ERM-R Model Solutions
Fall 2015

1.   **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.

   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.

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

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

Sources:
ERM-702-12: IAA Note on ERM for Capital and Solvency Purposes in the Insurance Industry

Commentary on Question:
The question tested candidates' understanding of unquantifiable risks, by identifying, by evaluating or measuring, and by managing them. Some candidates only listed and did not provide an adequate descriptions or explanations. Several candidates thought that group long-term disability has a cash surrender value. Some candidates did not respond in a manner that addresses what the CRO wanted and did not respond with "a rapid increase in interest rates" scenario in mind. Overall, candidates performed better in parts a & b than in parts c & d.

1. **Continued**

Solution:
(a)   Describe ways to evaluate non-quantifiable risks, in general

Commentary on Question:
Marks were not given if the candidate only identified ways and did not describe them.

Consult with subject matter experts or make educated guesses on the potential size of the loss: direct and indirect costs

Consider likelihood of the loss: qualitative or quantitative
Example of qualitative: very likely, moderately likely, very unlikely
Example of quantitative: probability: less than 25%, between 25% and 75%, over 75%

Use a risk map – a two-dimensional chart with likelihood and impact on the axes.
Use a residual risk map – similar to above risk map but with the original risk mitigated.
Use risk timing – risk velocity is near-term, mid-term or long-term.

If data is unavailable or is limited, use industry, competitor, reinsurer or consulting company's data to measure against.

Use extreme value theory to try to quantify the risk.

(b)   Describe the potential risks to your company under the following three risk categories if a rapid increase in interest rates occurs:

    I.   Product / Pricing

    II.   Liquidity

    III. Operational

Commentary on Question:
Many candidates were able to address the risks for UL and FA but did not address the risk on the GLTD product; as a result, partial marks were given. Some candidates incorrectly stated that there was no impact on GLTD.

Partial marks for part b.II were given if the candidate only identified the increased lapses but did not discuss either of the asset or funding liquidity risk.

Many candidates struggled with b.III and left this part unanswered.

1. Continued

I. Product/Pricing

For UL and FA in the accumulation phase: under a "rapid increase in interest rates" environment
- The earned rates in a portfolio may lag significantly behind the rapidly rising interest resulting in the inability to provide higher crediting rates and rates, leading to higher lapses, as policyholders seek better returns elsewhere.
- W.r.t. new business, the company may be slow in raising the crediting rate and lose sales to competitors.

For GLTD:
- Under the low-interest rate environment, the company may have been one of the first few companies to raise rates and lose new sales and renewals to competitors. Under the rapidly rising interest rates environment, the company may not be able to react quickly to adjust the manual rates and state-file in time during the high-quoting seasons.

A smaller inforce block (due to lapses) would lead to higher unit costs leading to potential uncompetitive new business pricing.

II. Liquidity
- Higher lapses may require the sale of illiquid assets, depending on market performance.
- Higher lapses may affect liquidity ratio.

- The company may have increased asset liquidity risk, depending on the price-impact function and the size of the asset position. -->Forced liquidation of assets creates unfavourable price movements.
- The company may have increased funding liquidity risk, which arises when financing cannot be maintained owing to creditor and investor demands. --> Arises from the liability side of the balance sheet.

III. Operational
- Policy administration may not have the personnel to process higher than expected volume of surrendered/lapsed policies, and policy loan activity.

- Potential over-expense on staff not having enough work in underwriting, new business processing and claims departments for all products if there is a decline in new sales and renewals and product lines decrease in size. Potential over-hiring of temporary staff during high quoting season.

1. Continued

- Potential turnover in distribution due to the low new sales and renewal business.

- Increase model risk as the pricing actuaries change their model assumptions to respond to the market changes and changes to policyholder behaviour.

(c) Recommend a specific approach for measuring liquidity risk for each of the company's three products.

Commentary on Question:
Some candidates did not answer the question but responded with mitigants to liquidity risk.

I recommend performing a 12-month projection using the following lapse assumptions: e.g., best estimate lapse assumption, 1.25 x best estimate, 1.5 x best estimate, 2 x, etc.

I would shock my lapse assumptions and project liability and asset cash flows to calculate future profits/losses. Similar to a DCAT exercise, in which I would test the impact of higher than expected lapses on future income and required capital levels, with and without management action such as increasing crediting rates for UL and FA, and reducing premium rates for GLTD.

Alternatively, candidate recommends an approach that monitors the risk and/or sets up an early warning signal:

I.e., measure:
- surrender activity on a weekly basis and reporting to ALM for advance warning/trend reporting
- liquidity ratio of the assets supporting each product and the company as a whole
- persistency ratio of existing business, at any time for UL and FA
- persistency ratio of existing business at renewal time for GLTD

Unlike the UL and FA policyholders who can decide to lapse their policy at any time in the year, GLTD policyholders usually make their decision to lapse at the annual renewal of the policy.

- the closing percentages on quoted business, as new business premiums can be used to mitigate liquidity risk by investing in liquid assets

I recommend setting liquidity benchmarks by reference to the amount of investment assets to be held in highly liquid assets.

1. Continued

(d)   Explain how you will monitor and report on the operational risks identified in part (b).

Commentary on Question:
Some candidates wrote answers more than what was asked by answering with all of part b in mind, instead of only with part b.III.

Some candidates described an operational risk management framework in general terms and received partial marks only, as they did not provide specific monitoring activities related to the operational risks as a result of "rapid increase rates."

Monitoring activities:
- Monitor the policyholder and broker inquiries on/requests for surrender, account values, etc.
- Monitor customer processing times. Conduct customer call satisfaction surveys.
- Monitor new sales activities and changes from before the mitigating actions were implemented.
- Monitor distribution calls and complaints on the higher premium rates, by product and by other categories, such as, region and distribution channel.
- Monitor employee turnover in distribution and sales support. Track historical number of openings versus current number, length of time position remains open.
- Monitor caseloads in policy administration, involving surrenders, and policy loans.
- Monitor caseloads in underwriting, new business processing and claims areas.

Reporting:
Report on a frequent basis (e.g., weekly) on key risk indicators to the operational committee or sub-committee and escalate issues to the risk management committee, senior leadership and/or the CRO.

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.

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

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.

(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.

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

(4d) Demonstrate how derivatives, synthetic securities, and financial contracting may be used to reduce risk or to assign it to the party most able to bear it.

(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.

(4f) Analyze the practicalities of market risk hedging, including dynamic hedging.

(4g) Demonstrate the use of tools and techniques for analyzing and managing credit and counterparty risk.

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

Sources:

Sweeting, Ch. 16 Responses to Risk; Sweeting, Ch. 14 Quantifying particular risks

ERM-110-12: Derivatives: Practice and Principles, Recommendations 9-24 & Section III

ERM-124-15: Counterparty Credit Risk, Ch.2

2. Continued

Commentary on Question:
The goal of the question was to test the candidate's knowledge and understanding of liability equity risk exposures and possible approaches to hedging this exposure. The candidates were expected to apply the Black-Scholes put option formula to a liability option and analyze and choose from amongst various derivative solutions to mitigate the equity delta risk exposure.

See comment on each part.

Solution:
(a)   Calculate delta, that is, the total exposure to the underlying S&P500 TR Index that needs to be hedged relative to the one-year ROP option written by Lily. Show your work.

Commentary on Question:
Generally this part was done well. Some candidates missed the 95% persistency expected at the end of the year.

$d_1 = [\ \ln(X_0/E) + (r + \sigma_x^2/2)\ ]\ /\sigma_x$
$\quad = [\ln(2100/2100) + (0.01 + 0.2^2/2\ )\ ]/(0.2)$
$\quad = [\ln(1) + (0.01 + 0.02)\ ]/0.2$
$\quad = [0 + 0.03]/0.2$
$\quad = 0.15$

$\Phi(d_1) = \Phi(0.15) = 0.56$

$\Delta P = \Phi(d_1) - 1]$
$\quad = [0.56 - 1]$
$\quad = -0.44$

Delta exposure to hedge is -0.44 * $5,800,000 * 0.95
$\qquad\qquad\qquad\qquad = -0.44 * \$5,510,000$
$\qquad\qquad\qquad\qquad = - \$2,424,400$

(b)   You now consider alternative I to delta-hedge the equity risk exposure from LVA.

