CSP-IU Complete Illustrative Solutions
Spring 2010

1. Learning Objectives:

6A: The candidate will be able to explain various strategies and evaluate results for an ALM model.

Sources:

Life Insurance Products and Finance, Ch 14: Financial Modeling

ILA-C112-07: ALM for Insurers

ILA-C113-07: Life Insurance Accounting, Ch 22: Asset/Liability Management

Commentary on Question:

The purpose of this question was to test the candidate's knowledge of two of the ALM strategies: exact cash flow matching and immunization. Also, the candidates were required to apply their knowledge of immunization by determining the asset portfolio of the two given bonds that would immunize the impact of the given liability cash flows. The case study was not used for this question.

Overall, the candidates did well on this question especially in part (b) and (c). To do well, the candidate needed to know the modified duration formula and the asset portfolio required to immunize the given liability cash flows is a weighted average of durations of the bonds to the duration of the liability cash flows. Common errors were mistakes in the calculation of the liability duration (eg. Using Macaulay duration instead of modified duration) or not knowing how to use the duration information to determine the asset portfolio.

In part (a), some candidates listed less available assets to cover liability cash flows with long durations as a limitation of exact cash flow matching. While this point was not in the grading outline, it is in the syllabus so candidates were given credit for it.

Solution:

(a)

(i) Exact Cash Flow Matching

Benefits:

- Eliminates interest rate risk if cash flows are exactly matched

1. Continued

Limitations:

- Impractical due to uncertainty in the timing of liability cash flows
- Reduces flexibility since it can force insurer to accept bond yields that are below what it could earn if it allowed itself some slight mismatch

(ii) Immunization

Benefits:

- Protects from losses due to changes in interest rates by matching the durations of assets and liabilities
- Impact on value of liabilities due to change in interest rates offsets the corresponding impact on value of assets

Limitations:

- Requires monitoring of asset and liability durations and rebalancing of asset portfolio to maintain the duration match
- Duration does not accurately predict the change in value for large interest rate changes
- Duration assumes the parallel shifts in yield curve shifts which is unrealistic
- Duration does not incorporate uncertainties in cash flows due to calls and prepayment in assets and premature surrenders in liabilities

(b) Modified Duration

$$= \Sigma t * v\hat{}(t+1) * Cashflow(t) / \Sigma v\hat{}t * Cashflow(t)$$

Liability Modified Duration

$$= [1*0.9524*(1/1.05)*10 + 2*0.9070*(1/1.05)*15 + 3*0.8638*(1/1.05)*28$$
$$+4*0.8227*(1/1.05)*32 + 5*0.7835*(1/1.05)*37 + 6*0.7462*(1/1.05)*40$$
$$+10*0.6139*(1/1.05)*50]/[0.9524*10 + 0.9070*15 + 0.86388*28 + 0.8227*32 +$$
$$0.7835*37 + 0.7462*40 + 0.6139*50] = 4.94$$

Let x be the percentage of assets invested in the 2 year bond

x * Duration of 2 year bond + (1-x) * Duration of 10 year bond = Liability Duration

$$x*(1.87) + (1-x)*(7.95) = 4.94$$

$$x = .496$$

Therefore, the asset portfolio is 49.6% of 2 year bonds and 50.4% of 10 year bonds

1. Continued

(c) Revised Modified Duration

$$= [1*0.9524*(1/1.05)*10 + 2*0.9070*(1/1.05)*15 + 3*0.8638*(1/1.05)*28 +$$
$$4*0.8227*(1/1.05)*32 + 5*0.7835*37 + 6*0.7462*(1/1.05)*40]/[0.9524*10 =$$
$$+0.9070*15 + 0.8638*28 + 0.8227*32 + 0.7835*37 + 0.7462*40] = 3.87$$

Difference between asset and liability durations = 4.94 – 3.87 = 1.07 which is > 1
Therefore, company needs to re-immunize liability cash flows

2. Learning Objectives:

4A: Apply methods of valuation to business and asset acquisitions and sales.

Sources:

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

ILA – C110-07: The Economics of Insurance; How Insurers Create Value for Shareholders

Commentary on Question:

The intent of this question was to test the candidate's ability to understand the mechanics and weaknesses of embedded value as a financial measure. Candidates were also expected to understand the various methods used to determine the cost of capital.

In general, candidates did poorly on this question. To do well, candidates needed to understand the general and specific factors that are taken into account in the setting of Non-Economic assumptions, demonstrate the transition of Inforce Business Value from one point to another as well discuss possible reasons why the target IBV may be different from the Actual IBV. Candidates were also expected to compare the Embedded Value framework with the Economic Value framework.

Candidates lost a lot of credit either by calculating a value and not stating the formula used or stating formulas without defining the variables used in the formula or both. A number of candidates failed to recognize that the Weighted Average Cost of capital approach was not what was required.

Solution:

(a)

(i) General Considerations

The assumptions should be entity specific best estimates reflecting management's unbiased estimates of future experience. The assumptions need not be consistent with market perceptions. Assumptions should be a combination of the historical experience of the company and blended, where necessary, with industry experience.

(ii) Specific Considerations

Taxes

- Reflect both federal and state\provincial taxes
- Project any changes in tax laws

2. Continued

Mortality

The mortality assumption should be a combination of company experience and industry experience with weighting determined by the credibility associated with the company's own experience. Assumptions are often expressed as a percentage of an industry table. Allowances are made for any anticipated improvements in mortality. The impact of anti-selection should also be considered and reflected. Assumptions may vary by product forms or apply across multiple product lines.

Persistency

This should be a combination of industry and company experience with more weight given to company experience. Companies differ in terms of product designs, distribution systems and policyholder service models. The relationship between policyholder behavior, product design and investment performance should also be considered. Thus, for interest sensitive products the lapse experience is related to interest rates. Products with a fixed surrender period as well as level term products should also reflect the impacts of shock lapse.

Expenses

All expenses should be considered. Assumptions should rely more on company experience than on industry experience. One-time expenses should be evaluated critically. Inflation should also be considered.

(b) From CAPM cost of equity RDR = RF + Beta *(RM - RF) where
RF = Risk Free Rate
RM = Expected Market Return
Beta = Relative risk of company stock to market

RDR -= 5 + 1.2 * (12 - 5) = 13.4%

$$CofC = [(RC_{t-1} - D_{t-1})]*(RDR - i_t)] + [D_t*(d_t - i_t)]$$

Where

RC = Required Capital at the beginning of the year
D = Debt
i = after tax return on assets
d = after tax cost of debt

2. Continued

$$CofC(2009) = (100-25)*(0.134-0.05)+25*(0.070-0.05) = 6.80$$
$$CofC(2010) = (120-30)*(0.134-0.065)+30*(0.09-0.065) = 6.96$$
$$CofC(2011) = (130-32.5)*(0.134-0.055)+32.5*(0.08-0.055) = 8.52$$
$$CofC(2012 = (140-35)*(0.134-0.06)+35*(0.085-0.06) = 8.65$$

$$PVCofC(12/31/2009) = CofC(2010)/1.134 + CofC(2011)/1.134\text{^}2 + CofC(2012)/1.134\text{^}3$$
$$= 6.96/1.134 + 8.52/1.134\text{^}2 + 8.65/1.134\text{^}3 = 18.69$$

$$PVFBP(12/31/2009) = 15/1.134 + 20/1.134\text{^}2 + 24/1.134\text{^}3 = 45.92$$

$$IBV(12/31/2009) = PVFBP - PVFCofC$$
$$IBV(12/31/2009) = 45.92 - 18.69 = 27.23$$

In-force After Tax Book Profits (2009) =Total After Tax Book Profits - New Business After Tax Book Profits

EIBV = Expected In-force Business Value

$$EIVB(IFB) = IBV(1/1/2009)*(1+RDR) - \text{BookProfits}(IFB) + (RDR-i)*RC(1/1/2009)$$
$$= 20*1.134 - 13 + (0.134-0.05)*100 = 18.08$$

$$\text{EIBV(New Business)} = VNB*(1+RDR)\text{^}0.5 - BP \text{ (New Business)}$$
$$= 5*1.134\text{^}0.5 + 3 = 8.32$$

Target IBV =EIBV(IFB) + EIBV(New Business)
$= 18.08 + 8.32 = 26.40$
Target IBV – Actual IBV = 26.40 - 27.23 = -0.83

Differences

- Model corrections
- Errors in calculations
- Deviations between expected and actual assumptions
- Current period Deviations between Actual versus Expected Assumptions

2. Continued

Prospective Differences

- EV is based on the composition of the backing assets not on the risk characteristics of the cash flows being valued
- Projected Statutory Profits are calculated incorporating expected returns
- Higher EV placed on portfolios backed by Corporate Bonds than backed by government bonds
- Bias created towards high yield investments that is not justified from an economic perspective
- Value of Liabilities should be independent of the composition of the backing assets
- Cost of capital should depend on the use of funding
- Cost of capital depends on source only if (or to the extent) frictional costs are affected
- EV method does not account for difference between diversifiable and non-diversifiable (or systematic) risks
- EV levies frictional capital costs solely on the basis of regulatory restrictions
- EV does not explicitly allow for frictional risk capital costs
- Identical lines of business will have different EV depending upon regulatory environment
- Under EV, the level of the regulatory capital charge is highest for business backed by the lowest yielding assets
- Least risky business would be allocated the highest frictional capital Cost
- EV method does not easily accommodate options and guarantees

3. Learning Objectives:

6C: Analyze and explain actual vs. projected differences.

