

ILA LRM Model Solutions

Fall 2018

1. Learning Objectives:

1. The candidate will demonstrate an understanding of the principles of Risk Management.
2. The candidate will demonstrate an understanding of the various sources of risks faced by an insurer.

Learning Outcomes:

- (1b) Evaluate the role of risk management within an insurance company
- (1d) Describe how risk management techniques may be used to manage capital deployed by insurers and how they impact strategic decision making.
- (2a) Identify, categorize and evaluate potential sources of risk in products including but not limited to mortality, morbidity, and lapse.
- (2b) Identify, categorize and evaluate potential sources of risk in investments including but not limited to credit risk, liquidity, equity-based exposure and asset-liability matching.
- (2c) Describe and evaluate the other risks an insurance company faces including operational, marketplace and expense risks.

Sources:

Risk Appetite: Linkage with Strategic Planning

Commentary on Question:

This question assessed candidate's understanding of capital allocation frameworks with a particular focus on understanding RAROC in relation to the hurdle rate. In general candidates performed well in the calculation of RAROC but had trouble providing a recommendation based on their analysis.

Solution:

- (a) Describe the advantages and disadvantages for each of the three frameworks used to allocate capital to different business units as defined in the SOA note *Risk Appetite: Linkage with Strategic Planning*.

1. Continued

Commentary on Question:

This part was not done well; very few candidates identified the capital allocation frameworks and related advantages and disadvantages

- 1) Regulatory (Statutory) Required Capital
 - a. Advantage
 - i. Conservatism included in calculation of reserves and required capital levels, benefits policyholders
 - b. Disadvantages
 - i. Factor based models do not capture company specific view impacting ability to make good business decisions
 - ii. Regulatory frameworks vary across world making it difficult to compare across different regions
- 2) Rating Agency Required Capital
 - a. Advantage
 - i. Helps to understand the requirement to maintain a target credit rating
 - b. Disadvantages
 - i. Prescribed model does not capture company specific views impacting ability to make good business decisions
 - ii. Different rating agencies have different models/requirement
- 3) Economic Capital
 - a. Advantages
 - i. Platform to consistently compare business lines, risks and geographic regions
 - ii. Captures company specific view aligning business decision
 - b. Disadvantage
 - i. Still subject to regulatory and rating agency constraints

(b)

- (i) Your coworker states ABC should focus on growing the line of business with the highest profit margin. Critique their statement.
- (ii) ABC's target hurdle rate is 7%. Recommend the optimal business strategy for each product line. Justify your answer.

Commentary on Question:

This part of the question was answered well. Most candidates derived the necessary formulas and performed the calculations correctly. For the recommendation, some candidates did not fully justify their response or did not provide a recommendation for each product. Some candidates did not calculate the total RAROC and missed the diversification benefit between the lines of business.

1. Continued

- (i) The statement is incorrect because:
- Profit margin does not fully consider underlying risks and capital
 - An effective measure needs to incorporate the level of risk and reflect risk appetite so a measure like RAROC should be used
 - RAROC allows for comparison across different types of risk and businesses while profit margin is not appropriate
- (ii) $RAROC = [PV(\text{Underwriting profit}) + PV(\text{investment income on capital})] \times (1 - \text{tax rate}) / PV(\text{required capital})$

Where $PV \text{ Underwriting profit} = \text{Profit Margin} \times PV(\text{Premium})$

- 1) $RAROC \text{ for Universal Life} = [15 \times 0.13 + 2] \times (1 - 0.21)/30 = 10.4\%$
- 2) $RAROC \text{ for LTC} = [35 \times 0.16 + 5] \times (1 - 0.21)/120 = 7.0\%$
- 3) $RAROC \text{ for Annuities} = [50 \times 0.22 + 10] \times (1 - 0.21)/300 = 5.5\%$
- 4) $RAROC \text{ Total} = [(15+35+50) \times 0.19 + 17] \times (1 - 0.21)/400 = 7.0\%$

Recommendation

- 1) Universal Life RAROC is greater than the hurdle rate of 7% therefore value is created by investing in UL. Recommendation is to continue to increase investment in Universal Life to increase sales
 - 2) LTC is neutral with RAROC of 7.0%. Recommendation is to investigate ways to increase profitability, however the products does not need immediate attention.
 - 3) Annuities RAROC of 5.5% is below the hurdle of 7% and therefore is destroying value. Recommendation is to review the product immediately; product could be reinsured, price increased, or reducing/closing sales. Care needs to be taken as diversification exist between UL, LTC and Annuities since the Total RAROC is at the hurdle rate of 7% showing capital diversification.
- (c) ABC is looking to reinsure its Annuity business on a funds-withheld basis. Under this agreement, ABC will continue to manage the assets backing the liabilities and maintain administration of the policy and claims systems. Describe the impact of the reinsurance arrangement on the following risk categories:
- Market risk
 - Insurance risk
 - Liquidity risk
 - Credit risk
 - Operational risk

1. Continued

Commentary on Question:

Candidates did fairly well but there was some confusion on the treatment of fund withheld reinsurance.

