

ILA LFBVU Model Solutions

Spring 2015

1. Learning Objectives:

1. The candidate will understand financial statements and reports of U.S. life insurance companies and be able to analyze the data in them.

Learning Outcomes:

- (1a) Construct financial statements for a life insurance company under U.S. GAAP accounting methods and principles
- (1d) Explain the appropriate accounting treatments for items such as, but not limited to:
 - (i) Separate Accounts
 - (ii) Embedded options
 - (iii) Derivatives
 - (iv) Secondary guarantees

Sources:

U.S. GAAP for Life Insurers, Second Edition, Ch 13 Investment Accounting (excl. 13.7)

U.S. GAAP for Life Insurers, Second Edition, Ch 14 (SFAS 115)

Commentary on Question:

Most candidates performed well on part (a), adequately demonstrating an understanding of SFAS 115 and its impact on the GAAP balance sheet and income statement.

On parts (b) and (c), most candidates also performed well. Different approaches were used to derive the correct answers, with full credit awarded to candidates who showed all of their work.

Solution:

- (a) Describe how SJG's assets are to be classified and accounted for under SFAS 115.

Commentary on Question:

See above

SFAS 115 requires the categorization of assets as follows:

1. Held to Maturity
2. Available for Sale
3. Trading

1. Continued

For assets classified as Held to Maturity:

- Their amortized cost, or book value, is held in the GAAP balance sheet.
- The change in amortized cost, or book value, impacts the GAAP income statement.
- Unrealized capital gains and losses do not impact the GAAP financial statements

For assets classified as Available for Sale:

- Their market value, or fair value, is held in the GAAP balance sheet
- The change in amortized cost, or book value, impacts the GAAP income statement
- The change in unrealized capital gains and losses impacts other comprehensive income

For assets classified as Trading:

- Their market value, or fair value, is held in the GAAP balance sheet
- The change in market value, or fair value, impacts the GAAP income statement

(b) Calculate the following for calendar year 2014 for this asset:

(i) Year-end holding value

(ii) Investment income

Show all work.

Commentary on Question:

See above

(i) Year-end holding value =
Prior year-end holding value \times (1 + Yield rate at purchase) –
Coupon payment at year-end – Principal payment at year-end

Prior year-end holding value =
Amortized cost as of 12/31/2013 =
97,276.75

Yield rate at purchase = 0.05

Coupon payment at year-end =
Coupon rate \times Par value = $.04 \times 100,000 = 4,000$

1. Continued

Principal payment at year-end = 0 (no principal paid until end of year 5)

Year-end holding value = $(97,276.75 \times 1.05) - 4,000 - 0 = 98,140.59$

- (ii) Investment income =
Prior year-end holding value x Yield rate at purchase

Investment income = $97,276.75 \times 0.05 = 4,863.84$.

- (c) Calculate the following as of 12/31/2014 for this cohort:

- (i) DAC asset
(ii) Shadow DAC adjustment
(iii) Other comprehensive income component of shareholder equity

Show all work.

Commentary on Question:

See above

- (i) DAC asset =
k-factor x PV of future estimated gross margins at 12/31/2014 –
PV of future deferrable costs at 12/31/2014

k-factor =
PV of future deferrable costs at issue /
PV of future estimated gross margins at issue =
 $60 / 150 = 0.40$

DAC asset = $(0.40 \times 30) - 4 = 12 - 4 = 8$

- (ii) The shadow DAC adjustment equals the impact on DAC assuming all Available for Sale assets are sold and reinvested at current rates. Since it is assumed that the realization of investment gain and loss is profit neutral, the k-factor does not change on such realization, and the alternative method can be used to approximate the adjustment:

Shadow DAC adjustment =
 $-1 \times \text{k-factor} \times \text{unrealized gains \& losses on Available for Sale assets} =$
 $-1 \times 0.40 \times 5 = -2$

1. Continued

- (iii) Other comprehensive income component of shareholder equity =
(Unrealized gains & losses on Available for Sale assets +
Shadow DAC Adjustment) x (1 – Federal income tax rate) =
 $(5 - 2) \times (1 - 0.35) = 3 \times 0.65 = 1.95$

2. Learning Objectives:

2. The candidate will be able to understand and apply valuation principles of individual life insurance and annuity products issue by U.S. life insurance companies.

Learning Outcomes:

- (2c) Calculate liabilities for life and annuity products and their associated riders under the following standards:
 - (i) U.S. Statutory
 - (ii) U.S. GAAP
 - (iii) U.S. Tax

Sources:

Valuation of Life Insurance Liabilities, Lombardi, 4th Edition, Ch. 9

Commentary on Question:

Commentary listed underneath question component.

Solution:

- (a) List the eight characteristics of an acceptable minimum guaranteed death benefit (MGDB) reserve system according to Actuarial Guideline 37 (AG 37) for a variable life insurance policy with an MGDB.

Commentary on Question:

In general, candidates did not perform well on part (a). Of the eight characteristics, the first four are primary, and most of the grading points were awarded to candidates who listed these four primary characteristics. However, few candidates were able to list all four. In place of the characteristics, many candidates instead described the formulas and/or assumptions used in the MGDB reserve calculation.

The eight characteristics of an acceptable MGDB reserve system are as follows:

1. MGDB reserve should be held in the general account and backed by fixed assets.
2. MGDB reserve should be adequate to cover MGDB claims for the next year under all but the most extreme conditions.
3. MGDB reserve should react slowly but steadily to an extended period of poor separate account performance.
4. MGDB reserve should not overreact and cause unnecessary fluctuations in surplus by increasing or decreasing too rapidly during sharp market downswings or upswings.
5. MGDB reserve should value any guaranteed death benefits not valued in the basic policy reserve.
6. MGDB reserve should be established over the period of time that revenue is collected to pay for MGDB claims.
7. MGDB reserve should not be reduced by deminimus revenue.

2. Continued

8. MGDB reserve should be held in addition to the basic policy reserve.

- (b) For each of the following independent events:
- (i) The variable fund drops 10%.
 - (ii) The policyholder deposits additional premium into the variable fund.
 - (iii) The insurance company increases cost of insurance (COI) rates up to the guaranteed maximum.
 - (iv) The policyholder transfers half of the variable fund to the fixed fund.

Explain how the MGDB reserve would be impacted if the event occurred immediately before the valuation date. Justify your explanation. No calculations are required.

Commentary on Question:

Candidates did better on part (b) compared to parts (a) and (c). In order to explain the impact on the MGDB reserve, the candidate was expected to first explain the impact on the attained age level reserve (AALR) and the impact on the one-year term reserve (OYTR). Once those impacts were known, the candidate was then expected to explain the impact on the MGDB reserve, taking into consideration that the MGDB reserve is the larger of the AALR and the OYTR.

Only a few candidates explained the impact on the AALR and the impact on the OYTR. Although none of them explained the resulting impact on the MGDB reserve, they received full credit.

Most of the other candidates were able to generally reason the impact on the MGDB reserve, taking into consideration the impact of the different events on the “in the moneyness” of the MGDB. These candidates received partial credit.

- (i) Variable fund drops 10%:
- a. For AALR, the projected fund would be more likely to go negative following the drop. AALR would either increase or not change.
 - b. For OYTR, the projected fund would also be more likely to go negative following the drop. OYTR would either increase or not change.

As a result, MGDB reserve would either increase or not change.

2. Continued

- (ii) Policyholder deposits additional premium into the variable fund:
 - a. For AALR, the projected fund would be less likely to go negative following the deposit. AALR would either decrease or not change.
 - b. For OYTR, the projected fund would also be less likely to go negative following the deposit. OYTR would either decrease or not change.

As a result, MGDB reserve would either decrease or not change.

- (iii) Insurance company increases cost of insurance (COI) rates up to the guaranteed maximum:

Changing COI rates would have no impact on the GMDB reserve, since the reserve is always calculated assuming COI rates equal valuation mortality rates.

- (iv) Policyholder transfers half of the variable fund to the fixed fund:
 - a. For AALR, since both funds are projected at the same interest rate, the transfer would have no impact. AALR would not change.
 - b. For OYTR, since the 1/3 drop only applies to the variable fund, the projected fund would be less likely to go negative following the transfer. OYTR would either decrease or not change.

As a result, MGDB reserve would either decrease or not change.

- (c) Calculate the MGDB reserve at the end of policy year 11 according to AG 37. Show all work.

Commentary on Question:

Only a few candidates received full credit on part (c). Most candidates understood that the MGDB reserve is the maximum of the AALR and OYT reserve, and they were able to write down the correct formulas. However, most of these candidates only received partial credit because they were unable to do all of the calculations correctly. Candidates generally struggled with the AALR payment calculation but did better with the OYT reserve and AALR residue calculations.

