ERM-GH 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.

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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.

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.*

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.
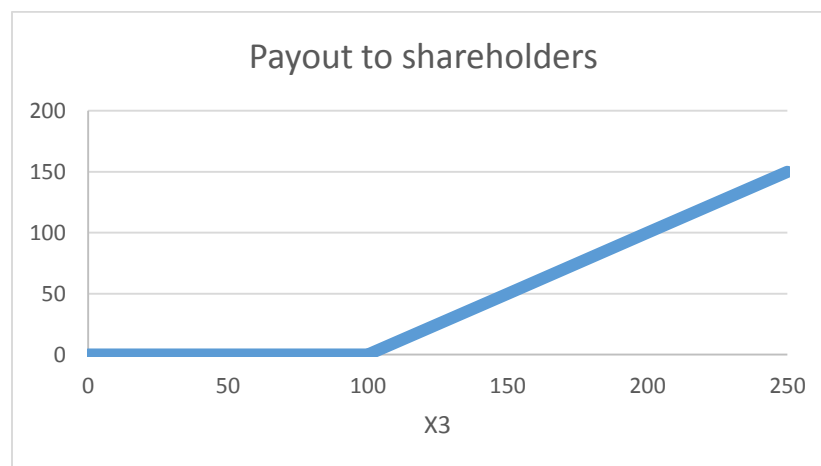
Commentary on Question:
Most candidates understood that the Shareholder was equivalent to the buyer of a call option. Many candidates did not recognize that the Bondholder was equivalent to the writer of a put option plus a risk free bond.

To receive full credit for the graphs candidates needed to label the x-axis, y-axis, and the debt level.
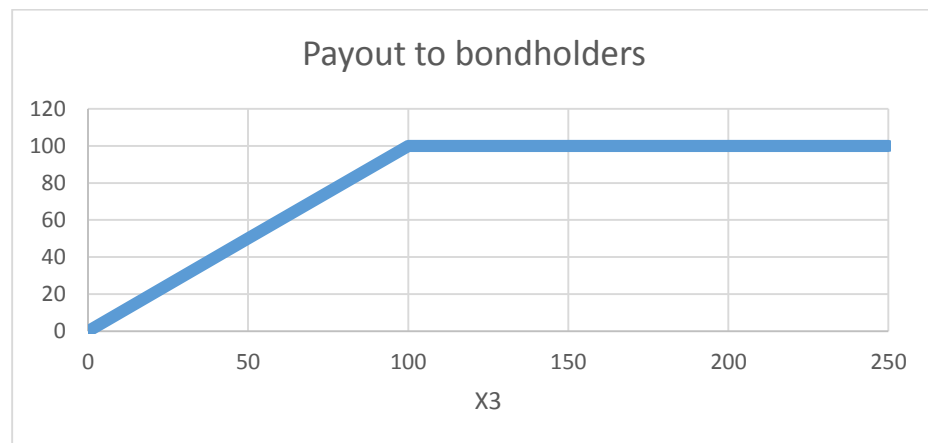
    (i)   Bondholders receive $B - \max(B - X_3, 0)$ This is equivalent to holding the bond, and writing a put option on the asset X_t, with term 3 years and strike B. Shareholders receive $\max(X_3 - B, 0)$ This is equivalent to a 3-year call option on the asset X_t, with strike price B.

    (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)

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

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

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

(ii)

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

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

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

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**

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.

(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

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

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

Subtract the mean for relative VaR:

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

(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:
    - 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).

