways:

Some pointed out the pros and cons of each choice.

Some made statements like, "If work/life balance is the most important thing, then Option II would be best. If being your own boss is the most important thing, then Option I would be best . . . "

Some presented a series of questions and explained why the answers would be important in making the decision.

One way to test the validity of a candidate's response was to ask whether Dr. Dan would consider such advice worth paying for.

In general, outlining general steps that you (the consultant) would take to make a plan was not considered a very good answer: the response needed to be something specific that could actually guide Dr. Dan's decision-making.

Some important factors that Dr. Dan should consider:

Why is owning an animal hospital his dream? If he breaks apart the many aspects, he may find out what really matters most to him. For example, he may get more job satisfaction from maximizing the amount of time he is able to spend practicing his profession, than from "being his own boss".

If Dr. Dan is holding an extremely optimistic view of the future, he may be ignoring many pesky details because he is focused on a big future payoff that he does not want to share with anyone else.

If Dr. Dan is a pioneer in his field, he may have more freedom to try new things in Option I. In options II and III, what is management's tolerance for breaking new ground or differing from standard practice?

What is Dr. Dan's utility function? What are his family responsibilities? Does he have a life partner who could help absorb financial losses?

4.   **Learning Objectives:**
5.   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:
(5d)   Propose techniques for allocating/appropriating the cost of risks/capital/hedge strategy to business units in order to gauge performance (risk adjusted performance measures).

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

ERM-117-14: AAA Practice Note: Insurance Enterprise Risk Management Practices

ERM-119-14: Aggregation of risks and Allocation of capital (Sections 4-7)

Commentary on Question:
The question tested candidates' understanding of the different return metrics used in a company. Candidates needed to show both how to calculate the returns and whether they understood how the various metrics are used.

Solution:
(a)   Calculate the following measures of return for each unit:

>   (i)   ROA
>
>   (ii)   ROE
>
>   (iii)   RAROC
>
>   (iv)   RORAC
>
>   (v)   RARORAC

Show your work.

Commentary on Question:
Candidates generally performed well on part (a). Some common mistakes were:
- *Not applying the Risk Adjustment to Net Income correctly. Some candidates incorrectly did the one or more of the following:*
  - *Summing Net Income and Risk Adjust to Net Income, as opposed to subtracting the Risk Adjustment to Net Income from the Net Income.*
  - *Using the Risk Adjustment to Net Income by itself as the RAR (risk-adjusted return) value in the numerator.*

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4. **Continued**

> o *Either adding or subtracting Risk Adjust to Net Income to the Available Economic Capital or Required Economic Capital to determine the RAC (risk-adjusted capital) in the denominator.*
> - *Using Required Economic Capital in the RAROC calculation and Available Economic Capital in the RORAC and RARORAC calculations.*
>
> *If a candidate wrote down the formula, partial marks were given, even if the final numerical answer was wrong.*

	Unit A	Unit B
ROA = Net Income / assets	2.61%	2.80%
ROE = Net Income / Shareholder Equity (Assumption: Shareholder Equity = Available Economic Capital)	11.60%	11.20%
RAROC = (Net Income - Risk Adjustment to Net Income) / Available Economic Capital	7.38%	6.40%
RORAC = Net Income / Required Economic Capital	11.86%	13.39%
RARORAC = (Net Income - Risk Adjustment to Net Income) / Required Economic Capital	7.55%	7.65%

(b)   Explain the benefits of using risk-adjusted return measures as compared to traditional measures.

Commentary on Question:
Candidates performed well on this question part.

No points were given to candidates who merely stated that risk-adjusted return measures reflected risks while traditional measures did not, and who did not provide the benefits.

Risk adjusted returns can be compared across business units within a company as well as with the same measure employed in parallel businesses, such as banking, asset management and non-life insurance within diversified financial services companies.

Risk adjusted measure are considered more accurate, because the non-risk-adjusted return measures (ROE and ROA) do not take account of the risk that is being accepted to achieve the return generated.

4. **Continued**

(c) The CFO of Cypress concludes from your calculations that unit B is underperforming based on the RAROC measure.

   (i) Explain why the CFO may be most focused on the RAROC measure.

   (ii) Provide arguments to counter the CFO's conclusion that unit B is underperforming.

   Commentary on Question:
   Candidates generally did not perform as well on part (c). A few candidates, who did not derive the correct answer for RAROC in part (a), acknowledged that they may have made mistakes in their calculations for part (a) and answered part (c) with arguments as to how it could be shown that Unit B is not underperforming. These candidates did receive some credit.

   (i) If Cypress is a stock company, the CFO could be interested in the measure that the stockholders are concerned with, which is RAROC. RAROC is based on the published capital that shareholders see.

   RAROC allows comparison across different product lines and takes into account the risks of the businesses. Shareholders will be most concerned about the risk-adjusted return of the equity position / available capital. Shareholders do not see required capital as this is typically for internal use.

   (ii) Unit B does worse on a RAROC basis, but does better on a RORAC basis (and a little bit better on a RARORAC basis). So, once the capital is risk-adjusted, Unit B is performing better than A.

   RAROC is lower for Unit B because it has more excess capital. A sufficient buffer should be maintained between economic capital and risk-taking capacity, but Unit B appears to have more capital than it needs – it might be a newer business unit or a unit expected to be impacted by external forces (such as regulatory changes), which may warrant a larger buffer between economic capital and available capital. On a risk-adjusted basis Unit B would not be penalized for the excess capital.

5. **Learning Objectives:**

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

Learning Outcomes:

(2b) Evaluate how risks are correlated, and give examples of risks that are positively correlated and risks that are negatively correlated.

(2c) Analyze and evaluate risk aggregation techniques, including use of correlation, integrated risk distributions and copulas.

(2h) Construct approaches to modeling various risks and evaluate how an entity makes decisions about techniques to model, measure and aggregate risks including but not limited to stochastic processes.

Sources:
Financial Enterprise Risk Management, Sweeting, 2011, Ch. 14 Quantifying Particular Risks

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

ERM-101-12: Measurement and Modeling of Dependencies in Economic Capital, Ch. 4-5

Commentary on Question:
The goal of this question was to determine if candidates could apply financial models to a specific situation for two companies described in the stem. It asked candidates to apply a specified default model and a defined copula, and then analyze the reasonableness of the models used.

In parts (b) and (d) the candidate was asked to prove the answer given. (This allowed candidates who could not do the calculations in these parts to still proceed with the rest of the question.) We noted that some candidates provided a formula and numbers and then pretended to arrive at the correct answer. Those candidates did not receive any credit.