6D: Explain limitations of models and possible sources of error:
- (i) Quality of data
- (ii) Granularity of the model

Sources:
Valuation of Life Insurance Liabilities, Chapter 13

Case Study included with examination

Commentary on Question:
The intent of this question was to test the candidate's ability to explain an answer to an extremely common real world question (especially in the wake of the financial crisis), "Why is actual experience not matching expected."

One significant problem with many answers is that they were not based on the block of business being Single Premium Fixed Deferred Annuities. Three common errors were:

1. Thinking that lower interest rates somehow increase account value (because the product was thought to be a variable annuity invested in some kind of bond fund where lower interest means higher bond fund values), or

2. Thinking that premium increases might cause excess lapses and/or mortality anti-selection lapses (because the product was thought to be a life insurance policy with recurring premium and mortality underwriting), or

3. Thinking that mortality plays any significant part (because the product was thought to be an immediate annuity).

The block of business was deliberately vaguely described, not showing specific surrender charge schedule(s) or specific minimum guaranteed interest rate(s), or policies issued in certain issue year(s). These were indications that a variety of Fixed SPDA products sold in various issue years are now at various points in their product life cycle. This is not a pricing exercise.

Generally, candidates did relatively evenly on the various sections of the question.

To do well on section (a), candidates needed to understand the product type mentioned in the question and have some idea how to describe information out of the case study. In this question, the case study was merely a proxy for the real world financial crisis and its aftermath.

3. Continued

To do well on section (b), candidates needed to understand that the objective is to model liabilities (not specifically assets), so describe elements of an excess lapse function. Policyholder behavior is an output of the process, not an input to it. Some candidates were confused by the "…asset liability matching" phrase, describing ALM or related processes. A few candidates described a specific excess lapse function in a formula.

To do well on section (c), candidates needed make a recommendation with a reasonable justification. A number of candidates listed items to consider and then failed to recommend something. A smaller number of candidates criticized the listed base and excess lapse expected assumptions as not being dynamic or sufficiently formula-driven, when the question said nothing about how these values were created. A few candidates rightly pointed out that the approach the company uses when it resets credited rate may have some bearing on the lapse rate.

Solution:

(a) Explain factors in the economic environment that may be causing the following actual to expected differences:

(i) Account value is higher than expected.

Case study items:

- Policyholders are more likely to retain policies to preserve principal and interest credited.
- Policyholders are more likely to retain policies due to value of minimum guarantee.
- Due to nature of underlying risks and high degree of uncertainty associated with the determination of liabilities, cannot precisely determine amount ultimately paid, particularly when well into the future.

Other points:

- Lapse (including excess lapse) rate is a significant factor in determining total account value.
- As other investment options become less attractive, policyholders are less likely to lapse.
- As other investment options become more attractive, policyholder are more likely to lapse.
- Little published industry experience describes interaction between lapse and credited interest.

3. Continued

(ii) Actual investment income is lower than expected.

Case study items:

- Investment yields declined in many asset classes.
- Defaults and downgrades in investment credit quality reduced earnings.
- Companies enhanced their liquidity positions by holding historically high levels of cash, cash equivalents and short-term investments.

Investment income in expected and actual depends on:

- Strategy regarding sale of assets prior to maturity
- Asset segmentation in support of the insurer's policy cash flows
- Strategy regarding the sale of assets with a declining market value
- Strategy for investment of future positive or negative cash flows
- Level of borrowing allowed in covering negative cash flows
- Derivative contracts, including strategies to mitigate risk, policy or other liability cash flow risk
- Capital contributions from parent
- Gains or losses due to asset, policy or other liability cash flows denominated in foreign currencies
- Any other factor that might have a material effect on investment strategy or the insurer's ability to execute the investment strategy

(b) Identify the key considerations in creating an excess lapse function for asset liability matching.

Considerations in creating an excess lapse function for deferred annuities:

- Presence and level of any surrender charges
- Policy duration
- Marketing techniques and loyalty of the field force
- Prominence of interest rate in the policy's marketing and maintenance
- Guarantees available under the contract, which may be in-the-money or out-of-the-money
- Primarily investment types of products more subject to excess lapse
- Participating types of products may be less prone to lapse
- Develop estimates of excess lapses at various differentials between credited or company rate and market or competitor rates, adjusting for expected impact of surrender charges
- Set parameters of excess lapse formula to reproduce actual lapses

3. Continued

Mathematical excess lapse formula:

- Total Lapse = Base Lapse + Excess Lapse
- Excess lapse is negative if company rate > competitor rate
- Excess lapse is zero if company rate = competitor rate
- Excess lapse is positive if company rate < competitor rate
- Excess lapse function can look like an "S" curve starting negative on left side of graph, through zero, and maxing at some level asymptotically on right side of graph
- It eventually makes little difference if company rate falls far enough behind competitor rate for a long enough time (known as "burnout" phenomenon)
- Book formula: Excess Lapse = C / (1 + A * e^(B * (int_credited + Surrender Charge) – int_credited_competitor) – C / (1 + A * e), where A, B, and C are calibration factors

(c) Recommend any changes to future excess lapse assumptions. Justify your answer.

Comments: It was equally acceptable to clearly recommend a change or to clearly recommend no change in the excess lapse assumption. It was not sufficient to either recommend without any justification or to discuss considerations without making a clear recommendation.

If no change in the excess lapse assumption was recommended, reasons:

- Current low lapse rate is an aberration or abnormal.
- Lapses will return to normal when the economic environment improves.
- Lapses will return to normal when alternative investments again become more available.

If a change in the excess lapse assumption was recommended, reasons:

- Set excess lapse assumption by considering characteristics that affect the timing and amount of cash flows.
- Excess lapse assumption should reflect external factors such as interest rates, equity or other market returns, unemployment and inflation rates.
- Due to model validation considerations, the model must be able to reproduce recent historical experience; otherwise it is unlikely it can be relied upon to project future lapses.

4. Learning Objectives:

5B: Compute RBC for a life insurance company, including:
- (i) Identification of significant risk components
- (ii) Identification of specialized product RBC requirements
- (iii) Interpreting results from a regulatory perspective

5C: Explain and apply the concepts, approaches and method for determining Economic Capital

Sources:
Valuation of Life Insurance Liabilities, Chapter 16

Economic Capital for life Insurance Companies, SOA Research paper, Feb 2008

Commentary on Question:
The intent of this question was to test the candidate's understanding of the treatment of asset risks under RBC and Economic Capital. The question tested the candidate's ability to apply the RBC C-1 formulas to a specified asset portfolio, and the candidate's understanding of appropriate approaches to model asset risks under an Economic Capital framework.

In general, candidates did reasonably well on this question. To do well on part (a), candidates needed to reflect all components of the RBC C-1 formula, and explicitly show their calculations. A common problem from poorer candidates was a failure to explicitly state the formulas and step-by-step calculations to derive the final RBC C-1 component.

In part (b), a common problem from poorer candidates was describing the nature of the risks and how they could be mitigated, rather than answering the question about modeling approaches. While the model solution captures some of the main points for part (b), candidates could earn credit for other relevant information from the study note.