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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 $(30, 30^2)$ 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)
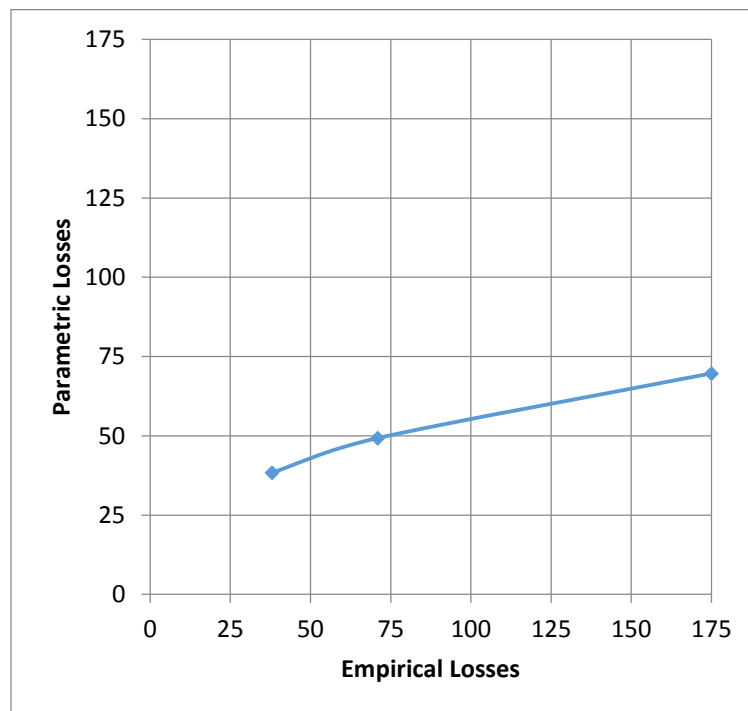
The answer should be a graph with these values:
Recall $z = (x-\mu) / \sigma$, therefore $x = \sigma z + \mu$
Loss (in million) [absolute]
90th sample:
$8 loss vs. N($30,30^2): x = (-1.28 x$30) + $30 = -($38.4 - $30) = -$8.4.
95th sample:
$41 loss vs. N($30,30^2): x = (-1.64 x$30) + $30 = -($49.2 - $30) = -$19.2.
99th sample:
$145 loss vs. N($30,30^2): x = (-2.33 x$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 x$30) = -$38.4.
95th sample:
$71 loss vs. N($30,30^2) - $30: x = (-1.64 x$30) = -$49.2.
99th sample:
$175 loss vs. N($30,30^2) - $30: x = (-2.33 x$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

- 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.

---

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.

2. 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 the approaches for managing risks and how an entity makes decisions about appropriate techniques.

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:
(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.

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

(4c) Demonstrate means for reducing risk without transferring it.

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

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

ERM 503-12: Hedging with Derivatives in Traditional Insurance Products

ERM 504-12: Mapping of Health Company Risks

8. Continued

Commentary on Question:
This question required candidates to explain and evaluate Eureka's various risks and incorporate them into a suitable Economic Capital framework to support AHA's decision whether to acquire Eureka. Candidates generally performed well on parts (a) and (d). However, most candidates did not do as well on parts (b) and (c), which required greater knowledge utilization and application.

Solution:
(a)

(i)   Describe each of the risk categories I through V as they apply to a health insurance EC model.

(ii)   Classify the importance of each of the risk categories as low, medium, or high, as they apply to Eureka's <u>medical</u> product line.

Justify your classifications in the context of Eureka.

(iii)   Classify the importance of each of the risk categories as low, medium, or high, as they apply to Eureka's <u>LTC</u> product line.

Justify your classifications in the context of Eureka.

Commentary on Question:
Candidates performed reasonably well on this part. The rankings required in sub-parts (ii) and (iii) were evaluated with respect to the justifications provided.

A number of candidates indicated there is no underwriting risk in Eureka's closed LTC block. Underwriting risk is still present in closed blocks. This risk relates to more than just the administrative function of underwriting, as explained in the solution below.

- Underwriting
(i) Pertains to risk that pricing is inadequate to cover costs resulting from actual morbidity, mortality, lapse, and claim experience.
(ii) Medical: High – There are no capitation agreements and only minimal bonus/withhold arrangements to mitigate claim cost volatility.
(iii) LTC: Medium – Lapses are low and LTC is a lapse-supported line of business. This may be an indicator that the product is underpriced.

8. Continued

- Credit
  (i) The risk of counterparty default, particularly relating to financial instruments such as bonds, swaps, and derivatives. Credit risk also includes the risk of default by capitated providers.
  (ii) Medical: Low – Eureka invests in highly rated bonds and is not subject to counterparty risk of capitated providers.
  (iii) LTC: Low – Eureka invests in highly rated bonds.

- Market
  (i) The risk resulting from uncertainties inherent in future asset and liability cash flows, including interest rate, ALM, currency, and reinvestment risk.
  (ii) Medical: Low – Comprehensive major medical is a short duration arrangement. As a result, reserves are generally held in short-term investments that bear very little market risk. Additionally, Eureka has no currency risk and practices asset/liability duration matching.
  (iii) LTC: Medium – Although Eureka invests in highly rated bonds, the long duration nature of Long Term Care business exposes it to reinvestment risk.

- Operational
  (i) The risk of loss due to external events and inadequate internal people, processes, and systems.
  (ii) Medical: High – Eureka is not adequately prepared for ACA implementation, with the possibility that its home grown claims system fails during conversion for ACA.
  (iii) LTC: Medium – Eureka's platform may not be compatible with AHA's platform.