- 1) Market risk - No Change. ABC continues to manage the assets under the FWH agreement
- 2) Insurance risk – Decreases. Insurance risk (lapse, mortality) is shared with the reinsurer. This is partially offset through the loss of the natural hedge between the Annuity and Life (UL) Businesses
- 3) Liquidity risk – Decreases. In stress scenarios the reinsurer pays a portion of claims
- 4) Credit risk – Increases. There is the potential for the reinsurer to default, risk is partially mitigated through FWH but higher than without reinsurance
- 5) Operational risk – Increases. ABC is required to administer the treaty

2. Learning Objectives:

2. The candidate will demonstrate an understanding of the various sources of risks faced by an insurer.
3. The candidate will demonstrate an understanding of important risk measurement techniques along with their uses and limitations, and be able to perform risk measurement calculations.

Learning Outcomes:

- (2a) Identify, categorize and evaluate potential sources of risk in products including but not limited to mortality, morbidity, and lapse.
- (2b) Identify, categorize and evaluate potential sources of risk in investments including but not limited to credit risk, liquidity, equity-based exposure and asset-liability matching.
- (3a) Analyze and evaluate risk measures & estimators (e.g., Value-At-Risk, Conditional Tail Expectations, etc.)

Sources:

The xVA Challenge, Ch.7, Credit Exposure and Funding

The xVA Challenge, Ch. 17, Wrong-Way Risk

Commentary on Question:

This question tests candidates on their understanding of measuring counterparty credit risk, the effect of netting, and the limitations of VaR when measuring credit exposure.

Solution:

- (a) Define netting in the context of counterparty credit risk.

Commentary on Question:

Candidates generally did well in defining the effect of netting. Full credit is given when the benefit of diversification is discussed in the context of counterparty credit risk.

Netting effectively allows the future values of different transactions to offset one another thanks to contractual terms. Netting provides diversification benefit when evaluating counterparty credit risk, depending on the correlation between different transactions.

2. Continued

(b) Assume:

- Scenarios have equal weight
- Mark-To-Market (MTM) values are positively correlated

Calculate the total netting benefit. Show all work.

Commentary on Question:

Candidates generally did well in Part (b) in correctly calculating the total netting benefit and showing supporting calculation work.

Under each scenario,

$$\text{total exposure with no netting} = \sum \max(\text{trade future value}, 0)$$

$$\text{total exposure with netting} = \max(\sum \text{trade future value}, 0)$$

In Scenario 1,

$$\text{total exposure with no netting} = \max(-10, 0) + \max(15, 0) = 15$$

$$\text{total exposure with netting} = \max(-10 + 15, 0) = 5$$

$$\text{netting benefit} = 15 - 5 = 10$$

The remaining calculations are shown in table below:

	Future Value		Total Exposure		Netting Benefit
	Trade 1	Trade 2	No Netting	With Netting	
Scenario 1	-10	15	15	5	10
Scenario 2	-15	-20	0	0	0
Scenario 3	20	10	30	30	0
Expected Exposure			15	11.7	3.3

Given scenarios have equal weight,

$$\text{total expected exposure with no netting} = (15 + 0 + 30) / 3 = 15$$

$$\text{total expected exposure with netting} = (5 + 0 + 30) / 3 = 11.7$$

$$\text{Total netting benefit} = 15 - 11.7 = 3.3$$

(c) Describe the deficiencies of Value-at-Risk (VaR) in quantifying credit exposure.

Commentary on Question:

Part (c) intends to test candidates' understanding of why measuring credit risk can be more complex than what VaR can handle. Many candidates listed the general limitations of VaR (such as incoherent measure, normal distribution assumptions, etc.), but failed to discuss the specific deficiencies related to quantifying credit exposure.