2. Continued

Notation and formulas:

$q(t)$ = valuation mortality rate for policy year t

$p(t) = 1 - q(t)$

vir = valuation interest rate

$a(t)$ = life annuity of 1 per year starting at the beginning of policy year $t+1$ and continuing for the remainder of the MGDB period, calculated using valuation mortality and interest

$ExcessDB(t)$ = excess death benefit payable during policy year t

$PVExcessDB(t)$ = present value of future excess death benefits at end of policy year t , calculated using valuation mortality and interest

$ExcessDBShock(t)$ = excess death benefit payable during policy year t assuming the variable fund depreciates by one-third at the end of policy year $t-1$ and then appreciates thereafter at the assumed investment rate

$MGDBR(t)$ = MGDB reserve at end of policy year t
= $\text{Max}(AALR(t), OYTR(t))$

$AALR(t)$ = attained age level reserve at end of policy year t =
 $\text{Residue}(t) + AALR \text{ Payment}(t)$

$\text{Residue}(t)$ = residue of $AALR(t-1)$ at end of policy year t

$$= \frac{AALR(t-1) \cdot (1+vir) - ExcessDB(t) \cdot q(t)}{p(t)}$$

$AALR \text{ Payment}(t)$ = AALR payment at end of policy year t

$$= \frac{PVExcessDB(t) - \text{Residue}(t)}{a(t)}$$

$OYTR(t)$ = one-year term reserve at end of policy year t

$$= \frac{ExcessDBShock(t+1) \cdot q(t+1)}{1+vir}$$

2. Continued

Calculations for end of policy year 11:

$$\begin{aligned}\text{Residue}(11) &= \frac{\text{AALR}(10) \cdot 1.04 - \text{ExcessDB}(11) \cdot q(11)}{p(11)} \\ &= \frac{1200 \cdot 1.04 - 0 \cdot 0.003}{1 - 0.003} = 1251.76\end{aligned}$$

$$\begin{aligned}a(11) &= 1 + \frac{p(12)}{1.04} + \frac{p(12) \cdot p(13)}{1.04^2} + \frac{p(12) \cdot p(13) \cdot p(14)}{1.04^3} \\ &= 1 + \frac{0.996}{1.04} + \frac{0.996 \cdot 0.995}{1.04^2} + \frac{0.996 \cdot 0.995 \cdot 0.994}{1.04^3} = 3.75\end{aligned}$$

$$\begin{aligned}\text{AALR Payment}(11) &= \frac{\text{PVExcessDB}(11) - \text{Residue}(11)}{a(11)} \\ &= \frac{1677 - 1251.76}{3.75} = 113.4\end{aligned}$$

$$\begin{aligned}\text{AALR}(11) &= \text{Residue}(11) + \text{AALR Payment}(11) \\ &= 1251.76 + 113.4 = 1365.16\end{aligned}$$

$$\begin{aligned}\text{OYTR}(11) &= \frac{\text{ExcessDBShock}(12) \cdot q(12)}{1.04} \\ &= \frac{150000 \cdot 0.004}{1.04} = 576.92\end{aligned}$$

$$\text{MGDBR}(11) = \text{Max}(1365.16, 576.92) = 1365.16$$

3. Learning Objectives:

3. The candidate will be able to understand and analyze the implications of emerging financial and valuation standards.

Learning Outcomes:

- (3b) The candidate will be able to describe and assess the impact on reserves, capital, and/or income of emerging developments in International Finance Reporting Standards.

Sources:

IASB Staff Paper, Effect of Board Deliberations on the 2013 Exposure Draft Insurance Contracts (April 2014)

Practical Guide to IFRS, PwC (July 2013)

Commentary on Question:

This question tested the candidates' knowledge of emerging developments with IFRS 4 Phase II and assesses their impact on financial statements. Candidates were expected to evaluate each statement below and either confirm or reject validity, while providing support from the stated sources.

Solution:

Critique the following statements made by the actuary for JJB Life, a U.S. insurance company, with respect to the IFRS 4 Phase II exposure draft on insurance contracts:

- A. *"IFRS may have an impact on the reporting for our SuperVUL, a variable universal life product that has a separate account investment option that guarantees 95% return of deposits on death."*
- B. *"The profitability of our SuperTerm, a term life insurance product, won't be affected. New SuperTerm sales will continue to add to our bottom line at issue. For instance, take a hypothetical SuperTerm policy with a present value of cash inflow of 20,000, a present value of cash outflow of 12,000 and a total margin for uncertainty of 5,000. This policy will produce a 3,000 gain at issue since there is a liability at initial recognition of -3,000. This will allow the SuperTerm business to continue to offset the loss at issue from our disability income business."*
- C. *"Updates for current estimates and for current market rates will impact our financial reporting in the same way."*
- D. *"Net income will be more volatile."*
- E. *"Insurers may become more aware of the costs and risks of embedded options and guarantees."*

3. Continued

F. *“The current accounting mismatch will increase due to valuing assets and liabilities on different bases.”*

G. *“Costs will increase as insurance companies move to more market-value management reporting and providing more information to investors.”*

A. Solution: this statement is correct.

A rider or option must be reported separately or unbundled from the host contract under IFRS if both of the following apply:

- (i) The economic characteristics and risks of the Embedded Derivative (ED) are not closely related to those of the host contract;
- (ii) The separate financial instrument with the same terms as the ED would meet the definition of a derivative under IFRS 9

Based on the definition of IFRS 9, the guarantees 95% return of deposits on death is an embedded derivative and the separate account investment option is not closely related to the host contract. IFRS will require this option be reported separately and the remaining components be treated as an insurance contract.

B. Solution: this statement is incorrect.

There will not be any gain at issue for this hypothetical SuperTerm policy since IFRS does not allow front-ending of profit. A Contractual Services Margin (CSM) should be included in the measurement of liability and offset the initial gain, which represents the unearned profit of the contract. The CSM will be amortized into earnings over the coverage period.

- $PV \text{ fulfilment cashflows} = PV \text{ of cash outflow} - PV \text{ of cash inflow} + \text{risk adjustment}$
- $PV \text{ fulfilment cashflows} = 12,000 - 20,000 + 5,000 = -3,000$
- $\text{Contractual service margin} = \max(0, -PV \text{ fulfilment cashflows})$
- $\text{Contractual service margin} = 3,000$
- $\text{Liability at initial recognition} = PV \text{ of fulfilment cashflows} + \text{contractual service margin} = 0$

Businesses may be managed together if the provided coverages are similar. The contractual service margin and the onerous contract test are calculated at the portfolio level, not policy level. Therefore the SuperTerm cannot be combined with disability income business.

The service margin cannot be negative, so the loss of the DI business results at issue must be immediately recognized in earnings.

C. Solution: this statement is incorrect.

The updates for current estimates flow through to the income statement, while the updates for current market rates flow through to Other Comprehensive income (OCI).

3. Continued

D. Solution: this statement is not necessary correct.

The net income in IFRS might become more volatile due to the changes of the estimates & assumptions, which are in fair value basis and are tied to the market. On the other hand, because the assets and liabilities are measured in a same fair value basis in IFRS, volatility due to different measuring basis might be reduced. However, potential volatility due to mismatching of the asset and liability portfolio related to duration convexity and credit standing might increase.

Some other aspects, such as reflecting the updates for current market rates through Other Comprehensive income (OCI) and amortizing initial gain with the Contractual Service Margin (CSM), could reduce the income volatility.

E. Solution: this statement is correct.

Under IFRS, Insurers will be required to reflect the value of the embedded options & guarantees in their products on a fair value basis, which would increase the awareness of the costs and risks.

F. Solution: this statement is incorrect.

Assets are already at fair value, and liabilities will be measured at fair value as well under IFRS. Therefore, the accounting mismatch will be reduced.

G. Solution: this statement is not necessary correct.

An initial cost of the implementation might be required due to potential upgrading computing system, additional reporting requirements, or consultation of methodology change.

However, after that, costs may be lower because reporting bases are more aligned and communication and collaboration of between actuarial and accounting team are improved.

4. Learning Objectives:

3. The candidate will be able to understand and analyze the implications of emerging financial and valuation standards.

Learning Outcomes:

- (3b) The candidate will be able to describe and assess the impact on reserves, capital, and/or income of emerging developments in International Finance Reporting Standards.

Sources:

LFV-809-09: Emerging Financial Reporting Issues

An Approach for measurement of the Fair Value of Insurance Contracts, Actuarial practice Forum, May 2007

Commentary on Question:

The purpose of this question was to test the candidates understanding of various fair value accounting concepts.

Solution:

- (a) Describe the three levels of fair value inputs as categorized in SFAS 157.

Commentary on Question:

This part was very straight forward and most candidates did very well as they were able to describe the key points to distinguish between the three levels of fair value inputs.