In sub-part (d)(iii) many candidates failed to justify their recommendations based on the information provided and instead provided generic reasons why copulas where appropriate.

5. Continued

Solution:
(a)

   (i)   Explain how the payoffs to Acme's bondholders and stockholders can be
         viewed in terms of puts and calls.

   (ii) Graph the payoffs to Acme's stockholders as a function of the potential
         asset values at the end of year three. Label your graph.

   (iii) Graph the payoffs to Acme's bondholders as a function of the potential
         asset values at the end of year three. Label your graph.
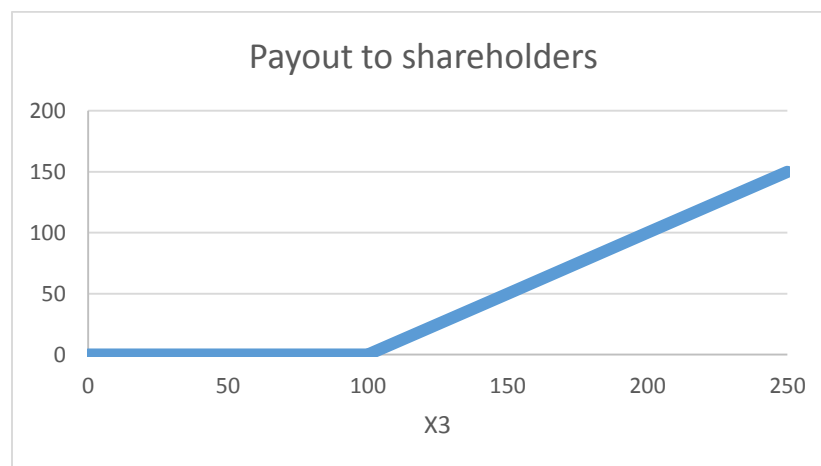
Commentary on Question:
*Most candidates understood that the Shareholder was equivalent to the buyer of a
call option. Many candidates did not recognize that the Bondholder was
equivalent to the writer of a put option plus a risk free bond.*

*To receive full credit for the graphs candidates needed to label the x-axis, y-axis,
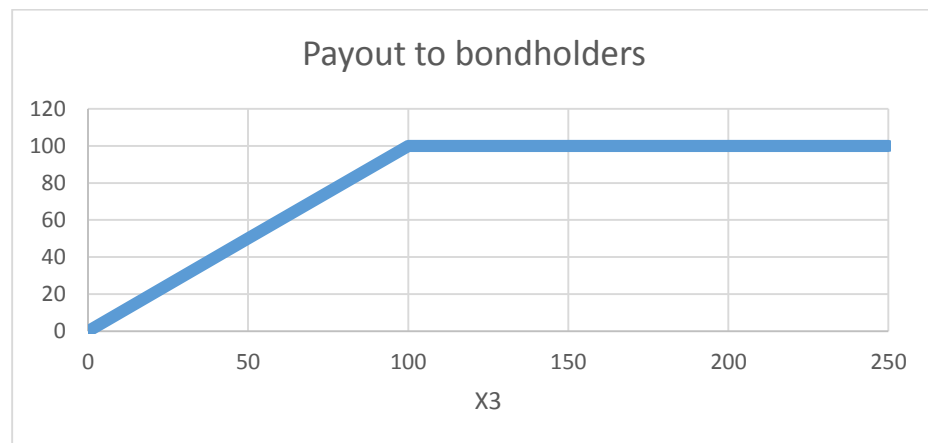and the debt level.*

   (i)   Bondholders receive B - max(B - X_3,0) This is equivalent to holding the
         bond, and writing a put option on the asset X_t, with term 3 years and strike
         B. Shareholders receive max (X_3 - B,0) This is equivalent to a 3-year call
         option on the asset X_t, with strike price B.

   (ii)

Payout to shareholders

5. Continued

(iii)

Payout to bondholders

(b) Show that the probability of default at the end of year three using the Merton model is:

(i)   12.2% for Acme

(ii)   3.5% for Elliott.

Commentary on Question:
Candidates needed to demonstrate the steps in the calculation since the solution was given. Partial credit was awarded to calculating the mean and variance correctly, even if the candidate could not go further.

(i)

$$\frac{A_T}{A_0} \sim \log N\left((\mu\text{-}\sigma^2/2)\,T, \sigma\sqrt{T}\right) \sim \log N\,(\mu^*, \sigma^*)$$

$$\mu^*_A = (0.12 - 0.36^2/2) \times 3 = 0.1656 \qquad \text{and } \sigma^*_A = .36\sqrt{3} = 0.6235$$

$$\Pr[A_T < B] = \Pr\left[\frac{A_T}{A_0} < \frac{B}{A_0}\right] = \Phi\left(\frac{\log(100/175) - 0.1656}{0.6235}\right) = \Phi(\text{-}1.164) = 0.1222$$

(ii)

$$\frac{A_T}{A_0} \sim \log N\left((\mu\text{-}\sigma^2/2)\,T, \sigma\sqrt{T}\right) \sim \log N\,(\mu^*, \sigma^*)$$

$$\mu^*_A = (0.04 - 0.29^2/2) \times 3 = \text{-}0.006 \qquad \text{and } \sigma^*_A = .29\sqrt{3} = 0.5023$$

$$\Pr[A_T < B] = \Pr\left[\frac{A_T}{A_0} < \frac{B}{A_0}\right] = \Phi\left(\frac{\log(100/250) - (\text{-}0.006)}{0.5023}\right) = \Phi(\text{-}1.812) = 0.035$$

5. **Continued**

(c)   Calculate the probability that both companies will default at the end of year three. Show your work.

Commentary on Question:
Most candidates received full credit. Candidates who did not generally didn't assume independence as instructed.

0.1222 * 0.035 = 4.3%

(d)

(i)   Show that the probability that both companies will default at the end of year three using the Clayton Copula is 3.4%.

(ii)   Explain why the maximum possible value for the probability that both companies will default at the end of year three is 3.5%.

(iii)   State with reasons whether the Clayton Copula with parameter $\alpha = 2$ is an appropriate model for the joint probability functions for the two distributions in this case.

Commentary on Question:
To receive full credit for sub-part (ii) candidates needed to identify that the maximum was limited by Elliott's probability of default and include a justification. Both mathematical and descriptive justifications were acceptable, assuming they were correct. Many candidates achieved full credit for this part.

Sub-part (iii) proved more challenging; a relatively small number of candidates noticed that the previous parts indicated a strong dependency between the two firms. Partial credit was given for relevant comments on tail dependency. Little credit was given for generic comments about the Clayton copula that did not relate to the question context.