2. Continued

In quantifying credit exposure, there are additional complexities that VaR cannot properly address:

Time Horizon

- Exposure needs to be measured over multiple time horizons; thus, one needs to consider the “aging” of transactions to understand future contractual payments and changes such as cashflows, termination events, exercise decisions and collateral postings. These aspects are neglected in VaR models due to the short time horizon used.
- Exposures are measured at longer time horizon in the future; the trend (or “drift”) of market variables is relevant. This is also ignored in VaR models due to the short time horizon used.

Risk Mitigants

- Exposure is typically reduced by risk mitigants such as netting and collateral, and the impact of these mitigants must be considered to properly estimate future exposure. These elements are not considered in VaR models.

Application

- VaR is a risk management approach. Exposure must be defined for both risk management and pricing. This creates additional complexity in quantifying exposure that VaR alone isn't sufficient to support.

- (d) JOE Life decides to mitigate their credit risk by purchasing a Credit Default Swap.
- (i) Describe how JOE can minimize their Wrong Way Risk in this transaction.
- (ii) Identify challenges JOE will face in quantifying this risk.

Commentary on Question:

Most candidates demonstrated a fair understanding of the concept of wrong way risk and were able to discuss the challenges in quantifying this risk. In part (i) on minimizing wrong way risk, the most obvious mitigation is by purchasing CDS (Credit Default Swap) with a counterparty with uncorrelated credit risk. Some candidates offered other solutions, which earned credit as long as the rationale was explained.

2. Continued

- (i) Wrong way risk arises if there is strong correlation between the credit quality of the reference entity of the CDS and the counterparty. Wrong way risk can be minimized by entering the CDS with a counterparty with uncorrelated credit risk.
- (ii) *Uninformative historical data* – wrong way risk may be subtle and not obvious in empirical data.
Misspecification of relationship - the way in which the dependency is specified may be inappropriate. Rather than being the result of correlation, it may be the result of causation.
Direction – it may not be clear on the direction of the wrong way risk.

3. Learning Objectives:

4. The candidate will demonstrate an understanding of the principles of modeling, cash flow testing and asset-liability matching, and perform related calculations.

Learning Outcomes:

- (4a) For an ALM model
 - (i) Select appropriate assumptions and scenarios
 - (ii) Model dynamic behavior of both assets and liabilities
 - (iii) Model and explain various strategies, including hedging
 - (iv) Analyze and evaluate results (including actual v. projected differences)
 - (v) Recommend appropriate strategies
- (4c) Evaluate the principles of Cash Flow Testing to help in understanding the underlying risk and to assess their impact on capital and surplus

Sources:

LRM-119-14: Chapter 13 of Valuation of Life Insurance Liabilities, Lombardi

Commentary on Question:

This question tested the candidate's understanding of how product design creates risk and how that risk is reflected in actuarial assumptions.

Solution:

- (a) For each of the four products offered by Simple Life, analyze how the following factors will impact the lapse assumption:
 - (i) Product design
 - (ii) Simple Life's distribution method

Commentary on Question:

To receive full credit, the candidates are expected to identify at minimum a couple product design features for each product and analyze how they would impact the lapse assumption.

Most candidates did well in part (i) of the question. For part (ii), some candidates focused on the commission structure and rates, instead of the distribution method. Credit wasn't given for this type of answer.

(i)

Level Premium Term

- No cash value and convertibility would lead to a lower lapse assumption.
- Price is lower than competition, which will also lead to lower lapse.
- Shock lapse is expected at the end of level term period.

3. Continued

Variable Annuities

- Presence of surrender charge in the first 10 years will reduce lapse. Lapse is expected to increase after the surrender charge grades off. Expect a shock lapse when the surrender charge reaches \$0
- GMDB/GMWB would significantly lower lapse if they are in the money.
- Comparing with competition, the limited fund offering may increase lapse.
- Not allowing partial withdraw will increase lapse if policyholders need to access fund value

Universal Life

- Presence of surrender charge in the first 10 years will reduce lapse. Lapse is expected to increase after the surrender charge grades off. Expect a shock lapse when the surrender charge reaches \$0
- Allowing partial withdraw will decrease lapse.
- 3% guaranteed crediting rate floor will create situations where the guarantee is in the money which will reduce lapses

SPIA

- Lapse rate should be zero due to the single premium and no cash value nature of the product. No incentive for policyholders to lapse after issue.

(ii)

Simple Life distributes through an independent brokerage system. The brokers are not affiliated with Simple Life and have access to other products. This may increase lapse as brokers are incentivized to earn more compensation through replacement activities.