Level 1 inputs

- Observable
- Quoted prices for identical assets or liabilities in the principal market

Level 2 inputs

- Quoted prices for similar assets or liabilities in an active market
- Quoted prices for identical or similar assets or liabilities in market that are not active
- Market inputs other than quoted prices
- Market inputs derived principally from or corroborated by other observable market data

Level 3 inputs

- Unobservable market inputs that are not able to be corroborated by observable market data
- Most insurance companies' liabilities are classified as level 3 inputs

4. Continued

- (b) Calculate the fair value liability of this contract in the second policy year using the Total Return Swap approach, as proposed by Gutterman, et al. Show all work.

Commentary on Question:

Candidates generally did well for this part of question also. There were multiple reasonable interpretations of the timing of the cash flows (beginning of year vs. end of year) and candidates were able to receive full credit for them. Also, the original version of the study note had the formula written such that the cash flows were discounted back to time zero. Candidates who answered with this discounting were able to receive full credit as well.

$$LIAB(y) = \sum EDB / (1+S(t)+CS(t))^{(t-y)} - \sum PREM / (1+S(t)+R)^{(t-y)}$$

Present Value of Expected Death Benefit @ year 2:

$$\begin{aligned} &= EDB(2)/(1+S(2)+CS(2))^0 + EDB(3)/(1+S(3)+CS(3))^1 \\ &= 250/(1+3.5\%+.4\%)^0 + 450/(1+3.5\%+.4\%)^1 = 683 \end{aligned}$$

Present Value of Premium @ year 2:

$$\begin{aligned} &= PREM(2)/(1+S(2)+R)^0 + PREM(3)/(1+S(3)+R)^1 \\ &= 300/(1+3.5\%+12\%)^0 + 110/(1+3.50\%+12\%)^1 = 395 \end{aligned}$$

Fair value of the liability @ year 2

$$LIAB(2) = 683 - 395 = 288$$

5. Learning Objectives:

4. The candidate will be able to explain and apply the methods, approaches and tools of financial management and value creation in a life insurance company context.

Learning Outcomes:

- (4d) Apply methods of valuation to business and asset acquisitions and sales. This includes explaining and applying the methods and principles of embedded value.

Sources:

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

LFV-106-07: Mergers and Acquisitions, Chapter 4 (Sections 4.1-4.6)

Commentary on Question:

Commentary listed underneath question component.

Solution:

- (a) Describe how you would determine the discount rate for each of the following:
 - (i) Actuarial Appraisal Value
 - (ii) Embedded Value

Commentary on Question:

The question makes it clear in part (a) that we are looking for ways to determine the discount rate, not asking the candidate to compare and contrast differences between AAV and EV.

Actuarial Appraisal Value (AAV)

- For an appraisal, one would usually show results for a range of interest rates
- You would most likely used the Capital Asset Pricing Model (CAPM); the weighted average cost of capital (WACC) should be used as the discount rate.
- Other factors may influence the discount rate, such as: internal company targets (current hurdle rates and long-term targets), cost of funds for transactions, or M&A marketplace discount rates (rates may reflect supply and demand, types of business sold, etc).

Embedded Value (EV)

- While cost of equity capital is most often used, there are methods for determining cost of debt and so in some cases WACC may be used.
- For Market-Consistent Embedded Value, which has evolved more recently, the risk discount rate and investment returns are both considered to be equal to the risk-free rate.

5. Continued

- (b) Recommend using either Embedded Value or Actuarial Appraisal Value for each of the following circumstances:
- (i) Your company wants to determine the value of a company that it is acquiring.
 - (ii) Your company is valuing some stocks and other assets that it is selling.
 - (iii) Your company wants to distinguish movements from economic earnings in values.
 - (iv) You want to determine the value of a company as a "going concern."

Justify your recommendation.

Commentary on Question:

Giving an answer of EV or AAV without any further explanation was not sufficient. Even if the candidate's reasoning was not right in line with the full credit answers, they could still receive partial credit for an answer if they included facts that were pertinent and true.

- (i) Actuarial Appraisal Value
 - Want to use Actuarial appraisal value as it reflects the value of new business sold whereas EV would not. The ability to sell new business is part of the enterprises value and should be included in the sale price.
 - Appraisals commonly use a range of reasonable discount rates; this range of values could be used in negotiating a selling price.
 - The appraisal can be used as a basis for ongoing performance measurement after the acquisition.
 - AAV uses market based assumptions
- (ii) Either method could be used
 - EV is a measurement of the value that shareholders own in an insurance enterprise; companies routinely use EV to justify their stock prices.
 - EV would use the company's own expense assumptions and own cost of capital in the discount rate; the company would likely use their own company-related assumptions to value their stock.
 - However, it may be difficult to directly place a value on the company's stock and assets when selling it; the value is highly subjective and dependent on the assumptions used. For this reason, an actuarial appraisal may be used.

5. Continued

(iii) Embedded Value

- EV is a financial measurement that is used to measure the value of business at any point in time and to measure the financial performance of business over time.
- EV rollforward of the value of the company from one period to the next would give the detailed movements in earnings that is being sought.

(iv) Actuarial Appraisal Value

- If a company is a "going concern", you are assuming its business will continue. An actuarial appraisal would be appropriate to value this business because it includes the value of future new business in its calculation.

(c) Calculate the Embedded Value and Actuarial Appraisal Value. Show all work.

Commentary on Question:

Most did well on computing the adjusted net worth and value of inforce business but didn't get full credit because AAV and EV were not computed correctly. Many candidates left the TVFOG (time value of Future Options and Guarantees) out of the solution. Some attempted to integrate that component and used the wrong formula. Finally, just knowing that the difference between AAV and EV (given that no assumption differences were cited between the two methods) is the value of new business got many candidates partial credit.

$$\text{Adjusted net worth} = \text{required capital} + \text{free surplus} = 100 + 150 = 250$$

$$\text{Value of inforce business} = \text{PV of After-tax Statutory Book Profits} - \text{PV of Cost of Capital} = 2000 - 500 = 1500$$

$$\text{TVFOG} = \text{Mean of PV of DE for stochastic scenarios} - \text{PV of DE for single deterministic scenarios} = 1300 - 900 = 400$$

$$\text{EV} = \text{ANW} + \text{VIF} + \text{TVFOG} = 250 + 1500 + 400 = 2150$$

$$\text{AV} = \text{EV} + \text{VNB} = 2150 + 300 = 2450$$

6. Learning Objectives:

5. The candidate will understand the Risk Based Capital (RBC) regulatory framework and the principles underlying the determination of Regulatory RBC and Economic Capital.
6. The candidate will be able to evaluate various forms of reinsurance, the financial impact of each form, and the circumstances that would make each type of reinsurance appropriate.

Learning Outcomes:

- (5a) Explain and distinguish the roles of capital from the perspectives of regulators, investors, policyholders and insurance company management
- (5b) Describe the U.S. Risk Based Capital (RBC) regulatory framework and the principles underlying the determination of Regulatory RBC, and be able to compute RBC for a U.S. life insurance company including:
 - (i) Identification of significant risk components
 - (ii) Identification of specialized product RBC requirements
 - (iii) Interpreting results from a regulatory perspective
 - (iv) Implementation under U.S. principle-based approach
- (6a) Describe the considerations and evaluate the appropriate form of reinsurance from the ceding and assuming company perspectives.
- (6b) Explain the consequences and evaluate the effect on both ceding and assuming companies with respect to:
 - (i) Risk transfer
 - (ii) Cash flow
 - (iii) Financial statements
 - (iv) Reserve credit requirements

Sources:

Valuation of Liabilities, Ch 16 Risk-Based Capital (exclude section 16.6)

A Multi-Stakeholder Approach to Capital Adequacy, Conning Research

Life, Health & Annuity Reinsurance (Tiller)-Chapters 4 and 5

Commentary on Question:

This question tested the candidate's knowledge in Capital Management, including requiring practical application of the Risk Based Capital framework, as well as understanding of different types of reinsurance and their respective impacts on capital.

6. Continued

Solution:

- (a) Describe the actions the company might take if its capital level is below its target surplus goal.

Commentary on Question:

The items listed below are all valid answers; if a candidate listed at least half of the items, they received full credit. The majority of candidates were able to achieve full marks.

- Emphasize products with low RBC requirements and de-emphasize those with high RBC requirements
 - Redesign products to lower the risk based capital requirements
 - Increase the profitability by lowering expenses, exiting unprofitable lines, and/or increasing prices
 - Reduce asset risk by buying assets with low RBC requirements and selling assets with high RBC requirements
 - Reduce liability risk by entering into reinsurance agreements or selling certain product lines
 - Re-organize the legal structure of the life insurance company by moving certain subsidiaries to a holding company
 - Raise capital by issuing surplus notes or issuing equity securities
- (b) Explain possible reactions that various stakeholders might have to the company holding capital below its target surplus goal.