(i)   Calculate the optimal hedge ratio to minimize the volatility of the S&P500 one-year futures hedge.

(ii)   Determine the number of one-year S&P500 futures contracts that Lily should enter into to cover the delta risk exposure from LVA.

Show your work.

2. **Continued**

Commentary on Question:
Generally part (i) was done well. For part (ii), a good portion of candidates used the full premium of $5,800,000 as the exposure to hedge, instead of the delta exposure of $2,424,400 calculated in part (a).

(i) β_M
       $= \rho_{F,M} * \sigma_M / \sigma_F$
       $= 0.80 \, (0.20/0.16)$
       $= 0.80 \times 1.25$
       $= 1$

(ii)   Number of contracts N
       $= h \times \$delta \ exposure \ to \ hedge/\$exposure \ per \ contract$
       $= 1 \times (\$2,424,400 \,)/(\$250*2100)$
       $= 1 \times (\$2,424,400 \, / \, \$525,000 \,)$
       $= 4.62$

       Thus 5 S&P500 futures contracts should be purchased.

(c)   You now consider alternative II to delta-hedge the equity risk exposure from LVA.

       (i)   Calculate the theoretical cost of an S&P500 ATM put option.

       (ii)   Calculate the number of put options that Lily should purchase.

       Show your work.

       Commentary on Question:
       This part was generally done well. As the contract size was not specified, full credit was given for any reasonable value used.

       (i) d_1 (from (a)) $= 0.15$
              $d_2 = 0.15 - 0.20 = -0.05$
              $X_0 = 2100$
              $E = 2100$

              $P_0 = -2100* \Phi(-0.15) + 2100* e^{-0.01}*\Phi(0.05)$
                  $= -2100*(0.44) + 2100*(0.99)*(0.52)$
                  $= -924.00 + 1081.08$
                  $= 157.08$

2. **Continued**

      (ii)   Using a contract size of $100:
             N = $5,510,000/($100 x 2100)
                = 26.2

             Thus 26 S&P put option contracts should be purchased

(d)   Assume Lily purchases the put option from Magnolia Bank.

       Calculate Lily's current counterparty risk exposure to Magnolia Bank under each of (i) and (ii):

       (i)   Assume no netting agreement is in place

       (ii)   Assume a cross-product netting agreement is in place

       Show your work.

       Commentary on Question:
       This part was not done well by most candidates as they included most or all financial exposures. Only the market value of derivative instruments represent counterparty risk exposure and are relevant to netting agreements.

       (i)   No netting: is the sum of positive counterparty exposures
             Positive exposure of $2,300 from put option only
             Therefore, total MegaBank exposure is $2,300

       (ii)   Netting: is the sum of all counterparty exposures
           • Put option +$2,300
           • IRS   -$50,903
           Total MegaBank exposure with netting = Max(0, $2,300 - with $50,903)
                                         = 0

(e)   Compare and contrast the nature of the counterparty risk between the exchange-traded put option hedge and the OTC put option hedge with Magnolia Bank.

       Commentary on Question:
       This part was generally done well. Some candidates did not realize that the exchange-traded option does have a small degree of counterparty risk. Many candidates made points unrelated to counterparty risk that did not receive credit.

2. **Continued**

For the exchange-traded put option hedge, counter-party risk is reduced by the pooling of contracts – since each party has a contract directly with the exchange, the failure of a single counterparty does not directly affect the payment of any single option contract. The exchange underwriting the contracts protects itself from its counterparties through the use of margins. Lily will contract directly with the exchange as counterparty, and there is a low likelihood of a default of the exchange.

The OTC put option hedge with Magnolia Bank, the counterparty risk will be with Magnolia Bank. Risk would depend on the agreement set with Magnolia Bank, and the credit rating of the Bank. The counterparty risk in the option is one-sided, with Lily paying the option cost upfront, but Magnolia is not required to perform until the option is exercised. Lily is exposed to a default of Magnolia before the option is exercised.

(f)

    (i)   Identify the criteria you would use in evaluating a recommendation to pursue one of the three alternative hedging approaches.

    (ii)   Recommend one of the three alternative hedging approaches based on the criteria identified in (i). Justify your response.

Commentary on Question:
Part (i) was generally well answered. Full credit was given for any 3 relevant criteria. On part (ii), the responses varied. Credit was given for any of the three approaches chosen, as long as there were well-reasoned arguments relative to the listed criteria to support the choice.

    (i)   <u>Hedge Effectiveness</u> – consider the hedge effectiveness of the three alternatives with respect to the liability exposure.
        <u>Counterparty risk</u> exposure – consider the degree of additional counterparty risk involved in each of the three alternatives
        <u>Operational risk</u> of each of these hedge alternatives – what is the additional operation risk involved with the three alternatives, i.e. complexity, infrastructure, knowledge/sophistication required

2. **Continued**

(ii)   I would recommend the Magnolia OTC put option, and for the following reasons:

Hedge Effectiveness: For the exchange-traded S&P500 futures contract or S&P500 put option, there will be basis risk to the extent that the All-American fund does not track the S&P500 fund. The whole number of contracts purchased may produce over- or under-hedging of the delta exposure. The OTC put from Magnolia may be customized to minimize basis risk by hedging the actual exposure of the All-American fund returns.

Counterparty risk: The exchange traded alternative would have significantly lower counterparty risk vs. the OTC option. However, Magnolia counterparty risk could be mitigated using collateral requirements and a netting agreement.

Operational risk: Lily Life is currently holding an interest rate swap with Magnolia Bank and thus there is already an established process in place to manage this position with this counterparty, thus new operational risk exposures would be minimized.

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:
(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.

(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.

(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.

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

Commentary on Question:
The purpose of this question was to test knowledge and understanding of common approaches used to forecast volatility and to determine their applicability for use in a delta-hedging program. Candidates were required to demonstrate thorough understanding of the approaches through both quantitative calculations and qualitative application.

3. Continued

Solution:

(a)   Consider the observation that financial market volatility is predictable. Describe three implications for risk management assuming this is the case.

Commentary on Question:
Most candidates performed well on this part. However, a common misconception is that predictable volatility implies perfect knowledge of future market movements. Even if volatility were constant and known, it would not logically follow that market prices would be known. There is also some confusion about the meaning of the word predictable*. In this context it means that the distribution and parameters can be determined, not that the actual sample measurements are known in advance.*

Additionally, the answers should pertain to risk management. Common responses which were not accepted related purely to arbitrage opportunities.

A variety of responses were acceptable for full credit.

- There is a strong position correlation between market volatility and VaR. Increases in market volatility imply increases in VaR.
- Assets, such as derivatives, that depend directly on market volatility will change in value in a predictable way.
- Equilibrium asset prices will be affected by changes in volatility. Investors who can reliably predict changes in volatility should be able to control financial market risks better.

(b)   Describe two features of empirical equity returns that are inconsistent with the assumption that returns are normally distributed.

Commentary on Question:
Candidates performed well on this part. The following list is not exhaustive and only two relevant points are required for full credit.

Compared to the normal distribution, distributions of empirical equity returns:
- are asymmetric
- exhibit fatter tails
- contain larger centers
- change over time
- exhibit volatility clustering
- exhibit autocorrelation
- may be regime-switching

3. Continued

(c)   Calculate the daily σ_t^2 using the MA model with a 20-day window, given $\left(100 \times \sigma_{t-2}^2\right) = 0.8311\%$. Show your work.

