CSP-IC 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**

<blockquote>
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
</blockquote>

    (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

$$= \Sigma t * v^\wedge (t+1) * Cashflow(t) / \Sigma v^\wedge t * Cashflow(t)$$

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)   <u>General Considerations</u>
            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)   <u>Specific Considerations</u>

            <u>Taxes</u>
              • 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

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

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

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

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

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

EIBV = Expected In-force Business Value

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

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

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 <u>Single Premium Fixed Deferred Annuities</u>. 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 = $C / (1 + A * e^{\wedge}(B * (int\_credited + Surrender\ Charge) - int\_credited\_competitor) - C / (1 + A * e)$, 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.

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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 $q_x(d)$ 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

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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.*

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

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

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

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

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

5. Continued

- $FANIP = \Sigma t = 1\ to\ 3\ LCF_t / (1 + S_t + CS_t)^t +$ Acquisition Cost FANIP $= \sum t=1$ 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 $= \Sigma t = 1\ to\ 3\ \mathrm{Prem}/(1 + S_t + R)^{t-1}$

  $\mathrm{Prem}_1 = 250$

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

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

  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**

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

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

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

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)

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%	1,000	30	3,000,000	3,000,000/1.04 = 2,884,615
2	3%	970	3% x 970 = 29.1	2,910,000	2,910,000/1.04^2 = 2,690,459
3	3%	940.9	3% x 940.9=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%	1,000	42.88	4,288,000	4,288,000/1.04 = 4,123,077
2	3%	957.12	3% x 957.12 = 28.7136	2,871,360	2,871,360/1.04^2 = 2,654,473
3	3%	928.4064	3% x 928.4064=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

ILA-C606-07: OSFI: Guideline Minimum Continuing Capital and Surplus Requirements
for Life Insurance Companies (Dec 2008)

Commentary on Question:
Candidates were expected to demonstrate 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 MCCSR, including
  actually stating the impact on each component (i.e. increased or decreased)

Solution:
(a)
       (i)   <u>Types of risk transferred</u>
            YRT: only mortality/morbidity risk is transferred
            Coinsurance: all risks are transferred proportionally

       (ii)   Retention method
            <u>YRT</u>
- 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 default risk:
- Requirement = MCCSR factor x balance sheet's value of the company's assets
- Transfer of assets to reinsurer to back the reinsurer's share of the reserves
- Thus, transfer of C-1 component
- Thus, C-1 component is reduced

7. **Continued**

C-2: Mortality, Morbidity and Lapse Risk
- Mortality component for life insurance is the sum of the components for volatility and catastrophe risks
- Benefit amounts and reserve amounts used to determine mortality component should be calculated net of all reinsurance
- Thus, transfer of C-2 component (mortality/morbidity) from ceding company to reinsurer
- Thus, C-2 component (mortality) is reduced
- Lapse risk calculated as the increase in the reserve produced by higher/lower lapse assumptions
- Thus, transfer of lapse risk to reinsurer
- Thus, C-2 component (lapse) is reduced

C-3: Changes in Interest rate environment
- Requirement = factor x policy liability amount
- Transfer of interest rate risk from ceding company to reinsurer
- Thus, C-3 component is reduced

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

Sources:
ILA-C622-09: CIA: Consolidated Standards of Practice: (Section 2400) – February 2009

ILA-C612-07: Guideline AuG 43 – Audit of Actuarial Liabilities of Insurance Enterprises

Commentary on Question:
The intent of this question was to test the candidate's understanding of the requirements related to the MCCSR opinion in part (a), and of the controls around liabilities from the AuG 43 guidelines in part (b).

In general, candidates did poorly on this question. To do well in part (a), candidates needed to focus on the format of the opinion rather than on how the policy liabilities and capital have been calculated. To do well in part (b), candidates needed to identify several types of controls that an auditor may want to look at to evaluate the appropriateness of policy liabilities, and to group the controls by categories.

Solution:
(a)   The actuarial opinion should be signed by the appointed actuary, not any actuary.

The modelling limitations should not be part of the signed opinion. They should be discussed in the MCCSR memorandum.

The actuary should not give an opinion on whether the MCCSR factors are appropriate.

The opinion does not follow the prescribed wording in the standards of practice.

Therefore, the actuarial opinion is not appropriate.

