

# ILA LFMU Model Solutions

## Spring 2022

### 1. Learning Objectives:

5. The candidate will understand the fundamental purpose of capital, and its determination and stakeholders.

### Learning Outcomes:

- (5a) The Candidate will be able to describe and evaluate the theory of capital (including economic capital), and evaluate its applicability for various purposes and its value to different stakeholders.

### Sources:

Economic Capital for Life Insurance Companies, SOA Research Paper, Oct 2016 (excluding sections 5 & 7)

Economic Capital A Case Study to Analyze Longevity Risk, Risk & Rewards, Aug 2010

### Commentary on Question:

*This question tested candidates' understanding of the Economic Capital framework, and the impact of the mortality assumption on liability cash flow projections. For the EC framework portion of this question, while most candidates were able to describe the main difference of the two approaches and make the correct choice under each scenario, few candidates could demonstrate the in-depth understanding needed for some parts of this question. For the mortality assumption portion, most candidates showed the basic understanding, but failed to demonstrate full knowledge.*

### Solution:

- (a) Compare and contrast the two approaches based on each of the following management considerations:
  - (i) We use buy-and-hold strategy for fixed interest investment and intend to closely match assets and liabilities.
  - (ii) We want to know how many assets are required to cover liabilities with some degree of security.
  - (iii) We closely monitor changes in market conditions and respond accordingly. We want to reflect these actions in the Economic Capital framework.

## 1. Continued

- (iv) We believe that yield curves eventually go back to normal after extreme market events.
- (v) We want to be consistent with the reality of capital management and regulatory reporting that requires capital to be calculated on an annual basis.
- (vi) We hope to easily calibrate EC to a target security level.

### **Commentary on Question:**

*Most candidates were able to demonstrate an understanding of the two approaches when it comes to the basic concepts and generally did well on parts (i), (ii), (v), and (vi).*

- (i)
  - Even a buy-and-hold strategy is regularly monitored and rebalanced.
  - A runoff EC model is more appropriately aligned with its long term focus, which would emphasize risks such as defaults over the investment horizon.
  - Finite risk horizon approach suggests a strong focus on the tradeable value of the insurance portfolio, suggesting market-based values cannot be ignored, even for buy-and-hold strategies.
- (ii)
  - Both approaches can achieve that goal
  - Run off approach investigates a runoff of the business,
  - While the finite risk horizon approach looks at transfers to a third party.
- (iii)
  - A one-year model using market consistent valuations is inherently more aligned with financial markets and therefore with market-based risk mitigation strategies that can be or are being undertaken, including financial derivatives, reinsurance or securitization transactions
  - A runoff approach with no intermediate valuation metrics may become disconnected from financial market conditions. However, it is appropriate where the management action model used is realistic and explicitly tied to a formal business strategy.
- (iv)
  - Both the adjusted market-based and runoff cash flow methodologies embed strong assumptions about the mean reversion of asset returns after extreme market events.

## 1. Continued

- A runoff model will typically make an assumption about the expected level of yield curves based on historic experience that is different from the future level implied by the long end of the initial market yield curve. Whereas the Solvency II adjusted market-based model incorporates these effects by ignoring parts of the initial yield curve and extrapolating quickly to real world expectations.
- The effects of both are to introduce a type of mean reversion into the measurement of capital that diverge strict short term market pricing or market implied risk levels.
- The nature of this mean reversion assumption is highly subjective and difficult to reliably estimate. The evidence for these effects is also mixed and dependent on the particular time periods, asset types and economies included.

(v)

- When applied over a one-year time period, the finite risk horizon approach acknowledges this reality and better aligns itself with the actual management of the company.
- In contrast, the liability runoff approach attempts to find the amount of capital today that will provide sufficient protection for the lifetime of the portfolio, thus ignoring the reality that capital levels will be annually reevaluated.

(vi)

- It is generally viewed as easier to calibrate EC to a target security level under a finite risk horizon approach, and there is a significant body of statistics available regarding corporate bond defaults against which a reasonable calibration can be made.
- Calibration of a liability runoff approach to an external data source is more difficult as:
  - The block of business (and therefore the risk exposure) will typically be reducing over time.
  - The projection would typically not include all risks for all time periods; in particular, new business may be included for only a limited time period, if at all.

- (b) Recommend changes to the current liability projection model in order to accomplish ABC's intended objective.

### **Commentary on Question:**

*Most candidates pointed out the assumptions based on historical experience may have deviated over time due to various reasons, and provided responses regarding how to fix/improve these assumptions. Some candidates recognized the need to use different discount rates, as well as taking into account of extreme scenarios such as a pandemic. But few candidates touched on other aspects discussed in the source material.*

## 1. Continued

- Volatility can rise from a mismatch between the population used to generate the mortality table and the population of lives in ABC's customers.
- Recommend to review historical deviation of mortality from current table and incorporate volatility in based table projection.
  - May use combination of SS table and company data based on credibility.
- For mortality improvement:
  - Reflected historical levels of correlation by age and genders over time periods.
  - Then project volatility in future mortality improvement in manners consistent with how the factors were derived from the historical data.
- Reflect the possibilities of extreme mortality occurrences, such as a pandemic or earthquakes
- May use different discount rates depending on the asset portfolios, i.e. different asset portfolios may have different asset risk that would need to be reflected in Economic Capital
- Consider using formula based mortality rate depending on market condition for certain products, if historical data shows correlation between them.

## 2. Learning Objectives:

2. The candidate will understand and apply U.S. Statutory valuation principles and methods applicable to individual life insurance and annuity products issued by U.S. life insurance companies.

### Learning Outcomes:

- (2b) Describe, apply and evaluate the Principle-Based Reserves valuation methods and techniques for specific insurance products under U.S. Statutory rules.

### Sources:

LFM-143-20: Fundamentals of the Principle Based Approach to Statutory Reserves for Life Insurance.

### Commentary on Question:

*This question tested the candidates' knowledge of principle-based reserves and the rationale behind the regulations and other professional guidance.*

### Solution:

- (a) Regarding starting assets and the use of a discount rate, describe 2 approaches that can be used to calculate deterministic reserve.

#### Commentary on Question:

*To receive full credit, candidates had to include an accurate description of the scope of cash flows used in each approach, a description of the discount rate used for the PV of cash flows approach, and an indication that all projected benefits and expenses must be liquidated by the end of the projection horizon in the direct iteration method.*

*Most candidates received at least partial credit by correctly naming each approach. The model solution reflects the approach names used in LFM-143-20, but names from other source material were treated as equivalent such as "Gross Premium Valuation method" and "Prospective method" in lieu of "PV of cashflows," and "Retrospective method" in lieu of "Direct iteration."*

*Describing the discount rate for the PV of cash flows approach as the net asset earned rate (or NAER for short) was seen as equivalent to the description in the model solution.*

*Common errors for the PV of cash flows approach included describing the cash flows as either liability only or including inflows from investment income only (i.e., not including premium cash flows). Many candidates also mistakenly described the discount rate as prescribed. Most candidates failed to mention that all policy obligations must be liquidated by the end of the projection period for the direct iteration method, which is a fundamental component of the calculation.*

## 2. Continued

Two approaches- PV of cashflows and direct iteration

PV of cashflows:

DR is APV of benefits, expenses - APV of premiums, less PIMR (pre-tax interest maintenance reserve). Cashflows should also include policy loan, separate accounts, reinsurance, etc. using the path of discount rates for the corresponding model segment.

Direct iteration:

Assigns an amount of starting assets which, when projected along with all premiums and investment income, results in the liquidation of all projected future benefits and expenses by the end of the projection horizon.

- (b) Describe the purpose of the following exclusion tests:
- (i) Deterministic Exclusion Test (DET)
  - (ii) Stochastic Exclusion Test (SET)

### **Commentary on Question:**

*Most candidates received partial credit by explaining that passing each test allows the insurer to avoid calculating the corresponding reserve. Few candidates explained the purpose of the tests, which is to identify cases where the deterministic/stochastic reserves are highly unlikely to exceed the net premium reserve.*

*Full credit responses also described the property that each test identifies – the sufficiency of premium revenue to fund liabilities in the case of the DET, and the lack of interest rate and asset return volatility sensitivity in the case of the SET. Another acceptable description of the DET is that it is used to demonstrate that the sum of valuation net premiums for all future years is less than the sum of the corresponding guaranteed gross premiums.*

- (i) The deterministic exclusion test (DET) is designed to identify those groups of policies that have anticipated premium revenue that is adequate to fund the future obligations of the policy group and likely to produce a deterministic reserve that, if calculated, would not provide the basis for the minimum reserve (i.e. would not exceed the net premium reserve).
- (ii) The stochastic exclusion test (SET) is intended to identify those groups of policies that are insensitive to interest rate and asset return volatility risk and are likely to produce a stochastic reserve that, if calculated, would not provide the basis for the minimum reserve (i.e. would not be the greatest of the three reserve components).