Commentary on Question:
Most candidates either performed very well or very poorly on this part. Candidates who recognized how to apply the information provided in the stem to solve the problem generally received close to full credit.

$$\sigma_t^2 = \frac{1}{M}\Sigma_{i=1}^M r_{t-i}^2$$

The MA model specified has a 20-day window, therefore M = 20.

$$\sigma_t^2 - \sigma_{t-2}^2 = \frac{1}{20}(r_{t-1}^2 + r_{t-2}^2 - r_{t-21}^2 - r_{t-22}^2)$$

$$\sigma_t^2 - .008311\% = \frac{1}{20}(.004339\% + .001241\% - .020378\% - .000143\%)$$

$$\sigma_t^2 = .007564\%$$

(d)

(i)   Calculate h, the long-run average, unconditional variance. Show your work.

(ii)   Calculate the expected 1-month equity return variance at *t*, assuming the one-day variance h_t is equal to 0.008750%. Show your work.

Commentary on Question:
Performance on this part was split. In general, candidates performed better on subpart (i) than on subpart (ii).

In subpart (ii), the shortcut was accepted only if the candidate calculated the correct answer to subpart (i), thereby confirming that the long-term variance equals the given daily variance. Full credit was possible for subpart (ii) by using the longer formula (provided in the stem), regardless of whether the answer to subpart (i) was correct. Substantial partial credit was awarded in subpart (ii) for long method answers that went astray due to calculation error.

(i)
$$h = \frac{\alpha_0}{1-\alpha_0-\beta} = \frac{0.000049\%}{1-.0485-.9459} = .00875\%$$

3. Continued

(ii)

Short method:

Note that $h_t = h$. Therefore:

$E_{t-1}[r^2_{t,T}] = hn$.

$= .00875\% \times 20$

$= 0.175\%$

Long method:

$$E_{t-1}\left[r^2_{t,T}\right] = \frac{\alpha_0}{1-(\alpha_1+\beta)}\left[(n-1)-(\alpha_1+\beta)\frac{1-(\alpha_1+\beta)^{n-1}}{1-(\alpha_1+\beta)}\right] + \frac{1-(\alpha_1+\beta)^n}{1-(\alpha_1+\beta)}h_t$$

Substitute:

α_0	α_1	β	n	h_t
.000049%	.0485	.9459	20	.00875%

$$E_{t-1}\left[r^2_{t,T}\right] = 0.175\%$$

(e) Explain specifically how this market option price data can be used to provide a forecast of the 1-month volatility of the S&P 500 Index returns.

Commentary on Question:
Candidates generally performed well on this part. A variety of responses was acceptable for full credit. However, complete answers were required to make reference to the Black-Scholes option pricing model—either by name or by writing out the formula.

Given the market price of the 1-month put option, the implied volatility can be solved using the Black-Scholes equation. The volatility that produces the 1-month put option price when used in the Black-Scholes formula is the implied volatility of the S&P 500 Index.

(f) Recommend one of the three approaches below to forecast equity volatility, citing the advantages of your recommended approach and the disadvantages of each of the other two approaches:

I. The MA model

II. GARCH(1,1)

III. Use of market option prices

3. **Continued**

Commentary on Question:
The quality of responses to this part varied substantially. The candidate was expected to make a recommendation. Only minimal credit was possible for candidates who failed to do so. Credit was not awarded for any disadvantages cited for the recommended approach. Similarly, credit was not awarded for any advantages offered for the other two approaches.

The GARCH(1,1) is the best answer given that Rose Life uses delta-hedging to manage its risk. However, it was possible to receive full credit by recommending either the GARCH(1,1) approach or the use of market option prices. There were not enough advantages of the MA model to justify its recommendation, although partial credit was possible.

The GARCH (1,1) method is the best approach for Rose Life to make use of in its delta-hedging program. It provides a better fit to empirical data than the MA model and is commonly used in practice. It also accounts for serial dependency in volatility, which is observed in empirical data. Unlike the implied volatility from market option prices, GARCH (1,1) is also more relevant for internal hedging purposes, since it is not loaded for profit and contingencies like the implied volatilities.

The MA approach is not recommended because:
- It ignores the dynamic ordering of observations, assigning the same weight to recent and older observations within the moving observation window.
- There is no clear choice of the size of the moving window. While a larger window increases precision, it may miss underlying variation in volatility.
- There is a "ghosting" phenomenon which may lead to illogical plateaus in the data. There could be a large jump on the day a large return falls out of the observation window.

The use of market option prices is not recommended because:
- Quotes may not be available for the required time period, requiring the extrapolation of a volatility surface.
- Implied volatilities are loaded for profit and contingencies, which makes them more relevant for modeling the cost of market options rather than for use in an internal hedging program.
- Option-implied volatilities are based on risk-neutral distributions, rather than on real-world distributions. This could cause a systematic bias relative to actual volatility.

4.

Learning Objectives:

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:

(4i) Analyze the application of Asset Liability Management and Liability Driven Investment principles to Investment Policy and Asset Allocation.

(5c) Apply risk measures and demonstrate how to use them in capital assessment. Contrast regulatory, accounting, statutory and economic capital.

Sources:
ERM 112-12: Revisiting the Role of Insurance Company ALM within a Risk Management Framework

Commentary on Question:
This question tested the candidates' understanding of the ALM process and how to apply it to a Basic GIC product. Furthermore, candidates were asked to demonstrate understanding of how the ALM process would produce differing outcomes for two different product designs of a GIC product.

The question was divided into five parts, with parts (a) through (d) referring to the Basic GIC product only. Many candidates answered these parts as if both the Basic GIC and the GIC Plus were part of Begonia Life's portfolio. Portions of the candidates' responses that referred to the surrenderability feature of the GIC Plus product in these parts were not awarded credit.

Solution:
(a) Identify three Investment Objectives that would be important for this product. Justify your response.

Commentary on Question:
Full credit on part (a) required candidates to name three investment objectives and relate them back to the Basic GIC product. Overall, candidates performed well on this part. Partial credit was given for responses that were general and did not tie directly to the Basic GIC.

Target Spread – Profit on the Basic GIC comes from the spread between the asset earned rate and the fixed guaranteed rate. A target spread is needed to achieve the desired profitability level.

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4. Continued

Duration Matching – The Basic GIC product has a fixed term of five years and is non-surrenderable, so liability cash flows are very predictable. Duration matching would limit volatility from interest rate changes.

Asset Quality Mix – A high quality portfolio is necessary to ensure the ability to meet the obligation at the end of each GIC's 5-year term.

(b) Consider the following asset classes:

  I. Cash

  II. Investment grade bonds or Treasuries with maturities less than 5 years

  III. Investment grade bonds or Treasuries with maturities greater than 5 years

  IV. Equities

Explain the role, if any, that each of the asset classes I through IV could play in your overall ALM strategy.

Commentary on Question:
Full credit on part (b) required an explanation of each of the four asset classes related to a portfolio of Basic GICs. Many candidates realized that a portfolio consisting primarily of asset classes II and III would be a good portfolio for the Basic GIC product. However, several candidates put too much emphasis on using equities to increase returns while not acknowledging the high level of risk that equities would bring to the portfolio.

  I. Cash provides little return but has no risk and is very liquid. For an individual GIC, it is not needed because Basic GICs are non-surrenderable. For a block of GICs sold on different dates, holding some cash allows for more asset classes to match duration and provides liquidity for maturities.
  II. Short-term investment grade bonds provide the same benefits as cash, but with higher yields and lower liquidity. They can be used to decrease duration of the portfolio if other longer-term instruments are used.
  III. Long-term investment grade bonds can be used to increase portfolio yield and raise the duration of the portfolio. One strategy would be to use a combination of short-term and long-term investment grade bonds to maximize yield while matching the duration of the liability

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4. Continued

     IV.   Equities could provide higher returns and diversification benefits, but given the volatility and risk of losses, they should represent a minimal portion of the portfolio if used at all.

(c)   Explain how the size of the fixed spread may influence your Investment Objectives and Constraints in step 1 and your Asset Universe in step 2.