(b)   Controls related to developing assumptions:
- Get studies to monitor emerging experience
- Compare the valuation assumptions to those used in pricing
- Perform sensitivity analysis to determine the effect of changes in assumptions

Controls related to getting source data:
- Change control over programs used to get policy information from administration system
- Reconciliation of policy counts from input and output files
- Access control over the files containing investment data

8. **Continued**

Controls related to ensuring the valuation models properly reflect the significant attributes of the business:
- Reconciliation of valuation system outputs to ledger data
- Comparison of current period results with the results projected in prior period
- Comparison of the model cash flows to significant product features

Controls related to reserve calculation:
- Change control over programs used to calculate reserves
- Password protection of spreadsheets used to calculate reserves
- Peer review of calculations
- Identification of sources of earnings
- Trend analysis of results

9. **Learning Objectives:**
5A: The candidate will be able to describe the MCCSR 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-C606-10: OSFI Guideline: Minimum Continuing Capital and Surplus Requirements for Life Insurance Companies 1-5, 8 (Dec 2009)

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

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

9. **Continued**

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)

MCCSR 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 MCCSR, driven by rating agencies
- While based on risk elements, MCCSR 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**

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

MCCSR:
- No explicit component added for annuity mortality improvement.
- Risk of a long-term mortality improvement implicitly reflected in C-3 since based on a % of policy liabilities, which may increased due to mortality improvement.

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: The candidate will understand the role and responsibilities of the appointed actuary.

8B: The candidate will understand the role and responsibilities of the appointed actuary.

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 to 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" and not limited to specific risks. It must be take 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)   The appointed actuary (AA) needs to write a report to senior management describing the threatening condition. A copy should go to the board of directors. The report should contain recommendations for rectifying the condition. The report should contain a reasonable deadline for taking action. If there is no action by the deadline, the AA must report the matter to Globalized's regulator.

11. **Learning Objectives:**

2A: Describe valuation methods and select appropriate valuation assumptions.

Sources:

CIA Educational Note: Margins for Adverse Deviations (Mfad), Nov 2006, Page 17

CIA Educational Note: Approximations to the Canadian Asset Liability Method (CALM), November 2006, Pages 6-7

Commentary on Question:

This tests the student's knowledge of the CALM valuation methodology, including appropriate methods for setting the VIR. It also tests the student's knowledge of the impact of reinsurance on mortality assumptions.

For part (a) most candidates made the common error of only stating the general considerations for setting PfADs and did not fully answer in the context of the question.

Solution:

(a)   General Consideration:
- Low credibility of data
- Future experience difficult to estimate (change in underwriting or new product)
- Lack of homogeneity
- Anti-selection is present

Considerations in the context of the question:
- If the best estimate includes mortality improvement, this must be negated by an offsetting increase or decrease in the MfAD
- For death supported products, a negative MfAD would increase reserves
- Death supporting occurs when amount ceded exceeds direct NAAR
- If negative MfAD needed and mortality improvement anticipated, improvement not reversed in MfAD

(b)   Method 1 - solve for non-level equivalent vector such that PV liability cashflows equal reported CALM liabilities
Simplification of this approach is to solve for a level equivalent rate.

11. Continued

>Method 2 - solve for an explicit mismatch provision
>Solve for non-level equivalent rate using base scenario.
>C3 interest margin based on difference between reported CALM liabilities and base scenario

>(c)   Positive mortality MfADs decreased reserve.
>Negative mortality MfADs increased reserve.
>This indicates the block is death supported.
>This is most likely due to the high ceded percentage and level NAAR.

>The two discount rate assumptions produce similar results for the current reporting period.

>I recommend using the 1% mortality improvements.
>I recommend using a mortality mfad of -10/ex.
>For the interest rate both the flat rate of 4.41% or the declining rate were acceptable answers.
>Therefore, a candidate recommending scenario 6 or 8 gets full credit.

12. **Learning Objectives:**

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

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

Sources:

ILA-C606-07: OSFI: Guideline Minimum Continuing Capital and Surplus Requirements for Life Insurance Companies 1-6, 9 (Dec 2008)

CIA Consolidated Standards of Practice – Section 2100, 2300, 2500 – Feb 2009

CIA Educational Note: Considerations in Valuation of Seg Fund Products, November 2007

Commentary on Question:

For part (a) candidates were expected to demonstrate an understanding of the impact of economic conditions on income statement and balance sheet. For part (b), candidates were expected to demonstrate an understanding of the impact of reserves on seg fund capital requirements.

The case study is used for part (a).