Solution:
(a) RBC C-1 requirement = C-1 requirement for bonds + C-1 requirement for mortgages + asset concentration factor

C-1 requirement for bonds = [Σ (statement value * RBC factor)] * bonds size adjustment

Bonds size adjustment= total weighted issuers ÷ total issuers
= (50 * 2.5 + 40 * 1.3) ÷ (90) = 1.97
Note that government bonds are not included when calculating the bonds size adjustment.

4. Continued

C-1 requirement for government bonds = 1,000 * 0.000 = 0
C-1 requirement for medium quality bonds = 700 * 0.046 = 32.2

Total C-1 requirement for bonds = (0 + 32.2) * 1.97 = 63.32

C-1 requirement for mortgages = statement value * RBC factor * Mortgage Experience Adjustment Factor

Note that the Mortgage Experience Adjustment Factor is the rolling average of actual mortgage default experience of ABC Life over the past 8 quarters, divided by the rolling average of actual mortgage default experience of life insurance industry over past 8 quarters.

C-1 requirement for mortgages = 600 * 0.026 * 1.2 = 18.72

Asset concentration factor = C-1 requirement for the ten largest asset holdings
= 200 * medium quality bond C-1 factor
= 200 * 0.046 = 9.2

Total RBC C-1 requirement = 63.32 + 18.72 + 9.2 = 91.24

(b)

(i) Equity Risk
- Typically, stochastic or stress test approaches are used
- Under a stochastic approach, generate scenarios using a calibrated Economic Scenario Generator
- Can define stress test scenarios using historical data such as stock indices

(ii) Liquidity Risk
- For an extensive approach, use dynamic cash flow models
- Static factor approach does not recognize the dynamic nature of liquidity risk and its interaction to other risks

(iii) Credit Risk
- A stress test approach is most commonly used
- Focus is usually on credit spread risk
- Factor-based approach considered too crude for spread and default risk

5. Learning Objectives:

2A(iv): Describe, compare, and contrast valuation methods under fair value accounting

Sources:

Study Note "An Approach for Measurement of the Fair Value of Insurance Contracts," Actuarial Practice Forum, May 2007

Case Study

Commentary on Question:

The intent of this question was to test the candidate's ability to apply fair market value measurement concepts. This included the calculation of various fair value figures and applying scenario testing to assumptions.

In general, candidates performed poorly on this question, especially for parts (b) and (c). To do well, candidates needed to project asset and liability cash flows correctly and apply appropriate interest discounting, using a base LIBOR rate and adding the appropriate risk premiums. The following is a list of commonly noted errors:

(a) Method for calculating RP

- Leaving out ED in formula
- Not specifying ED=0, since policyholder has right to unilaterally stop paying premium

(b) Calculating FVL, FANIP, economic asset

- Not adjusting asset/liability CFs to in-force basis
- Applying CS and RP to the wrong CF stream: premium stream attracts RP, benefit stream attracts CS
- Netting CFs: cannot do since each stream has different discount rate
- Attempting to use recursive equation for liability calculation: cannot do since liability and asset streams have different discount rates
- Not using single spot rate to discount given CF
- Not adding acquisition costs to FANIP formula
- Using qx(d) as given in question, but not dividing by 1,000
- Using best estimate reserve + risk margin

(c) Scenario calculations

- Similar to comments for part (b)
- Adjusting liability CF for given change in decrement, but not adjusting premium CF as well

5. Continued

(d) Categorize liability w.r.t. fair value hierarchy

- Most recognized liability as Level 3
- Not providing justification
- Split inputs by level, but not making final categorization

(e) Market related factors that will affect RP

- Not citing items from case study to back up point

Solution:

(a) To determine the risk premium at equilibrium, you must equate the present value of assets and liabilities for term contract using the following formula:

$$\Sigma t = 1 \text{ to } 3 \text{ Prem}/(1+S_t+ED_t+R)^{t-1} = \Sigma t = 1 \text{ to } 3\ EDB_t/(t+S_t+CS_t)^t$$

S – spot rate
CS – credit spread for issuer
ED – expected default rate (= 0, since policyholder has unilateral right to stop premium)
R – risk premium at equilibrium

(b) *Comment: Partial credit was given for knowing most if not all of the formulae.*

- $FVL \text{ at time } 1 = \Sigma t = 2 \text{ to } 3\ EDB_t/(1+S_t+CS_t)^{t-1} - \Sigma t = 2 \text{ to } 3 \text{ Prem}/(1+S_t+R)^{t-2}$

$$EDB_2 = 500{,}000*(1-0.3/1000)*(1-0.1)*(0.32/1000)$$
$$= 143.96$$
$$EDB_3 = 500{,}000*(1-0.3/1000)*(1-0.1)*(1-0.32/1000)*(1-0.05)*(0.35/1000)$$
$$= 149.53$$

$$\text{Prem}_2 = 250*(1-0.3/1000)*(1-0.1)$$
$$= 224.93$$

$$\text{Prem}_3 = 250*1-0.3/1000)*(1-0.1)*(1-0.32/1000)*(1-0.05)$$
$$= 213.62$$

$$FVL = 143.96/(1+0.03+0.005)+149.53/(1+0.0372+0.005)^2$$
$$-224.93-213.62/(1+0.03+0.06)$$
$$= (144.16)$$

5. Continued

- $FANIP = \Sigma t = 1\ to 3\ LCF_t /(1 + S_t + CS_t)^t$ + Acquisition Cost FANIP = ∑ t=1 to

  Acquisition cost = 90% * premium = 90% * 250 = 225

  $LCF_1 = 500,000 * (0.3/1000)$
  $= 150.00$

  $LCF_2 = 500,000 * (1 - 0.3/1000) * (1 - 0.1) * (0.32/1000)$
  $= 143.96$

  $LCF_3 = 500,000 * (1 - 0.3/1000) * (1 - 0.1) * (1 - 0.32/1000) * (1 - 0.05) * (0.35/1000)$
  $= 149.53$

  $FANIP = 150.00/(1 + 0.025 + 0.005) + 143.96/$
  $(1 + 0.03 + 0.005)^2 + 149.53/(1 + 0.0372 + 0.005)^3 + 225$
  $= 637.11$

- Economic asset = $\Sigma t = 1\ to\ 3 \text{Prem}/(1 + S_t + R)^{t-1}$

  $\text{Prem}_1 = 250$

  $\text{Prem}_2 = 250 * (1 - 0.3/1000) * (1 - 0.1)$
  $= 224.93$

  $\text{Prem}_3 = 250 * (1 - 0.3/1000) * (1 - 0.1) * (1 - 0.32/1000) * (1 - 0.05)$
  $= 213.62$
  Economic asset $= 250 + 224.93/(1 + 0.025 + 0.06) + 213.62/(1 + 0.03 + 0.06)^2$
  $= 637.11$

(c) Comment: Although the model solution shows a formulaic approach for the scenario testing, credit was given for providing a qualitative answer for each scenario.

(i)

$EDB_2 = 500,000 * (1 - 0.3/1000) * (1 - 0.1) * (2.32/1000)$
$= 1043.69$
$EDB_2 = 500,000 * (1 - 0.3/1000) * (1 - 0.1) * (1 - 2.32/1000) * (1 - 0.05) * (0.35/1000)$
$= 149.23$

5. Continued

$$\text{Prem}_2 = 250*(1-0.3/1000)*(1-0.1)$$
$$= 224.93$$

$$\text{Prem}_3 = 250*(1-0.3/1000)*(1-0.1)*(1-2.32/1000)*(1-0.05)$$
$$= 213.19$$

$$FVL = 1043.69/(1+0.03+0.005)+149.23/(1+0.0372+0.005)^2$$
$$-224.93-213.19/(1+0.03+0.06)$$
$$= 725.27$$
Change in $FVL = 725.27-(144.16)$
$$= 869.42$$