Commentary on Question:
Full credit on part (c) required candidates to address both the Objectives/Constraints and the Asset Universe steps in the ALM process. Many candidates answered only one of the two steps.

Investment Objectives and Constraints
- If the fixed spread increased, may need to consider relaxing constraints to allow for higher yielding assets.
- If the fixed spread decreased, may consider using stricter cash flow matching to lock in the desired profitability level.

Asset Universe
- A larger spread would likely expand the asset universe to include lower quality bonds or derivatives to increase yield.
- A smaller spread would likely narrow the asset universe to higher quality bonds to reduce risk and volatility while achieving the desired yield.

(d)   Explain the implication of basing the Risk Measures in step 4 on the economic surplus amount instead of the regulatory surplus.

Commentary on Question:
The goal of part (d) was to focus on the impact to risk metrics of using economic surplus vs. regulatory surplus. Many candidates explained the difference between economic capital and regulatory capital but did not make any connection to risk metrics. These responses did not get full credit.

Statutory valuation of both assets and liabilities are relatively predictable and stable. Economic valuation will have more volatility due to marking assets to market and using a dynamic discount rate on liabilities.

For this reason, risk metrics based on economic surplus will tend to be more volatile, which may lead to a more conservative investment strategy. They should also provide a better measure of the true risk profile of the block of GICs.

4. **Continued**

(e)   Explain how the following items will differ between Basic GIC and GIC Plus:

        (i)   Effective liability duration

        (ii)   Setting Investment Objectives and Constraints

        (iii)   Setting Asset Universe and Assumptions

        (iv)   Risk Measure based on an economic basis

Commentary on Question:
Candidates did very well on subpart (i). Most candidates received some credit for subparts (ii) and (iii), but many did not distinguish between the two enough to receive full credit. Subpart (iv) proved to be more of a challenge, as candidates had difficulty explaining how risk measures would differ between the Basic GIC and GIC Plus.

        (i)   The Basic GIC and GIC Plus have the same 5-year structure, but the GIC Plus has a surrender provision. Therefore, the GIC Plus will have a shorter effective liability duration.

        (ii)   Liability cash flows on the GIC Plus product are more variable, as they can occur as early as the end of year 2. Duration matching will be more difficult, so duration matching objectives may need to be relaxed on the GIC Plus to avoid frequent rebalancing.

        (iii)   For GIC Plus, one might consider adding derivatives to the asset portfolio that will pay out when interest rates rise and surrenders are more likely.

        (iv)   Risk measures will show increased risk on the GIC Plus product due to higher uncertainty around cash flows, whereas cash flows are locked in on the Basic GIC product.

5.   **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:
(5a) Describe the concepts of measures of value and capital requirements (for example, EVA, embedded value, economic capital, regulatory measures, and accounting measures) and demonstrate their uses in the risk management and corporate decision-making processes.

(5c) Apply risk measures and demonstrate how to use them in capital assessment. Contrast regulatory, accounting, statutory and economic capital.

Sources:
ERM-123-14: S&P Enterprise Risk Management Criteria (#1-71, 86-88)

ERM-501-12: Risk Based Capital – General Overview

Commentary on Question:
This question asked candidates to analyze and develop recommendations for real-life business situations involving ERM.

Solution:
(a) Describe three significant issues with Peony's risk management culture.

> **Commentary on Question**:
> *Candidates generally did well on part (a). Credits were only given for answers related to risk management culture issues.*

- The CEO wants to focus the ERM program on only the problem areas in the company (underwriting department). The risks are managed in complete silos on an annual basis or not managed at all.
- The CEO and the Board display a lack of understanding of the importance of ERM, and have insufficient active involvement in the ERM process.
- The CEO is concerned about increasing sales so everyone can have big bonuses this year, to the exclusion of risk concerns such as profitability and capital.
- The CEO believes that a strong RBC ratio is the only requirement for risks to be "financially covered".

(b) Outline the basic components of the ERM program you will design for Peony.

5. Continued

Commentary on Question
Candidates generally didn't perform well on part (b). They needed to demonstrate an understanding of how to develop an ERM program and apply it to Peony. Some candidates only listed key components without any brief explanation.

- The ERM function needs to be led by a well-qualified senior executive with risk management functions at the business level, and should be independent of the CEO.
- Active involvement from the Board, and strong buy-in from senior management and business units.
- Significant resources need to be committed to the day-to-day execution of the program.
- Develop methods to consistently identify, measure, and manage risk exposures and losses within chosen risk tolerances.
- Peony needs to aggregate and manage risk with an enterprise view, taking into consideration correlation and diversification.
- Need comprehensive and frequent risk reporting around all key areas of risk exposures.

(c)   Explain to the CEO why Peony's strong RBC ratio may not translate into a strong S&P score.

Commentary on Question:
Candidates generally got most credits on part (c). But to receive full credit, candidates needed to discuss both RBC and components of the S&P scoring system.

- The RBC ratio provides a capital adequacy standard using a generic formula by primary insurance type.
- Although this formula requires companies to hold capital for most major risks, it does not solely fulfill the criteria of the major components of the S&P scoring system for a "strong" score.
- S&P ERM analysis is comprised of five subfactors:
  - Risk management culture
  - Risk controls
  - Emerging risk management
  - Risk models, and
  - Strategic risk management
- Peony received a "weak" score because the risk management culture and the risk controls subfactors were scored negative. For a "strong" score, the risk management culture, risk controls, and strategic risk management subfactors must be scored positive, with no subfactor scored negative.

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5. **Continued**

(d)   The CEO is reviewing Peony's RBC level. He asks you to provide information on four competitors. You research the RBC data from these companies and obtain the following:

Commentary on Question:
Candidates generally did well on part (d). Some candidates lost partial credits on NAIC action level.

Company #	Authorized Control Level ($)	Total Adjusted Capital ($)	RBC Ratio	NAIC Action Level
1	100	195	195%	Company Action Level
2	99	215	217%	No action
3	242	505	209%	No action
4	86	125	145%	Regulatory Action Level

(e)   Companies 1 and 2 are considered peers of Peony. The CEO has proposed maintaining Peony's RBC ratio equal to the average RBC ratio of these two companies.

   (i)   Explain the positives and the negatives of maintaining Peony's RBC ratio at that level.

   (ii)   Assume you move forward with the CEO's proposal.

         Propose three specific ways to lower Peony's RBC ratio to that level.

Commentary on Question:
Candidates generally did well on part (i). To receive full credit, candidates needed to discuss both positives and negatives.

Candidates did well on part (ii) if they knew the RBC formula well and tried to adjust the ratio from both the numerator and the denominator.

   (i)   The average RBC ratio of Companies 1 and 2 is 206%

         Positives:
         • The "no action" level does not require the company to take action.
         • Frees up capital for new opportunities and future growth

5.   **Continued**

Negatives:
- Peony is not considering risk vs. reward when determining what level of total adjusted capital to hold. Lowering the RBC ratio from 300% may force the company to take riskier investments and/or seek out riskier ventures without considering the additional risks associated with these opportunities. Poor strategic risk management may lead to a ratings downgrade.
- The average RBC ratio places Peony very close to the "Company Action Level" (150%-200%). If there is suddenly a strain on capital or surplus, Peony's RBC ratio may drop below 200%.
- Although the companies are considered peers of Peony, the other companies may have a different mix of products which result in different RBC ratios.
- Company 1 does not provide a good comparison since the company has a RBC ratio that falls into the "Company Action Level", which has a number of negative implications.

(ii)   Lower the total adjusted capital:
- Seek alternative ways to utilize excess capital, such as new ventures, alternative investments (i.e. mortgage loans), acquisitions, and dividend payment, etc.

Increase the "Authorized Control Level" capital:
- Increase concentration in a single issuer (subject to concentration factor).
- Invest in riskier investments, such as junk bonds and/or riskier short and long term investments (increase potential for default and fluctuations in the fair value of assets).
- Seek rapid/excessive growth.

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.

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.