(i) $C_\theta(u_1, u_2) = (u_1^{-\theta} + u_2^{-\theta} - 1)^{-1/\theta}$, $(0.1222^{-2} + 0.035^{-2} - 1)^{-0.5} = 0.034$

(ii)   The probability that both bonds default must be less than the probability that Elliott defaults. Adding another company cannot increase the chances above the probability of either individual company defaulting.

(iii)   The Clayton Copula gives an answer very close to the maximum for joint default. This implies that if Elliott defaults, Acme will also default, which is an unreasonable assumption given that they operate in very different industries. Thus the Clayton Copula is not an appropriate model for this situation.

6. **Learning Objectives:**

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

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

Learning Outcomes:

(2a)   Demonstrate how each of the financial and non-financial risks faced by an entity can be amenable to quantitative analysis including an explanation of the advantages and disadvantages of various techniques such as Value at Risk (VaR), stochastic analysis, and scenario analysis.

(2e)   Evaluate the theory and applications of extreme value theory in the measuring and modeling of risk.

(2f)   Analyze the importance of tails of distributions, tail correlations, and low frequency/high severity events.

(2g)   Analyze and evaluate model and parameter risk.

(2h)   Construct approaches to modeling various risks and evaluate how an entity makes decisions about techniques to model, measure and aggregate risks including but not limited to stochastic processes.

(3a)   Apply and construct risk metrics to quantify major types of risk exposure such as market risk, credit risk, liquidity risk, regulatory risk, etc., and tolerances in the context of an integrated risk management process.

(3b)   Analyze and evaluate the properties of risk measures (e.g., Delta, volatility, duration, VaR, TVaR, etc.) and their limitations.

(3c)   Analyze quantitative financial data and insurance data (including asset prices, credit spreads and defaults, interest rates, incidence, causes and losses) using modern statistical methods. Construct measures from the data and contrast the methods with respect to scope, coverage and application.

Sources:
Financial Enterprise Risk Management, Sweeting, 2011, Ch. 12 Extreme Value Theory

Value-at- Risk: The New Benchmark for Managing Financial Risk, Jorion, 3rd Edition Ch. 5 Computing VaR

Modeling Tail Behavior with Extreme Value Theory, Risk Management, Sept 2009

ERM-102-12: Value-at-Risk: Evolution, Deficiencies, and Alternatives

6.   Continued

Commentary on Question:
The question is designed to test candidates' understanding of a company's risk modeling and various approaches to analysis of risk in the tail. Candidates are expected to be able to demonstrate and contrast how different risk metrics work, explain model and parameter risk, comprehend the appropriateness of various methods as applied to a company's businesses, and make reasonable recommendations.

Overall, candidates struggled with this question. Many of them received partial credit for their answers, but very few were able to respond to the entire question appropriately. It showed on the papers that many candidates didn't fully understand how to approach the question.

Solution:
(a)   Calculate the following risk metrics for Gaia's life and annuity block at a 95% confidence level over a quarterly horizon:

   (i)   Parametric VaR

   (ii)   Empirical VaR

   Show your work.

Commentary on Question:
Either relative VaR or absolute VaR could be used to answer the question. However, candidates needed to stay with choosing one method (either relative or absolute) in both parts of the question

Candidates in general were able to provide calculations for this part of question. However, many were not careful in applying numbers to the parameters and in consistently using either the relative or absolute method. So, the number of candidates who received full credit was fewer than expected.

We recognize that there are alternative views on whether 95% VaR refers to the 96th ordered loss or the 95th ordered loss (i.e., 8.2 vs. 7.4) for the empirical calculation. Either was accepted as an answer. The model solution below uses 8.2.

   (i)   Parametric VaR:
            The quarterly loss is assumed to be normally distributed, with mean -5 and standard deviation 8. The (absolute) VaR of losses is
            $$VaR = -5 + 1.645 \times 8 = 8.16$$

            The relative VaR is (VaR - Mean) = 13.16

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6. **Continued**

      (ii)   The (absolute) VaR is estimated from the data as the 96th ordered loss value, i.e., VaR=8.2
             The relative VaR is VaR - Mean = 13.2.

(b)   Calculate a 95% confidence interval for each of the following risk metrics with respect to a sample of 100 observations that have an underlying Normal distribution.

      (i)   95% Parametric VaR

      (ii)   95% Empirical VaR

     Show your work.

Commentary on Question:
Comparison must be apples-to-apples, i.e., either using the absolute or relative VaR method. Some candidates took a mixed approach, which distorted their results and the recommendations that were required for the remaining parts of the question. Care was taken in grading to avoid double-penalizing candidates for taking the same incorrect approach throughout the question.

Candidates generally received at least partial credit for this part of the question. Common errors were: missing the 2-sided test component, omitting 1.96 or using 1.645 instead of 1.96 in their calculations.

We recognize that the question did not specify how the parameters of the Normal distribution were to be treated. However, candidates generally assumed that the standard error for the parametric VaR arose solely from uncertainty in the standard deviation estimate (and not from uncertainty in the mean estimate), which was what the committee intended.

      (i)   The standard error for $\hat{\sigma}$ is $\dfrac{\hat{\sigma}}{\sqrt{200}} = 0.57$

             This gives a 95% CI for σ of (8-1.96(0.57), 8+1.56(0.57)) = (6.9, 9.2), which gives a 95% CI for the VaR (ignoring uncertainty in the mean) of (6.35, 10.13). Subtract the mean for relative VaR, which gives (11.35, 15.13).

      (ii)   For Sample: Need to calculate the density function f(q), which we approximate with the density of a normal distribution with the same mean and variance as the data, i.e.,

6. **Continued**

$$f(q) = \frac{1}{\sqrt{2\pi}(8)} e^{-\frac{1}{2}(1.645)^2} = 0.0129$$

Then the standard error of the VaR (absolute or relative) is

$$\sqrt{\frac{(0.05)(0.95)}{100\, f(q)^2}} = 1.69$$

which gives a 95% CI for the VaR of

$$\left(8.2 - 1.96(1.69), \quad 8.2 + 1.96(1.69)\right) = (4.89, 11.51)$$

Subtract the mean for relative VaR:

$$\left(5 + 8.2 - 1.96(1.69), 5 + 8.2 + 1.96(1.69)\right) = (9.89, 16.51)$$

(c)   Assess whether the parametric or empirical VaR is the better approach for Gaia's life and annuity block. Explain your conclusions using your analysis in (a) and (b).

Commentary on Question:
Recommendations for either method received credit based on substantiation from the candidate's earlier analysis and other relevant support, as detailed below. Candidates using different empirical values could draw different conclusions.