## 2. Continued

(c) Critique the following statements:

A. *Term products are eligible for DET while ULSG is not. While premiums are low during the level period, there will always be more than enough premium post level period to fund the policy so that there's no need to calculate a deterministic reserve.*

B. *ALF's term and ULSG products are eligible for SET.*

**Commentary on Question:**

*Most candidates correctly identified that both Term and ULSG products are eligible for DET. The key issue with the statement regarding the post level period is the impact of shock lapse in the post level period. Some candidates attempted to refute the statement by discussing prescribed assumptions and limits from actuarial guideline XXX and/or the net premium reserve rules for VM-20, neither of which are relevant to the accuracy of the statement or the calculation of the deterministic reserve.*

*No partial credit was received for suggesting that Term or ULSG policies are sometimes eligible for the DET.*

*Candidates generally did well critiquing statement B. Candidates who confirmed that each product was eligible for the SET but failed to mention that this is due to the lack of a clearly defined hedging strategy received partial credit.*

A. Without the consideration of PLT shock lapses and adverse selection, term policies will be able to fund future obligations because the PLT (Post Level Term) premium is much higher than the level term premium. However, a lot of policyholders surrender their policies at renewal due to sharp increase in PLT premium rates, leaving a lot of term products underfunded in later years. In other words, the anticipated premium revenue is inadequate to fund the future obligations. Therefore, it is not eligible for the DET. It is also true that ULSG is ineligible for the DET.

B. True – both products are eligible for SET because there is no Clearly Defined Hedging Strategy.

## 2. Continued

- (d) You are given one of the projected scenarios from ALF's cash flow model.

Projection period	0	1	2	3	4
Statement value of assets	2,000	400	-200	-650	1,000
One – Year Treasury Rate	N/A	1.00%	1.20%	1.50%	2.00%

Calculate the scenario reserve. Show all work.

### Commentary on Question:

*To receive full credit, the candidate must calculate the greatest present value of accumulated deficiency (GPVAD) and demonstrate understanding that the reserve is the sum of time 0 asset and the GPVAD. Most candidates successfully calculated the scenario reserve. Some candidates ignored multiplying the treasury rate by the 1.05 factor. Some candidates failed to include the statement value of assets at time 0.*

	Period	0	1	2	3	4
1. Statement value of assets		2,000	400	-200	-650	1,000
2. One - Year Treasury Rate			1.00%	1.20%	1.50%	2.00%
3. Negative of the Statement of value of assets		-2,000	-400	200	650	-1,000
4. 105% of 1 year treasury			1.05%	1.26%	1.58%	2.10%
5. Accumulative Discount Factor		1	0.9896	0.977	0.962	0.942
6. Discounted negative accumulated deficiencies		-2,000	-395.84	195.46	625	-942
7. Greatest present value of accumulated deficiency (GPVAD)		625				
Starting Reserve (Time 0 Asset + GPVAD)		2,625.39				



### 3. Learning Objectives:

4. The candidate will understand the fundamental features of the U.S. and International regulatory framework.

#### Learning Outcomes:

- (4a) The features of the U.S. regulatory regime and the forces which are shaping the evolution of the regime.
- (4b) The features of the emerging International regulatory framework, and its development in Canada.

#### Sources:

LFM-144-20 Modernization of Insurance Company Solvency Regulations in the US and Implications

LFM-151-22 IAIS-International Capital Standard Conframe

LFM-851-22 OSFI - Life Insurance Capital Adequacy Test

#### Commentary on Question:

*This question tested candidates' knowledge of the U.S. and international regulatory capital requirements.*

#### Solution:

- (a) Describe how capital for insurance risk should be addressed in the following:
  - (i) United States
  - (ii) Canada
  - (iii) European Union

#### Commentary on Question:

*To receive full credit, candidates had to describe how insurance risk specifically is addressed in the given capital frameworks. Most candidates listed or described broader capital requirements in each governing body, which received partial credit. Candidates generally did not do well on this part of the question.*

- (i) Insurance risk is calculated under the U.S. RBC framework within the C-2 component. It is a formulaic approach, where different formulas are utilized for P&C, health, and life insurance companies. For insurance risk, a factor is multiplied by the net amount at risk and summed, with a covariance adjustment, across different RBC components.

### 3. Continued

- (ii) Capital for insurance risk in Canada is part of both available capital and the Surplus Allowance. Within the Surplus Allowance, provisions for adverse deviations also account for insurance risk within the total liability. Components related to insurance risk can also be approximated with shocks in assumptions like mortality and lapse for one year.
  - (iii) In the European Union, insurance risk is addressed via a stress approach. The stresses follow a dynamic approach using the IAIG's current balance sheet pre-stress and the IAIG's balance sheet post-stress; changes in net asset value under the stresses are then used as a proxy for changes in capital resources.
- (b) Determine whether the Total Ratio and Core Ratio meet the Office of the Superintendent of Financial Institutions (OSFI)'s minimum requirement and supervisory target, respectively. Show all work.

**Commentary on Question:**

*Candidates generally did well on this part of the question. To receive full credit candidates had to both show and calculate the formulas for the Core and Total Ratio, explain what the minimum and supervisory targets were for each, and conclude whether the calculated ratios met those targets. Candidates were not penalized for assessing whether the targets were met if they wrote the wrong formula or had an arithmetic error.*

$$\begin{aligned} \text{Total Ratio} &= \frac{\text{Tier 1 Capital} + \text{Tier 2 Capital} + \text{Surplus Allowance} + \text{Eligible Deposits}}{\text{Base Solvency Buffer}} \\ &= \frac{1.3 + 1.2 + 0.2 + 0.4}{3} \\ &= 103\% \end{aligned}$$

Minimum target = 90%, supervisory target = 100%, so the Total Ratio meets both targets

$$\begin{aligned} \text{Core Ratio} &= \frac{\text{Tier 1 Capital} + 70\% * \text{Surplus Allowance} + 70\% * \text{Eligible Deposits}}{\text{Base Solvency Buffer}} \end{aligned}$$

### 3. Continued

$$= \frac{1.3 + 0.7 * 0.2 + 0.7 * 0.4}{3}$$
$$= 57\%$$

Minimum target = 55%, supervisory target = 70%, so the Core Ratio meets the minimum target but not meet the supervisory target.

#### **4. Learning Objectives:**

2. The candidate will understand and apply U.S. Statutory valuation principles and methods applicable to individual life insurance and annuity products issued by U.S. life insurance companies.
6. The candidate will understand important insurance company issues, concerns and financial management tools.

#### **Learning Outcomes:**

- (2b) Describe, apply and evaluate the Principle-Based Reserves valuation methods and techniques for specific insurance products under U.S. Statutory rules.
- (2c) Describe and evaluate the fundamental features and design of the U.S. Statutory regulatory system.
- (6a) The candidate will be able to describe, apply and evaluate considerations and matters related to:
  - Insurance company mergers and acquisitions
  - Management of variable deferred annuities
  - Embedded Value determinations
  - VM-20 financial impacts
  - Rating agency considerations
  - Model Audit Rule and Sarbanes-Oxley Section 404 considerations
  - Source of Earnings analysis

#### **Sources:**

Statutory Valuation of Individual Life and Annuity Contracts, Claire, D., Lombardi, L. and Summers, S., 5th Edition, 2018

- Chapter 19: Variable Deferred Annuities, Section 19.4

LFM-849-22 Implementation of Requirements for Principle-Based Reserves for Variable Annuities – 2021 Edition of VM-21 (required questions are listed on the first page of this study note)

Principle-Based Reserves Interactive Model

Lombardi, Chapter 24 Addendum for Variable Annuity PBR Updates

#### **Commentary on Question:**

*The question tested the candidates' understanding of the risks underlying a product and how such risks drive costs and reserves.*

## 4. Continued

### Solution:

(a) Critique the following statements:

- A. *If the assumed volatility increased, the rider cost line would steepen causing the calculated reserve to decrease.*
- B. *If the corresponding graph was created for the 5% rollup GMDB, both the revenue and cost lines would increase over time due to the higher level of risk.*
- C. *It is unnecessary to use the full stochastic model to measure the cost of the return of premium GMDB since the guaranteed amount never changes.*

### Commentary on Question:

*This part of the question tested the candidates' knowledge of the risks of GMxBs and the implications for costs, revenue and reserves. It requires understanding of the risks of different types of guarantees, and the drivers of costs and reserves.*

*Candidates generally did well on statement C, but struggled with statements A and B. Common mistakes were related to understanding underlying reasons for the effects of inputs, such as volatility.*

- A. When volatility increases, there are more scenarios with higher increases in death benefits. It is correct that the cost curve will steepen. However, because the revenue curve is not as sensitive to volatility, the reserve increases as the cost curve steepens.
- B. It is correct that the 5% rollup GMDB will cause the cost line to increase over time due to the higher level of risk because 5% rollup is more costly than return of premium benefit. However, the revenue line will most likely stay relatively similar to the revenue line for return of premium GMDB, because the GMDB design doesn't affect the account value and corresponding fees (since rider fees are collected as a percentage of account value).
- C. The statement is incorrect. It is important to use full stochastic model to measure the cost of return of premium GMDB. There is a mismatch between revenue and cost of the guarantee, and volatility and policyholder behavior magnify this mismatch. Using a deterministic model based on historical returns would underestimate the cost of the guarantee.

## 4. Continued

- (b) Describe which factors will cause the following prescribed assumptions in VM-21 to vary with respect to XYZ's VA products with GMDB:
- (i) Full surrender rate
  - (ii) Partial surrender rate
  - (iii) Mortality rate

**Commentary on Question:**

*This part of the question tested the candidates' knowledge of the principle-based valuation of variable annuities based on the 2019 revisions to VM-21. This part of the question required demonstrating knowledge of the prescribed assumptions to be used in determining the Prescribed Projection Amount.*

*A common mistake was responses that were not specific to statutory reserving, and more specifically to the prescribed assumptions under VM-21.*

- (i) The prescribed full surrender rate is based on a standard table, and will vary with
    - Whether the contract is in the surrender charge period
    - Whether the GMDB is in the money and the level it is in-the-money (ITM)
  - (ii) The prescribed partial surrender rate is based on the type of guarantee
    - Return of premium GMDB has no guaranteed growth rate
    - 5% rollup GMDB has a guaranteed growth rate and has a lower prescribed rate
  - (iii) For GMDB, the mortality factors vary only by attained age.
- (c) Describe two methods that are available to XYZ if they choose not to use the Direct Iteration Method.

**Commentary on Question:**

*This part of the question tested the candidates' knowledge of the different approaches to calculating statutory reserves for variable annuities. It requires understanding of the conditions under which certain methods may be acceptable to use.*

*It was common for candidates to only list one method.*

## 4. Continued

Given that the products do not contain any guaranteed living benefits, and only contain the GMDBs, they are eligible for an alternative method that is a non-stochastic, factor-based approach under VM-21 as well. This could be computationally simpler than the NAER and direct iteration methods.

The NAER method involves projecting asset and liability cash flows, then discounting them at the net asset earned rate on additional assets.

- (d) You are given the following Standard Projection calculations for five policies at the model point level and at the aggregate level:

	GPVAD	Present value of net liabilities	Cash surrender value
<b>Policy 1</b>	20	210	200
<b>Policy 2</b>	10	190	180
<b>Policy 3</b>	0	200	220
<b>Policy 4</b>	50	295	250
<b>Policy 5</b>	6	155	150
<b>Aggregate</b>	75	1050	1000

Determine which of the two methods for quantifying the impact of aggregation in the standard projection described in the AAA practice note “Implementation of Requirements for Principle-Based Reserves for Variable Annuities – 2021 Edition of VM-21” has a larger impact.

### Commentary on Question:

*This part of the question required candidates to understand the Standard Projection and the impact of aggregation, and why different methods may produce different impacts.*

*The candidates who were successful were able to apply the methods described in this practice note and not just performance of an impact calculation.*

Method 1:

$$\sum \text{GPVAD}_{\text{policy}} - \text{GPVAD}_{\text{Aggregate}}$$

Take the sum of the individual GPVAD:  $20 + 10 + 0 + 50 + 6 = 86$

Aggregate GPVAD: 75

Impact of aggregation for Method 1 =  $86 - 75 = 11$

Method 2:

$$\sum \max(\text{CSV}, \text{PV of Net Liab}) - \sum \text{PV of Net Liab}$$

#### 4. Continued

For each policy, take the greater of CSV and PV of Net Liability:

CSV	PV of Net Liability	Max(CSV,PV of Net Liability)
210	200	210
190	180	190
200	220	220
295	250	295
155	150	155
Total	1,050	1,070

Impact of aggregation for Method 2:  $1070 - 1050 = 20$

Since  $20 > 11$ , Method 2 has the greater impact.



## 5. Learning Objectives:

1. The candidate will understand and apply U.S. GAAP valuation principles and methods applicable to individual life insurance and annuity products issued by U.S. life insurance companies.

### Learning Outcomes:

- (1a) Describe, apply and evaluate the appropriate valuation methods and techniques and related accounting treatments for reserves and related items (e.g., DAC), and other assets and liabilities for specific insurance products under U.S. GAAP. Further, describe and recommend assumptions and margins appropriate to these GAAP reserves.

### Sources:

LFM-848-22 A Comprehensive Guide – Reinsurance, E&Y, 2020, (Sections 1, 2, 4, 7, Appendix D)

### Commentary on Question:

*This question tested the candidates' understanding of accounting treatments of different reinsurance approaches, as well as the ability to calculate reinsurance reserve adjustments and net cost of reinsurance correctly.*

### Solution:

- (a) Calculate the following as required by FASB ASC 944 (formerly FASB 113) based on TOB's product cashflow projections:
  - (i) Reinsurance Benefit Reserve Adjustment at the end of each year.
  - (ii) Reinsurance Expense Reserve Adjustment at the end of each year.
  - (iii) Cost of Reinsurance after Interest at the end of each year.
  - (iv) Fill in the effects of the net cost of reinsurance on TOB's year 1 balance sheet and income statement in the applicable cells below.

## 5. Continued

	Year 1			
	Balance Sheet		Income Statement	
	Debit	Credit	Debit	Credit
<b><i>Recognition of the Cashflows</i></b>				
Cash				
Premiums Ceded				
Benefits Incurred				
Amortization of Acquisition Costs				
<b><i>Recognition of the Adj. to net COR</i></b>				
Reinsurance Recoverable				
Benefits Incurred				
Amortization of Acquisition Costs				
Deferred Policy Acquisition Costs				

Show all work.

### **Commentary on Question:**

*Candidates were generally able to demonstrate knowledge of all the key steps to perform the calculations in parts (i) and (ii). Common errors included using the reinsurance premium instead of gross premium; having the wrong sign for the cash flow adjustments; and not deducting the reinsurance premium from the reinsurance reimbursement calculation.*

*Candidates generally did not perform well on part (iii). Candidates provided either the total of reinsurance benefit reserve adjustment and expense reserve adjustment or the expected net cashflows.*

*Most candidates struggled with part (iv). Candidates in general were not familiar with how transactions should be booked on the financial statements.*

***Please refer to Excel for the calculations and additional comments.***

- (b) Describe the differences in the accounting treatment of the cost of reinsurance with the following changes to the reinsurance transaction:
- (i) YRT
  - (ii) Reinsurance of an existing block of business
  - (iii) Modified Coinsurance

### **Commentary on Question:**

*Candidates need to describe the differences in the accounting treatment to receive full credit.*

## 5. Continued

*For part (i), candidates who received full credit generally discussed the lack of commissions.*

*For part (ii), candidates generally discussed the deferral of gains, but few pointed out the adjustment to net cost of reinsurance calculation.*

*For part (iii), many candidates identified the risk transfer requirements must be met and assets are retained, but few discussed the reserves are also retained under coinsurance with funds withheld.*

- (i) The cost of reinsurance is amortized against expected gross profits rather than expected gross premiums. There are no commissions under YRT, no amortization of acquisition costs in the balance sheet and income statement.
- (ii) For contracts that reinsure existing blocks of business, in the calculation of the net cost of reinsurance, the ceding company is required to include the difference between the amount paid for reinsurance and the net amount of the expense and benefit reserves relating to the underlying policies at the time that the reinsurance contracts become effective. The inclusion of the amount in the net cost of reinsurance calculation results in the deferral of the gain over the remaining life of the underlying policies reinsured.
- (iii) The terms of modified coinsurance contracts are like coinsurance with funds withheld, with the exception that the ceding company retains the reserves in addition to the supporting assets on the underlying policies reinsured. Like coinsurance with funds withheld, the assets typically are segregated from the general investment portfolio. Except for adjusting the expected cash flows under the contract, the accounting for Modco contracts and arrangements structured as coinsurance with funds withheld contracts that meet the risk transfer requirements should be the same as the coinsurance

## 6. Learning Objectives:

1. The candidate will understand and apply U.S. GAAP valuation principles and methods applicable to individual life insurance and annuity products issued by U.S. life insurance companies.