Commentary on Question:

Ideal responses included a description of the action(s) that the stakeholder would undertake as well as their respective interests in having the company well-capitalized. Full credit was achieved for full responses for four stakeholders, or mostly complete responses for five or all six stakeholders.

1. Policyholders want to be fully protected in case of a loss. Current policyholders may consider surrendering their contracts.
2. Regulators primary concern is for the policyholders, especially in the case of company insolvency. If capital falls below specified RBC ratios, may trigger regulatory action levels such as:
 - "Trend Test Corridor" - require company to perform trend test
 - "Company Action Level" - require company to submit an RBC plan
 - "Regulatory Action Level" - require company to submit an RBC Plan and issue an order for corrective action
 - "Authorized Control Level" - may take regulatory actions considered necessary to protect the best interest of policyholders and creditors

6. Continued

- "Mandatory Control Level" - must take regulatory actions considered necessary to protect the best interest of policyholders and creditors
3. Debt holders/Creditors are best off when capital is maximized. They may view reduced capital as reason to sell before rating agencies issue downgrade.
 4. Rating Agencies are concerned about the company's ability to pay out to the creditors (after policyholders are paid). May issue a downgraded rating. Their longer term view is the company's continued solvency.
 5. Shareholders/Equity Analysts may have a positive reaction if the company had been overcapitalized previously as lower capital results in a higher return on capital. They may also have a negative reaction if the lower capital amount brings into question the ability of the company to continue as a going concern.
 6. Company Management shares the objectives of the other stakeholders, primarily around keeping the company open so they can continue their employment.
- (c) Assess the validity of the following statements:
- (i) *"Yearly Renewable Term (YRT) reinsurance will not serve to improve the surplus position."*
 - (ii) *"If we use YRT reinsurance for our level term policies, the net amount at risk for all years would simply be the initial reinsured face amount."*
 - (iii) *"Funds Withheld Coinsurance is the same as Modified Coinsurance."*
 - (iv) *"Coinsurance is not a good option for term insurance because assets must be transferred."*

Justify your response.

Commentary on Question:

Credit for the question was granted when the candidates demonstrated their understanding of the reinsurance approaches and applied this knowledge in response to the statements. For part (iii), candidates were required to directly compare and contrast the two types of reinsurance.

- (i) Not entirely true
 - Can obtain relief for C-2 risk due to reduced net face amount
 - However little or no ceding allowance will not help with surplus relief
 - Little or no liability transferred

6. Continued

- (ii) Not necessarily true
- For level term plans of less than 20 years, reserves are generally minimal and can be ignored for reinsurance purposes; the NAR for all years would be the initial reinsured face amount.
 - However, for level term policies of 20 years or longer, meaningful reserves and cash values can develop.
 - Typically the "Tenth Year Cash Value" method would be used to determine the NAR; for the first duration the NAR would be the initial face amount, but years 2-10 would be determined by using the 10th year cash value, and years 11-20 would be calculated by using an interpolation of 10th yr and 20th yr cash values.
- (iii) A lot of similarities
- Assets remain on the cedant's balance sheet for both Modco and FWH
 - Liabilities remain on reinsurer's B/S under FWH. Liabilities remain on cedant's B/S under Modco. and the reinsurer returns the increase in statutory reserve to the cedant through modco adjustment
 - Under FWH no cash exchange hands in the initial transaction and cash flow is minimized throughout the treaty. Under Modco cash flows exchange hands throughout the transaction.
- (iv) Not necessarily true
- Coinsurance allows a better matching of reinsurance costs with premiums received from the policyholder on level premium term products, and passes the risk of adequacy of rates along to the reinsurance
 - Coinsurance is used most commonly for reinsuring term products which have little or no cash value buildup and, therefore, minimal investment risk
 - YRT is the best choice when the primary objective is the transfer of mortality risk
- (d) Calculate the change in the Risk Based Capital amount for bonds if the company were to sell all of its Class 6 bonds and not reinvest the proceeds in bonds. Show all work.

Commentary on Question:

Approximately one-third of candidates received full credit for this part. Common mistakes were candidates not recognizing that the size factor is calculated at the total portfolio level or that the size factor would change upon the sale of the Class 6 bond.

6. Continued

Class 1: $100,000,000 \times 0.0040 = 400,000$
Class 2: $200,000,000 \times 0.0130 = 2,600,000$
Class 3: $100,000,000 \times 0.0460 = 4,600,000$
Class 6: $2,000,000 \times 0.3000 = 600,000$

RBC before size adj. (before selling bonds)
 $= 400,000 + 2,600,000 + 4,600,000 + 600,000$
 $= 8,200,000$

RBC before size adj. (after selling bonds)
 $= 400,000 + 2,600,000 + 4,600,000$
 $= 7,600,000$

Size factor before selling:

First 50: 50 issuers \times 2.500 factor = 125 weighted issuers
Next 50: 50 issuers \times 1.300 factor = 65 weighted issuers
Next 300: 300 issuers \times 1.000 factor = 300 weighted issuers
Over 400: 400 issuers \times 0.900 factor = 360 weighted issuers
Total number of issuers = 800
Total weighted issuers = 850
Size factor before selling: $850/800 = 1.0625$

Size factor after selling:

First 50: 50 issuers \times 2.500 factor = 125 weighted issuers
Next 50: 50 issuers \times 1.300 factor = 65 weighted issuers
Next 300: 300 issuers \times 1.000 factor = 300 weighted issuers
Over 400: 300 issuers \times 0.900 factor = 270 weighted issuers
Total number of issuers = 700
Total weighted issuers = 760
Size factor after selling: $760/700 = 1.0857$

Total RBC for bonds (before selling bonds)
 $= 8,200,000 \times 1.0625$
 $= 8,712,500$

Total RBC for Bonds (after Selling bonds)
 $= 7,600,000 \times 1.0857$
 $= 8,251,320$

Change: reduction of 461,180

7. Learning Objectives:

7. The candidate will understand the professional standards addressing financial reporting and valuation

Learning Outcomes:

- (7b) Identify and apply relevant professional actuarial qualification standards.
- (7c) Identify and apply actuarial standards of practice relevant to financial reporting and valuation.

Sources:

Actuarial Standard of Practice No. 41

LFV-804-07: Actuarial Opinion and Memorandum Model Regulation

Commentary on Question:

Comments listed underneath question component.

Solution:

- (a) Identify any deficiencies in the letter relative to the general requirements for actuarial communications contained in Actuarial Standard of Practice No. 41.

Commentary on Question:

Most candidates were able to identify two obvious deficiencies in the letter: "response was not timely" and "appointed actuary should have responded". However, many candidates did not receive full credit because they did not identify any of the other deficiencies.

- Does not clearly identify the principal
 - Only mention of LEO is in signature section
- Does not clearly identify the scope
 - Mentions questions raised by commissioner but says nothing regarding why the questions were asked
- Does not clearly identify the responsible actuary
 - It is not clear who "we" refers to
 - Appointed Actuary is responsible for the opinion/memorandum and therefore should have responded but instead had his assistant actuary respond
- Format could be clearer
 - Stating the responses without stating the questions asked by the commissioner is confusing
- Response was not timely
 - Should have replied by June 14 or requested an extension

7. Continued

- (b) Critique the adequacy of the assistant actuary's response to the insurance commissioner relative to the requirements of the Actuarial Opinion and Memorandum Model Regulation.

Commentary on Question:

Part (b) is a very good situational type of question to test the candidate's understanding of the requirements of the Actuarial Opinion and Memorandum Model Regulation. Most candidates did well on this part. Candidates who received full credit clearly and completely addressed each of the five major points in the letter.

- Method used to analyze asset adequacy
 - Response is adequate
 - Cash flow testing is not always required but is always acceptable
 - Cash flow testing exemptions could be: cash flow is insensitive to economic changes, short term products or little / no reinvestment risk
 - Immaterial blocks do not need to be studied
- Reliance statements
 - Response is not adequate
 - Reliance statements are required from those individuals the Appointed Actuary has relied upon for data or other critical aspects of the analysis
- Assumptions
 - Response is not adequate
 - Documentation of assumptions should be in sufficient detail such that an actuary reviewing the memorandum could form a conclusion regarding their reasonableness
- Economic scenario generator
 - Response is not adequate
 - Scenarios should be described in sufficient detail such that an actuary reviewing the memorandum could form a conclusion regarding their appropriateness for asset adequacy testing
- Asset adequacy criteria
 - Response is adequate
 - Assets should be adequate under moderately adverse conditions
 - Moderately adverse conditions are not precisely defined, but assuming the economic scenario generator is appropriate for asset adequacy testing, passing at least 85% of the scenarios appears to be a reasonable definition

8. Learning Objectives:

1. The candidate will understand financial statements and reports of U.S. life insurance companies and be able to analyze the data in them
2. The candidate will be able to understand and apply valuation principles of individual life insurance and annuity products issue by U.S. life insurance companies.