- Liquidity
  (i) The risk that insufficient liquid assets will be available to meet financial obligations such as claims payments, or that the liquidation of assets results in a significant financial loss.
  (ii) Medical: Low – Medical liabilities are short duration and assets backing the reserves are highly liquid.
  (iii) LTC: High – Eureka invests in illiquid assets to support its LTC block.

(b) Recommend an approach to estimate required EC for Eureka's two product lines, taking into consideration your analysis in (a).

Commentary on Question:
In general, candidates performed poorly on this part, often failing to outline the basic mechanics of an Economic Capital model.

8. **Continued**

A complete answer considers how to model the health and LTC lines of business and provides sufficient justification for the proposed models based on the analysis performed in part (a). If the two blocks are modeled separately (as in the model solution), the answer should recommend a method to aggregate the results. The models should also include a time horizon and desired confidence level.

Responses varied significantly and the solution provided below is just one example deserving of full credit.

Group Health Model
The primary risk is morbidity, since market, liquidity, and credit risks are low. Although operational risk is also high, this can be mitigated by converting to AHA's claim system. Policies only last for one year, although there is some lag time between the pricing, regulatory approval, and implementation of future rates.

Therefore, a stochastic analysis with a 2-year time horizon is recommended. Monte Carlo simulation should be performed on AHA's trended experience to determine surplus required to absorb any losses with a probability of 99%.

Long Term Care Model
The duration of this block is long, exposing it to material underwriting, market, and liquidity risks.

A holistic 99% VaR aggregation calculation for morbidity, mortality, lapse, investment, and liquidity risks with a 30-year time horizon is recommended. Correlation between risks—especially lapse, investment, and liquidity risks—should be incorporated into the model.

Total Economic Capital
There is likely a large diversification benefit to total economic capital beyond the simple sum of group health and LTC economic capital calculations. It is unlikely there is a negative correlation between the two products, since these products do not naturally hedge each other and both lines are materially exposed to morbidity risk. A study of industry results could help to determine the appropriate correlation. The difference in contract duration suggests it would be closer to zero than 1. Therefore, a conservative approach may be to assume a correlation of 0.5 for use in this simplified EC model.

(c)   Explain whether the CEO's condition will be satisfied after the Eureka purchase.

Commentary on Question:
Most candidates provided incomplete answers for this part. Complete answers should explain whether the condition would be satisfied, provide a minimum of 3-4 statements of support, and address both health and LTC products.

8. **Continued**

Candidate answers were evaluated based on the justification provided. The solution below states that the CEO's condition would not be satisfied. Credit was also awarded for reasonable justifications supporting the alternative affirmative conclusion. Although the model solution does not take this approach, it would also be acceptable to evaluate the CEO's condition under the explicit assumption that Eureka business would be managed differently post-acquisition, as later addressed in part (d).

The CEO's condition will not be satisfied. Greater EC would be required for AHA to acquire Eureka than to develop its own block in New York.

- Eureka's health business is primarily fee-for-service with very little risk sharing, resulting in greater volatility than if AHA developed a capitated block of business.
- Eureka's LTC business is maintained on an in-house system that may be incompatible with AHA's existing system.
- LTC lapses are low and there hasn't been a rate increase since inception. It is possible that regulators would deny or severely limit proposed increases on the closed block of business. AHA would have greater ability to price appropriately in a new block of business.
- In a new block of LTC business, AHA could adjust policy provisions to mitigate its risk.
- Eureka's investment portfolio contains illiquid assets which may be difficult for AHA to unwind without incurring losses.

(d) Identify one strategy, other than reinsurance, to reduce the required EC for Eureka in order to make the purchase more attractive.

Commentary on Question:
Candidates generally performed well on this part. Only one mitigation strategy is required. In cases in which multiple satisfactory strategies were offered, only the best strategy was evaluated for credit. The solution below provides several examples, each of which is deserving of full credit. The list below is not exhaustive.

- Increase provider risk sharing through capitation agreements in order to reduce variability of medical claims costs.
- File for a LTC rate increase, which would likely improve the underwriting margin and increase lapse rates.
- Divest illiquid assets over time and invest in public bonds to support the LTC block.
- Sell structured liabilities to create a natural hedge of the reinvestment risk with the LTC block.

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.

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.

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

Sources:
ERM 504-12: Mapping of Health Company Risks

ERM 509-13: PPACA MLR Regulations

Commentary on Question:
This question required candidates to apply their understanding of both risk concepts and ACA provisions in the context of a scenario faced by health insurers during the implementation of the ACA. Most candidates did not do well on this question. They were generally not able to apply their knowledge to this particular scenario effectively.