### Learning Outcomes:

- (1a) Describe, apply and evaluate the appropriate valuation methods and techniques and related accounting treatments for reserves and related items (e.g., DAC), and other assets and liabilities for specific insurance products under U.S. GAAP. Further, describe and recommend assumptions and margins appropriate to these GAAP reserves.
- (1b) Describe and apply the requirements, calculations, and disclosures related to GAAP "Targeted Improvements".

### Sources:

LFM-841-20: A Closer Look at How Insurers Will Have to Change their Accounting and Disclosures for Long-Duration Contracts, E&Y, Nov 2018

### Commentary on Question:

*This question tested the candidates' knowledge of U.S. GAAP valuation principles. Candidates generally did well on this question.*

### Solution:

- (a) Calculate the liability for future policyholder benefits (LFPB) at the end of year 2.

Show all work.

### Commentary on Question:

*In general, candidates successfully displayed the formulas and numerical values necessary to determine the net premium ratio and the reserves needed to answer this part of the question. The biggest issue that candidates had with this part of the question was selecting the calculated values from the proper duration to answer the question that was posed to them. Another issue that impacted candidates was discounting cash flows for calculation of later-duration reserves. Some candidates would forget to change the discounting that was used to calculate the cash flows needed to determine the net premium ratio, and then used to determine the discounted cash flows for determining the later-duration reserves. Candidates used several acceptable approaches to determine the reserves they were being asked to calculate, including the prospective and retrospective approaches. Another acceptable approach was to use the goal-seek function in Excel to determine the net premium ratio that will produce a reserve of zero in the last duration.*

## 6. Continued

1. Determine Net Premium Ratio (NPR)

$$\text{NPR} = \text{PVFB}(0) / \text{PVFGP}(0)$$

$$\text{PVFB}(0) = (3806v^1 + 4738v^2 + 5407v^3 + 5561v^4 + 5806v^5), \text{ where } v = (1/1.055) = 0.9478673$$

$$\text{PVFB}(0) = (3806)(0.9478673) + (4738)(0.89845242) + (5407)(0.85161366) + (5561)(0.80721674) + (5806)(0.76513435)$$

$$\text{PVFB}(0) = 3607.58 + 4256.87 + 4604.68 + 4488.93 + 4442.37 = 21400.43$$

$$\text{PVFGP}(0) = 10000v^0 + 8499v^1 + 7476v^2 + 6801v^3 + 6321v^4, \text{ where } v = (1/1.055) = 0.9478673$$

$$\text{PVFGP}(0) = (10000)(1) + (8499)(0.9478673) + (7476)(0.89845242) + (6801)(0.85161366) + (6321)(0.80721674)$$

$$\text{PVFGP}(0) = 10000.00 + 8055.92 + 6716.83 + 5791.82 + 5102.42 = 35666.99$$

$$\text{NPR} = 21400.43 / 35666.99 = 0.60000662$$

2. Determine Liability for Future Policyholder Benefits at End of Policy Year 2 at the end of Year 2 = LFPB(2)

$$\text{LFPB}(2) = \text{PVFB}(2) - \text{NPR} \times \text{PVFGP}(2)$$

$$\text{PVFB}(2) = 5407v^1 + 5561v^2 + 5806v^3, \text{ where } v = (1/1.055) = 0.9478673$$

$$\text{PVFB}(2) = (5407)(0.9478673) + (5561)(0.89845242) + (5806)(0.85161366)$$

$$\text{PVFB}(2) = 5125.12 + 4996.29 + 4944.47 = 15065.88$$

$$\text{PVFGP}(2) = 7476v^0 + 6801v^1 + 6321v^2, \text{ where } v = (1/1.055) = 0.9478673$$

$$\text{PVFGP}(2) = (7476)(1) + (6801)(0.9478673) + (6321)(0.89845242)$$

$$\text{PVFGP}(2) = 7476.00 + 6446.45 + 5679.12 = 19601.57$$

$$\text{LFPB}(2) = 15065.88 - 0.60000662 \times 19601.57 = 3304.81$$

Calculate the LFPB at the end of year 3. Show all work.

## 6. Continued

### Commentary on Question:

*The comments pertaining to part (a) are also applicable to part (b). In addition, some candidates erroneously assume that the 15% excess benefits occurring in year 3 was also applicable to years 4 and 5. Some candidates also tried to adjust premiums paid after year 3 to adjust for the additional benefits paid in year 3. This was not necessary since the problem noted that all assumptions other than benefits paid were not to be modified. Some candidates erroneously tried to grade the reserve previously calculated at the end of year 2 in part (a) to years 3 and later incorporating the excess benefits in year 3. The reserve in part (b) was required to be entirely recalculated with a revised net premium ratio incorporating the additional benefits paid in year 3.*

1. Benefits and expenses paid in year 3 are increased by 15%

$$\text{Revised BenExp}(3) = \text{BenExp}(3) \text{ from Part(a)} \times 1.15$$

$$\text{BenExp}(3) \text{ from Part(a)} = 5407$$

$$\text{Revised BenExp}(3) = 5407 \times 1.15 = 6218.05$$

2. Revised NPR = Revised PVFB(0) / Revised PVFGP(0)

$$\text{Revised PVFB}(0) = \text{PVFB}(0) \text{ from Part (a)} + (\text{Revised BenExp}(3) - \text{BenExp}(3) \text{ from Part(a)}) \times v^3, \text{ where } v = (1/1.055) = 0.9478673$$

$$\text{PVFB}(0) \text{ from Part(a)} = 21400.43$$

$$\text{Revised BenExp}(3) = 6218.05$$

$$\text{BenExp}(3) \text{ from Part(a)} = 5407$$

$$\text{Revised PVFB}(0) = 21400.43 + (6218.05 - 5407) \times 0.85161366 = 22091.13$$

Revised PVFGP(0) = PVFGP(0) from Part (a) since there is no change to gross premiums paid.

$$\text{Revised PVFGP}(0) = \text{PVFGP}(0) = 35666.99$$

$$\text{Revised NPR} = 22091.13 / 35666.99 = 0.61937186$$

3. Remeasured LFPB(3) = PVFB(3) – Revised NPR from Part(b) x PVFGP(3)

$$\text{PVFB}(3) = 5561v^1 + 5806v^2, \text{ where } v = (1/1.055) = 0.9478673$$

$$\text{PVFB}(3) = (5561)(0.9478673) + (5806)(0.89845242)$$

$$\text{PVFB}(3) = 5271.09 + 5216.41 = 10487.50$$

## 6. Continued

Revised NPR from Part(b) = 0.61937186

$$PVFGP(3) = 6801v^0 + 6321v^1 = (6801)(1) + (6321)(0.9478673)$$

$$PVFGP(3) = 6801.00 + 5991.47 = 12792.47$$

$$\text{Remeasured LFPB}(3) = 10487.50 - 0.61937186 \times 12792.47 = 2564.20$$

- (c) Determine the following impacts to the GAAP income statement in Year 3 due to the revised LFPB:
- (i) Remeasurement gain or loss
  - (ii) Change in reserves
  - (iii) Total benefit expense
  - (iv) Change to GAAP income due to revision of assumption (assume change to investment income equals 0)

Show all work.