Learning Outcomes:

- (2d) Calculate DAC assets for life and annuity products and their associated riders under the standard: U.S. GAAP.

Sources:

US GAAP For Life Insurers, 2nd Edition, Chapters 3 and 7

SOP 05-1: Financial Reporter Article 03/06

Commentary on Question:

The question was intended to test the candidate's knowledge of US GAAP concepts, which included the ability to recall the terminology as well as the ability to apply the principles in specific examples. While part A was more straight forward, many candidates (surprisingly) were unable to recall all six expense categories. For the application questions, many candidates relied on stating what they believed to be key words (e.g. Sales Inducement Asset, SOP 03) but missing the main point. Answers from many candidates also indicated a lack of understanding of general insurance concepts, such as confusing persistency bonus as a type of par product style dividend.

Solution:

- (a) Describe the expense categories stipulated by U.S. GAAP and their impact on the calculation of the DAC asset.

Commentary on Question:

Many candidates were unable to list all six expense categories, and some listed items such as "marketing expense" as categories. Some candidates did not provide proper descriptions or give examples of the categories, and merely listed them.

The 6 expense categories are:

- 1) Deferrable Acquisition Costs
These are expenses that vary with and primarily related to the acquisition of new business. Examples include commissions in excess of ultimate level on long duration contracts, and direct underwriting.
These expenses can be deferred, i.e. they are included in the DAC

8. Continued

2) Non Deferrable Acquisition Costs

These are expenses associated with new business, but do not vary with and are not primarily related to acquiring new policies. Examples include new rate books, dividend and reserve factor development, and general advertising. These expenses cannot be deferred and have no impact on DAC calculation.

3) Direct Maintenance Costs

These are expenses associated with maintaining insurance contracts. Examples include records management, premium processing, commission processing, commissions at the ultimate renewal level. These expenses are included in EGP and impact the amortization of DAC.

4) Investment Expenses

These are expenses chargeable against investment income. Examples include investment advisor expenses, internal investment department expenses, and transaction costs. These expenses are included in EGP and impact the amortization of DAC. Investment Expenses also impact the determination of the discount rate.

5) Future Utility Expenses

These are one time costs that contribute to long term value in the business. Examples include computer hardware and software costs. These expenses cannot be deferred and have no impact on DAC calculation.

6) Overhead

These are all other expenses not captured by the above 5 categories. Examples include office space and executive salaries. These expenses cannot be deferred and have no impact on DAC calculation.

- (b) Your company is developing a new deferred annuity product with a policyholder persistency bonus feature. Describe how this feature would impact the following:
- (i) Estimated gross profit (EGP)
 - (ii) k-factor
 - (iii) DAC amortization

Commentary on Question:

Many candidates answered the question by simply citing the concept of SOP 03 and sales inducement asset / liability, but did not recognize that sales inducement asset is reported separately on the balance sheet from the DAC, and therefore did not actually address the question, which is specifically asking about DAC.

8. Continued

Two outcomes will result from adding a persistency bonus:

- 1) More policyholders will persist
- 2) The insurance company will earn less interest spread than before, since policyholders will now receive more credited interest

The first outcome results in higher profits, while the second results in reduced profits. In the absence of a product misprice, the first outcome should have a larger impact and more than offset the second. As a result:

- (i) EGP will increase
 - (ii) K-factor will decrease, due to higher EGP
 - (iii) DAC amortization will be lower to start, as the k-factor will dominate and the initial EGP will be about the same as before the change. Later on, DAC amortization will be higher as the EGP becomes larger and overcomes the lower k-factor.
- (c) Describe the impact on the DAC asset with respect to SOP 05-1 for each of the following scenarios:
- (i) A policyholder persistency bonus is added to in-force deferred annuity policies.
 - (ii) An upgrade to the administration system requires that inforce policies be treated as if they are cancelled and reissued on the new system.
 - (iii) A group of policyholders convert their deferred annuity policies to fixed payout annuities.

Commentary on Question:

Not many candidates knew all the criteria for substantially changed, and therefore it was not possible to know if they were merely guessing when they claimed that a policy is not substantially changed. Many candidates lack understanding of what participating products are, and referred to a persistency bonus as a "dividend". Some candidates also incorrectly cited the AV criteria as "change in AV", instead of "decrease" in AV.

There are six criteria for determining whether the policy has been substantially changed:

- 1) Type and degree of insured risk has changed
- 2) Nature of how investment return is credited has changed
- 3) Additional premium is required in order to stay inforce
- 4) Decrease in account value

8. Continued

5) Change in policyholder participation / dividends

6) Change in amortization method

If any of the above criteria is met, the policy is considered substantially changed, and DAC must be written off and a new DAC established.

- (i) It can be argued that the policy is substantially changed due to the investment return criteria, because the persistency bonus is a different way of receiving credited interest. In this case the current DAC must be written off and a new DAC established. Alternatively, it can be argued that the investment return criteria refers to a fundamental change in how credited interest is calculated, such as changing from General Account fixed crediting rate to external market indexed, and therefore the mere addition of a persistency bonus does not constitute a change in the nature of the investment return. In this case, existing DAC would continue to be amortized.
- (ii) The admin system change does not meet any of the listed criteria, and the policy is not substantially changed. Existing DAC would continue to be amortized.
- (iii) This meets the amortization change criteria and the policy is substantially changed. Current DAC must be written off and a new DAC established.

9. Learning Objectives:

2. The candidate will be able to understand and apply valuation principles of individual life insurance and annuity products issue by U.S. life insurance companies.

Learning Outcomes:

- (2c) Calculate liabilities for life and annuity products and their associated riders under the following standards:
 - (i) U.S. Statutory
 - (ii) U.S. GAAP
 - (iii) U.S. Tax

Sources:

Valuation of Life Insurance Liabilities, Lombardi, 4th Edition, Ch. 7

Commentary on Question:

For part (a), the examiners were looking for the motivation behind the enactment of the Valuation of Life Insurance Policies Model Regulation. A good number of candidates failed to understand what was required and instead described the reasons for the existence of the NAIC and the need for uniform standards across the U.S. in the regulation of life insurance companies. There are specific reasons for the enactment of the regulation, and candidates were expected to explain them. Only a few candidates did well on part (a)

For part (b), most candidates were able to determine the segments, but the vast majority of candidates failed to utilize the factors provided to calculate the unitary and segmented reserves. Even though candidates struggled with the calculations, partial credit was awarded to those candidates who demonstrated an understanding of the concepts.

Solution:

- (a) Explain why the NAIC adopted the *Valuation of Life Insurance Policies Model Regulation*.

Commentary on Question:

See above

- Unitary approach may not recognize premium deficiencies on renewable term products
- Under the unitary approach, gross premiums can be set at very high levels in later policy years to offset deficiencies in earlier policy years
- Regulators became concerned and responded for two reasons:
 - Using premiums in later years to cover cost of insurance in earlier years is not a sound practice
 - Higher premiums in later years may result in anti-selection
 - Healthy policyholders may lapse their coverage and reenter the market
 - Only unhealthy policyholders may persist, leading to a mortality spiral

9. Continued

- (b)
- (i) Calculate the statutory basic and deficiency reserves at the end of policy year 2. Show all work.
 - (ii) Explain how different valuation mortality assumptions might be used to reduce deficiency reserves for term policies.