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

Sources:
Study note – Aggregation of Risks and Allocation of Capital (Sections 4-7)

Study note – Measurement and Modeling of Dependences in Economic Capital (Ch 3-5)

Loss Models Ch. 10 Copula Models

Commentary on Question:
This question in general is testing candidates' ability to, first, analyze and evaluate risk aggregation techniques, including use of correlation, integrated risk distributions and copulas, and, secondly, analyze the importance of tails of distributions. In order to obtain the maximum points for this question, one would need to demonstrate the right calculation steps that lead to the given answers for Parts (a) and (b) and give four distinct advantages and/or disadvantages of the two models in Part (c). Many candidates attempted to work on Part (a) and to give a couple of reasons in Part (c). However, the general observation is that most of the candidates had not familiarized themselves with the topic of Copula models.

Solution:
(a)
(i)   Demonstrate that the correlated uniform values using the Gaussian copula are $v_1 = 0.950$, $v_2 = 0.171$. Show your work.

(ii)   Calculate the simulated total loss due to Equity and Credit risk factors using the correlated uniform values from (i). Show your work.

Commentary on Question:
*Most of the candidates attempted to work on Part (a) but skipped the first step of finding the independent normal random values and mistakenly used the independent uniform pseudorandom numbers as the **Z** in the matrix. Partial points were considered for matrix formation and for understanding the calculation result, i.e. not interpreting a loss as a gain.*

6. Continued

(i)

1. Turn u_1 and u_2 into independent normal random values, z_1 and z_2:
$z_1 = \Phi^{-1}(u_1 := 0.95)$ and $z_2 = \Phi^{-1}(u_2 := 0.08)$, where Φ is the standard normal cumulative distribution function.
$\Longrightarrow z_1 = 1.645, z_2 = -1.405$.

2. Calculate the corresponding **correlated standard normal values** by calculating LxZ, where
$Z^t = (z_1, z_2) = (1.645, -1.405)$:
$$L\,x\,Z = \begin{bmatrix} 1 & 0 \\ 0.25 & 0.968 \end{bmatrix} \begin{pmatrix} 1.645 \\ -1.405 \end{pmatrix} = \begin{pmatrix} 1.645 \\ -0.949 \end{pmatrix}.$$

3. Calculate the correlated uniform values, v_1 and v_2 using the Gaussian copula:
$v_1 = \Phi(1.645) = 0.95$, $v_2 = \Phi(-0.949) = 0.171$.

(ii)

4. Calculate $F_1^{-1}(0.95)$ and $F_2^{-1}(0.171)$, where F_1 and F_2 are marginal loss distribution for Equity and Credit risk factor, respectively:
$F_1^{-1}(0.95)$ is the value x_1 such that $\text{Prob}(Z_1 \leq x_1) = 0.95$, where Z_1 is a normal random variable with mean, 0, and standard deviation, 500.
$F_2^{-1}(0.171)$ is the value x_2 such that $\text{Prob}(Z_2 \leq x_2) = 0.171$, where Z_2 is a normal random variable with mean, 0, and standard deviation, 1000.

$x_1/500 = 1.645$, so $x_1 = 500*1.645 = 822.43$. Likewise, $x_2/1000 = -0.949$, so $x_2 = -0.949*1000 = -949$.
The simulated total loss $= 822.43 + (-949.2) = -126.81$.

(b)

    (i)   Demonstrate that the correlated uniform values using the t-copula are $v_1 = 0.972$, $v_2 = 0.071$. Show your work.

    (ii)   Calculate the simulated total loss due to Equity and Credit risk factors using the correlated uniform values from (i). Show your work.

Commentary on Question:
There were only a few candidates who were able to demonstrate calculations in Part (b) correctly or use the right steps that lead to the given answers. Points were considered for the alternative solution.

6.   **Continued**

(i)

1. Step 1 is exactly the same as part (a).
Turn u_1 and u_2 into independent normal random values, z_1 and z_2:
$z_1 = \Phi^{-1}(u_1 := 0.95)$ and $z_2 = \Phi^{-1}(u_2 := 0.08)$, where Φ is the standard normal cumulative distribution function.
$\Longrightarrow z_1 = 1.645, z_2 = -1.405$.

2. Calculate the corresponding correlated t- values:
Divide the corresponding correlated standard normal values calculated in Step 2 of Part (a) by the square root of the simulated gamma value/degree of freedom.
$(1.645, -0.949) / (0.325/2)^{\wedge(1/2)} = (4.081, -2.355)$.

3. Calculate the correlated uniform values, v_1 and v_2 using the given cumulative distribution function of the t-distribution with 2 degrees of freedom, $F_{t,2}(x) = \frac{1}{2} + \frac{x}{2\sqrt{2+x^2}}$:
$v_1 = F_{t,2}(4.081) = 0.972, v_2 = F_{t,2}(-2.355) = 0.071$.

(ii)

4. Calculate $F_1^{-1}(0.972)$ and $F_2^{-1}(0.071)$:
$F_1^{-1}(0.972) = 958.9, F_2^{-1}(0.071) = -1{,}465.7$.
The simulated total loss $= 958.9 + (-1{,}465.7) = -506.76$.

Alternative solution using Source method (i.e. Normal Distribution):
3. $v_1 = \Phi(4.081) = 0.99998, v_2 = \Phi(-2.355) = 0.00927$.
4. $F_1^{-1}(0.99998) = 2{,}040, F_2^{-1}(0.00927) = -2{,}355$.
The simulated total loss $= 2{,}040 + (-2{,}355) = -315$.

(c)   Outline the advantages and disadvantages of the proposed t-copula over the standard Gaussian copula in this situation.

Commentary on Question:
Most of the candidates attempted to give a couple of reasons in Part (c), and therefore received partial points. Full points in Part (c) were given to candidates who were able to demonstrate their understanding about the Copula models by pointing out four correct and distinct advantages and disadvantages.

6.   **Continued**

Gaussian Copula
- Advantages:
  - Relatively easy to understand and mathematically tractable.
  - Correlation (or dependency) parameters easy to estimate and interpret.
  - Easily extended to the multidimensional case.
  - Can be easily programmed to generate simulated output within an economic capital model.
  - Normal distribution is well known and understood.
- Disadvantages:
  - Gaussian Copula's tail dependencies in the limit are zero.
  - This limitation means that the Gaussian Copula is not suitable for modelling dependency with heavy tails.

t-Copula
- Advantages:
  - The t-copula has non-zero tail dependency, upper and lower.
- Disadvantages:
  - It requires a degree of freedom ("df") parameter.
  - t-Copula is symmetrical and its left and right tail dependencies are equal.
    - This is not a perfect solution given that economic capital modeling is predominantly concerned with only one side of the distribution.
  - Some limitations exist when modeling more than two risks.
  - t-distribution is less well known.

7. **Learning Objectives:**

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

Learning Outcomes:

(4a) Demonstrate and analyze applicability of risk optimization techniques and the impact of an ERM strategy on an organization's value. Analyze the risk and return trade-offs that result from changes in the organization's risk profile.

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

Sources:

Risk Appetite: Linkage with Strategic Planning;

ERM-114-13 Introduction to Reinsurance

Commentary on Question:

This question was intended to test the candidate on his or her understanding of the components of a Risk Appetite Statement, as well as ability to apply different types of reinsurance to blocks of business.

Solution:

(a)

(i) Evaluate items I to IV in the bank's RAS with respect to their applicability to PIC and, where necessary, explain how they should be modified for PIC's RAS.

(ii) Identify two additional items that would be important for PIC to include in its RAS.

Commentary on Question:

Candidates appeared to struggle with part (i). Candidates did well on part (ii).

Many candidates evaluated the bank's RAS with respect to using it for any insurance company, but not specifically for PIC. Depending on the level of detail, partial credit was given.