Based on the approach used in the model solution, given the results in (a), the two approaches seem equally appropriate. But based on (b), it could be argued that the parametric approach is better due to the narrower confidence interval. There is not sufficient information about the company and the distributions to make a definitive statement, and candidates could receive credit for discussing the issues involved in making a choice.

Credit was also given to candidates who answered in a logical fashion even though their answers from (a) might lead them to a different conclusion. In all cases, answers needed to relate back to the information provided about Gaia's situation.

Some candidates who were unable to complete part (b) were still able to receive credit for (c) by stating how assumed results for (b) would affect their decision on the better approach.

In general, candidates did relatively better on this part than on the computational parts of the question. Many were able to explain the fundamental differences between the parametric and the empirical approaches.

The explanations given below are more complete than expected from candidates for full credit, but are intended to be educational.

6. **Continued**

The two approaches give similar results for Gaia's traditional business:
Parametric VaR and empirical VaR are very close.

- For a 95% confidence level, which is not too high, the normal distribution
  may adequately represent the empirical distribution.
- If the normal distribution adequately represents the loss data, the parametric
  approach is justified and gives tighter bounds (though we have ignored
  uncertainty in the mean).
- Intuitively, the parametric σ-based VaR approach should be more precise:
  o Uses information about the whole distribution of the sample (in terms of
    all squared deviations around the mean), whereas a quantile, empirical
    approach uses only the ranking of observations and the two observations
    (or one) around the estimated value.
- However, VaR based on the normal distribution ignores the actual data in the
  tail.
- Without evidence that the normal distribution is appropriate, the non-
  parametric approach may be better, as it makes fewer assumptions. The CI is
  wider, but that may appropriately reflect greater uncertainty in the estimate.
  (Also, the CI for the parametric case would be wider if we allowed for
  uncertainty in the mean.)
- However, the use of the normal distribution in estimating f(q) can lead to
  errors in the estimators.

(d)   Calculate the following risk metrics for Kismah General over a one-year horizon
        and at a 98% confidence level:

        (i)   Parametric VaR, assuming losses are normally distributed

        (ii)   Empirical VaR

        Show your work.

        Commentary on Question:
        Similar to parts (a) and (b), because comparison must be apples-to-apples,
        candidates needed to choose to use either the absolute or relative VaR method.
        Grading credit was given to candidates who looked for a 98% confidence level on
        the empirical data via interpolation or using an open interval concept (as
        opposed to a closed interval).

6. **Continued**

    (i)   Parametric: Mean = $30m, Variance = $30m, α=2.05, T=1
             VaR(98%)[relative to mean] = α(W(0)xσ)sqrt(T) = 2.05 x ($30m) x
             sqrt(1) = $61.5m.
             OR
             VaR(98%)[absolute] = $61.5m - $30m = $31.5m.

    (ii)   Empirical: VaR(98%)[relative to mean] = E(W) - W* = $30 - (-$111)
             {2nd percentile value} = $141m annually.
             OR
             VaR(98%)[absolute] = - W* = - (-$111) = $111m.

(e)

    (i)   Plot the losses predicted by assuming a Normal $\left(30, 30^2\right)$ distribution for

             the P&L of the Kismah General insurance block against the historical
             values at the following percentiles:

             1. 90th

             2. 95th

             3. 99th

    (ii)   Interpret the results.

Commentary on Question:
The candidates were expected to sketch a q-q plot with normal losses vs empirical losses, which do not fall on a 45 degree angled line. However, other graphs were also acceptable for demonstrating the loss comparison.

The question did not direct candidates to show their work, so a graph with the appropriate values could receive full credit in sub-part (i) even if candidates did not show the calculations. Partial credit was given to candidates who showed work correctly but didn't plot a graph.

6. Continued

(i)
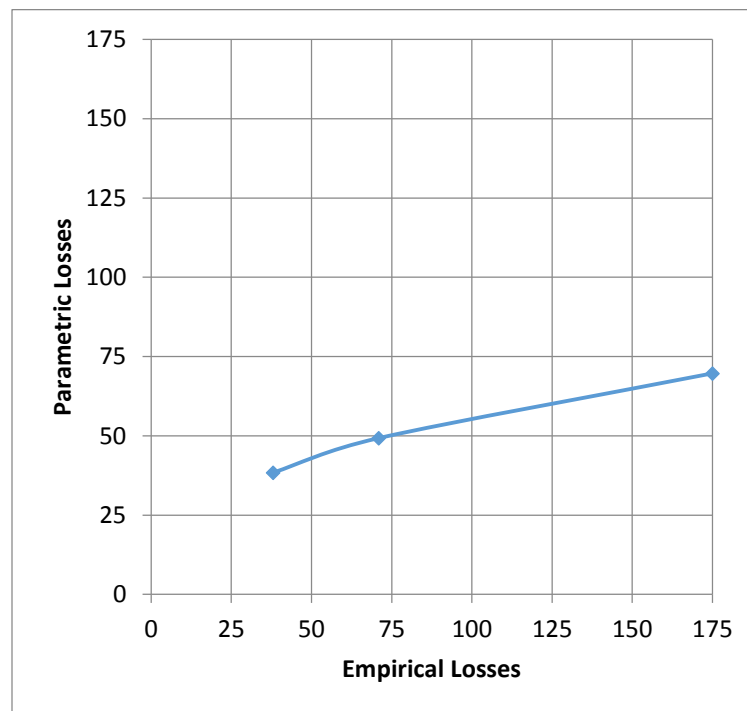
The answer should be a graph with these values:

Recall $z = (x-\mu) / \sigma$, therefore $x = \sigma z + \mu$

Loss (in million) [absolute]

90th sample:

$8 loss vs. N($30,30^2): $x = (-1.28 \times \$30) + \$30 = -(\$38.4 - \$30) = -\$8.4$.

95th sample:

$41 loss vs. N($30,30^2): $x = (-1.64 \times \$30) + \$30 = -(\$49.2 - \$30) = -\$19.2$.

99th sample:

$145 loss vs. N($30,30^2): $x = (-2.33 \times \$30) + \$30 = -(\$69.9 - \$30) = -\$39.9$.

OR

Loss (in million) [relative to mean]

90th sample:

$38 loss vs. N($30,30^2) - $30: $x = (-1.28 \times \$30) = -\$38.4$.

95th sample:

$71 loss vs. N($30,30^2) - $30: $x = (-1.64 \times \$30) = -\$49.2$.

99th sample:

$175 loss vs. N($30,30^2) - $30: $x = (-2.33 \times \$30) = -\$69.9$.