Commentary on Question:

See above

- (i) **Step 1: determine contract segments**
New segment begins in policy year 4 when premium ratio exceeds mortality ratio

$$\text{Year 4 premium ratio} = 5,000 / 3,500 = 1.43$$

$$\text{Year 4 mortality ratio} = 4.57 / 3.97 = 1.15$$

Step 2: calculate basic reserve

Unitary reserve

$$\begin{aligned} k &= \text{PV}(\text{Benefits}) / \text{PV}(\text{Gross premiums}) \\ &= 1000A(46:4) / (5 \times \ddot{a}(46:4) - (5 - 3.5) \times \ddot{a}(46:2)) \\ &= 17.14 / (5 \times 3.98 - 1.5 \times 2.00) = 1.0142 \end{aligned}$$

$$\begin{aligned} \text{Unitary reserve} &= 1000 \times (1000A(47:3) - k \times (5 \times \ddot{a}(47:3) - 1.5)) \\ &= 1000 \times (13.74 - 1.0142 \times (5 \times 2.99 - 1.5)) \\ &= 1000 \times (13.74 - 13.64) = 100 \end{aligned}$$

Segmented reserve

$$\begin{aligned} k &= \text{PV}(\text{Benefits}) / \text{PV}(\text{Gross premiums}) \\ &= 1000A(46:2) / (3.5 \times \ddot{a}(46:2)) \\ &= 7.41 / (3.5 \times 2.00) = 1.0586 \end{aligned}$$

$$\begin{aligned} \text{Segmented reserve} &= 1000 \times (1000A(47:1) - k \times 3.5) \\ &= 1000 \times (3.97 - 1.0586 \times 3.5) \\ &= 1000 \times (3.97 - 3.71) = 260 \end{aligned}$$

Basic reserve

$$\begin{aligned} \text{Basic reserve} &= \text{MAX} [\text{Unitary reserve}, \text{Segmented reserve}] \\ &= \text{MAX} [100, 260] = 260 \end{aligned}$$

9. Continued

Step 3: calculate deficiency reserve

Only need to calculate on segmented basis since basic reserve is segmented

Only need to calculate for first segment since second segment does not have a premium deficiency

Recalculate basic reserve substituting gross premium for net premium

$$\begin{aligned}\text{Recalculated basic reserve} &= 1000 \times (1000A(47:1) - 3.5) \\ &= 1000 \times (3.97 - 3.5) = 470\end{aligned}$$

Deficiency reserve

$$\begin{aligned}\text{Deficiency reserve} &= \text{Recalculated basic reserve} - \text{Basic reserve} \\ &= 470 - 260 = 210\end{aligned}$$

(ii)

- Minimum prescribed mortality table can be used for deficiency reserves even if not used for basic reserves
- X-Factors can be applied to deficiency reserve mortality table, subject to various restrictions

10. Learning Objectives:

2. The candidate will be able to understand and apply valuation principles of individual life insurance and annuity products issue by U.S. life insurance companies.

Learning Outcomes:

- (2a) Describe and differentiate between valuation assumptions under the following standards:
 - (i) U.S. Statutory
 - (ii) U.S. GAAP
 - (iii) U.S. Tax
- (2c) Calculate liabilities for life and annuity products and their associated riders under the following standards:
 - (i) U.S. Statutory
 - (ii) U.S. GAAP
 - (iii) U.S. Tax
- (2d) Calculate DAC assets for life and annuity products and their associated riders under the standard: U.S. GAAP.

Sources:

US GAAP for Life Insurers, Chapter 4;

Commentary on Question:

Commentary listed underneath question component.

Solution:

- (a) Calculate the following as of December 31, 2014, for a 100,000 policy issued on July 1, 2014:
 - (i) Mean GAAP maintenance expense reserves
 - (ii) Mean GAAP DAC asset

Commentary on Question:

Candidates generally answered this part fairly well. This question required the candidate to calculate mean GAAP reserves from scratch based on the provided assumptions. Candidates were given credit for alternative acceptable approaches to get to their final results, e.g. One possible alternative approach would for the candidate to use the retrospective approach rather than the prospective approach for calculating the reserves.

Some candidates were unable to complete the numerical calculations but were still able to receive some credit for noting formulas and demonstrating an understanding of the concepts.

10. Continued

SFAS 60 is applicable.

PVFGP calcs used in both (i) and (ii) shown first.

$$\text{PVFGP}(0) = \text{FA} \times (\text{GP}(1)/1000 + \text{GP}(2)/1000 \times (1 - \text{mq}(1))/1000) \times (1 - \text{lq}(1)) / (1 + i) \\ + \text{GP}(3)/1000 \times (1 - \text{mq}(1))/1000 \times (1 - \text{mq}(2))/1000 \times (1 - \text{lq}(1)) \times (1 - \text{lq}(2)) / \\ (1 + i)^2$$

$$\text{PVFGP}(0) = 100,000 \times (1.32/1000 + 1.35/1000 \times (1 - .62/1000)) \times (1 - .15) + \\ 1.39/1000 \times (1 - .62/1000) \times (1 - .655/1000) \times (1 - .15) \times (1 - .05) = 342.8954505$$

$$\text{PVFGP}(1) = \text{FA} \times (\text{GP}(2)/1000 + \text{GP}(3)/1000 \times (1 - \text{mq}(2))/1000) \times (1 - \text{lq}(2)) / \\ (1 + i)$$

$$\text{PVFGP}(1) = 100,000 \times (1.35/1000 + 1.39/1000 \times (1 - 0.655/1000)) \times (1 - 0.05) / \\ 1.05 = 260.6795307$$

- (i) Mean GAAP Maintenance Expense Reserves(t) = $1/2 \times (\text{MaintV}(t) + \text{MaintV}(t+1) - \text{MaintNP}(t) + \text{MaintExp}(t))$, where $\text{MaintExp}(t)$ are maintenance expenses incurred at beginning of year.
Maintenance expenses include per policy maintenance expenses and premium taxes.

First calculate maintenance expense net premium ratio.

$$\text{MaintNPRatio} = \text{PVFME}(0) / \text{PVFGP}(0)$$

$\text{PVFGP}(0) = 342.8954505$ as calculated in section (i) above.

$$\text{PVFME}(0) = (\text{ME}(1) + \text{PT}\% \times \text{FA} \times \text{GP}(1)/1000) + (\text{ME}(2) + \text{PT}\% \times \text{FA} \\ \times \text{GP}(2) / 1000) \times (1 + (1 - \text{mq}(1))/1000) \times (1 - \text{lq}(1)) / (1 + i) + (\text{ME}(3) + \\ \text{PT}\% \times \text{FA} \times \text{GP}(3)/1000) \times ((1 - \text{mq}(1))/1000) * (1 - \text{mq}(2)/1000) * (1 - \\ \text{lq}(1)) * (1 - \text{lq}(2)) / (1 + i)^2$$

$$\text{PVFME}(0) = (30 + 0.02 \times 100,000 \times 1.32/1000) + (30 + 0.02 \times 100,000 \times \\ 1.35/1000) \times (1 - 0.62/1000) \times (1 - 0.15) / 1.05 + (30 + 0.02 \times 100,000 \times \\ 1.39/1000) \times (1 - 0.62/1000) \times (1 - 0.655/1000) \times (1 - 0.15) \times (1 - 0.05) / \\ 1.05^2 = 83.07334888$$

$$\text{MaintNPRatio} = 83.07334888 / 342.8954505 = 24.227\%$$

Now have information available to calculate terminal GAAP maintenance expenset reserve factors ($\text{GMEV}(1)$).

$$\text{GMEV}(0) = \text{PVFME}(0) - \text{MaintNPRatio} \times \text{PVFGP}(0) = 0$$

$$\text{GMEV}(1) = \text{PVFME}(1) - \text{MaintNPRatio} \times \text{PVFGP}(1)$$

$$\text{PVFME}(1) = (\text{ME}(2) + \text{PT}\% \times \text{FA} \times \text{GP}(2)/1000) + (\text{ME}(3) + \text{PT}\% \times \text{FA} \\ \times \text{GP}(3)/1000) \times (1 - \text{mq}(2))/1000 \times (1 - \text{lq}) / (1 + i)$$

10. Continued

$$\text{PVFME}(1) = (30 + .02 \times 100,000 \times 1.35/1000) + (30 + .02 \times 100,000 \times 1.39/1000) \times (1 - 0.655/1000) \times (1 - 0.05) / 1.05 = 62.33866919$$

$$\text{PVFGP}(1) = 260.6795307 \text{ as calculated in section (i) above}$$

$$\text{GMEV}(1) = 62.33886919 - .242270199 \times 260.6795307 = -0.8161248$$

$$\begin{aligned} \text{Need to calculate GAAP maintenance expense net premium} &= \text{GMENP}(0) \\ &= \text{MaintNPRatio} \times \text{FA} \times \text{GP}(1) / 1000 = 0.242270199 \times 100000 \times \\ &1.32/1000 = 31.97966621 \end{aligned}$$

$$\begin{aligned} \text{Maintenance expense incurred at beginning of first year} &= \text{ME}(1) + \text{PT}\% \times \\ &\text{FA} \times \text{GP}(1)/1000 = 30 + .02 \times 100,000 \times 1.32/1000 = 32.64 \end{aligned}$$

$$\text{Thus, GAAP mean maintenance expense reserve in first year} = 0.5 \times (0 - 0.8161248 + 31.97966621 - 32.64) = -0.07793935$$

- (ii) Mean GAAP Deferred Acquisition Expense Reserves(t) = $1/2 \times (\text{DefAcqV}(t) + \text{DefAcqV}(t+1) - \text{DefAcqNP}(t) + \text{DefAcqExp}(t))$, where $\text{DefAcqExp}(t)$ are deferred acquisition expenses incurred at beginning of year).

Deferred acquisition expenses include commissions.