### Commentary on Question:

*Candidates generally did not do well on this part of the question. Candidates had trouble selecting values from the proper duration. For part (i), some candidates did not correctly identify whether the impact was a remeasurement gain or loss. For part (iv), there were alternative ways to determine the impact to GAAP income, like using a strictly "GAAP income statement approach" involving just those items in a GAAP income statement directly impacted by the change in benefits paid, which would include just the benefits and expenses paid and the change in reserves (liability for policyholder benefits).*

- (i) Remeasurement Gain/Loss(3) = Remeasured Liability at Beginning of Year 3 – Original Liability at Beginning of Year 3

$$\text{Remeasurement Gain/Loss}(3) = \text{Remeasured LFPB}(2) - \text{LFPB}(2) \text{ from Part(a)}$$

$$\text{Remeasured LFPB}(2) = \text{Revised PVFB}(2) - \text{Revised NPR from Part(b)} \times \text{PVFGP}(2) \text{ from Part(a)}$$

$$\text{Revised PVFB}(2) = \text{PVFB}(2) \text{ from Part(a)} + (6218.05 - 5407) \times v^1$$

$$\text{Revised PVFB}(2) = 15065.88 + 811.05 \times 0.9478673 = 15834.65$$

## 6. Continued

Revised NPR from Part(b) = 0.61937186

PVFGP(2) from Part(a) = 19601.57

Remeasured LFPB(2) = 15834.65 - 0.61937186 x 19601.57 = 3693.99

LFPB(2) from Part(a) = 3304.81

Remeasurement Gain/Loss(3) = 3693.99 - 3304.81 = 389.18

Since this result is a positive value, then this is a Remeasurement Loss.

- (ii) Change in Reserves(3) = Remeasured Liability at End of Year 3 -  
Remeasured Liability at Beginning of Year 3

Change in Reserves(3) = Remeasured LFPB(3) from Part(b) -  
Remeasured LFPB(2) from Part(c)(i)

Remeasured LFPB(3) from Part(b) = 2564.20

Remeasured LFPB(2) from Part(c)(i) = 3693.99

Change in Reserves(3) = 2564.20 - 3693.99 = -1129.79

- (iii) Total Benefit Expense(3) = Revised BenExp(3) from Part(b) +  
Remeasurement Loss(3) from Part(c)(i) + Change in Reserves(3) from  
Part(c)(ii)

Revised BenExp(3) from Part(b) = 6218.05

Remeasurement Loss(3) from Part(c)(i) = 389.18

Change in Reserves(3) from Part(c)(ii) = -1129.79

Total Benefit Expense(3) = 6218.05 + 389.18 - 1129.79 = 5477.44

- (iv) Impact to GAAP Income due to Assumption Modification = Total Benefit  
Expense(3) from Part(c)(iii) - Total Benefit Expense(3) Prior to  
Assumption Modification

Total Benefit Expense(3) Prior to Assumption Modification = BenExp(3)  
from Part(b) + Remeasurement Loss(3) Prior to Assumption Modification  
+ Change in Reserve(3) Prior to Assumption Modification

BenExp(3) from Part(b) = 5407

Remeasurement Loss(3) Prior to Assumption Modification = 0



## 6. Continued

Change in Reserve(3) Prior to Assumption Modification = LFPB(3) –  
LFPB(2) from Part(a)

LFPB(3) = PVFB(3) from Part(b) – NPR from Part(a) x PVFGP(3) from  
Part(b) = 10,487.50 – 0.60000662 x 12792.47 = 2811.93

LFPB(2) from Part(a) = 3304.81

Change in Reserve(3) Prior to Assumption Modification = 2811.93 –  
3304.81 = -492.88

Total Benefit Expense(3) Prior to Assumption Modification = 5407 + 0 -  
492.88 = 4914.12

Total Benefit Expense(3) from Part(c)(iii) = 5477.44

Impact to GAAP Income due to Assumption Modification = 5477.44 –  
4914.12 = 563.32

## 7. Learning Objectives:

2. The candidate will understand and apply U.S. Statutory valuation principles and methods applicable to individual life insurance and annuity products issued by U.S. life insurance companies.

### Learning Outcomes:

- (2a) Describe, apply and evaluate the appropriate valuation methods and techniques and related accounting treatments for reserves and related items, and other assets and liabilities for specific insurance products under the U.S. Statutory rules. Further, describe and recommend assumptions and margins appropriate to these statutory reserves.

### Sources:

Statutory Valuation of Individual Life and Annuity Contracts, Claire, D., Lombardi, L. and Summers, S., 5th Edition, 2018 chapter 18

### Commentary on Question:

*This question tested the candidates' understanding of key components of CARVM reserve calculation.*

### Solution:

- (a) Calculate the CARVM reserves, assuming the mortality rate is 0 and no partial withdrawals are available prior to contract maturity. Show your work.

### Commentary on Question:

*Candidates generally did well on this part of the question. Common errors include using incorrect interest rate for interest accumulation in different periods; incorrect valuation interest rate for discounting of cash surrender value; and not adjusting for the front-end load.*

### Account Value Rollforward:

Front-End Load (% of Premium) is a one-time expense taken at time 0.

The Account Value accumulate interest each year. The Initial Guaranteed Interest Rate is applied for the first 4 years. The Ultimate Guaranteed Minimum Interest Rate is applied afterwards.

### Cash Surrender Value:

To calculate Cash Surrender Value, deduct Surrender Charge from Account Value. The Surrender charge deduction does not reduce the Account Value.

### CARVM Reserve:

The Cash Surrender Value of each year is calculated until end of year 7. The Present Value is calculated with interest discounting and survivorship. Since mortality is assumed to be 0, the Statutory Valuation Interest Rate of 3% is used for discounting.

The final CARVM Reserve is the Max Present Value of Cash Surrender Value of all 7 years.

## 7. Continued

Year	Premium	Load	Account Value	Interest	SC schedule	Cash Surrender Value	Stat Val Rate	Discounted Value	CARVM Reserve
0	10000	1.5%	9,850.00			9,850.00		9,850.00	10,432.07
1			10,342.50	5%	10%	9,308.25	3%	9,037.14	
2			10,859.63	5%	8%	9,990.86	3%	9,417.34	
3			11,402.61	5%	6%	10,718.45	3%	9,808.90	
4			11,972.74	5%	4%	11,493.83	3%	10,212.12	
5			12,212.19	2%	2%	11,967.95	3%	10,323.66	
6			12,456.44	2%	0%	12,456.44	3%	10,432.07	
7			12,705.56	2%	0%	12,705.56	3%	10,330.79	

(b) The following additional features are being considered for the annuity product:

- A. Policyholder can withdraw a certain portion of their account value each year without penalty
- B. An annuitization option that can be exercised based on account value
- C. A guaranteed death benefit that equals the account value

With respect to CARVM:

- (i) Explain how each feature should be modeled.
- (ii) Explain how incidence rates for each feature should be set.

**Commentary on Question:**

*Full credit was received by demonstrating an understanding of the characteristics of each benefit. Most candidates recognized that CARVM calculation looks for the most conservative assumption for incident rate for feature A and B, and assigns prescribed mortality rate for feature C. Candidates had to recognize that since there is no penalty for withdrawal, the most conservative assumption for benefit A is 100% incident rate. Candidates were expected to mention whether each benefit was elective or non-elective. Some candidates incorrectly referenced CSO, PBR, and VM-21 in their responses.*

All three rider benefits should be modelled for CARVM calculation. These benefit streams should be projected in each period and discounted by valuation interest rate and survivorship for the present value calculation.

## 7. Continued

### **Benefit A:**

Partial withdrawal is an elective benefit. Since there is no penalty for withdrawal each year, the assumption that generates the most conservative CARVM reserve is 100%.

### **Benefit B:**

Annuitization is an elective benefit. Incident rates of 0% and 100% should be tested. The incident rate chosen should generate the most conservative / highest CARVM reserve level.

### **Benefit C:**

Guaranteed Death Benefit is a non-elective benefit. A prescribed mortality rate should be used.

(c) Critique the following statements about CARVM for fixed annuities:

A. *The statutory valuation rate is set at the product level.*

B. *Non-elective benefits (other than mortality) where the contract holder may have a financial benefit not to report the claim should use an incidence rate of 0%.*

C. *Non-elective benefits are considered in a separate benefit stream.*

D. *For contracts where annuitization is guaranteed at current purchase rates, the basic reserve shall be no less than 93% of the amount used to purchase annuitization benefits at time of valuation.*

### **Commentary on Question:**

*No credit was received for contradictory statements.*

### **Statement A:**

False

The valuation rate is not only set at the product level; it is also set at the benefit level. Valuation rate varies based on product characteristics such as plan type and interest guaranteed period.