6. Continued

(ii) The Normal distribution does not fit well with the tails of the sample data. The further into the tail, the bigger deviation there is in estimating losses.

(f) Calculate the 98th percent quantile estimator of VaR using your fitted Generalized Pareto model. Show your work.

Commentary on Question:
Most candidates did well on this part and received full credit. Among the candidates who earned only partial credit, many of them made mistakes in their computations because they assigned incorrect values to the parameters.

$c = 0.98$, $\xi = 0.5$, $\beta = 100$, $u = 41$

$\widehat{VaR} = u + (\beta / \xi)\{[(N/Nu)(1-c)]^{\wedge}(-\xi) - 1\}$

$= \$41 + (\$100/(1/2))\{[(100/5)(1 - 0.98)]^{\wedge}(-1/2) - 1\}$

$= \$41 + \$200\{[(20)(0.02)]^{\wedge}(-1/2) - 1\}$

$= \$41 + \$200\{[0.4]^{\wedge}(-1/2) - 1\}$

$= \$41 + \$200\{1.5811 - 1\}$

$= \$41 + \$200\{0.5811\}$

$= \$41 + \$116.22$

$= \$157.22$ million

(g) Recommend the most appropriate method for estimating VaR from those computed in (d) and (f) to use for the Kismah General insurance block. Justify your choice with reference to specific results from your analysis.

Commentary on Question:
The answer needs to apply to Kismah, and should reference the computations in (d), (e) and (f). To get full credit, candidates need to show good understanding in explaining their choice and in comparing Gaia and Kismah General. A good recommendation should not be simply based on which method would be easier to compute. It should use the results of analysis, giving reasons to reject methods that are less appropriate for Kismah's fat tail risk and to indicate why the recommended method is the best.

Most of the candidates were able to provide some levels of comparison between methods to support their recommendations, even if their computations in parts (d) and (f) were incorrect. Some candidates gave more thorough and logical answers than others and therefore received more credit.

6. Continued

With respect to current Parametric VaR:
Even though a higher confidence level is used, (d) and (e) demonstrate that the Normal distribution does not fit the tails of the historical data, getting worse as one goes further into the tail. The historical data clearly has fatter tails than the Normal distribution, so Gaia's current parametric approach should not be used for Kismah General.

With respect to VaR using historical data or EVT:
Comparing the results of (d) and (f), the estimated VaR using the fitted Pareto distribution indicates much higher risk exposures uncovered by the tail loss data than is revealed by the quantile measure.

EVT applies only to the tails and may be inaccurate for the center of the distribution. The extreme value semi-parametric approach should be used to assess Kismah General's losses, as this company has very concentrated risks which could be expected to exhibit greater relative losses than that experienced by the industry overall.

7.   **Learning Objectives:**
2.   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 concept of economic capital, risk measures in capital assessment and techniques to allocate the cost of risks within business units.

Learning Outcomes:
(2g)   Analyze and evaluate model and parameter risk.

(2h)   Construct approaches to modeling various risks and evaluate how an entity makes decisions about techniques to model, measure and aggregate risks including but not limited to stochastic processes.

(5e)   Demonstrate the ability to develop a capital model for a representative financial firm.

Sources:
ERM-104-12: Study Note on Parameter Risk, Venter and Sahasrabuddhe

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

ERM-118-14: Model Validation Principles Applied to Risk and Capital Models in the Insurance Industry

Summary of "Variance of the CTE Estimator", Risk Management, August 2008

SOA 2012 Annual Meeting - Session 53 -- Assumption Setting Best Practices (Steiner slides)

Commentary on Question:
This question tests candidates' understanding of model and parameter risk, by application to a specific company situation. Overall, candidate performance on this question was disappointing, particularly on the parts that required candidates to go beyond direct recall from the sources.

Solution:
(a)   Describe potential areas of concern with model governance (Principle II) at Bunche.

7. Continued

Commentary on Question:
Candidates did well on this question part.

Many candidates provided areas of concern with the model that were not specifically issues relating to model governance. Points were awarded only if the concern listed could be related to model governance. Three distinct concerns were required for full credit.

- Is the segregation of duties defined? Although the pricing actuaries created the model, the corporate risk actuaries converted it for internal capital. Both pricing and corporate risk teams are using the same model for different purposes, which indicates the segregation of duties is not well-defined.
- The groups responsible for model usage and model changes are not clearly defined.
- There is no reference to how senior management or internal audit is involved in the model implementation.
- Some of the model assumptions have not been changed since it was developed five years ago, which could indicate that model governance may not be aligned with the importance of the model as part of the decision making process.

(b) You are validating the model parameters for the following risks:

   (i) Pandemic Risk

   (ii) Operational Risk

   (iii) Expense Risk

   Identify an appropriate estimation method for parameterizing each of the risks listed above. Explain your response.

Commentary on Question:
Candidates appeared to struggle with this question part.

The question was intended to get at specific parameter estimation methods, but many candidates addressed the question more generally, describing how they might estimate, without identifying a specific method. Credit could still be earned for this approach.

Many candidates provided a method for validating and described the method, but didn't explain why that method was appropriate for the specific risk. Partial credit was given in these cases.

7. **Continued**

Some candidates specified risk estimation methods, not parameter estimate methods. Depending on the level of detail, partial credit was given.

    (i)   A *Pandemic Risk* model uses frequency and severity parameters to determine the impact of a pandemic. Information may be limited, but if some information is available, the parameters could be estimated using MLE.

    (ii)   An *Operational Risk* model also uses frequency and severity parameters. Information may be limited, but if some information is available, the parameters could be estimated using MLE.

    (iii)   If there is not enough historical information then the *Expense Risk* model could include an expense assumption that would be estimated using model free methods. If expenses are based on claim amounts, then the claim amount parameter could be estimated using Regression analysis.

(c)   The mortality assumption currently used in the model was provided by a consultant five years ago and has not been updated since. There have been changes to the product designs and mix of business in the last five years.

    (i)   Identify key considerations that should be taken into account in updating Bunche's mortality assumption.

    (ii)   Explain how to apply each of Principles I, II, and III to the mortality updating process.

Commentary on Question:
Candidates did well on both sub-parts of this question.

On sub-part (ii) many candidates explained Principles I, II, and III but not how to specifically apply them to the mortality updating process. Points were only awarded if the explanation could be applied to the mortality updating process in an EC model.

The model solution given is more complete than would be required for full credit under exam conditions.

7. **Continued**

(i) *Experienced Mortality* – mortality assumption should not be solely based on industry data, but should also reflect experienced mortality. Reinsurer and consultant data should also be considered. As the experience data becomes more credible, it is given a larger weight in the assumption.