(ii)

$$EDB_2 = 500,000*1-0.3/1000)*(1-0.1)*(0.32/1000)$$
$$= 143.96$$
$$EDB_3 = 500,000*(1-0.3/1000)*(1-0.1)*(1-0.32/1000)*(1-0.1)*(0.35/1000)$$
$$= 141.66$$

$$\text{Prem}_2 = 250*(1-0.3/1000)*(1-0.1)$$
$$= 224.93$$

$$\text{Prem}_3 = 250*(1-0.3/1000)*(1-0.1)*(1-0.32/1000)*(1-0.1)$$
$$= 202.37$$

$$FVL = 143.96/(1+0.03+0.005)+141.66/(1+0.0372+0.005)^2-224.93-$$
$$202.37/(1+0.03+0.06)$$
$$= (141.09)$$

Change in $FVL = (141.09)-(144.16)$
$$= 3.07$$

(iii)

$$EDB_2 = 500,000*(1-0.3/1000)*(1-0.1)*(0.32/1000)$$
$$= 143.96$$
$$EDB_3 = 500,000*(1-0.3/1000)*(1-0.1)*(1-0.32/1000)*(1-0.05)*(0.35/1000)$$
$$= 149.53$$

5. Continued

$$\text{Prem}_2 = 250*(1-0.3/1000)*(1-0.1)$$
$$= 224.93$$

$$\text{Prem}_3 = 250*(1-0.3/1000)*(1-0.1)*(1-0.32/1000)*(1-0.05)$$
$$= 213.62$$

$$FVL = 143.96/(1+0.03+0.02)+149.53/(1+0.0372+0.02)^2 - 224.93 - 213.62/(1+0.03+0.06)$$
$$= (150.02)$$

$$\text{Change in } FVL = (150.02) - (144.16)$$
$$= (5.87)$$

(iv)

$$EDB_2 = 500,000*(1-0.3/1000)*(1-0.1)*(0.32/1000)$$
$$= 143.96$$
$$EDB_3 = 500,000*(1-0.3/1000)*(1-0.1)*(1-0.32/1000)*(1-0.05)*(0.35/1000)$$
$$= 149.53$$

$$\text{Prem}_2 = 250*(1-0.3/1000)*(1-0.1)$$
$$= 224.93$$

$$\text{Prem}_3 = 250*(1-0.3/1000)*(1-0.1)*(1-0.32/1000)*(1-0.05)$$
$$= 213.62$$

$$FVL = 143.96/(1+0.025+0.005)+149.53(1+0.0322+0.005)^2 - 224.93 - 213.62/(1+0.025+0.06)$$
$$(143.05)$$

$$\text{Change in } FVL = (143.05) - (144.16)$$
$$= 1.10$$

(d)

- Life insurance liabilities are not traded in an active market
- Most inputs are unobservable
- Most life insurance liabilities classified as Level 3
- Main difference with Level 2 is that Level 2 models reflect some form of reliable market data

5. Continued

(e) *Comment: the following items identify the study note reference and corresponding case study risk factor.*

- Exit/entry of recent new entrants (note); Industry Trends Could Adversely Affect the Profitability of Our Business (Case study)

- Change in prices in response to a shift in level of competition (note); Competitive Factors May Adversely Affect Our Market Share and Profitability (Case study)

- A change in reinsurance capacity, especially due to the exit and entrance of reinsurers (note); Reinsurance May Not Be Available, Affordable, or Adequate to Protect Us Against Losses (Case study)

- Emerging uncertainty regarding the effect on mortality or morbidity of an epidemic/pandemic; Catastrophes May Adversely Impact Liabilities for Policyholder Claims (Case study)

- Significant changes in persistency or other experience (Note); Differences Between Actual Claims Experience and Underwriting and Reserving Assumptions May Adversely Affect Our Financial Results (Case study)

Comment: Also acceptable for grading points:
(i) *Alternative risk transfer mechanisms*
(ii) *Change in volume/mix of business sold*

6. Learning Objectives:

1E: The candidate will be able to explain fair value accounting principles

Sources:

ILA-C107-09: Market Value margins for Insurance Liabilities in Financial Reporting and Solvency Applications, E7Y October 2007- through page 65

Commentary on Question:

The calculation in part (a) was done well with many candidates earning nearly full points for the question. Those who did not receive full points failed to show formulas or all steps to attaining the correct answer.

Most candidates did not write enough in part (a)(ii) and part (b) to receive enough points to do well on the question. There were many points to be gained here and most candidates did poorly on this section.

Solution:

(a)

(i)

Ultimate horizon basis includes all years.					
Year	Qx	Lives- BOY	Deaths	Benefits Paid	PV Benefits
1	3%	1000	30	3,000,000	3,000,000/1.04 = 2,884,615
2	3%	970	3%x970 = 29.1	2,910,000	2,910,000/1.04^2 = 2,690,459
3	3%	940.9	3%x940.9=28.23	2,822,700	2,822,700/1.04^3 = 2,509,370
Best estimate liability = sum of PV Benefits = 8,084,444					
MVM is BEL + 1.83 million = 9,914,444					
one year risk horizon basis					
99.5% percentile for mortality in year one = 3% + .5%x2.576 = 4.288%					
Year	Qx	Lives- BOY	Deaths	Benefits Paid	PV Benefits
1	4.288%	1000	42.88	4,288,000	4,288,000/1.04 = 4,123,077
2	3%	957.12	3%x957.12 = 28.7136	2,871,360	2,871,360/1.04^2 = 2,654,473
3	3%	928.4064	3%x928.4064=27.852	2,785,200	2,785,200/1.04^3 = 2,476,050
MVM = 4,123,077 + 2,654,473 + 2,476,050 = 9,253600					

(ii)

- Ultimate risk exposure horizon is 660,844 greater than the one year risk horizon.

6. Continued

- For the Ultimate risk horizon the following are true:
  - Capital for all future periods at 99.5% is obtained at issue.
  - Potential variability in mortality rates in all future periods is included.
  - The ultimate risk must be fully funded at inception.
  - No need to raise additional funds unless material change in the perception of future risks.

- For the One year risk horizon the following are true:
  - Only has capital for 99.5% exposure in the first year.
  - Assumes capital will be obtained in subsequent years.
  - Ignores variability of mortality in future years.
  - Assumes the company can fund risks sequentially, one period at a time.

- The cost of capital assumption could be modified to bring the two approaches closer together.

- The percentile in future years could be lowered (99.5% may only be appropriate for the first year).

(b)

- There is nothing inherently inconsistent between the percentile and cost of capital methods.

- For the percentile method, the following is true:
  - If risk distribution is stable from product to product and all underlying assumptions are identical then the same PERCENTILE could be used across all products.
  - Requires complete risk distributions underlying the best estimate liability.
  - Uses information required for initial capital base so implementation is easy.

- For the cost of capital method, the following is true:
  - This method makes the underlying assumptions explicit, which is a considerable advantage.
  - Allows market participants to assess the calibration of results.
  - Uses many approximations that would be precluded under the percentile method.
  - Shares many commonalities with pricing methods.
  - Some aspects of key assumptions may be easier with the cost of capital method as compared to percentile method.

7. Learning Objectives:

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

Sources:
Life and Health Reinsurance, Ch 4 Basic Methods of Reinsurance

Valuation of Liabilities, Ch 16 Risk-Based Capital

Commentary on Question:
Demonstration of an understanding of various reinsurance approaches/types, their uses and effects.

In general, candidates did poorly on this question. To do well, candidates needed to:

- Provide more description and demonstration of understanding the features for YRT and coinsurance,
- Provide appropriate advantages and disadvantages of using coinsurance for UL
- Properly assess the impact of reinsurance on each component of RBC, including actually stating the impact on each component (i.e. increased or decreased).