First calculate deferred acquisition expense net premium ratio.

$$\text{DefAcqNPRatio} = \text{PVFDAE}(0) / \text{PVFGP}(0)$$

$$\text{PVFGP}(0) = 342.8954505 \text{ as calculated in section (i) above.}$$

$$\begin{aligned} \text{PVFDAE}(0) &= (\text{Comm}\%(1) \times \text{FA} \times \text{GP}(1)/1000) + (\text{Comm}\%(2) \times \text{FA} \times \\ &\text{GP}(2)/1000) \times (1 + (1 - \text{mq}(1)/1000) \times (1 - \text{lq}(1)) / (1 + i)) + (\text{Comm}\%(3) \\ &\times \text{FA} \times \text{GP}(3)/1000) \times ((1 - \text{mq}(1)/1000) * (1 - \text{mq}(2)/1000) * (1 - \text{lq}(1)) * \\ &(1 - \text{lq}(2)) / (1 + i)^2) \end{aligned}$$

$$\begin{aligned} \text{PVFDAE}(0) &= (0.5 \times 100,000 \times 1.32/1000) + (0.05 \times 100,000 \times \\ &1.35/1000) \times (1 - 0.62/1000) \times (1 - 0.15) / 1.05 + (0.05 \times 100,000 \times \\ &1.39/1000) \times (1 - 0.62/1000) \times (1 - 0.655/1000) \times (1 - 0.15) \times (1 - 0.05) / \\ &1.05^2 = 122.2996445 \end{aligned}$$

$$\text{DefAcqNPRatio} = 76.54477252 / 342.8954505 = 0.223230645$$

Now have information available to calculate terminal GAAP deferred acquisition expense reserve factors ($\text{GDAEV}(1)$).

$$\text{GDAEV}(0) = \text{PVFDAE}(0) - \text{DefAcqNPRatio} \times \text{PVFGP}(0) = 0$$

$$\text{GDAEV}(1) = \text{PVFDAE}(1) - \text{DefAcqNPRatio} \times \text{PVFGP}(1)$$

$$\begin{aligned} \text{PVFDAE}(1) &= (\text{Comm}\%(2) \times \text{FA} \times \text{GP}(2)/1000) + (\text{Comm}\%(2) \times \text{FA} \times \\ &\text{GP}(3)/1000) \times (1 - \text{mq}(2)/1000) \times (1 - \text{lq}) / (1 + i) \end{aligned}$$

10. Continued

$$\begin{aligned}PVFDAE(1) &= (0.05 \times 100,000 \times 1.35/1000) + (0.05 \times 100,000 \times \\ &1.39/1000) \times (1 - 0.655/1000) \times (1 - 0.05) / 1.05 = 13.03397654 \\ PVFGP(1) &= 260.6795307 \text{ as calculated in section (i) above} \\ GDAEV(1) &= 13.03397654 - .223230645 \times 260.6795307 = -45.1576832\end{aligned}$$

$$\begin{aligned}\text{Need to calculate GAAP deferred acquisition expense net premium} &= \\ GMENP(0) &= \text{MaintNPRatio} \times \text{FA} \times \text{GP}(1) / 1000 = 0.223230645 \times \\ 100000 \times 1.32/1000 &= 29.46644512\end{aligned}$$

$$\begin{aligned}\text{Deferred acquisition expense incurred at beginning of first year} &= \\ \text{CommPT}\%(1) \times \text{FA} \times \text{GP}(1)/1000 &= 0.5 \times 100,000 \times 1.32/1000 = 66 \\ \text{Thus, GAAP mean deferred acquisition expense reserve in first year} &= 0.5 \\ \times (0 -45.1576832+29.46644512-32.64) &= -40.845619\end{aligned}$$

- (b) Assume that expected results are consistent with GAAP assumptions.
- (i) Calculate the expected pre-tax statutory income for the first policy year.
 - (ii) Calculate the expected pre-tax GAAP income for the first policy year.
 - (iii) Describe how the expected earnings emerge over the life of the policy on statutory and GAAP bases.

Show all work.

Commentary on Question:

In this question, the candidates were expected to demonstrate their understanding of how statutory and GAAP pre-tax income are constituted and to demonstrate how GAAP income emerges as a level percentage of premium under SFAS60 while stat income is lower in the first year then higher in later years.

Overall, candidates did well with part b. Candidates did very well on part (iii). Candidates generally did a little better on the Statutory income part (i) than the GAAP income part (ii). The investment income portion of the calculation was the most challenging.

Income statements, in general, are presented as:

Premiums + Investment Income - Death Benefits - Surrender Benefits - Increase in Statutory or GAAP Benefit Reserves - Maintenance Expenses - Premium Taxes - Increase in Maintenance Expense Reserves - Commissions - Other Acquisition Expenses - Increase in GAAP Deferred Acquisition Expense Reserves = Before-Tax Statutory or GAAP Income.

10. Continued

Cash flows, with the exception of investment income, will appear the same on both statutory and GAAP income statements.

Increase in reserves for income statements on a policy year basis are based on terminal reserves only.

Items in income statement assumed to occur at points in time other than at issue are discounted for survivorship.

$$\text{Premium}(1) = \text{FA} \times \text{GP}(1) / 1000 = 100000 \times 1.32 / 1000 = 132$$

$$\text{Death Benefits}(1) = \text{FA} \times \text{mq}(1) / 1000 = 100000 \times 0.62 / 1000 = 62$$

$$\text{Surrender Benefits}(1) = 0$$

Increase in Statutory Reserves(1) = $V(1) \times (1 - \text{mq}(1)/1000) \times (1 - \text{lq}(1)) - V(0) = 0$; For annual renewable term products, terminal statutory reserves for all policy years are equal to 0.

$$\text{Increase in GAAP Benefit Reserves}(1) = \text{GBV}(1) \times (1 - \text{mq}(1)/1000) \times (1 - \text{lq}(1)) - V(0) = 2.162864239 \times (1 - 0.62/1000) \times (1 - .15) - 0 = 1.837295$$

$$\text{Maintenance Expenses}(1) = 30$$

$$\text{Premium Taxes}(1) = \text{FA} \times \text{PT}\% \times \text{GP}(1)/1000 = 100,000 \times 0.02 \times 1.32/1000 = 2.64$$

$$\text{Increase in Maintenance Expense Reserves}(1) = \text{GMEV}(1) \times (1 - \text{mq}(1)/1000) \times (1 - \text{lq}(1)) - 0 = 0 - 0.8161248 \times (1 - 0.62/1000) \times (1 - 0.15) - 0 = -0.69335$$

$$\text{Commissions}(1) = \text{FA} \times \text{GP}(1)/1000 \times \text{Comm}\%(1) = 100,000 \times 1.32/1000 \times 0.50 = 66$$

$$\text{Other Acquisition Expenses}(1) = 0$$

$$\text{Increase in Deferred Acquisition Expense Reserves}(1) = \text{GDEV}(1) \times (1 - \text{mq}(1)/1000) \times (1 - \text{lq}(1)) = -45.1576832 \times (1 - 0.62/1000) \times (1 - .15) = -38.3602$$

$$\text{Statutory Investment Income}(1) = i \times (V(0) + \text{Premiums}(1) - \text{Maintenance Expenses}(1) - \text{Premium Taxes}(1) - \text{Commissions}(1) - \text{Other Acquisition Expenses}(1)) = 0.05 \times (0 + 132 - 30 - 2.64 - 66 - 0) = 1.668$$

$$\text{GAAP Investment Income}(1) = i \times (\text{GBV}(0) + \text{GMEV}(0) + \text{GDEV}(0) + \text{Premiums}(1) - \text{Maintenance Expense}(1) - \text{Premium Taxes}(1) - \text{Commissions}(1) - \text{Other Acquisition Expenses}(1)) = 0.05 \times (0 + 0 + 0 + 132 - 30 - 2.64 - 66 - 0) = 1.668$$

10. Continued

(i) $\text{Statutory Income}(1) = 132 + 1.668 - 62 - 0 - 30 - 2.64 - 66 - 0 = -26.972$

(ii) $\text{GAAP Income}(1) = 132 + 1.668 - 62 - 1.837295 - 30 - 2.64 + 0.69335 - 66 - 0 + 38.3602 = 10.24429$

(iii) GAAP Income on a FAS60 product would be expected to emerge as a level percentage of premium.

Due to up front acquisition costs the first year stat income would be expected to suffer from new business strain.

In contrast to the higher losses/lower income in early years for stat compared to GAAP, later years should result in higher stat income relative to GAAP

11. Learning Objectives:

5. The candidate will understand the Risk Based Capital (RBC) regulatory framework and the principles underlying the determination of Regulatory RBC and Economic Capital.