### **Statement B:**

This statement is correct. CARVM assumes the most conservative reserve, and so should reflect the 0% interest rate.

## 7. Continued

**Statement C:**

False.

Non-elective benefits need to be considered in each integrated benefit stream.

**Statement D:**

This statement is correct.

## 8. Learning Objectives:

2. The candidate will understand and apply U.S. Statutory valuation principles and methods applicable to individual life insurance and annuity products issued by U.S. life insurance companies.

### Learning Outcomes:

- (2a) Describe, apply and evaluate the appropriate valuation methods and techniques and related accounting treatments for reserves and related items, and other assets and liabilities for specific insurance products under the U.S. Statutory rules. Further, describe and recommend assumptions and margins appropriate to these statutory reserves.

### Sources:

Statutory Valuation of Individual Life and Annuity Contracts, Claire, D., Lombardi, L. and Summers, S., 5th Edition, 2018 chapters 19 and 24

### Commentary on Question:

*This question tested the candidates' understanding of VM-21 and how to appropriately calculate a VM-21 reserve.*

### Solution:

- (a) Critique the following statements with respect to VM-21:
  - A. *Annuity contracts with an in-the-money GMWB rider have a higher likelihood to surrender for cash value and thus are projected to have an increased lapse rate.*
  - B. *Products within the scope of VM-21 include products such as variable deferred annuity contracts with a GMxB, variable immediate annuity without a GMxB, and a separate account product that guarantees an index without a GMxB.*
  - C. *If the Alternative Method is elected for variable deferred annuity contracts with a GMxB feature, the CTE amount should be floored at the aggregated cash surrender value.*
  - D. *The projection of accumulated deficiencies should include all the expected cash flows for the entire group of contracts, such as hedging and federal income tax.*
  - E. *For general account asset projections, the forward interest rates implied by the swap curve in effect as of the valuation date could be used without adjustments to reflect the current market expectations about the future interest rates.*

## 8. Continued

### **Commentary on Question:**

*This part of the question required the candidate to critique statements regarding VM-21. Credit was not awarded for simply restating a statement correctly or only identifying the statement as false. An explanation was required in order to demonstrate an understanding of the topic. Candidates generally struggled with demonstrating sufficient knowledge and only received partial credit. Full credit was not received if the candidate did not clearly address the validity of the statement.*

*Common omissions included not stating the GMWB rider has a higher value than the cash value in statement A; not realizing that a variable immediate annuity without a GMxB is within scope of VM-21 in statement B; not stating that the Alternative Method only applies for variable deferred annuity contracts without a GMxB feature other than a GMDB in statement C; and not explicitly stating that an adjustment would be needed to reflect current market expectations in statement E. Candidates generally received full credit on statement D.*

*Candidates who stated part of a statement was true and part was false were awarded credit as long as explanations were valid and the full statement was evaluated.*

- A. This is not true. An annuity contract that is in-the-money is less likely to surrender for cash value and thus has a decreased lapse rate. The decrease lapse rate is due to the benefit having value greater than the account value available to the customer.
- B. This is not true. The separate account index product without a GMxB is not in scope. Both the variable deferred annuity contracts with a GMxB, and variable immediate annuity without a GMxB are in scope of VM-21.
- C. This is not true. The Alternative Methodology is only for variable deferred annuity contracts that contain either no guaranteed benefits or only GMDB's. The CTE amount for the group of contracts to which the Alternative Methodology is applied cannot be less than the aggregate cash surrender value of those contracts.
- D. This is not true. Federal income tax should be excluded, however all other cash flows (e.g. hedging) should be included.
- E. This is not true. An amount should be deducted to reflect the current market expectations for future interest rates.

## 8. Continued

- (b) GVB Company has a small block of variable deferred annuities. The total CTE is 840,000. The table below includes the available information for each policy.

Policy ID	Standard projection amount	Cash value
1	26,582	26,850
2	301,438	292,658
3	160,681	159,090
4	742,727	707,359
5	91,148	82,862
6	46,349	45,890

Calculate the VM-21 reserve for each policy.

### Commentary on Question:

*Candidates generally did well on this part of the question. Common mistakes included neglecting to calculate the allocation factor base; incorrectly applying the block level CTE; and forgetting to add the Standard Scenario to the Allocated CTE.*

				Step 1	Step 2	Step 3	Step 4
Policy ID	Standard Scenario	Cash Value	Block Level CTE	Allocation Factor Base	Allocation Factor	CTE Allocated	Reserve
1	26,582	26,850	840,000	-	0%	-	26,850
2	301,438	292,658	840,000	8,780	16%	135,365	428,023
3	160,681	159,090	840,000	1,591	3%	24,529	183,619
4	742,727	707,359	840,000	35,368	65%	545,282	1,252,641
5	91,148	82,862	840,000	8,286	15%	127,748	210,610
6	46,349	45,890	840,000	459	1%	7,077	52,967

Step 1: Calculate the allocation base factor as the difference the amount the standard reserve is greater than the cash value

Example: Policy ID 2: Greater of 0 or  $301,438 - 292,658 = 8,780$

Step 2: Calculate the Allocation Factor as the policy level allocation factor base divided by the sum of the block level allocation base:

Example: Policy ID 2:  $8,780 / (\text{Sum of the total in Step 1}) = 16\%$

Step 3: Allocate the CTE by multiplying the allocation factor by the block level CTE

Example: Policy ID 2:  $840,000 \times 16\% = 133,365$



## 8. Continued

Step 4: Reserve is the greater of CTE Allocated + Standard Scenario, or the Cash Value

Example: Policy ID 2: Greater of 292,658 or  $135,365 + 301,438 = 428,023$

## 9. Learning Objectives:

1. The candidate will understand and apply U.S. GAAP valuation principles and methods applicable to individual life insurance and annuity products issued by U.S. life insurance companies.
2. The candidate will understand and apply U.S. Statutory valuation principles and methods applicable to individual life insurance and annuity products issued by U.S. life insurance companies.
3. The candidate will:
  - Understand the significant impact on individual life insurance and annuity product design and management of U.S. insurance product taxation rules.
  - Understand and apply the significant rules of U.S. insurance company taxation as they apply to U.S. life insurers.

### Learning Outcomes:

- (1a) Describe, apply and evaluate the appropriate valuation methods and techniques and related accounting treatments for reserves and related items (e.g., DAC), and other assets and liabilities for specific insurance products under U.S. GAAP. Further, describe and recommend assumptions and margins appropriate to these GAAP reserves.
- (2a) Describe, apply and evaluate the appropriate valuation methods and techniques and related accounting treatments for reserves and related items, and other assets and liabilities for specific insurance products under the U.S. Statutory rules. Further, describe and recommend assumptions and margins appropriate to these statutory reserves.
- (3b) Describe, apply and evaluate the valuation methods and techniques for specific insurance products under U.S. taxation rules. Further, evaluate and calculate deferred tax items.

### Sources:

Statutory Valuation of Individual Life and Annuity Contracts, Claire, D., Lombardi, L. and Summers, S., 5th Edition, 2018

- Chapter 1: Overview of Valuation Concepts (excluding 1.1-1.9)
- Chapter 2: Product Classifications (2.2 only)
- Chapter 10: Valuation Assumptions (excluding 10.1.3 & 10.3.8)
- Chapter 11: Valuation Methodologies (excluding 11.3.9-11.3.11)
- Chapter 21: Immediate Annuities

US GAAP for Life Insurers, Herget et al., 2nd Edition, 2006

- Chapter 9: Annuities in Payment Status (excluding 9.5)

The Tax Cuts and Jobs Act of 2017— Effects on Life Insurers, American Academy of Actuaries, Oct 2020

## 9. Continued

### **Commentary on Question:**

*This question tested the candidates' knowledge of variable annuity assumption setting and calculation of various reserve values. Candidates who perform well understood the GMIB and how it works as an optional benefit in a deferred variable annuity that becomes a fixed payout annuity after GMIB exercise. Details are provided in the specific commentary for each part.*

### **Solution:**

- (a) Describe the considerations in setting the following policyholder behavior assumptions for valuing guaranteed minimum income benefits:
- (i) Annuitization rates
  - (ii) Lapse rates