Brokers are responsible for their own training. This may lead to uneducated brokers who may not be able to provide quality service after issue, resulting in higher lapses.

(b) For Simple Life's Universal Life product:

- (i) Describe the parameters that would impact a dynamic lapse rate formula
- (ii) Recommend an approach to set the parameters in part (i)

Commentary on Question:

For (i), many candidates received partial credit for identifying some of the parameters. For (ii), most candidates didn't do well because they failed to make a clear recommendation on how to set the parameters. Many made general comments or high-level approaches without specifications, which didn't receive credit.

3. Continued

Surrender Charge Schedule

- Surrender charge rate grading down to zero in 10 years. Lapse generally increases as surrender charge decreases.
- Set surrender charge in accordance to the pricing rates. Lapse rate grades up over time and include a spike when surrender charge hits zero.

Market/Competitor Rate

- This is the rate that the policyholders could receive elsewhere in the market. A higher market/competitor rate would lead to higher lapses as policyholders seek higher return.
- Identify the main competitor products that Simple Life's UL product competes with. Set the market rate to be the average of the crediting rates of the competitor products. Monitor the crediting rates movement for those products and update this market rate parameter periodically.

Crediting Rate

- This is the rate that policyholders earn on their policy value. Lapse will generally be higher with a lower crediting rate (comparing with market).
- Set the credit rate in accordance to the defined formula, which is the greater of the underlying portfolio earned rate minus a 2% spread, and five-year treasury bond yield plus 0.25%, subject to a 3% floor. Earned rate and treasury bond yield needs to be updated periodically to reflect market movement. If the 3% credit rate floor kicks in, set a very conservative lapse rate (for example, 1%).

Policy Duration/Attained Age

- As the policies stay in force longer and policyholders get older, it is less likely to they would lapse their policies.
- Set the lapse assumption so that it varies by policy duration and attained age.

- (c) Simple Life is focused on minimizing disintermediation risk.
- (i) Identify which product has the least amount of disintermediation risk. Justify your response.
- (ii) Explain the impact on mortality risk if sales shift to this product.

Commentary on Question:

Many candidates answered Single Premium Term Insurance to part (i) with the justification that there is no cash value. This is incorrect, as cash value is not the only source of disintermediation risk.

3. Continued

If a candidate did not answer part (i) correctly, they did not lose credit for part (ii) providing they were able to explain how SLIC's mortality risk profile would change if sales shifted to the product they proposed in part (i).

To receive full credit, candidates were expected to associate product design features and/or experience factors that could contribute to company mortality risk. For example, if Term was answered in part (i), candidates could point out the fact that there is no reinsurance and the product is underpriced, which would increase mortality risk.

(i)

The product that has the least amount of disintermediation risk for Simple Life is SPIA.

- All premium is paid upfront, so the lapse rate is 0%
- The product has no cash value
- If interest rates rise, policyholders cannot surrender their policy to purchase a new product with better rates

(ii)

SPIA poses longevity risks to Simple Life, which offsets the mortality risks from other life insurance products, such as Term and Universal Life, providing a diversification benefit.

However, if sales shift heavily to SPIA, Simple Life may have too much longevity risk exposure. The fact that SPIA will have very low lapse rate, together with that mortality improvement experience has been higher than expected, will compound the longevity risk.

In addition, it is noted that many of the annuitants also have taken out term life insurance contracts with "We-Serve-the-Healthy" Life. This indicates that there could be anti-selection involved and the mortality of the annuitants maybe lower than the pricing mortality, diminishing the diversification benefits between longevity and mortality risks as expected.

4. Learning Objectives:

3. The candidate will demonstrate an understanding of important risk measurement techniques along with their uses and limitations, and be able to perform risk measurement calculations.

Learning Outcomes:

- (3a) Analyze and evaluate risk measures & estimators (e.g., Value-At-Risk, Conditional Tail Expectations, etc.)

Sources:

How Fair Value Measurement Changes RM Behavior in the Insurance Industry SoA-
Rosner 2013

LRM 112-14: Stress Testing OFSI E-18

Commentary on Question:

Commentary listed underneath question component.

Solution:

- (a) Describe the differences in fair value techniques between GMAB, GMDB and GMIB riders under the following valuation frameworks:
 - (i) US Statutory
 - (ii) US GAAP
 - (iii) Market Consistent Embedded Value (MCEV)

Commentary on Question:

Part (a) tests understanding of the methods used to apply fair value under different reporting bases. To get full credit, candidates needed to explain how fair value was applied when applicable, and differences with fair value when it was not applicable.