Some candidates indicated whether the items in the bank's RAS were applicable, but didn't explain why or why not. No points were given in this case.
For part (ii) additional solutions other than the one shown below were accepted. For full credit the candidate had to identify items relevant to PIC, not just general items that could be included in any RAS

7. Continued

(i)   *Be the top Bank on the island with a Moody's rating of at least Aa1*
- Too vague – what does top mean?
- The capital required to maintain Aa1 rating may not be initially feasible for PIC. What was PIC's rating prior to being acquired?

Have an average customer satisfaction rating of at least 90%.
- How is this rating determined? PB only serviced the community on the island, while PIC may be servicing clients elsewhere in the world. Can this same method be used for PIC?
- A bank may be valued for its person-to-person interactions, while an insurance company would more likely be valued based on the speed of its claims-paying, or its financial strength. The statement should identify clearly how an insurance company is valued

Annually grow overall client base by 5% while retaining 95% of present clients
- What is the PIC's client turnover level? Is the overall client base % so high that this type of measure isn't valuable?
- If this is a valuable measure, then proposed RAS should be back-tested to see if the limits would have been crossed in prior years.

Meet all withdrawal requests upon demand for all events
- What products does PIC have that have a cash value? (the products listed: term life, car insurance, critical illness and disability would generally not have a cash value.)
- Consider changing this to have liquidity able to meet a 1 in 200 year event

(ii)
- An overall annual profit / loss
  - "Risk appetite helps prevent default by preserving capital position" There should be a quantitative measure for the capital / equity PIC is willing to put at risk.

- A level of surplus required
  - What level of surplus is needed for PIC to handle an extreme event with a probability of x%?
  - This will be important in maintaining the required rating level.

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7. Continued

(b) Recommend the most appropriate type of reinsurance from the list above for each of blocks I and II, based on the objective of mitigating earnings volatility. Justify your answer.

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

Many candidates would recommend a type of reinsurance without providing details to why it was the most appropriate type of reinsurance.

Points were awarded only if the type of reinsurance recommended was a viable option.

Solutions other than one shown below were accepted if the choice recommended was viable, and the answer showed that the candidate had a clear understanding of the types of reinsurance.

Critical Insurance

- Recommend: Excess of Loss, on entire block of business.
- This is a closed block with a known NAR that is small. PIC can set the priority (fixed chosen quantity) at a level within PIC's risk tolerance and link the coverage to a fixed dollar amount per calendar year in relation to annual earnings.
- NOT Catastrophic excess of loss. Insuring against a tail event is an effective way to mitigate volatility. I would instead say, cat events usually do not lead to CI claims. CI claims relate to cancer, dread disease, etc. and not to cat events (9/11, earthquake, etc.)
- NOT treaty proportional quota share. PIC is not concerned with any individual claim on this small exposure to CI business as exposure to any one life is limited to $50K so cession of individual policies is not the best approach. They are concerned with overall deterioration of block resulting in multiple claims at once.
- Automatic / facultative is not really relevant here as the business is already inforce; auto/fac would apply to new risks being underwritten and individually assessed by the reinsurer.

7.   Continued

20 year term insurance
- Recommend: Automatic (treaty) proportional quota share reinsurance.
- Automatic, not facultative, because we don't want to be sending each application to the reinsurer for their approval if this can be avoided (typically required for only very large policies / impaired lives which does not appear to be PIC market)
- NOT excess of loss, as this is a growing business and reinsurer's liability would not grow proportionately with PIC.

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.

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.

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

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

Sources:
Financial Enterprise Risk Management, Sweeting, 2011 Ch. 16 Responses to Risk

Commentary on Question:
This question required candidates to apply their understanding of People Risk to the scenario presented. Credit was given only for risks categorized as People Risk in the source (Sweeting Ch. 16). No credit was given for risks included in other categories in this source (e.g. Crime Risk, Bias, Operational Risks), even if the answers were relevant and otherwise correct.

The intent was to have risks related to the divestiture project discussed only in part (b), and risks related to the VA business in general discussed only in part (a). But credit was given for appropriate answers that were included in the opposite place. However, if answers were repeated in both parts, credit was only given once.

Greater credit was given if risks were appropriately labeled, e.g. as Agency, Employment-related, etc. Moral Hazard and Adverse Selection were both accepted as appropriate labels for policyholder behavior risk in part(a).

Solution:
(a)
(i)   Identify and analyze People Risk associated with the VA product.

(ii)   Propose means for reducing such risk.

8. Continued

Commentary on Question:
Full credit could be attained for a correct answer that focused just on Adverse Selection related to policyholder investment options. Credit was also given for other types of People Risk discussed in the context of the VA business (e.g. employment-related risks, adverse selection related to longevity risk, etc.).

(i) The main people risk here is Adverse Selection. Policyholders can purposely choose very risky investments, because there are no investment restrictions, and will get very high returns if markets returns are favorable. But if market returns are unfavorable, the policyholder is protected by the investment guarantees and Fuchsia will incur the losses.

(ii) To reduce this risk, Fuchsia could re-design its VA product and make these changes:
- place restrictions on riskier investment options
- charge higher fees for riskier investments to create a disincentive for policyholders' choosing them
- reduce or eliminate the guarantees

(b)

(i) Identify and analyze two types of People Risk related to the divestiture project.

(ii) Propose means for reducing such risks.

Commentary on Question:
The best answers focused on Mr. A as the project leader, i.e. his incentives and fitness for the assignment. Partial credit was also given for answers that focused on the external consultants or other project team members.

(i) Two types of People Risk related to the project:

1. Agency Risk. Mr. A is promised a large bonus if the project is completed by year-end. So he may act in his own self-interest, not in Fuchsia's best interest. He might try to rush the project, without proper due diligence, in order to get the bonus, and the deal may not be as favorable to Fuchsia as it otherwise could have been.

2. Employment-related Risk. There is a risk that Mr. A is not the right person to lead the project. His background is in securities and sales. He does not have direct experience with VA products or with mergers & divestitures. This could result in mis-evaluation of the deal or in making bad decisions.

8. **Continued**

(ii)   To reduce these risks:

1. Agency Risk: Redesign Mr. A's bonus package to better align his interests with Fuchsia's interest. For example, the bonus could be linked to the sales price of the divestiture or some other measure of value to the company, instead of simply to the timing of the deal.

2. Employment-related Risk. Instead of Mr. A, Fuchsia could pick a team leader that has experience in the VA business and/or experience with mergers & divestitures. Good recruitment techniques (e.g. interviews, checking references, use of head-hunters) should be used to ensure that the project leader has the right skills and background. Additional training could be also given to the project leader and others on the team to help prepare them for this project.

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

(4a) Demonstrate and analyze applicability of risk optimization techniques and the impact of an ERM strategy on an organization's value. Analyze the risk and return trade-offs that result from changes in the organization's risk profile.

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

Sources:
ERM-307-12: Pensions Risk in an ERM Context

ERM-320-14: Retirement Risk Metrics for Evaluating Target Date Funds

Commentary on Question:
This question was designed to test candidates' understanding of the retirement adequacy risks faced by plan sponsors and participants and how risks are affected by adopting a DC plan with target date funds as the investment option.

Candidates who did well on this question thoroughly analyzed risks from the perspectives of SLIC and participants and demonstrated their good knowledge of target date funds.

Solution:
(a)
　　(i)　Describe retirement adequacy risk.

　　(ii)　Explain how this risk will be impacted by the Plan change from the perspectives of SLIC and the active participants.

9. Continued

Commentary on Question:
Many candidates just defined retirement adequacy risk in part (i) without describing the impact it has on employers and employees.

In part (ii) several candidates lost points for talking about risks other than retirement adequacy risk. Very few candidates discussed how an individual will have more control over the risk in a defined contribution plan.

(i)   From an employee's perspective, this is the risk of not being able to afford to retire or of not being able to maintain an adequate standard of living in retirement.

For an employer this refers to the risk that employees may not be able to afford to retire when their productive working years are over. They may remain on the payroll without producing as much as they cost.