Solution:

(a)   MER:
- Fixed % of AV
- Widening of credit spread
- Investors concern over the health of the economy and defaults and bankruptcies
- Decrease in the Bond Fund Value
- Sharp declines in the Equity markets
- Lack of investors' confidence and perception of riskiness of the financial markets

   Surrender Charges were higher:
- Recession and high unemployment rate lead to withdrawals
- Increase in the number of lapses

   Commissions and Expenses were lower:
- Less new business
- Increased lapses resulting in lower commissions

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12. **Continued**

GMDB payment higher:
- The higher guaranteed death payment was caused by higher number of death claims which were "in-the-money."

GMMB payment higher:
- The higher guaranteed maturity payment was caused by more matured policies which were "in-the-money."

Change in policy liabilities higher:
- The Guarantees liability was higher because under the updated 2008 stochastic model, there were more scenarios (ie higher probability) that the guarantee would be "in the money."
- "In volatile or declining equity market conditions, we may need to increase liabilities for future policy benefits and policyholder account balances ...."

(b)
- MCCSR ratio equals available capital/ required capital
- Allowed range for guarantee risk reserves is CTE(60) to CTE(80)

Preliminary MCCSR ratio at December 2008 – at CTE(75)
Required capital = CTE(95) – CTE(75) = 28,020 – 18,649 = 9,371
Available capital at CTE(75) = 12,386 (given)
MCCSR ratio = 12,386/9,371 = 132%
MCCSR ratio below required level of 160%, parent needs to inject additional capital
Additional capital required = required capital * 160% - available capital
$\qquad$ = 9,371 * 160% - 12,386 = 2,608

Preliminary MCCSR ratio at December 2008 – at CTE(60)
Required capital = CTE(95) – CTE(60) = 28,020 – 14,467 = 13,552
Dec 2008 available capital = Dec 2007 available capital + 2008 profit/loss (as given)
Change in reserve = Dec 2008 reserve at CTE(60) – Dec 2007 reserve
= 14,467 – 14,304 = 163
Profit/loss at CTE(60) = 5,700 + 380 – 1,500 – 2,200 – 1,250 – 163 = 967
Available capital at CTE(60) = 15,600 + 967 = 16,567
MCCSR ratio = 16,567/13,552 = 122%
Additional capital required = 13,552*160% - 16,567 = 5,117

12. Continued

Preliminary MCCSR ratio at December 2008 – at CTE(80)

Required capital = CTE(95) – CTE(80) = 28,020 – 20,166 = 7,854

Change in reserve = Dec 2008 reserve at CTE(60) – Dec 2007 reserve
        = 20,166 – 14,304 = 5,862

Profit/loss at CTE(80) = 5,700 + 380 - 1,500 - 2,200 - 1,250 - 5,862 = -4,732

Available capital at CTE(80) = 15,600 + (-4,732) = 10,868

MCCSR ratio = 10,868 / 7,854 = 138%

Additional capital required = 7,854 * 160% - 10,868 = 1,698

Recommendation: Set guarantee risk reserve to CTE(80) to minimize capital injection from parent

Note: Partial credit given if CTE(65) and/or CTE(70) were used in the calculations, rather than CTE(60) and/or CTE(80).

13. Learning Objectives:
2 A: The candidate will be able to select appropriate valuation assumptions.

Sources:
CIA Consolidated Standards of Practice – Section 2100, 2300, 2500 – Feb 2009

CIA Educational Note: Margins for Adverse Deviations (MfAD) – Nov 2006

CIA Draft Educational Note: Valuation of Universal Life Policy Liabilities – Dec 2006

Commentary on Question:
The intent of part (a) of this question was to test the candidate's ability to assess the appropriateness of using valuation assumptions for an existing product in the valuation of a new product and to recommend appropriate assumptions – both best estimate and margins for adverse deviations - for the new product.

In part (b), the intent was to test the candidate's ability to identify policyholder behavior assumptions that can impact the valuation for a universal life product.

To do well on part (a), candidates needed to make a recommendation and provide clear justification for that recommendation based on CIA standards of practice and relevant educational notes. To do well in part (b), candidates needed to list policyholder behavior assumptions that apply to the product in the question.

Solution:

(a) **Mortality Recommendation**

Best Estimate
- Use base term to 100 mortality rates plus an additional percentage to account for anti-selection for the UL.
- Mortality experience for term to 100 business is very credible given the company's long history selling the product.
- Assuming that the company has a similar target market, underwriting practices, and average policy size for the UL product, it is appropriate to use the T100 mortality experience as base, however, with an increase to account for differences in product features that can lead to anti-selection, such as:
  - Policyholder can pay minimum premium to keep contract in force, or can stop making premium payments and use cash value to pay for future premiums; and
  - Allowing for NAAR increases without underwriting.