Solution:
(a)
        (i)   Identify and describe one risk from each category to which AHA is exposed by the HHS ruling, assuming AHA <u>allows</u> customers to renew non-compliant plans.

        (ii)   Identify and describe one risk from each category to which AHA is exposed by the HHS ruling, assuming AHA <u>does not allow</u> customers to renew non-compliant plans.

        Commentary on Question:
        Candidates did not do especially well on part (a). They found it difficult to identify risks that were present in the scenario, fit the risk category, and were the result of the HHS ruling. Some candidates answered with more general risks – those that were broadly the result of the ACA or those that are simply inherent in the medical business. These answers received little or no credit.

9. Continued

In sub-part (i), pricing, operational and underwriting risks are the most serious and received more credit. In sub-part (ii), pricing and reputational risks are the most serious, and received more credit.

In each risk category, credit was given for appropriate risks that were well supported, even if they differed from the risks shown in the model solution below.

Graders were particularly open to alternate answers in sub-part (ii) for underwriting, legal and operational risks. The wording of the question implied that there should be a risk for each category, so we recognize that candidates might have been reluctant to answer that no additional risks in those categories arise from the HHS ruling.

(i)   Assuming AHA allows renewal of non-compliant plans:

Pricing Risk
Anti-selection risk, since healthy people will continue old plans, which are less expensive for healthy risks. ACA-compliant plans will attract worse risks and will be underpriced. Also, it will be difficult, if not impossible, to gain state approval of rate changes for non-compliant plans that could offset some of the losses now more likely on the ACA-compliant plans.

Reputation Risk
If AHA allows renewal of non-compliant plans, there's also a reputational risk. The claim and billing systems used for the old policies have been dismantled. They may not be administered properly and customer dissatisfaction would result.

Underwriting Risk
The individual medical underwriters were terminated. There's no one to underwrite the non-compliant plan renewals.

Legal Risk
Despite the HHS decision not to enforce part of the ACA, the law hasn't changed. There's risk of a lawsuit if a policyholder files a claim for an essential benefit that isn't covered by a non-compliant policy but that the law says should be covered.

Operational Risk
The billing and claim systems that administered the old policies are in the process of being dismantled. Retooling the new systems would be difficult and costly.

9. Continued

      (ii)   Assuming AHA does not allow renewal of non-compliant plans:

Pricing Risk
Anti-selection risk: healthier people, who want less expensive, more limited coverage, might cancel in frustration because they cannot renew their prior plan. Also, it will be difficult, if not impossible, to gain state approval of rate changes for compliant plans to address additional anti-selection.

Reputation Risk
If AHA doesn't allow renewal, brokers and customers may be very upset and leave in frustration. This will damage persistency and new business opportunities.

Underwriting Risk
The company does not need underwriters for ACA compliant plans, so AHA would be exposed to no additional underwriting risk due to the HHS ruling.

Legal Risk
The company is not required to offer non-compliant plans, so AHA would be exposed to no additional legal risk due to the HHS ruling.

Operational Risk
The company's systems are ready to administer compliant plans, so there is no system-related operational risk. Operational risks related to the offering of new compliant plans could occur, but these risks do not result from the HHS ruling.

(b)   Estimate the maximum potential impact of anti-selection on net income, separately for each of the three states. Show your work.

Commentary on Question:
Candidates struggled with part (b). The question asks for a rough "back of the envelope" estimate, which may have been difficult to develop under exam conditions. Key simplifying assumptions were provided. However, other simplifying assumptions are necessary for this type of estimate, which added to the difficulty.

To receive full credit, candidates needed to lay out a reasonable estimation approach, including consideration of possible MLR rebates, and then execute the approach for each of the three states. The approach could be different than the one shown below. Candidates earned approximately half credit for laying out a reasonable approach and half credit for executing it and providing an estimate.

9. **Continued**

The most important concepts to include in the estimate are that worse risks will move to the ACA-compliant plans, better risks will stay in the non-compliant plans, and the premium collected for the ACA-compliant plans will be insufficient.

Partial credit was given for answers that appeared to be on the right path, either in the description of the approach or in the calculations. Answer content did not necessarily need to be repeated three times, for each state, if it was indicated that it applied to all states, or if the work for one state was specifically referenced in the work for another state.