### **Commentary on Question:**

*Candidates generally received partial credit for this part of the question. The intent was to describe considerations in assumption setting for variable deferred annuities with GMIBs attached, where some may have been exercised. A GMIB exercise is a form of life contingent annuitization; no lapse thereafter (no cash value to surrender after a GMIB exercise). Considerations will relate only to prior to GMIB exercise where both annuitization and lapse might be potential decrements. Prior to GMIB exercise, there are three concurrent values: Continue current deferred contract (account value); Move to a different deferred contract (lapse for cash value); and GMIB exercise in current contract (annuitization, implicitly assuming GMIB exercise benefits exceed regular annuitization benefits in current or competing contract). Some candidates incorrectly answered from a generic GMxB perspective, focused nearly exclusively on the waiting period, or answered lapse is possible after GMIB exercise/annuitization. Some candidates answered the questions from the assumption review and unlocking perspective and focused on the experience and credibility, instead of the initial assumption setting.*

- (i)  
Annuitization rates ( $\text{Annuitization} = \text{GMIB Utilization}$ )

Any four for maximum credit:

1. Policy vs Market performance – If AV recovery unlikely, higher annuitization
2. Volatility – When market volatility high, seek safety of a guaranteed payout
3. Mortality – Poor health/low mortality, lower annuitization
4. Age – Before attained ages with tax effects, lower annuitization
5. Other income sources – When wealthier, lower annuitization
6. Commissions – If commission is paid, higher annuitization
7. Taxes – Benefit amounts > exclusion level are taxed, lower annuitization

## 9. Continued

(ii)

Lapse rates (*Lapse includes both full surrender and 1035 exchange*)

Any four for maximum credit:

1. Performance/In-the-moneyness (ITM) – If GMIB ITM, lower lapse
2. Surrender charges – Low during surrender charge schedule, shock at end
3. Competitors - Availability & price of contract options/guarantees
4. Contract - Richness of guarantees in existing contract
5. Age - Withdrawal before a certain age of 59.5, Low lapse
6. Distribution channel - Recommendations may be commission-driven
7. Tax - NQ: Tax excess of benefit over net premium, Q: Tax entire benefit
8. Q vs NQ - More restrictions on qualified plans

(b) Calculate the following reserves for the policy when the policyholder attains age 69.

(i) US GAAP reserves

(ii) US statutory reserves

(iii) Tax reserves

### Commentary on Question:

*Most candidates received partial credit for this part of the question. For GAAP reserve, some candidates correctly calculate a benefit reserve and an expense reserve using the 6% GAAP factors. Few candidates correctly calculate a DPL (Deferred Profit Liability) which ensures no gain or loss at issue. Some candidates incorrectly attempt to accumulate a fund value (there is no fund value or cash value after GMIB exercise/annuitization). For STAT reserve, many candidates correctly use only benefits and the 3% statutory factors. For Tax reserve, many candidates correctly use the 92.81% factor. Some candidates use only a 1,000 annual benefit instead of 12x1,000 or 1,000 a month.*

(i)

#### GAAP Reserve

Pol Yr	Age	Premium (BOY)	Benefit (EOY)	Expense (EOY)	Factor @6%	Benefit Reserve	Expense Reserve	DPL	GAAP Reserve
0	65	200,000	0	0	14.76	177,120	739	22,142	200,000
1	66		12,000	50	13.96	167,520	698	20,942	189,160
2	67		12,000	50	13.26	159,120	663	19,892	179,675
3	68		12,000	50	12.56	150,720	628	18,842	170,190
4	69		12,000	50	11.86	142,320	593	17,792	<b>160,705</b>

## 9. Continued

$$\text{Benefit Reserve (n)} = 12,000 * \text{Factor (n)}$$

$$\text{Expense Reserve (n)} = 50 * \text{Factor (n)}$$

$$\text{DPL (0)} = 22,142 = \text{Premium} - \text{Benefit Reserve (0)} - \text{Expense Reserve (0)}$$

$$\text{K-Factor} = 12.50\% = 22,142 / 177,120 = \text{DPL (0)} / \text{Benefit Reserve (0)}$$

$$\text{DPL (n) where } n > 0 = \text{K-Factor} * \text{Benefit Reserve (n)}$$

$$\text{GAAP Reserve (n)} = \text{Benefit Reserve (n)} + \text{Expense Reserve (n)} + \text{DPL (n)}$$

$$\text{GAAP Reserve (4)} = 160,705 = 142,320 + 593 + 17,792$$

(ii)

STAT & Tax Reserve

Pol Yr	Age	Benefit (EOY)	Factor @3%	STAT Reserve		Tax Factor	Tax Reserve
0	65	0	16.45	197,400		.9281	183,207
1	66	12,000	15.65	187,800		.9281	174,297
2	67	12,000	14.95	179,400		.9281	166,501
3	68	12,000	14.25	171,000		.9281	158,705
4	69	12,000	13.55	<b>162,600</b>		.9281	<b>150,909</b>

$$\text{STAT Reserve (n)} = \text{Benefits (n+1)} * \text{Factor (n)}$$

$$\text{STAT Reserve (4)} = 162,600 = 12,000 * 13.55$$

(iii)

$$\text{Tax Reserve (n)} = \text{Tax Factor} * \text{STAT Reserve (n)}$$

$$\text{Tax Reserve (4)} = 150,909 = .9281 * 162,600$$

*Note: Immediate annuity has no CV. By using tax factor Tax < STAT.*

*Reasonableness checks: STAT => GAAP => TAX ✓*

*Reserves somewhat close to provided fund value ✓*

## 10. Learning Objectives:

6. The candidate will understand important insurance company issues, concerns and financial management tools.

### Learning Outcomes:

- (6a) The candidate will be able to describe, apply and evaluate considerations and matters related to:
- Insurance company mergers and acquisitions
  - Management of variable deferred annuities
  - Embedded Value determinations
  - VM-20 financial impacts
  - Rating agency considerations
  - Model Audit Rule and Sarbanes-Oxley Section 404 considerations
  - Source of Earnings analysis

### Sources:

Embedded Value: Practice and Theory, SOA, Actuarial Practice Forum, March 2009

### Commentary on Question:

*This question tested the candidates' knowledge of embedded value. Candidate generally did well on this question.*

### Solution:

Critique each statement.

- A. *The traditional, formula-based approaches of US statutory reserving provide a commonly used basis for assessing company solvency, but they fail to distinguish movements in reserve margins from economic earnings in a reporting period.*
- B. *Embedded Value is a more effective accounting basis that addresses the criticisms of current accounting methods.*
- C. *Embedded Value is the same as the actuarial appraisal value of a company when used for mergers and acquisitions.*
- D. *When calculating the Adjusted Net Worth, both the Required Capital and Free Surplus are assumed to earn market rates of return.*
- E. *It is common to use a Risk Discount Rate that is consistent with the reporting entity's cost of equity capital, provided that the rate reflects the risks inherent in the business.*

## 10. Continued

- F. *It is essential to have a clearly defined process for the selection of assumptions in the calculation of the Embedded Value.*
- G. *All non-economic assumptions used in the Embedded Value calculation should be based on industry data plus a provision for adverse deviations.*
- H. *When calculating the Time Value of Financial Options and Guarantees (TVFOG) using stochastic scenarios, it is recommended to use “real-world” scenarios.*
- I. *The accurate calculation of the final Embedded Value is more important to investors than adequate disclosure of the movement.*
- J. *There is substantial subjectivity on the part of the company for the disclosure of sensitivity tests for assumptions used in their Embedded Value calculations.*

(A)

**Commentary on Question:**

*Many candidates commented that RBC would be more commonly used to assess solvency than US Stat and received partial credit. Discussing transition to PBR and VM-20 also received partial credit if statements were true and relevant.*

This statement is true.

US Stat reserving focuses on cost-based approaches to measuring earnings and does not directly reflect changes in the economic environment (i.e. changes in prevailing interest rates) as economic assumptions are locked in.

(B)

**Commentary on Question:**

*Candidates generally performed well on this part of the question.*

This statement is partially true. While EV addresses some of the criticisms of current accounting methods/standards, it also has shortcomings. For example, EV may be difficult to compare between companies or subject to manipulation. EV is not technically an accounting basis but has evolved to embody a codified collection of rules and practices that are almost universally recognized.