Learning Outcomes:

- (5c) Explain and describe the concept and roles of Economic Capital including:
- (i) Identification of the significant risk components
 - (ii) Selecting calculation methods appropriate to stakeholder's perspectives
 - (iii) Describing how a company would implement an Economic Capital Program

Sources:

Economic Capital for Life Insurance Companies, SOA Research paper, Feb 2008, Ch. 1 and 3-6

A Multi-Stakeholder Approach to Capital Adequacy, Section 6

LFV-121-08: Economic Capital Modeling: Practical Considerations, Milliman White Paper (US: pp 4-34, Can: all)

Commentary on Question:

Commentary listed underneath question component.

Solution:

- (a) Critique LVD's economic capital framework. Justify your answer.

Commentary on Question:

Examiners were looking for a critical assessment of LVD's proposed economic capital framework. They were interested in a discussion to illustrate how the proposed framework stacks up against the principles of economic capital planning and implementation. Generally candidates did well in this question

Economic capital should be calculated enterprise-wide; if term is not included then LVD is not including all risks.

Measuring capital under 2 bases is inconsistent; it makes it hard to compare and make decisions.

Under the proposed framework, diversification would not be considered between the two products.

11. Continued

- (b) For the variable annuity product:
- (i) Describe the key risks that LVD should address in the economic capital model.
 - (ii) Identify a plausible catastrophic event for each of these key risks.

Commentary on Question:

Part (i) was straightforward and candidates were able to identify the risks that should be addressed. Some candidates identified the risk but failed to describe the risk and therefore lost valuable points in the process. It is not enough to list an item without describing that item. Failure to describe the item leads to points being left on the proverbial table. In part (ii), a few candidates struggled to identify a plausible catastrophic exposure for each risk identified in part (i). A few did not even bother to attempt part (ii).

- (i) Equity risk: poor equity market performance and high market volatility could affect product guarantees.

Mortality risk: risk that the actual mortality rates are higher than expected when the account value falls below the guarantee value; mortality risk can consist of catastrophe risk, volatility risk, mis-estimation risk, and trend risk.

Operational risk: LVD should consider the process/system risks in their new hedging program because it is the first time they are doing it and the cost of a mistake could be high.

Credit risk - Counterparty default or default risk: The counterparty providing risk mitigating derivative contracts to LVD to hedge their equity risk could default on their obligation to pay LVD when stock prices decrease.

Lapse risk: if lapses are lower than expected in the first 5 years, then LVD will collect less income from the 10% fee on the account value

Liquidity risk: This does exist but it may not be very significant for LVD unless there is a catastrophic event; most companies do not include this risk in their EC model.

11. Continued

(ii) Equity risk: a stock market crash could both increase the value of the guarantee to the policyholder and the cost to hedge the guarantees for LVD.

Mortality risk: a pandemic outbreak (such as the ebola virus) where a lot of insureds die would cause LVD to pay out a large amount of death claims for both the annuity product with GMDB's and the term product.

Operational risk: examples of catastrophic events include a massive systems failure; a large lawsuit that damages the reputation of the company; or regulatory fines against the company

Credit risk - a stock market crash could cause counterparties that provide the derivative contracts on LVD's hedges to default on their obligations

Lapse risk: a major scandal involving LVD could cause a large number of policyholders to lapse their policies; a "run on the bank scenario" during a market crisis could also cause a catastrophic number of lapses

Liquidity risk: typically not as big of a concern for insurers, though a catastrophic operational risk event or market event could lead to this risk

12. Learning Objectives:

6. The candidate will be able to evaluate various forms of reinsurance, the financial impact of each form, and the circumstances that would make each type of reinsurance appropriate.

Learning Outcomes:

- (6a) Describe the considerations and evaluate the appropriate form of reinsurance from the ceding and assuming company perspectives.

Sources:

Life, Health and Annuity Reinsurance, Tiller, 3rd Edition, Ch. 4-5

Commentary on Question:

The question asks about a) reinsurance treaty provisions that relate to risk transfer and b) specific differences between Yearly Renewable Term (YRT) and Modified Coinsurance (Mod-co) reinsurance arrangements both theoretically and based on facts provided. Many of the facts provided were strongly in favor of Mod-co.

Solution:

- (a) Describe three possible treaty provisions DEF should include to ensure the reinsurance arrangement provides legitimate risk transfer.

Commentary on Question:

Candidates answered reasonably well on part a). The key phrase is “provides legitimate risk transfer”. Candidates did not score well if they described common reinsurance treaty provisions when those provisions were not in some way relevant to some aspect of risk transfer.

Partial credit was available if treaty provisions close to those listed in the answer were mentioned but not fully described. For example, some candidates mentioned a “solvency clause” where the reinsurer remains liable for the reinsured portion of a claim even if the ceding company is insolvent. That is part of the third point below but not completely descriptive of the desired answer.

Some candidates focused on implementing a trust, letter of credit or other collateral agreement to enhance the ability of the ceding company to claim a reserve credit. Those provisions may help the ceding company receive a reserve credit but may not be as directly applicable to the risk transfer question. Risk may be transferred whether or not there is a statutory reserve credit.

The question asked for three possible treaty provisions. Any three of the points listed below were considered a full response:

1. The reinsurer must have an actual obligation to pay benefits should experience reach a certain level.

12. Continued

2. Gains to the reinsurer must be based on the actual experience of the reinsurance.
3. No event, such as insolvency or management change, should automatically terminate the reinsurance in force. However, reinsurance may be terminated due to a certain level of earnings being attained, or if a warranty is violated.
4. Inforce reinsurance cannot be terminated unilaterally by the reinsurer, except for nonpayment of premiums.
5. Interest paid or credited via the reinsurance should be reasonable in relation to the investment markets or the assets involved.
6. The relevant significant risks of the underlying policies should be transferred to the reinsurer, including capital loss, disintermediation, and asset default risks if they are deemed relevant.
7. The ceding company should not be forced to pay back losses except for voluntary termination.

(b) From DEF's perspective:

- (i) (5.5 points) List the advantages and disadvantages of the two reinsurance proposals.
- (ii) (1.5 points) Recommend the treaty DEF should elect. Justify your answer.

Commentary on Question:

Candidates answered with some variance on part b). The question wording contains significant clues that influence the answer:

- *Ceding company is offering new UL product expected to sell well*
- *Ceding company has investment management expertise*
- *Reinsurer is not licensed or admitted*
- *YRT is based on smoker mortality*
- *YRT includes a high annual cession fee*
- *Mod-co has a significant first year expense allowance*
- *Mod-co has a fairly high interest rate*

12. Continued

These items almost completely favor the Mod-co arrangement; however, one unknown is the current surplus position of the ceding company. If ceding company can handle surplus strain from new UL issues then the primary reason to enter into a reinsurance arrangement is to limit earnings volatility due to large mortality claims. The YRT proposal is a percentage “up to an amount” rather than an “amount in excess of retention limit”. The YRT proposal covers the smaller risks and not the largest risks, which may be a fatal flaw especially in conjunction with an annual cession fee.

A few candidates argued for the YRT proposal and some partial credit was available for a well-reasoned argument even though the facts provided favored Mod-co.

A primary focus was the lack of reserve credit available in the YRT proposal due to the reinsurer being neither licensed nor admitted in the ceding company’s state of domicile and the lack of need for a reserve credit in the Mod-co proposal as the mod-co adjustment is used in lieu of a reserve credit for a similar effect on the balance sheet.

(i) YRT Advantages

- Less costly and simpler to administer
- Transfers only mortality/morbidity risk based on net amount at risk (may also be described as a disadvantage)

YRT Disadvantages

- No reserve credit as reinsurer not licensed or admitted
- Reinsurance premiums are based on smoker mortality (doesn’t reflect actual sales distribution)
- No zero first year reinsurance premium to help with surplus strain
- Cession fees are rarely used today
- Frequent reporting may be needed for UL business as net amount at risk varies through time and policyholder may change death benefit amount and option

Mod-Co Advantages

- Mod-co adjustment eliminates need for a reserve credit
- Retain assets for investments area to use expertise
- With no asset transfer there are no sales gains/losses to cause distortions
- Mod-co transfers all risks: mortality, investment, lapse and surrender
- Holding assets helps Assets Under Management (AUM) and asset ranking

12. Continued

- May have better rate of return than mod-co interest rate
- May more easily fund policy loans

Mod-Co Disadvantages

- More difficult to administer due to mod-co adjustment calculation

(ii) *Alternatives were discussed in part i). Part ii) asks for a specific recommendation and justification. This should involve more than repeating the advantages, but focusing on how they apply to the specific situation.*

Recommend Mod-co Reinsurance Arrangement

- Mod-co reinsurance arrangement does not have a reserve credit problem like the YRT proposal (use a mod-co adjustment in lieu of a reserve credit)
- Product is expected to sell well making more complex reinsurance administration more worthwhile and help with surplus strain on new issues
- Mod-co is favored for reinsuring products that develop cash values or have significant asset risk components.