To estimate the impact to net income, assume:
- half of the members are currently paying rates above the average rate for the state, and half are paying rates below the average
- all members currently above the average rate will choose an ACA compliant plan, which is community rated, to maximize anti-selection
- the impact of anti-selection may be reduced to the extent that MLR rebates are reduced by the increase in loss ratios

Nevada: Cost is 15% (average underpricing for those in top half of rate band) x 50% x ($271.1M) = $20.3M
Since Nevada's loss ratio is well over the minimum MLR of 80% for Individual business, the $20.3M potential cost of anti-selection would be a direct reduction of net income.

California : Cost is 5% (average underpricing for those in top half of rate band) x 50% x ($255.1M) = $6.4M
California's loss ratio is well under the minimum MLR of 80%. So we must consider the impact of the $6.4M potential cost of anti-selection after MLR rebates in 2014.

2014 CA rebate without transitional relief:
(0.80 - (($161.3 + $161.3 + $161.3) / ($255.1 + $255.1 + $255.1))) * $255.1 = $42.8M.

2014 CA rebate with transitional relief:
(0.80 - (($161.3 + $161.3 + $161.3) /
($255.1 + $255.1 + $255.1 - $6.4 anti-selection loss))) *
($255.1 - $6.4) = $40.4M.
The cost of anti-selection after rebates is ($6.4M – ($42.8M - $40.4M)) = $4.0M.

9. Continued

Ohio: Cost is 25% (average underpricing for those in top half of rate band) x 50% x ($70.4M) = $8.8M
Since Ohio's loss ratio is also well over the minimum MLR of 80%, the $8.8M potential cost of anti-selection would be a direct reduction of net income.

(c)   Recommend whether or not to allow renewal of non-compliant Individual plans in any or all of Nevada, California, and Ohio based on this cost information and your analysis in parts (a) and (b). Justify your recommendation.

Commentary on Question:
Candidates had trouble with part (c). Since most candidates were not able to reach a final result in part (b), they did not have a complete basis for their justification in part (c).

For full credit, the candidate's answer needed to consider both the potential anti-selection cost and non-pricing risks for each state, and make a well supported recommendation for each state. The pricing risk (i.e., anti-selection cost) is the most serious risk, and was given more credit. The most important non-pricing risks were the legal risk if the non-compliant plans are continued and the reputational risk if the plans are not continued.

Partial credit was awarded for any relevant and reasonable consideration or justification.

The answer shown below is more complete than would be required for full credit.

For California, the difference between premium and claims plus rebates is about $51M ($255.1M - $161.3M - $42.8M = $51M). So AHA is getting $51M pre-tax expense and profit coverage from this market in 2014.

The case study states that lapses will be as high as 50% if AHA does not offer transitional relief. It makes sense to spend the $2M to continue the old administration and underwriting systems for the non-compliant plans and absorb the $4.0M cost of anti-selection ($2M + $4.0M = $6.0M) at the risk of losing half of that $51M expense coverage and profit ($51M / 2 = $25.5M).

I recommend allowing renewal of the non-compliant plans in California. The cost of continuing the old plans in California is lower than the cost of not continuing them.

9. **Continued**

The operational, underwriting, and reputation risks referenced in part (a) will be eliminated in California since they're spending the $2M to continue the old plan administration and underwriting systems. The legal risk of not paying for all essential health benefits still exists. However, the risk seems relatively small since these customers want to renew their own plans and probably will not sue.

Nevada is already running well over the MLR. The impact of anti-selection would be a direct reduction of net income. Nevada is currently only contributing $23M to expense and profit coverage (premium minus claims). The cost of anti-selection is almost equal to the expense and profit coverage. AHA would be better off with half of the current expense and profit coverage rather than absorbing the cost of anti-selection. It doesn't make sense to offer transitional relief in Nevada. The cost of continuing the old plans in Nevada is greater than not continuing the old plans.

Ohio is already running well over the MLR. The impact of anti-selection would be a direct reduction of net income. Ohio is currently only contributing about $11M to expense and profit coverage. The cost of anti-selection is almost equal to the expense and profit coverage. AHA would be better off financially with half of the current expense and profit coverage rather than absorbing the cost of anti-selection. It doesn't make sense to offer transitional relief in either of those two states. The cost of continuing the old plans in Ohio is greater than not continuing the old plans.

The analysis of the other risks is the same for Nevada and Ohio. There is no underwriting, legal or operational risk since we're not offering the old plans for renewal. Finally, there is still the reputational risk of upsetting brokers who want to renew their clients on the old plans. However, the tremendous financial cost seems to outweigh the reputational risk.