Industry trends – has the industry seen a trend in mortality of insured lives?

Target market – have the market demographics of people buying the product changed over the past five years? For example, has the male / female ratio changed? Has the distribution of risk classes (standard / preferred) changed over the past 5 years? Different cohorts could experience different mortality.

Distribution- Have the distribution methods for selling the product changed? If the distribution has changed (e.g., selling via the internet vs. agent-sold business), Alpha could be exposed to more anti-selection, which would negatively impact mortality.

Product Changes – Both product design changes and new product opportunities can give the policyholder more choices. If there are more choices, then there is more opportunity for the policyholder to anti-select, which could negatively impact mortality.

(ii) *I. Model design and build need to be consistent with the model's intended purpose*
- Ensure the mortality assumption is valid for an EC Model (the original model was for pricing, but its current intended use is EC).
- Is the mortality assumption a critical component of the EC model? This will help determine the level of sophistication that should be used in modeling this assumption.
- Ensure the correlations between mortality and other risks are reflected (e.g., mortality and lapse may be inversely related due to anti-selective behavior).

II. Ensure appropriateness of established model governance
- Are there controls around updating the mortality assumption (e.g., model version control)? Are results from prior model versions reproducible?
- Are the duties of those updating / validating / reviewing the mortality assumption clearly defined?
- Is relevant model documentation updated accordingly?

7. **Continued**

> > *III. Validate the model components* (Input - Calculation - Output)
> > - Ensure the new mortality assumption is implemented properly (e.g., dynamic validation testing of trends, single cell testing, etc.).
> > - Have all the key considerations been included in validating the mortality assumption (e.g., impact on other assumptions)?

(d) Outline the process you would follow to determine if your manager's focus on validating only the mortality and lapse assumptions in the EC model is appropriate.

Commentary on Question:
Candidates overall did not do well on this part.
Common responses that received partial credit were:
(i) describing the steps for validating a model in general
(ii) describing the steps for validating an EC model without a discussion of the choice of validating mortality and lapse over other assumptions

No points were awarded for responses that described the process for validating the mortality and lapse assumptions without mentioning other assumptions in the model.

- An important model validation principal is "Make model validation efforts proportional to evidenced areas of materiality and complexity". Is there evidence that the other assumptions are not as material as mortality and lapse? Are there defined company guidelines as to the materiality of risks?
- Evaluate sensitivities to each of the input assumptions used in the model: Mortality, Surrender/Lapse, Interest Rates, and Discount Rates. Were valid parameter estimation methods used?
- Evaluate sensitivities to the correlation assumptions. If the correlation changes, how significantly will this impact the Economic Capital?
- Are there components missing in the model? Are all the risks addressed?
- Does the complexity of the modeling for each risk correlate with the materiality of that risk?

8.   **Learning Objectives:**
1.   The candidate will understand the types of risks faced by an entity and be able to identify and analyze these risks.

Learning Outcomes:
 (1a)   Explain risk concepts and be able to apply risk definitions to different entities.

(1c)   Identify and assess the potential impact of risks faced by an entity, including but not limited to market risk, currency risk, credit risk, counterparty risk, spread risk, liquidity risk, interest rate risk, equity risk, hazard/insurance risk, inflationary risk, environmental risk, pricing risk, product risk, operational risk, project risk and strategic risk.

Sources:
ERM-402-12: Countering the Biggest Risk of All

Commentary on Question:
This question tested the candidate's understanding of the strategic risk taxonomy set out in the stem, and their ability to associate this taxonomy with specific threats described in the case study. Candidates were generally able to define the strategic risks introduced in the question, but struggled with relating them to the case study.

Solution:
(a)   Select the two risk categories from the list above that are the **least** relevant for Lyon as a holding company. Justify your selection.

Commentary on Question:
Candidates were able to describe the selected risks generally, and provide justification that the selected risks were relatively less relevant to any company generally similar to Lyon. However, a complete answer should include specific evidence from the case study to confirm that the risk is less relevant to Lyon. Candidates generally struggled with the latter.

Technology risk – the risk of outdated manufacturing processes, loss of patent protection, disruptive new technology, etc. create adversity for the company. For Lyon, the only major technology project underway is the new administrative system programming at SLIC. The current approach to capture the new features through electronic notes, though not sustainable, should be adequate while the programming project is complete.

8. **Continued**

Thus, it is reasonable to expect minimal risk due to outdated technology. It should be noted that SLIC's competitors have formed an administrative services only company and are poised to potentially reduce policy maintenance charges as a result; however, this is better categorized as an Industry (margin squeeze) risk rather than a Technology risk.

Stagnation risk – the risk that growth slows in a mature market, or prices fall to produce weak earnings. For Lyon, the group is well-diversified across multiple insurance lines. Furthermore, the group's markets are already fairly mature, so growth should be stable and predictable, and drastic price declines due to unforeseen innovations should be rare. Though stagnation should be of concern to any firm, it is relatively less important to Lyon compared to the other strategic risks presented.

Other strategic risks were acceptable as responses, provided the candidate demonstrated an understanding of the risk definition and was able to provide evidence from the case study as to why it is relatively less relevant to Lyon.

(b)

(i)   Identify the three risk categories from the list above that are the **most** relevant for Lyon as a holding company.

(ii)   Describe a specific threat to Lyon's strategic position for each of the three risk categories identified in (i).

Commentary on Question:
Candidates were able to describe the selected risks generally, and provide justification that the selected risks were relatively more relevant to any company generally similar to Lyon. However, a complete answer needed to include specific evidence from the case study to confirm that the risk is more relevant to Lyon. Candidates generally struggled with the latter.

For full credit, candidates needed to relate their answers to Lyon as a whole, not just to the individual subsidiaries.

Responses to (i) and (ii) combined are shown here for three appropriate risk categories. These answers are more complete than would be required for full credit under exam conditions.

8. **Continued**

Industry risk – the risk that costly research and development, increasingly powerful suppliers, overcapacity, and commoditization erode profit margins for all industry players. For Lyon, there are several industry risks that should be of concern to management. Generally, the low interest rate environment can slow revenue and erode profit margins. More specifically, the impending Affordable Care Act could have adverse implications for AHA's business, including but not limited to substantial investment in resources (currently have a hiring freeze in effect), as well as potential overcapacity in their primary markets.