US Stat:

Fair value is not used to value any of these riders. All reserves are valued under AG43 and capital is valued under C3 Phase II.

AG43 reserve = max(CTE 70 based on real word scenarios, Standard Scenario)

C3 Phase II = max(CTE 90, Standard Scenario)

US GAAP:

GMAB: Held at fair value. GMDB/GMIB: Not held at fair value

GMAB: Valued using best estimate non-economic assumptions and risk neutral economic assumptions with risk margins.

GMDB/GMIB: Valued under SOP 03-1

4. Continued

MCEV:

Fair value applied to all riders.

Differ from US GAAP in treatment of

Income taxes: Treated as a cashflow rather than a deferred tax liability

Risk margins: Determined using a cost of capital approach

Nonperformance Risk: Provide for liquidity premium rather than non-performance risk

- (b) Describe the impact the enhanced GMDB and GMIB riders will have on earnings volatility under the following valuation frameworks:
- (i) US Statutory
 - (ii) US GAAP
 - (iii) MCEV

Commentary on Question:

Part (b) tests understanding of how different reporting standards can create conflicting objectives in risk management practices. The case study indicates that the Company is already hedging economic liability.

Some candidates confused reserve volatility with earnings volatility. If reserves are stable, that could create earnings volatility if the investment income is behaving differently than reserves changes.

US Stat:

Reserves and capital will have varying level of sensitivity to changes in interest rates and equities, as they are based on mix of stochastic and deterministic components. Will not move consistently with fair value of assets, creating volatility in income statement.

US GAAP:

Earnings volatility may increase volatility. US GAAP rate includes nonperformance risk and risk margins, which will be different than the hedging target.

MCEV:

This is a fair value method, so there should be little volatility, but some will arise through use of frictional costs and liquidity premium.

4. Continued

- (c) Describe the goals of Stress Testing.

Commentary on Question:

Tested goals of stress testing. Full credit was given for listing and explaining each goal. Candidates generally did well on this part.

Risk Identification and controls:

Include stress testing at various levels from line of business to overall strategy.

Address institution wide risks

Provide Complementary Risk Perspective

Complement other risk quantification methodologies. Assess robustness of models to economic and financial changes. Help identify concentrations or interactions that could threaten solvency.

Support Capital Management

Identify severe threats such as a change in market conditions that could severely impact the company.

Improve Liquidity Management

Asses liquidity profiles and adequacies of buffers in case of institution-specific or market wide stress events.

- (d) Simple Life has decided to implement the product improvements proposed in the case study on their variable annuity business. Recommend three stress tests they could implement to strengthen their Stress Testing Program. Justify your answer.

Commentary on Question:

Question relates back to case study. New riders introduce new risk which are not covered in existing stress testing. To get full credit, candidate had to introduce three tests and explain how this test helped manage a new risk created by adding a new product feature.

Additional Economic Stress tests:

New fund families may expose SL to new sensitivities, especially if these are more volatile than existing funds. Need to test correlation between funds to ensure balance. SL is exposed to customer's choosing the most risky funds, and having these funds move against them in extreme market conditions

Mortality Risk

New GMDB rider will add mortality risk, especially if interest rates move lower bringing GMDB riders into the money. Company should test a combination of lower returns plus higher mortality to see that this rider is adequately priced.

4. Continued

Longevity Stress:

New GMIB rider introduces potential longevity risk, especially as annuity purchase amount is based on maximum of 5% accumulation of initial deposit and account value. Company should test lower returns with a higher election of GMIB and increased longevity. The use of dollar-for-dollar partial withdrawals makes this potentially worse as this proposal does not include an adjustment to the initial deposit.

Partial Withdrawal test:

Use of dollar-for-dollar partial withdrawal can increase the relative payment when the $AV < DB$. Under this proposal, a partial withdrawal will reduce the ratio of the Account Value to the death benefit, which further increases the cost of the GMDB rider. Company should test combination of higher partial withdrawals, lower returns and higher mortality.

For GMIB, lower partial withdrawals will keep account value high, and will increase minimum payments. Company should test combination of lower partial withdrawals, higher longevity and lower returns.

Operational Risk:

New plans and options are being added quickly. Stress test the operational capacity of SL by adding many different combinations of assets and riders to see if Company can adequately manage the additional requirements.