## 10. Continued

(C)

**Commentary on Question:**

*Candidates generally recognized the EV excludes the value of future NB. Some candidates also identified other differences.*

This statement is false. EV and AAV differ in three key ways: (1) AAV includes the value of future NB while EV does not; (2) AAV generally uses a higher discount rate; (3) EV and AAV generally use different assumptions. Particularly for expenses, EV assumptions tend to be company-specific while AAV assumption tend to reflect market sentiments.

(D)

**Commentary on Question:**

*Few candidates described the reason for treating FS and RC differently.*

This statement is partially true. Two approaches have emerged in practice. Since the entire ANW is not distributable, the literal approach is to use tax-effected marked-to-market only for Free Surplus and use book value for Required Capital (since only FS is distributable). A more practical approach is to use market returns for both.

(E)

**Commentary on Question:**

*Candidates generally did well on this part of the question. Many candidates discussed CAPM or cost of debt capital, which also received credit.*

This statement is true. The RDR is often assumed to be consistent with the reporting entity's cost of equity capital. Sometimes the RDR is defined as the Weighted Average Cost of Capital (WACC) as opposed to the equity cost of capital. Sometimes the RDR varies by term and sometimes it is kept constant. It is usual to use different RDRs for each country for multinational companies. RDRs may also vary by product line or inforce/new business.

(F)

**Commentary on Question:**

*Most candidate recognized that the statement is true, but many candidates struggled to explain why.*

This statement is true. Selecting appropriate assumptions is one of the most important elements of EV calculation. Because the process involves considerable judgement and subjectivity, a clearly defined process for selecting assumptions is critical to ensure EV remains a reliable measure of performance over time. EV can be very sensitive to key assumption, so even a small shift can have a large impact. Care must be taken to set assumptions properly and consistently.



## 10. Continued

(G)

**Commentary on Question:**

*Candidate generally did well on this part of the question. The most common error was stating that EV assumptions should include a margin or PfAD.*

This statement is false. EV assumptions should be best-estimate (no PfAD) and company-specific. This means that they should reflect management's unbiased estimate of future experience based on the specific circumstances of the company. The assumptions need not be consistent with the market's perception of what such assumptions should be. Observed trends (such as mortality improvement) may be extrapolated, though it is not typically considered appropriate to assume unit expense improvement beyond the valuation date, except for start-up operations.

(H)

**Commentary on Question:**

*Candidates did not need to discuss the CFO Forum's EEV principles to receive full credit. Full credit was received for recommending risk-neutral scenarios to produce market consistent results, relying on the evolution of practice in that direction.*

The CFO Forum's EEV principles from 2004 suggest using real-world scenarios. However, actuarial practice has evolved towards valuing TVFOG on a market-consistent basis, using risk-neutral scenarios

(I)

**Commentary on Question:**

*Most candidates recognized that understanding the movement was more important, but many candidates did not explain why. Many candidates did not demonstrate they understood that EV is used externally.*

This statement is false. Using EV to assess the performance of an entity requires the observer to have access to the analysis of movement, and that changes to methodology and assumptions are included in such analysis. A single point-in-time value of EV is not usually as useful as understanding how EV emerges over time when evaluating an entity's performance.

(J)

**Commentary on Question:**

*Most candidates understood the important of disclosures, but many candidates did not discuss the subjectivity involved in choosing what to disclose.*

## 10. Continued

This statement is partially true. Different observers will find different disclosures more or less helpful in understanding EV. This is partially down to personal preference. However, in general, items that have the most material impact are most important to disclose. This means that when an assumption is particularly critical, companies should disclose sensitivity testing to enable outside users to draw their own conclusions.

Understanding the sources of these items will lend insight into the comparability of results across companies and across time periods and may provide an indication of how likely a company is to be able to maintain or improve its financial performance, as measured by the change in EV, in the future.

The CFO Forum provides some guidance on sensitivities, however these are not binding. EV is not subject to regulatory requirements.

## 11. Learning Objectives:

2. The candidate will understand and apply U.S. Statutory valuation principles and methods applicable to individual life insurance and annuity products issued by U.S. life insurance companies.
3. The candidate will:
  - Understand the significant impact on individual life insurance and annuity product design and management of U.S. insurance product taxation rules.
  - Understand and apply the significant rules of U.S. insurance company taxation as they apply to U.S. life insurers.

### Learning Outcomes:

- (2a) Describe, apply and evaluate the appropriate valuation methods and techniques and related accounting treatments for reserves and related items, and other assets and liabilities for specific insurance products under the U.S. Statutory rules. Further, describe and recommend assumptions and margins appropriate to these statutory reserves.
- (3a) Describe and apply the significant US tax regulations relating to the taxation of individual life and annuity insurance products.

### Sources:

Lombardi, Chapter 14 – Universal Life (exclude 14.4.8, 14.4.9, 14.5.0, 14.6.2-14.6.6)

LFM-845-20 Chapters 1 and 2 of Life Insurance and Modified Endowments Under IRC §7702 and §7702A, Desrochers, 2nd Edition

LFM-850-22 Changes to Section 7702 (IRC) and Nonforfeiture Interest Rates

### Commentary on Question:

*This question tested candidates' understanding of Guarantee Maturity Premium (GMP) and Guideline Level Premium (GLP) for Universal Life product. GMP is a statutory concept, while GLP is used to determine whether an insurance contract can be taxable as insurance rather than an investment. This question required candidates to consider both statutory and tax perspectives.*

### Solution:

- (a) Explain what conditions must be met in order for the proposal to be valid for the following:
  - (i) Interest rate
  - (ii) Endowment date

## 11. Continued

- (iii) Cost of insurance
- (iv) Expenses

**Commentary on Question:**

*To receive full credit candidates had to discuss the different assumptions used in calculating GMP and GLP, and also compare them and discuss the conditions to be met in order for them to be equal. Candidates received no credit for describing considerations of GMP or GLP unrelated to the conditions.*

- (i) GMP uses policy guarantee credit interest rates. For GLP, the rate used is the guaranteed rate floored at the applicable accumulation test minimum, which is 2% in 2021 based on 7702. In order for GMP to equal to GLP, the guaranteed rate must be higher than 2%.
  - (ii) The GMP endows for the face amount at the latest permissible maturity date under the contract. To compute guideline premium, as defined in section 7702(e)(1), the maturity date assumed can be no earlier than the day on which the insured attains age 95 and no later than the day on which the insured attains age 100. In order for GMP to equal to GLP, the maturity date of the contract must be between the day the insured attains age 95 and age 100.
  - (iii) GMP uses guaranteed mortality thus guaranteed COI. GLP should use reasonable mortality. Notice 88-128 does not attempt to define reasonable mortality, instead providing that use of certain safe harbor mortality tables. For contracts entered into after Oct 20, 1988, the safe harbor mortality tables are 1980 CSO. Therefore, in order for GMP to equal to GLP, the guaranteed COI should be lower than COI calculated based on 1980 CSO.
  - (iv) GMP uses guaranteed expenses stated in the contract. GLP must use reasonable expenses, which regulation have yet to address. Thus, the guaranteed expenses should equal to reasonable expenses in order for GMP to equal to GLP.
- (b) Discuss how the increase in face amount will affect each of the GLP and the GMP.

**Commentary on Question:**

*Candidates generally did not do well on this part of the question. Candidates generally did not demonstrate understanding of the attained age increment and decrement method for GLP. Many candidates failed to identify the face amount increase as structural changes and stated that GMP should always be fixed at issue.*

## 11. Continued

The adjustments of the GLP with an attained age layering approach, sometimes referred to as the attained age increment and decrement method. An increase in a contract's face amount is treated separately from the pre-existing guideline premiums: separate guideline premiums are computed to reflect the increase or decrease in face amount. Equivalent "before and after" calculations based on the attained age of the insured at the time of the change can be used to implement this. Under this method, attained age layers of guideline premium values as of year 8 are added to the existing GLP as below:

$$\text{New GLP}_{x+8} = \text{Original GLP}_x + \text{GLP}(\text{new face})_{x+8} - \text{GLP}(\text{original face})_{x+8}$$

For GMP, if there are no structural changes to the policy, then the Guaranteed Maturity Premium and Guaranteed Maturity Fund Values are fixed at issue. If there are structural changes to the policy, such as face amount changes, then the Guaranteed Maturity Premium and Guaranteed Maturity Fund Values are recalculated reflecting the changes. In this case, GMF on the eighth anniversary is used and a new GMP is calculated such that the policy will mature and new GMFs in the future are calculated.