Solution:

(a)

(i) Types of risk transferred
YRT: only mortality/morbidity risk is transferred
Coinsurance: all risks are transferred proportionally

(ii) Retention method
YRT

- Pro-rata: ceding company retains a constant % of the NAR (original FA ceded/Total original FA)
- Level or constant retention: fixed amount of the NAR, thus amount reinsured is decreased if NAR decreases overtime
- Constant risk reinsured: rarely used method
- Formula retention: NAR and retention amounts are determined by a formula

Coinsurance: Level retention method is almost always used for coinsurance

7. Continued

(iii) Premiums and Allowances

YRT

- Rate can vary by sex, smoker status, age, policy year, underwriting class
- Percentage of COI table or mortality table
- Select period follows the select period of the underlying tables or COI
- Many arrangement has no first year premium, i.e. 100% allowance, to reduce the first year surplus strain of the ceding company
- May have an annual cession fee
- Can be experience rated
- Premium = YRT rate x NAR

Coinsurance

- Percentage of gross premium
- Ceding company gets allowance to cover expenses and commissions incurred by the company
- Premiums/allowances may vary by age, gender, risk class
- Ceding company may retain all policy fee
- Can be experience rated
- Can have persistency bonus

(b) Pros:

- The reinsurer establishes its proportionate share of the policy reserves
- All risks are transferred proportionally from the ceding company to the reinsurer
- Relief on surplus strain on new business

Cons:

- Reinsurer does not participate in policy loan
- Complex to administer as it involves many calculations: premiums, allowances, death benefit payments, CSV, reserves
- The calculation and treatment of reserve credit is under continuous review and refinement by the industry and regulatory groups
- Higher effective reinsurance cost

(c) C-1: Asset risk:

- RBC requirement = RBC factor x Statement Value
- Transfer of assets to reinsurer to back the reinsurer's share of the reserves
- Thus, transfer of C-1 component
- Thus, C-1 reduced

7. Continued

C-2: Pricing risk:

- RBC requirement = RBC factor x Net Amount At Risk
- Thus, transfer of C-2 component from ceding company to reinsurer
- Thus, C-2 reduced

C-3: Interest rate risk:

- Transfer of C-3 component from ceding company to reinsurer
- Thus, C-3 reduced

C-4: General Business risk:

- RBC requirement based on premium income
- Thus, reduced net premium income
- Thus, C-4 is reduced

Other - RBC requirement for reinsurance:

- RBC requirement = RBC factor x Amount due from reinsurer
- Thus, increased other component

8. Learning Objectives:

8C: Identify and apply actuarial standards of practice relevant to financial reporting and valuation.

Sources:

ASOP 21 Responding to the Auditor

ASOP 41 on Actuarial Communication

Commentary on Question:

The intent of this question was to test the candidate's understanding of ASOP 21 and ASOP 41 as it applies to writing a memo. It was not meant to test the candidate's understanding of the actuarial concepts contained in the memo.

In general, candidates did relatively well on this question. To do well, candidates needed to focus on the form of the memo as opposed to the actuarial content. They needed to identify the appropriate items in the ASOP that relate to the memo, then provide an opinion on whether each item was followed or not.

Solution:

(a) ASOP 21 states that:

- The responding actuary should be responsive to the auditor's requests.
  - Responding on May 1 to questions asked on March 25 is not very responsive.

- The responding actuary should be prepared to discuss with the auditor known circumstances that have a significant effect, including:
  - Changes in the operating environment;
  - Trends in experience;
  - Changes in product mix; and
  - Changes in the company's methods, policies, or procedures.
  - Cannot discuss the change in product mix or the impact of the change in the underwriting system.

- The responding actuary should be prepared to discuss with the auditor and provide documentation on the data, methods and assumptions used.
  - Does not have proper data to provide to the auditor

- The reviewing actuary's documentation should include evidence of planning and coordination with the auditor, as well as a description of the procedures followed.
  - The memo shows no evidence of planning or description of procedures.

8. Continued

ASOP 41 states that:

- The actuary writing an actuarial communication should be clearly identified.
  - The memo should name the actuary responsible rather than be from a department.

- The actuary can rely on information from other sources as long as reliance is properly disclosed.
  - Reliance on information from the Investment Division is disclosed.

- The form and content of the actuarial communication should be clear.

- An actuarial communication may be misused by someone who is not part of the intended audience.
  - The memo does not contain language to limit its distribution to the intended audience.

(b) The company should implement the following changes:

- Respond to the auditor quickly
- Provide recent data that is properly summarized
- Discuss any change in the operating environment
- Provide data that is properly documented
- Clearly identify the responding actuary
- Properly rely on others for information
- Limit the audience to avoid misuse of information

9. Learning Objectives:

5A: The candidate will be able to describe the RBC regulatory framework and the principles underlying the determination of regulatory RBC.

5C: The candidate will be able to explain and apply the concepts, approaches and method for determining Economic Capital.

Sources:

Economic Capital: The Controversy at the Watercooler, Financial Reporter, Fall 2006

Economic Capital for Life Insurance Companies, SOA Research Paper, Feb 2008, Ch. 1, 3, 4, 5, 6

ILA-C808-09: Fundamentals of the Principle Based Approach to Statutory Reserves and Risk Based Capital

Valuation of Liabilities, Ch. 16: Risk Based Capital

Stochastic Analysis of Long Term Multiple-Decrement Contracts, Clark & Runchey, Jan 2008 (Excluding Appendices)

Commentary on Question:

The intent of this question is to test the candidate's understanding of the fundamental differences between various risk capital methodologies and the reasons for those differences.

Solution:

(a) Solvency II risk capital approach is a 3-pillar approach similar to Basal II:

- Pillar I - quantification of risks
- Pillar II - internal and external governance
- Pillar III - supervisory and public disclosure

It is based on market-value accounting system, and is meant to provide assurance that net market values of assets and liabilities are greater than zero under all but most severe scenarios.

There are two major capital requirements:

- Solvency capital (SCR):
  - VAR method - calibrated at 99.5 percentile with one-year horizon level where supervisory intervention would start

- Minimum capital (MCR):
  - Level where ultimate supervisory intervention would take place
  - Maybe 80 to 90% confidence level

9. Continued

Risks covered are underwriting, market, credit, liquidity, operational and legal.

Risk mitigation is allowed, with a prescribed correlation approach.

SCR is calculated using standard approach or internal models subject to regulator approval.

Internal model approval has three main criteria:
- Use test (closely related to company ERM)
- Calibration test
- statistical test

Stress parameters will be prescribed (not entity specific).
Technical provisions (reserves) will be based on the concept of exit values.
- Valuation of hedgable risks is on a mark-to-market basis.
- Valuation of non-hedgable risks is best estimate discounted at risk-free rates, plus risk margin using cost-of-capital approach.

Premise is that if there is sufficient capital in stressed scenarios on market basis over one year, then sufficient assets should be available for a regulator to move liabilities to another company.

(b) ZYX should first determine its risk measurement preference.
Ultimate uses of capital should also drive the selection of a particular method.
- Liability run-off approach (focus on assets needed to run off liabilities over life horizon)
- One-year mark-to-market approach (assumes key risk is short-term market value fluctuations)

RBC is not an appropriate approach to be used for Economic Capital:
- Not designed as an economic capital metric – it was developed for regulators to identify weakly capitalized companies
- Companies frequently hold target multiples of RBC, driven by rating agencies
- While based on risk elements, RBC is not always reflective of specific company risk
- Factors may become obsolete
- Correlation function is not very realistic
- Focuses on selective risks, not all risks
- Uses statutory accounting basis
- Methodology inconsistent with emerging ALM and credit risk measurement practices

9. Continued

- Selection of risks focused on those that might provide for the rapid deterioration of surplus over a limited time horizon
- Provides a "cushion" to allow a company to survive over the short term; however, interim solvency checks may not be desired for economic capital metrics
- Pros of RBC:
  - Used liability run-off methodology over long term and direct modeling of interest rate and equity risk
  - Already need to calculate for regulators

Solvency II could be used as Economic Capital if have approved internal models:

- Designed as a market-consistent economic capital metric
- Appropriate if management believes risks can be "closed-out" by transactions at market prices within one year through hedging, reinsurance, sale of portfolios, or other risk reduction/transfer
- Possibly more consistent with emerging fair value accounting
- Fair value approaches tend to produce lower capital requirements
- Specific risks and correlations might be more realistically represented
- Use of deterministic adverse scenarios may help management focus specifically on those scenarios
- Typically includes one year of new business
- Total Balance Sheet approach on market consistent valuation
- Use of VaR as a risk metric

(c) Reflection of risk of long-term mortality improvement trend

RBC:

- Risk of a long-term mortality improvement trend ignored
- Mortality deterioration takes so long to emerge that it is not a threat to solvency over 5 to 10 years

Solvency II:

- Underwriting risk is a risk that is covered; however, it is very unlikely that long-term mortality improvement would be modeled as it is unlikely to develop over one year.
- Future risk uncertainties beyond the 1 year period are normally captured in market-consistent value of liabilities at the end of the year.
- The requirement to calibrate to a market-consistent basis can be very subjective.
- Longer-term risk issues and their potential consequences to capital normally addressed outside of economic capital assessment.