Brand risk – the risk that product defects or a failure to develop appealing new offerings endangers your brand. For Lyon, brand risk is particularly relevant as it has to manage multiple brands across its operations as well as at the Group level. With the impending release of Lyon's Kelly rating to the public, Lyon will have to carefully manage public and investor relations. Additionally, it will need to closely manage initiatives at the subsidiary level. First, SLIC has been steadily growing its presence in UL and VA markets, moving away from its historical focus on Term products. Second, AHA has been known to be relatively autonomous in managing its business, and is currently pursuing the acquisition of Eureka. Third, Pryde has recently struggled financially and exited its experimental markets. Each of these examples could have adverse brand effects to each of the respective subsidiaries and could have ripple effects for Lyon as a Group.

Customer risk – the risk that customers' preferences shift suddenly and dramatically, or gradually and invisibly. For Lyon, each of its subsidiaries has distinct customer risks that need to managed carefully. First, SLIC's customers have an increased demand for more complicated products, like the Indexed UL and VA Plus, drawing SLIC away from its historical focus on Term. This customer priority shift can impose substantial development costs and potential loss in market share. Second, AHA needs to carefully manage how potential customers will react to the Affordable Care Act and tailor its product offerings and strategy accordingly. Third, Pryde unsuccessfully forayed into new markets with more price-conscious and claims-conscious customers, prompting them to exit those markets. As a holding company, Lyon needs to balance a variety of customers, all with different needs.

Other strategic risks were acceptable responses, provided the candidate demonstrated an understanding of the risk definition and was able to provide evidence from the case study as to why it is relatively more relevant to Lyon.

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9.   **Learning Objectives:**
1.   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 the approaches for managing risks and how an entity makes decisions about appropriate techniques.

Learning Outcomes:
(1c)   Identify and assess the potential impact of risks faced by an entity, including but not limited to market risk, currency risk, credit risk, counterparty risk, spread risk, liquidity risk, interest rate risk, equity risk, hazard/insurance risk, inflationary risk, environmental risk, pricing risk, product risk, operational risk, project risk and strategic risk.

(4j)   Demonstrate risk management strategies for other key risks (for example, operational, strategic, legal, and insurance risks).

Sources:
ERM-402-12: Countering the Biggest Risk of All

Commentary on Question:
This question was intended to test the candidates' ability to identify risks in a new situation, as presented in the stem, and to suggest potential upsides and mitigation strategies for each risk.

Solution:
(a)   Identify and describe three key risks Lyon faces in its potential expansion of Helios.

Commentary on Question:
Candidates did well on this section, and were able to suitably describe three risks to Helios' operations in the given context of the question. A small number of candidates gave generic risks, which did not relate to either the case study or the information provided in the stem of the question. They received minimal credit.

The answers provided below are examples; other coherent answers were also accepted.

Extreme stock market volatility – there is a heightened potential for extreme losses on any equity position, which might increase the risk that Helios will need to call on Lyon for a capital injection to remain solvent.

9. Continued

Change in currency/government austerity measures –The potential for the economy to move away from the Euro, and the fiscal policy aimed toward reducing the deficit, create an inflationary regime. Coupled with the rapidly deteriorating credit quality of sovereign debt, there is potential for local holdings to become severely devalued relative to the US dollar (Lyon's home currency), and even a remote threat that the Atlantis government could nationalize private holdings in an effort to curb the fiscal crisis.

Customer priority – Shaky confidence in both the government and financial industry, coupled with rising unemployment, can shift customer priorities away from premium goods such as insurance, lowering demand and driving down prices/margins.

(b) Explain a mitigation strategy for each of the risks identified in (a).

Commentary on Question:
Candidates did relatively well on this section, generally being able to describe how to mitigate the risks identified in (a). Successful candidates were able to distinguish themselves with a thorough explanation of how their proposed strategy would work including the potential costs.

Extreme stock market volatility – Ideally, Helios should avoid the local stock market during this turbulent period as the heightened equity risk is likely outside the company's risk appetite. Alternatively, the company can explore layering financial hedges in the form of put options, futures, etc. However, the cost of such may be prohibitive and may also subject Helios to counterparty risk.

Change in currency/government austerity measures – Again, ideally Helios should avoid the local currency exposure and seek to denominate liabilities and holdings in the Euro or other strong currency. However, this could be impractical so an alternative is to explore hedging against the potential devaluation of the local currency by borrowing domestically and lending in a foreign market (either synthetically or via a currency derivative). Again, this may be prohibitively expensive and/or subject Helios to unwanted counterparty risk.

Customer priority – Helios can analyze customer preferences and emerging trends to anticipate how demand is evolving, and subsequently redesign product offerings to cater to the changings market. Helios may need to consider investing more in brand marketing to be able to attract the potentially scarce demand for insurance.

Other coherent answers that related to the risks the candidate identified in (a) were also accepted.

9. **Continued**

(c)   Describe the potential upside, if any, for each of the risks identified in (a).

Commentary on Question:
Candidates did relatively poorly on this section, and generally did not provide adequate detail as to how Helios could benefit from the risk identified in (a).

Extreme stock market volatility – With extreme volatility, there is of course a heightened potential for large favorable swings. With a diligent investment approach, Helios can potentially lock-in above average returns if it can time market fluctuations correctly.

Change in currency/government austerity measures – Sovereign debt should have relatively high yields as a result of the fiscal crisis. As long as Helios is able to fare relatively better than its competitors (perhaps due to its parental support from Lyon), Helios could potentially have opportunities to acquire troubled industry peers at a discount.

Customer priority – If Helios is able to successfully anticipate shifts in customer preferences, the company can reposition itself strategically to capture significant market share.

Other coherent answers that related to the risks the candidate identified in (a) were also accepted.

(d)   Explain why Lyon might want to continue with the expansion despite the current political and economic environment

Commentary on Question:
Candidates did relatively well on this section, understanding that the potential upsides can be realized through effective risk management.

As described in part (c), there are potentially significant upsides to continue with the expansion despite the turbulent environment. Furthermore, Lyon is committed to geographic diversity and being a responsible corporate citizen; thus, Lyon may provide Helios with a comparative advantage over its peers in maneuvering through the current instability.

10. **Learning Objectives:**
4. The candidate will understand the approaches for managing risks and how an entity makes decisions about appropriate techniques.

Learning Outcomes:
(4k) Apply best practices in risk measurement, modeling and management of various financial and non-financial risks faced by an entity.

Sources:
ERM-123-14: S&P Enterprise Risk Management Criteria (Paragraphs 72-85)

Commentary on Question:
The purpose of this question is to test the ability of the student to apply aspects of the S&P ERM assessment methodology as it pertains to the control function of liability risks of a typical insurer. The candidate is then asked to apply the methodology to the specific companies in the case study: SLIC, AHA, and Pryde.