This risk materializes most strongly in down economic environments—when the equity market and employees' personal assets are down. That is, when the business cycle is down and many employers tend to be struggling most (and often downsizing), some of their workers who want to retire are not able to do so.

(ii)   A traditional defined benefit plan will often reduce this risk more than a defined contribution plan by providing benefits not tied to the equity markets. Implementing a DC plan will generally increase this risk since employees will become responsible for investment risk and if they fail to achieve a reasonable return they will not be able to retire.

However, with DC plan the risk is more controllable by the employee since they can choose how much to save and how to invest so a participant may be able to lower their risk compared to a defined benefit plan by contributing sufficiently and investing wisely.

For employees with large frozen DB benefit near retirement, the impact is smaller than for young employees who will have a higher proportion of their benefit from the DC plan.

SLIC will generally have less influence over when employees retire under the new plan so the company will face greater risks related to retirement adequacy.

9. Continued

(b) SLIC is considering using target date funds as the default investment option in the new DC plan.

(i) Describe the key advantages of target date funds from the perspectives of the plan sponsor and the participant.

(ii) Describe the key considerations for selecting appropriate target date funds from the perspective of SLIC.

(iii) Describe the key challenges in evaluating the risk of target date funds with traditional investment risk measures.

Commentary on Question:
Candidates who provided generic considerations that weren't specific to target date funds received little credit for parts (ii) and (iii).

(i) Target date funds can reduce fiduciary impediments to automatic enrollment into DC plan by exempting plan sponsors from liability for market-related fluctuations, which helps reduce regulatory and legal risk. They can also simplify the communication and education components of sponsoring a DC plan.

From the perspective of a participant it can be easier to select an appropriate portfolio which reflects their risk tolerance. The portfolio will be automatically rebalanced in an appropriate manner without the participant needing to take action.

(ii) Market risk vs. Longevity risk - Different funds place greater importance on mitigation of one or another of these risks which causes them to have different glide paths. The largest impact is on equity allocation close to the target date.

"Target To" vs. "Target Through" - Some funds are designed to only be used until the target date at which time the investor will need to reallocate their investments while others are designed to be used throughout the decumulation phase.

Investor (plan participant) risk profile - Different funds will have different tradeoffs between risks and return and investors need to decide which funds best line up with their risk appetite. SLIC has an older population so they need have conservative fund options available.

9. Continued

(iii)   Asset allocation underlying the target date fund changes throughout the investment term while traditional risk metrics such as volatility assume a static asset allocation.

Traditional risk metrics ignore the effect and timing of cash flows. The performance of a target date fund is dependent on these factors. In particular, a traditional time-weighted risk measure will ignore the fact that poor returns in the final few years before retirement have much greater impact on retirement wealth than poor returns in the early years.

Risks in a target date investment are path-dependent. The outcome depends on the intermediate path of investment returns at each point in time over the investment period.

(c)

(i)   Compare the risks in funds A and B and their impact on retirement adequacy during the accumulation and decumulation phases, from the perspective of plan participants.

(ii)   Propose which fund is a better choice based on SLIC's average active participant information. Justify your choice.

(iii)   Recommend improvement to the glide path for the fund chosen in (ii). Justify your recommendation.

Commentary on Question:
Candidates who did poorly on part (i) generally didn't differentiate between the accumulation and decumulation phases. The best answers were able to talk about the advantages and disadvantages of the higher equity holdings in fund A.

Either fund could be selected for (ii) so long as appropriate justification was provided.

(i)   Total accumulation risk – Uncertainty about the cumulative investment growth on the retirement fund during the entire accumulation period. Fund B's lower allocation in equity throughout the period puts the fund at risk of not accumulating a sufficient level of funds at retirement (i.e. retirement adequacy risk).

9. Continued

Within-Horizon risk – Risk of significant fluctuations in fund value during the accumulation phase but particularly in the final years before retirement. The participants will have less time to react and mitigate losses. Fund A's high allocation in equities close to retirement date increases the risk of huge losses closer to the retirement date, so will increase retirement adequacy risk as well.

Longevity risk – This is the risk the investors outlives their retirement income. The risk can be mitigated by continuing to have a high equity allocation in the earlier stages of decumulation as with fund A. Fund B's low equity allocation post-retirement increases the chances that a retiree will outlive his/her retirement income.

Market risk (Sequence of returns risk) – Risk the investor has poor returns especially during the early years of the decumulation phase when there is the most money to lose. Higher equity exposure leads to higher market risk for fund A.

(ii)   Fund A - Many SLIC participants will have large frozen DB benefits and therefore can afford to take more market risk in DC plan. Also, since the average population is older they will not have as much time to take advantage of compound returns and may need to take more market risk in the short term in order to ensure adequate retirement income.

Alternative answer:

Fund B - Many SLIC participants will have large frozen DB benefits and therefore do not need to take as much market risk to ensure an adequate retirement income. Since the average population is older they will not have as much time to make up for market losses and therefore should not take as much market risk.

(iii) Fund A – The high equity allocations after retirement cause the participant to face too much market risk. Lowering the allocations for T+5, T+10 and T+15 to 40%, 35% and 30% may allow a sufficient equity exposure to hedge against longevity risk while reducing the possibility of large losses due to poor equity returns.

Fund B chosen in (ii)
Increase the equity allocation around T in order to use equity returns to mitigate the longevity risk. As participants' average salary is high, they might live a better life and have the longevity risk after retirement.

9.   **Continued**

(d)
    (i)   Describe the expected reactions of the participants to the proposed Plan change.

    (ii)   Assess the risks of making this Plan change from the perspective of SLIC.

    (iii)   SLIC is looking at the following scenarios:

- Slow company growth
- Rapid company growth

        Explain the favorable and unfavorable aspects of adopting this Plan change under each of the two scenarios.

    (iv)   Recommend an alternative plan design to address the issues identified above with the current proposal. Justify your recommendation.

Commentary on Question:
Many candidates gave very short answers for part (iii) which was asking for a robust discussion of the favorable and unfavorable aspects of the plan change under each scenario. The best answers had strong differentiations between the two scenarios.

Candidates who did not explain how their recommendation in part (iv) addressed the risks they had previously identified received very little credit.

    (i)   If new DC plan benefits are lower than the existing rich DB benefit, participants will not be happy and there may be turnover as a result.

        However, younger people may be happy as the change will increase portability of the benefit and they have a longer time horizon so they can handle the investment risk.

    (ii)   Retirement adequacy risk - If investment performance is poor participants may be unable to retire and may work longer than SLIC would like.

        Communication risk - If the plan change is not adequately communicated to the participants then there may be dissatisfaction even from participants who benefit.

        Fiduciary risk - May have more risk for fiduciary breaches with DC plan since fiduciaries choose the investment options.

9. **Continued**

    (iii)   Slow company growth:

           Favorable - Costs will be more predictable and company can control their growth easier. Less risk of having to pay significant legacy costs during period of slow growth.

           Unfavorable - Would be disadvantageous for current older employees and retention likely to be more important than hiring during period of slow growth.

           Rapid company growth:

           Favorable - May be more attractive to potential employees since benefit is more portable. More predictable costs could help with finding investors and lower costs of company issued bonds. Also can save money on pension and spend more on business growth.

           Unfavorable - DC plan doesn't encourage retention as much as DB plan so turnover is likely to increase. DC plan doesn't allow as much contribution flexibility as a DB plan.

    (iv)   Adopt a DC plan for new and younger employees while maintaining accruals under the DB plan for existing (older) employees. This will provide the recruitment advantage of the DC plan while maximizing the retention benefit of the DB plan. Over time the proportion of benefits being provided by the DC plan will increase and lead to more predictable costs.

10. **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.

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.

(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.

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

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

(4i) Analyze the application of Asset Liability Management and Liability Driven Investment principles to Investment Policy and Asset Allocation.