9. Continued

"Cash Balance" Economic Capital:

- Cash Balance Economic Capital is determined from the interactive projection of assets and liabilities under various scenarios without consideration of interim solvency, stat accounting, etc.
- Stochastic modeling of non-financial risks can be employed.
  - Long-term mortality improvement trend is one of 4 mortality factors that can be stochastically modelled.
  - While it is difficult to calibrate, should be included for products like payout annuities.
  - Scenarios where mortality trends improve should require longer payouts and more initial assets, resulting in higher levels of initial capital, all things being equal.

10. Learning Objectives:

7A/B: Identify potential sources of risks in products and investments.

7D: Describe how risks and opportunities interact and how they influence firm strategy.

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

Sources:

Insurance Risk Management Response to the Financial Crisis, CRO Forum, April 2009

ERM Specialty Guide, May 2006, Chapters 1-6

Responsibilities of the Actuary for Communicating Sarbanes-Oxley control: Effectiveness in Accordance with Actuarial Standards of Practice", 12/04 Financial Reporter #59

Note: (a)(iii) could also be answered in part from another Syllabus source. Points were given the candidate if they did so but a full credit for the section could be obtained from the above sources.

Commentary on Question:

Candidates were expected to analyze certain statements concerning risk, demonstrate knowledge of Enterprise Risk and be able to list minimum standards of control. Generally candidates did moderately well on this question; however no one did well on all three parts.

Poor marks resulted from:

- Lack of familiarity with the source material
- Not answering from the material in the context of the question
- Not arriving at a judgment when required.

Solution:

(a)

(i) This statement is not accurate- even quality assets can become illiquid.

- Especially crucial during a recession when policyholders may need money possibly causing assets to be sold at depressed values. Need to test a "run on the bank" scenario.

10. Continued

(ii) This statement is simply untrue.

- While models are critical to valuation they have their limitations. They are only as good as their inputs. Some risks are difficult to model properly. Judgment is more important than ever in setting and refining assumptions

(iii) This is exactly the right time to switch to market consistent valuation (MCV).

- Using a valuation that is not MCV may give a false sense of security, indeed may include incentives to do the wrong thing (example overload assets with bonds carried at amortized cost). MCV is merely telling the truth, however the process is not automatic. It requires some expertise. There are problems in getting proper valuations in an illiquid market. The process for doing so must be independent and comparable across different companies

(b)

(i) This approach is not valid.

- The definition of ERM is "across the enterprise" not limited to specific risks. It must be taken in context - a risky country may have immaterial affect on the company as a whole. You won't get the offsetting affects from taking a portfolio approach to the risks of the countries. In any case the goal of ERM is not purely to mitigate risk but also to identify opportunities

(ii) Risk management is critical in the product design process.

- When the product is launched it may be too late to correct mistakes. Sophisticated buyers may find arbitrage opportunities in the product, particularly given the complexity of many new products.

(c) Valuation data has been reconciled to the underlying records of the company.

- There are checks and balances in place for the manipulation of data.
- Actuarial methods and assumptions conform to accepted actuarial standards.
- Reserves are adequate.

11. Learning Objectives:

2E: Describe concepts underlying SVL II (principle-based reserves).

Sources:

ILA-C808-09: Fundamentals of the Principle Based Approach to Statutory Reserves and Risk Based Capital (L02) Pages 6, 7, 14, 29 and 30

Commentary on Question:

The intent of this question was to test the candidate's ability to list the value of data collection, to assess the appropriateness of statements on Principle-Based Valuation and to assess the appropriateness of assumptions under Principle-Based Valuations. In general, candidates did well on this question.

Solution:

(a) Used for reasonableness check on solvency requirement
Used for reasonableness check on methods and assumptions
Used for reasonableness check on premium rates
PBR uses company specific assumptions (sometimes blended with industry), Therefore, rely on data collection
Provides a rich database for inter-company studies
Serves as a source in situations where little or no company-experience data exists
Standard valuation tables can be updated

(b)

(i) This is appropriate and should include all risk including tail risk.

(ii) This is not appropriate.
- Uses company experience if credible and available
- If not credible, blend with industry
- If company has no control, use prescribed assumptions
- Provide margins for uncertainty

(iii) This is appropriate.
- Adopt internal controls consistent with the requirements of the NAIC
- Make report of the annual evaluation to the company's board of directors & the commissioner

(iv) This is not appropriate.
- If data not credible, blend with industry

11. Continued

(v) This is not appropriate.
- If company has no control, use prescribed assumptions

(c)

(i) It is not appropriate to use the same mortality margin for the in-house business and the TPA business.

The greater the uncertainty in the anticipated experience assumption, the larger the required margin.

TPA business has greater uncertainty in the anticipated experience assumptions due to:
- Unreliable data
- Incomplete data
- Untimely data

Compared to in-house business, TPA business should use higher margins. A margin > 10% is acceptable (e.g. 15%).

(ii) It is not appropriate to use the same lapse margin for the in-house business and the TPA business.

Negative lapse rate margin indicates that the business is lapse-supported. A margin < -10% is acceptable (e.g. -15%).

(iii) It is appropriate to use the prescribed interest-rate.
This assumption is prescribed according to VM-20.

12. Learning Objectives:

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

Sources:

SOA Research Project on Financial Reporting for Insurance Contracts under Possible Future International Standards, pp. 6-43, 67-70, 74-81

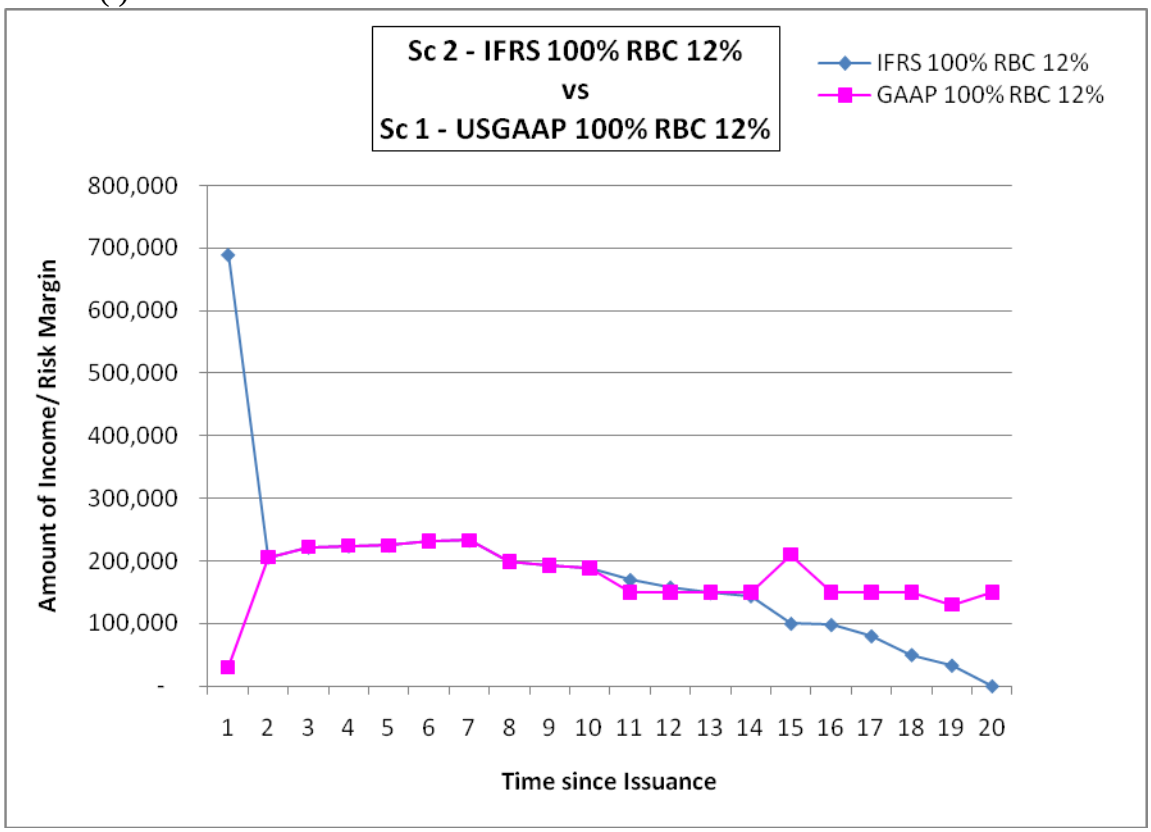
Commentary on Question:

The intent of this question was to test the candidate's ability to understand the International Financial Reporting Standards and how it compares to US GAAP