To receive the maximum credit for sub-part (i) of each question, candidates needed to describe relevant control factors used by S&P to assess an insurance operation in general, for the positive, neutral and negative. Most candidates were capable of identifying and describing factors for each risk control indicator.

For each specific indicator, to obtain maximum credit for sub-part (ii), a candidate had to assess using the control factors that he/she had just described and justify that specific assessment by identifying pertinent context elements found in the case study for each company.

For the assessment of each specific indicator, for SLIC, AHA, or Pryde, as requested, most candidates were able to provide an assessment in line with the model solutions below, with appropriate justification from the case study. Other assessments different from those shown below were accepted as valid as long as properly justified with facts from the case study. Generic statements were not accepted as valid.

This model solution is more complete than required to obtain full credit.

Solution:
(a) For each indicator I and II above:

(i) Describe positive, neutral and negative observations regarding life insurer operations in general.

(ii) Assess how S&P would view SLIC, given your responses in (i). Justify your response.

10. Continued

(i)   **Indicator I: Risk Identification**
Positive: The insurer captures all life insurance exposures (underwriting, mortality volatility, concentration, pandemic) and all behavioral risks (lapse, flexible premiums, annuitizations, in-the-money options).
Neutral: The insurer captures all insurance risks but it shows only limited understanding of behavioral risks.
Negative: There is limited or no identification, nor capturing, of either insurance or behavioral risks.

Indicator II: Experience studies / Insurer Reaction to Emerging Experience
Positive: The insurer performs frequent, comprehensive experience studies for all insurance/behavioral risks and has recently compared actual/expected experience. In addition, the insurer has an effective feedback loop to other operations, such as underwriting, product development, claims, and risk management.
Neutral: The insurer performs experience studies but less frequently and/or these are not linked to observed trends and recent developments in insurance/behavioral risks. In addition, there are limited stress tests and scenarios to compare pricing, valuation, and economic capital assumptions to reality.
Negative: The insurer doesn't undertake any experience studies. There is no monitoring of new business or inforce and there is no pro-active action/reaction by the insurer in spite of negative experience in insurance/behavioral risk in recent years.

(ii) **Indicator I: Risk identification**
Overall, probably neutral. There is some identification and measurement of insurance risks for some products - UL, VA, SPIA -   and in the Economic Capital model. However, for behavioral risks, identification of risk is more limited to traditional lapse rate studies.

Indicator II: Experience studies and action/reaction to emerging experience
Overall, probably neutral as there are some experience studies conducted but they are not updated frequently and the reaction and feedback loop is limited overall. However, an argument can be made that this indicator varies by line of business.
For Term products, this criterion is positive for mortality as SLIC uses cutting edge approaches to assess mortality, including predictive modeling. For the behavioral assumption – lapses – it is more neutral.
For VA, it is negative for both mortality and behavioral risks. No mortality study is conducted and behavioral risk analysis is limited in scope and history. In addition, there is no feedback loop.

10. Continued

For UL, it is negative for mortality, as SLIC uses term mortality assumptions. In addition, there is no feedback loop. However, for behavioral risks, it could be argued to be positive as the analysis is more comprehensive and there is a feedback loop.
For SPIA, it is neutral for mortality – SLIC only looks at 2 years experience, but the information is provided to pricing to update rates.

(b)   For each indicator III and IV above:

(i)   Describe positive, neutral and negative observations regarding health insurer operations in general.

(ii)   Assess how S&P would view AHA, given your responses in (i). Justify your response.

(i)   **Indicator III: Monitoring Claims Experience**
Positive: The insurer performs active monitoring of claims experience - incidence and severity - with a proactive feedback loop into pricing, valuation, business projection process, underwriting, and economic capital models.
Neutral: The insurer completes some claims experience analysis. However, when done, it is seldom shared and the feedback loop is not as effective. No action is taken when faced with a change in emerging claims experience.
Negative: The insurer doesn't monitor proactively its claims experience. There is no feedback loop into other operations and this inaction generates a concentration of risk in certain areas, groups, and regions.

Indicator IV: Underwriting
Positive: The insurer has implemented a disciplined underwriting process with explicit concentration limits. In addition, the governance and oversight of this function is well defined with well-laid out authority levels granted to some individuals. Larger cases are reviewed and authorized by multiple individuals.
Neutral: The insurer has a comprehensive underwriting process and authority levels but not as extensive as some peers in the same industry.
Negative: The underwriting operation is not well laid-out or explicitly defined. Authority levels are not well-defined and can be by-passed. No limits exist, or, if they do exist, they are not enforced.

10. Continued

    (i)   **Indicator III: Monitoring Claims Experience**
Overall, it would be positive. AHA has a robust data collection system used throughout the company, which feeds back into pricing and forecasting systems. It makes changes to pricing as needed. Data is collected by a central group and the system is maintained by a well-respected outside company. Up-to-date information is available rapidly and can be fed back into other operations that require it.

    (ii)   **Indicator IV: Underwriting**
Overall, it would be considered neutral or even negative. There are some authority levels defined for this function and AHA uses medical staff for some decisions. However, the limits are not quantitative and the underwriting is based on credibility rating in some cases. In addition, the senior pricing actuary can override on an ad hoc basis, creating a form of agency risk.

(c)   For V above:

    (i)   Describe positive, neutral and negative observations regarding property and casualty insurer operations in general.

    (ii)   Assess how S&P would view Pryde, given your response in (i). Justify your response.

    (i)   **Indicator V: Catastrophe Risk Tolerance**
<u>Positive</u>: The insurer has defined this criterion explicitly and it is supported by a clear rationale and analysis. The operational limits are set accordingly, monitored and respected. Limits encourage diversification.
<u>Neutral</u>: The insurer has defined this criterion explicitly and has translated it into risk-taking limits. However, the rationale is not as explicit or may not be stated at all. There is no link to an overall risk appetite statement.
<u>Negative</u>: The insurer does not take this criterion into account when it operates. There is no explicit definition used (e.g., Probable Maximum Loss), there are no explicit concentration limits set, and no feedback loop exists when experience is different than expected.

10. Continued

     (ii)   **Indicator V: Catastrophe Risk Tolerance**
Overall, Pryde could be assessed as neutral. It has defined its overall tolerance – 10% limit of capital for PML - but the analysis to justify this level is limited. It is set by its Chief Actuary on an ad hoc basis. With respect to limits, there is some diversification by line of business, but its largest risk concentrations are in California, with high risk of earthquakes, and in Florida, Texas, Georgia, and Mississippi, with high risk of hurricanes. However, the PML concentration is at 5% of capital and reinsurance is in place to reduce catastrophic risk.