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

Sources:
ERM-316-14: How Corporate Pension Plans Impact Stock Prices

ERM-325-14: The Credit Rating Impact of Pension De-Risking

ERM-324-14 Level 2 LDI Three key implementation considerations

Commentary on Question:
The goal of the question is to test the risks posed by a company's Pension Plan to the corporation, how the impacts can be magnified with changing interest rates and how to mitigate the risks.

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10. Continued

Solution:

(a)   Explain whether or not you agree with the CFO's concern. Justify your answer.

Commentary on Question:
While many candidates were able to identify that the low interest rates would increase the pension liabilities, many failed to discuss the specific impacts on the overall finances of the company. Full credit required a discussion of both components

The CFO has a right to be concerned. Low interest rates widen pension funding gaps by boosting the pension liabilities. This increases the magnitude of pension risk impacts on corporation's finances particularly for a pension-heavy company like Maple. Since investors view pension liabilities as riskier than debt this adds volatility to companies' stock prices,   increases the firm's beta and cost of capital and can lower credit rating.

(b)

(i)   List three main pension metrics that might impact a corporation's stock price.

(ii)   Describe the expected impacts to a corporation's stock price for each metric identified in (i), based on historical data.

Commentary on Question:
Many candidates successfully identified three pension metrics and had a basic understanding of how the stock price might be impacted. However, most candidates did not describe the impact based on historical data which was a specific requirement of the question
(Note that credit was given for other reasonable answers not listed below)

1) Pension plan size
    * Pension-heavy company stocks have been more correlated with equity markets than companies without material pension exposure.
    * They underperformed during the credit crisis (10/2007 to 3/2009). During the rebound, stocks outperformed (3/2009 to 4/2010).
    * Pension plan size is negatively correlated with stock price, particularly under extremely low interest rates, since pension liabilities begin to behave like perpetuities as interest rates approach zero and pensioners' claim on a firm's value grows.
    * Pension risk has a statistically significant relationship with equity beta. The bigger the pension, the higher the company's equity beta.

10. Continued

2) Funding Status/Contribution
- Stocks of companies with better-funded pension plans are more highly valued by the stock market than stocks of companies with large underfunded pensions.
- Investors view pension deficits as riskier than corporate debt, since pension deficits are inherently more volatile. Funding pension deficits with debt would likely create shareholder value by reducing enterprise volatility and lowering WACC (weighted average cost of capital).
- During the 2005- 07 boom, higher pension contributions (to reduce funding deficit) had a negative impact on stock price, while during the financial crisis contributions helped stock price indicating that in times of stress investors value lower pension deficits.

3) Equity Allocation
- Equity allocation impacts stock price over time, although it is inconsistent in some time periods and matters substantially less today than it did earlier in the 2000s.
- Slight increases in the equity weighting of a pension portfolio measurably increase the stock beta of the plan sponsor and so increase the WACC. Pension risk has a statistically significant relationship with equity beta. The riskier its asset allocation, the higher the company's equity beta.

(c)

(i) The CFO feels the current persistent low interest rate environment will intensify the impacts described in part (b).

Recommend methods Maple can use to reduce the impact on its stock price for each of the pension metrics identified in part (b). Justify your recommendation.

(ii) Evaluate the methods proposed in (i) if the CFO instead expects interest rates to increase in the near future.

Commentary on Question:
Many candidates were able to list methods Maple could use to reduce impact of the Pension Plan on its stock price. Fewer candidates made mention of the low interest rate environment in making their recommendations in part (i). For part (ii) some candidates basically reiterated their responses for part (i). Others however used this as an opportunity to demonstrate how the interest rate environment influenced their recommendations.

10. Continued

(i)

1) Reduce Pension plan size

- Reduce the pension liability, by changing the plan's benefit structure, closing, freezing or terminating the plan, annuity buy-out, or accelerating lump sum payouts.
- The tail risks of pension plans are greater in low interest rate environments because the present value exposure of extreme, long-term events is higher. The higher cost of tail exposures is partly why stocks are more sensitive to pensions today than during the prior funding crisis of a decade ago. Consequently, while plan terminations are more expensive amid low interest rates, the positive stock price impact of a plan termination is theoretically greater.
- For lump sum payout, although interest rate is low it may still be good to do now when considering (a) savings from reduced PBGC premium requirements and (b) increased liability from updated mortality tables which will be required in the near future.

2) Improve Funding status/contributions

- Fund the pension, which should help stock prices more than paying down corporate debt.
- The funding could take any form; even funding the pension with corporate debt is a net positive for the stock price because under the low interest rate environment, borrowing debt is cheaper and it replaces a more volatile form of debt (i.e., a pension deficit) with a less volatile form (i.e., corporate bond or loan). More funding is probably better, as more risk would be reduced.
- For pension-heavy companies, funding with common stock could be positive for the stock price despite the dilution.

3) Reducing Equity allocation of pension assets

- Employ LDI (Liability Driven Investment) strategy to lessen the funding status impacts during periods of low interest rates.
- Although under low interest rate environment, you may need a lower hedge ratio if there is an expectation that interest rates will increase. If interest rates rise, both assets and liabilities drop in value. Importantly, the liabilities drop more than the assets since we have only hedged part of interest rate risk and so the funded status and funding ratio of the plan actually increases.

10. Continued

(ii) As interest rates will increase in the near future, could hold on for method (1) to wait for interest rate to increase to lower the cost. For method (2), as Maple has 70% equity allocation, there is a large duration mismatch. As interest rates increase this should improve funded status so can contribute less to avoid overfunding. For method (3), as stated above, need lower hedge ratio as interest rates increase.

(d)

(i) Calculate the de-risked pension volatility and de-risked firm volatility for approaches I & II. Show your work.

(ii) You recommend that the CFO should not pursue an annuity buyout.

Explain your recommendation based on your results in (i).

Commentary on Question:
Candidates struggled on the calculation component. Most candidates were not able to fully develop the formula for the volatility of the company which was key to arriving at the correct answer for the Firm's volatility. Some candidates were able to arrive at the correct conclusion for the Plan's volatility.

Since many candidates did not arrive at the correct calculation, their assessment in part (ii) was compromised. Many were able to correctly identify the upfront liquidity requirements as a reason the annuity buyout was not the best option however many incorrectly concluded (either due to incorrect calculation or overall incorrect assumption) that the firm's volatility under the annuity buyout would be greater than the volatility of the de-risked firm.

(i) $\sigma_C^2 = \sigma_F^2 - \sigma_p^2 - 2 \times COV(C,P) = \sigma_F^2 - \sigma_p^2 - 2 \times COV(F-P,P) = \sigma_F^2 - \sigma_p^2 - 2 \times \sigma_p \times (\rho_{F,P} \times \sigma_F - \sigma_p) = 1.6^2 - 1.4^2 - 2 \times 1.4 \times (0.7 \times 1.6 - 1.4) = 1.384$, $\sigma_C = 1.176$

Under approach I
$\sigma_{\text{de-risked pension}}^2 = \sigma_{\text{Tracking Error}}^2 + \sigma_{\text{longevity}}^2$ as these risks are assumed to be uncorrelated.

$\sigma_{\text{de-risked pension}} = ((2.5\% \times 10)^2 + (0.5\% \times 10)^2)^{0.5} = 0.255$

After de-risking, $\sigma_{\text{de-risked F}}^2 = \sigma_{\text{de-risked P}}^2 + \sigma_c^2$ as P and C are uncorrelated now.
$\sigma_{\text{de-risked F}}^2 = 0.255^2 + 1.384 = 1.449$, $\sigma_{\text{de-risked F}} = 1.204$

If use annuity buyout, no pension asset, so $\sigma_{p=0}$, $\sigma_F = \sigma_c = 1.176$

10. Continued

    (ii)   This analysis demonstrates that by simply de-risking their pension plan, a company can realize most of the benefits of annuity purchases without incurring the upfront costs or committing to an irreversible decision (as 1.204 is close to 1.176) and so can increase its credit rating. Also due to the additional upfront cost, the annuity buyout is credit risk neutral because the liquidity drain will mostly offset the benefits of the eliminated volatility.