Solution:

(a)

(i)

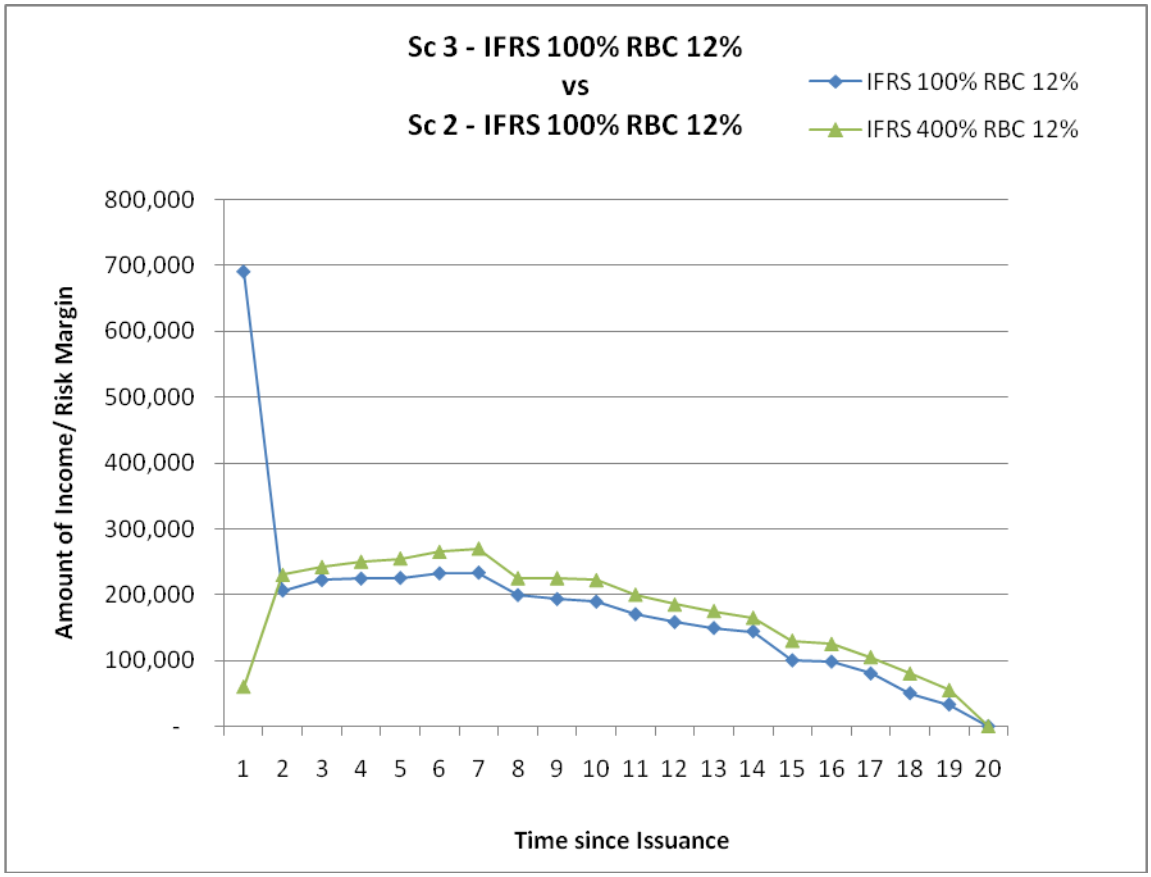


(ii) The IFRS gain in the first year represents the PV of future cash flows in excess of the PV of the cost of capital risk. The initial loss under GAAP is due to non-deferrable first year acquisition cost.

12. Continued

(b)

(i)

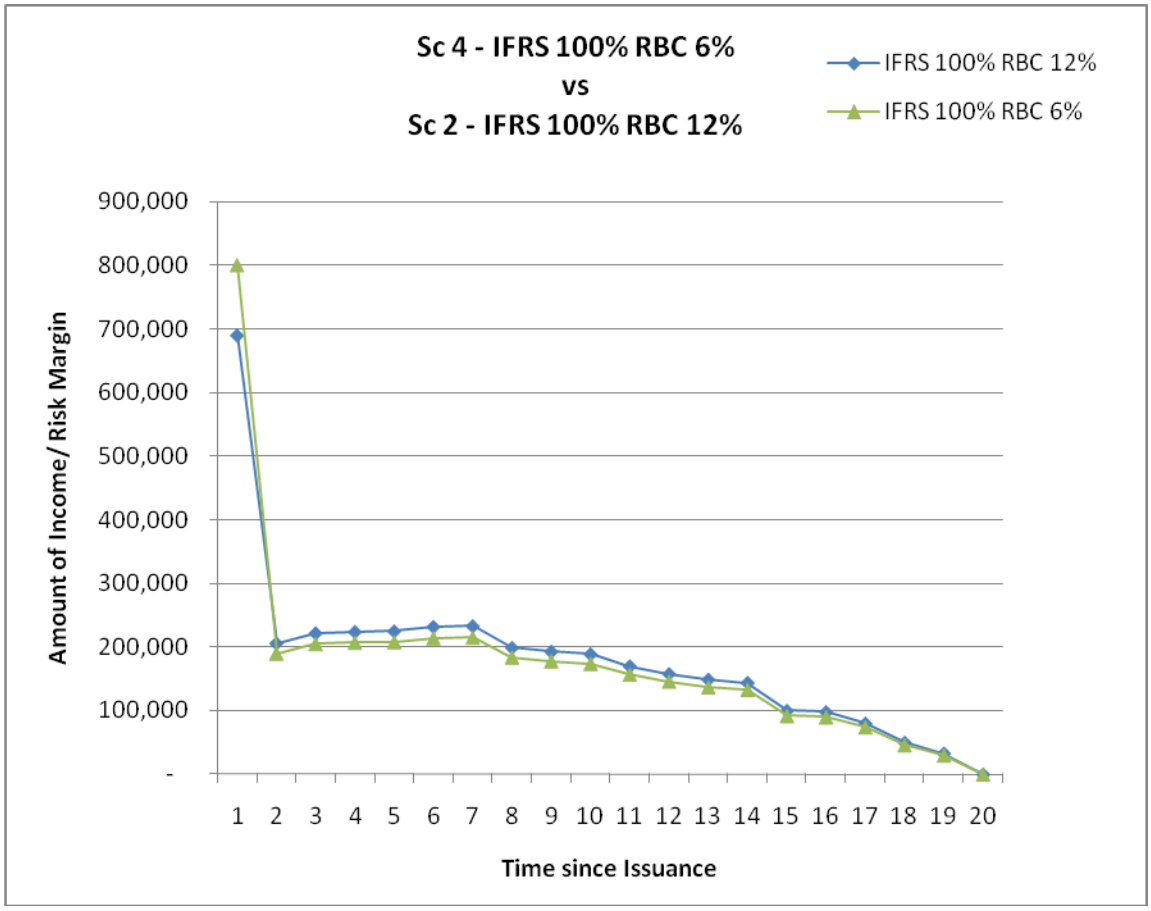


(ii) Scenario 3:
Less of a gain at issue and a higher income in the future.
This is due to the release of the larger economic capital.

12. Continued

(c)

(i)



(ii) Scenario 4:
Larger gain at issue and a slightly lower income in the future.
Timing of the release differs.

13. Learning Objectives:

2 C: Compute liabilities under US statutory and US GAAP for variable annuities.

Sources:

"A Discussion of AG 43 for Variable Annuities", Milliman Research Report, Apr 2009

US GAAP for Life Insurers, 2nd Edition, Ch. 8: Variable and Equity-Based Products

Commentary on Question:

The intent of this question was to test the candidate's understanding of two valuation methodologies for GMWB liabilities: AG 43 and US GAAP, and their ability to calculate reserves under those two methods.

To do well on part (a), candidates needed to list issues with prior statutory reserve approaches for variable products. To do well in part (b), candidates needed to outline the differences and similarities between the two valuation methodologies, and identify the appropriate US GAAP standard that applies to variable annuities. To do well in part (c), candidates needed to define the reserve calculation steps for AG 43 and complete a sample calculation.