13. Continued

MfAD
- Use a higher MfAD for UL product than T100 since best estimate derivation is unrefined and has low credibility.
  - This is a new product with no credible experience.
  - The best estimate is an approximation.

Lapse Recommendations

Best Estimate
- Use ultimate T100 lapse rates as base for UL lapse rates
- Use external sources and/or published studies to adjust lapse rates for surrender charges, persistency bonus, etc.
- UL has many different product features that affect the lapse assumption, therefore not appropriate to use the best-estimate lapses for Term
- Need to account for:
  - Surrender charges in first 10 years could lead to lower than normal lapse rates, followed by heaped lapses when charges stop
  - Persistency bonus could have similar impact
  - Tax aspect of UL policy, e.g. Joint-last-to-die basis for estate preservation may exhibit very low lapse rate
  - Different premium payment patterns can have very different lapse patterns, e.g. Minimum funded policies, max funded policies
  - Crediting rates on funds offered to policyholders may influence lapse behaviour

Lapse - MfAD
- Use a higher MfAD for UL product than T100 since best estimate assumptions not supported by appropriate experience sources
- The product is new with no credible experience

Interest Recommendations

Best Estimate
- Recommend a different investment strategy from T100, and having two separate investment strategies for the UL product:
  - One strategy that assumes investment according to expected policyholders' fund selection
  - A separate strategy for assets backing insurance cashflows
- The two investment policies may be subject to different limits, reinvestment and disinvestment practices

13. Continued

- It is not appropriate to use the CALM base scenario from the Term product.
  - The underlying assets and investment strategy is different for the UL product.
- When valuing policies/liabilities backed by equity investments, need to consider
  - Market risk, where market will move in direction that is detrimental to the company
  - Basis risk; the difference between the index-linked, equity returns credited to policy holders and the actual returns from the assets that are designed to mimic the index
  - Liquidity risk
  - Volatility risk
  - Counterparty risk
  - Currency risk; if offer foreign market index returns to policyholders' accounts, could be exposed to currency risk
  - Using financial futures, options, or currency swaps to hedge liabilities to policyholders
  - Whether expected investment return is a blend of equity-linked funds or distinct for each fund

Interest Rate - MfAD
- Need additional scenario testing which are appropriate to the UL product
- Consider stochastic modeling to test interdependencies on interest rates, persistency bonuses, crediting rate
- If stochastic modelling proves impractical, test additional scenarios that are appropriate to the circumstances

(b) Need to consider the following flexible elements that would affect the valuation:
- Premium payment amounts (ex. minimum, maximum)
- Premium payment frequencies
- Increase/decreases in face amount levels
- Selection of policy fund accounts
- Transfer of funds between accounts
- Partial withdrawals

Need to test interrelationships between the assumptions listed above.

Assumptions may be reflected in various manners:
- Separate assumption (e.g. Premium persistency)
- Addition to existing assumption (e.g. Partial withdrawal included in withdrawal assumption)
- Implicitly (e.g. More conservative assumption)

13. Continued

Other considerations:
- Can group policies together when selecting assumptions affected by policyholder actions. Grouping would apply to products with similar policyholder behaviour.
- Can use approximation methods to reduce the complexities of policyholder behaviour. Need to justify that use of approximations does not materially affect the amount of the policy liabilities.
- Assume that choices currently available today would be assumed to be available in the future.
- Assume that policyholders generally act in their best interest unless evidence exists to the contrary.
- Use historical experience to set the assumption, and apply judgement when experience not available.

MfAD considerations:
- Test sensitivities to change in liabilities with these assumptions to set MfAD
- Use larger MfAD when there is more uncertainty

14. **Learning Objectives:**

1A: Prepare the basic financial statements for a life insurance company.

4E: Explain and apply the basic methods and approaches of earnings management.

Sources:
CIA Educational Note: Calm implications of AcSB Section CICA 3855 Financial Instruments – Recognition and Measurement – June 2006

CIA Educational Note: Implications of CICA Accounting Standard 3855 and 1530 – Jan 2007

ILA-C623-09: Proceedings: Lesson Learned: Implications of CICA 3855, PD-30, June 2007

ILA-C603-09: OSFI Guideline D-10: Accounting for Financial Instruments Designated as Fair Value Option, February 2007

Commentary on Question:
The candidate must be able to distinguish income classification under CICA 3855 and CICA 1530; also, the candidate must evaluate the appropriateness of using the Fair Value Option for a given asset.

The case study is not used.