Solution:

(a) Problems with prior statutory reserve approaches:

- Not always suitable for the risk profile of the more complex guaranteed benefits
- Reserves were too conservative in some situations
- Reserves may be too volatile
- Reserves may be unintuitive
- Multiple standards existed for different Variable annuities - AG33, 34, 39
- Rules based approaches

(b) AG 43:

- Stochastic model with a deterministic floor
- Deterministic Component:
  - Prescribed, conservative assumptions are used
  - Seriatim calculation with a single drop and recovery scenario
  - Standard Scenario Reserve (SSR) is Greatest Present Value of Negative Accumulated Net Revenue plus Basic Adjusted Reserve
  - SSR is floored at the cash value

13. Continued

- Stochastic Component:
  - Utilizes stochastic cash flow model
  - Greatest Present Value of Accumulated Deficiencies is determined for each scenario
  - Reserve is set at the CTE 70 level
  - Assumptions are prudent best estimate, with some limitations
  - Limitations on hedging effectiveness and revenue sharing
  - Assumptions set on a holistic basis, considering overall risk profile
  - May use AAA pre-packaged scenarios or develop own, subject to calibration criteria

US GAAP

- GMWB is valued under FAS 133
- Must determine whether the benefit is a stand-alone derivative or an embedded derivative
  - If the benefit has separately identifiable charges, it is a derivative
  - If there are no separate charges, the annuity contract is a hybrid product with an embedded derivative and host contract
- The derivative liability must be recorded at fair value
  - May use option-pricing technique or stochastic technique
- Using stochastic technique,
  - Derivative liability is average present value of benefits plus "required profit" less specified charges
  - Embedded derivative liability is average present value of benefits plus "required profit", with a "host offset" to the host contract
  - Required profit is generally calibrated to generate zero liability at issue
  - Economic assumptions should be market consistent
  - Non-economic assumptions should be best estimate
  - There is no deterministic floor on the liability, and it can go negative

(c) AG 43 Reserve Calculation

<u>Stochastic Component</u>
Calculate CTE 70 from given information
CTE 70 is average of worst 30% of scenarios

First, order the scenarios:
Scenario 1, 4, 9, 3, 6, 2, 7, 8, 10, 5

Next, choose the worst 30% (i.e. 3 scenarios)
Scenarios 8, 10, 5

Average these three scenarios
= (1,991,000 + 2,327,000 + 2,804,000)/3

13. Continued

Total Stochastic Reserve = 2,374,000

Standard Scenario

Find Greatest PV in table for each age

- Age 55: 473
- Age 65: 4325

Standard Scenario Reserve = (1000+473)*200 + (2000+4325)*400 = 2,824,600

AG43 Reserve is Max(Stochastic Component, Standard Scenario)

= Max(2,374,000, 2,824,600)

= 2,824,600

14. Learning Objectives:

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

3: The candidate will be able to evaluate various forms of reinsurance and what the financial impact is of each form.

Sources:
Life and Health Reinsurance, Ch. 13 GAAP Accounting for Reinsurance

US GAAP for Life Insurers, Second Edition, Ch. 3 Expenses and Capitalization

Valuation of Life Insurance Liabilities, Ch. 8 Universal Life Insurance

US GAAP for Life Insurers, Second Edition, Ch. 4 Traditional Life Insurance (SFAS 60 & 97)

Commentary on Question:
This question tested candidate's ability to apply the principles of FAS 60 and FAS 97 to a simple UL product being reinsured on an YRT basis.

It was imperative for the candidate to realize that the account value is the benefit reserve and a PVFB – PVFP calculation is not required. Many candidates' PVFB – PVFP calculations resulted in a liability of $25-100 which should have been obviously wrong for a product with a $5,000 + account value.

A 10% mortality PAD means one uses 110% of the expected assumption (for FAS 60). But a 0.5% Interest PAD means you use 6.0% - 0.5% = 5.5% for the calc, not 6.0% + 0.5% = 6.5%. A number of candidates made that mistake.

Knowing 1) the GAAP standards that apply to each insurer, 2) the reserve = the account value and how to calculate a UL account value, and 3) the general methodology used to calculate FAS 60 DAC, went a long ways towards the candidate getting the majority of credit for the problem.

Assuming the policy was a death benefit option 2 policy with level NAR would have made the problem much easier but few candidates opted for that approach.

Solution:
(a)

(i) For ABC Direct, product falls under the FAS 97 standard since it's described as a UL contract.

14. Continued

(ii) For XYZ Re, contract as it exists under YRT reinsurance is a fixed premium contract, much like term. FAS 113 applies which means FAS 60 for the benefit reserve and DAC calcs.

(b)

(i) Net Benefit Reserves

1. ABC Life – Under FAS 97, the benefit reserve is the account value. Assume the policy is a death benefit option A policy. No features are given which would lead one to believe the contract gives rise to a URR or SOP 03-1 reserve so they will be ignored in the answer.

   $AV_t = AV_{t-1}$ + Premium – Expense Loads – Expense Charges – COI Charge + Interest Credited

   COI Charge = Net Amount at Risk X COI Rate
   = [Face - (AV_{t-1} + Premium - Expense Charges - Expense Loads)

   Interest Credited = (AV_{t-1} + Premium – Expense Loads – Expense Charges – COI Charge) X Credited Interest Rate

   COI_1 = [50,000 – 5,000] X 1.80 / 1000 = 81.00
   AV_1 = (0 + 5,000 – 81.00) X 1.04 = 5,115.76

   COI_2 = [50,000 – 5,115.76] X 2.10 / 1000 = 94.26
   AV_2 = (0 + 5,115.76 – 94.26) X 1.04 = 5,222.36

   COI_3 = [50,000 – 5,222.36] X 2.50 / 1000 = 111.94
   AV_3 = (0 + 5,222.36 – 111.94) X 1.04 = 5,314.84

   COI_4 = [50,000 – 5,314.84] X 3.00 / 1000 = 134.06
   AV_4 = (0 + 5,222.36 – 134.06) X 1.04 = 5,388.01

   So net benefit reserve per unit inforce at the end of year 2 is 5,222.36.This would be offset by an YRT reinsurance reserve credit of 94.26 X 0.7 X 0.5 = 32.99 (assuming mean reserves and annual reinsurance premiums).

14. Continued

(ii) Net Benefit Reserves (continued)

1. XYZ Re – Expected mortality is assumed to be a constant percentage of the YRT reinsurance premium rates (assumed PADs are included in coming to this conclusion). With a constant benefit to premium relationship on a FAS 60 product, no terminal reserve develops. A mean reserve of ½ the net premium would be held but we won't bother to do that calculation here.

(iii) DAC

1. ABC Life – Deferred expenses of $50 are exactly offset by reinsurance expense allowance of $50 for a net deferrable of $0 and no DAC. If there were a DAC, it would be amortized using a FAS 97 methodology.

2. XYZ Re – FAS 60 DAC would develop on the $50 of reinsurance expense allowance paid by XYZ Re. Amortize as a level percentage of premiums at the 6.00% earned rate less a 0.50% PAD = 5.50%. Assume PADs are in the assumptions given already and that those assumptions are applicable for the direct company and the reinsurer (for simplicity).

Premium stream is 70% of the COI stream noted above as block is reinsured at 70% and YRT reinsurance premiums are equal to COI rates.

Premium stream is 70% of 81.00, 94.26, 111.94, and 134.06 or premium stream is $56.70, 65.98, 78.36 and 93.84.

PV of premiums is equal to this premium stream discounted with survivorship and interest (no lapse is given so we'll assume it is zero).

PV Premium = 56.70
+ 65.98 X (1-0.6 X 1.80 / 1000) / 1.055
+ 78.36 X (1-0.6 X 1.80 / 1000) * (1-0.6 X 2.10 / 1000) / 1.055 ^ 2
+ 93.84 X (1-0.6 X 1.80 / 1000) * (1-0.6 X 2.10 / 1000) * (1-0.6 X 2.50) / 1.055 ^ 2
= 269.02

14. Continued

Amortization % = 50 / 269.02. = 18.6%

Using retrospective rollforward approach to calculate DAC

$DAC_0 = 50$

$DAC_1 = [(50 – 18.6\% \text{ X } 56.7) \text{ X } 1.055] / (1 – 0.6 \text{ X } 1.80 / 1000) = 41.68$

$DAC_2 = [(41.68 – 18.6\% \text{ X } 65.98) \text{ X } 1.055] / (1 – 0.6 \text{ X } 2.10 / 1000) =$ 31.07 is the DAC per policy inforce