The quality of responses to this question was mixed. Some candidates did well while most did poorly. In general, the poor responses were due to not providing enough detail in parts (b) and (c). Most candidates got at least some marks on part (d).

Solution:

(a)   A life insurer may use the Fair Value option under OSFI Guideline D-10 if either:

  1. Assets and/or liabilities are managed consistent with documented risk/investment strategy and info is provided internally to key management personnel

  2. Eliminates or significantly reduces measurement/recognition inconsistency of measuring financial assets/liabilities together on different bases

14. Continued

Issues to consider:

Fair values must be reliable.

If fair values cannot be reliably estimated at inception and for subsequent periods, FVO should not be used.

FVO should not be used for loans and mortgages to small companies (revenue < $62.5 million).

Requires a significant ALM function.

Company's risk management processes may not be up to OSFI's standards.

(b)   Order of reliability of fair values:

1. Published quotations for identical instruments in active 2 way market. Ability to reference market on regular basis is important.
    - Other considerations:
        - Independence of market quotes
        - Timeliness of quotes
        - Average volatility of trading volume
        - Market concentrations
        - Staleness of independent quotes

2. Published quotations for issues by same issuer of similar size, risk and duration. Should have only minor adjustments for other observable market inputs.

3. If quoted prices do not exist, valuation techniques that use market inputs to maximum extent possible.

Considering the above, implication of using FVO for the following asset classes:

Private Placement:
Private bond may have to be held as Loan at amortized cost
Obtaining fair values may be problematic
May be problems with timeliness and staleness of independent quotes
May be difficult to find price quotations for same issuer, size, risk, duration etc.
May have to rely on valuation techniques that maximizes use of observable inputs
Actuary needs to understand how fair value determined
Thus, FVO is not a preferred option to use for private placement bonds.

Equity:
Prices are publicly available
Active 2 way market
Can access price quotations on regular basis
Thus, FVO is reasonable to use for equities traded on the Toronto Stock Exchange.

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14. Continued

(c)   Items to consider when using the FVO for valuing assets under CALM:
- Fair Value Option will likely be the favoured option for assets backing policy liabilities
- Assets are marked to fair value
- Gains/losses are recognized immediately in net income
- Discount rate derived from backing assets will reflect market yield
- Volatility of policy liabilities will increase
- Volatility of asset value and investment gains/losses will increase
- Natural offsets will result in stable income
- To extent CF from assets and liabilities matched, gain/loss on assets will be offset by gain/loss on liabilities
- Use of PPM on Balance Sheet date requires true up process so policyholder liabilities reflect statement value of assets
- Must be able to demonstrate completeness and appropriateness of approximation and must be auditable
- Change in controls may be required
- In theory, CALM is perfectly compatible with HFT or FVO designated assets
- CALM reacts well to changes in asset side accounting because of linkage between policy liabilities and accounting value of the assets
- Policy liabilities at cost (term of liability = 0, no discounting) must be reported on a prescribed basis - asset liability mismatch - usually matched with longer-term asset
- Book Value (previous regime) generally predictable => discount rate needed only be reviewed annually. Now must review market discount rate quarterly.
- If significant change to market occurs in the period - the discount rate may need adjustment
- Reconsider selection of PfAD for investment return rates - should reflect increased volatility
- Fair Value of supporting assets may not be available on a timely basis - actuary may have to use market values from a prior fiscal period
- Book yields are much more variable from period to period - harder to validate.

(d)   Held to Maturity (HTM) method same as pre-3855; uses amortized cost basis
HTM net income not affected by changes in fair value

Held for Trading (HFT) marked to fair value
Gain/loss recognized immediately in net income

Available for Sale (AFS) net income = coupons + change in amortized cost +/- realized gain/loss
AFS change in difference between amortized cost and fair value recorded in other comprehensive income

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14. Continued

HTM net income = HTM investment income + change in amortized cost basis
=5 + (1050 − 1055)
=0
HTM OCI = 0 (no OCI for HTM)

HFT net income = HFT investment income + change in fair value
= 65 + 27,300 - 26,900
= 465
HFT OCI = 0 (gain/loss recognized immediately in net income)

AFS net income = AFS investment income + change in amortized cost
= 250 + (75,300 - 75,100)
= 450
AFS OCI = (FV 2009 − AC 2009) - (FV 2008 − AC 2008)
= (77,350 - 75,300) - (76,000 -75,100)
= 1150

Total net income = 0 + 465 + 450
= 915

Total OCI = 0 + 0 + 1,150
= 1,150