

# CSP-IC Model Solutions

## Fall 2012

### 1. Learning Objectives:

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

### Learning Outcomes:

- (5a) Describe the MCCR/RBC regulatory framework and the principles underlying the determination of Regulatory RBC.
- (5c) Explain and apply the concepts, approaches and methods for determining Economic Capital.

### Sources:

Valuation of Liabilities, Chapter 16 (Risk Based Capital)

Economic Capital for Life Insurance Companies, SOA Research Paper, Feb 2008

ILA-C121-08: Economic Capital Modeling: Practical Considerations, Milliman White Paper

### Commentary on Question:

The question combined retrieval of information (i.e. provide the definition of EC vs. RBC), comprehension and analysis. The cognitive level was relatively easy. Most students were able to answer part (a), which was pure memorization.

### Solution:

- (a) Compare the U.S. regulatory Risk Based Capital (RBC) factor-based methodology to the Economic Capital methodology of setting capital levels for life insurance companies.

#### RBC:

- Factor based model
- Contains 4 risk categories:
  - C1 – assets: affiliates, bonds, mortgages, preferred and common stocks, real estate
  - C2 – insurance risk: factors based on NAAR
  - C3 – interest rate/market risk: 3 categories of low, medium, high, depending on the different kinds of reserves
  - C4 – general business risk: fraud, mismanagement, litigation

## 1. Continued

- Includes covariance adjustment
- RBC ratio = total adjusted capital / authorized control level RBC
- Authorized control level RBC =  $C0 + C4a + \text{SQRT}((C1a+C3a)^2 + C1c^2 + C2^2)$
- Regulatory action level triggered depending on RBC ratio

### Economic Capital:

- EC is an internal calculation of the capital required, based on company's view of risk, with calculations based on economic principles.
  - Risk factors include: market risk, credit risk, insurance risk, operational risk, liquidity risk
  - 2 main approaches used: liability runoff, and 1 year mark-to-market
- (b) List the products for which U.S. Life Insurance companies currently do not calculate RBC using a factor-based methodology, and briefly describe the methodology used instead.

### Annuities and Single Premium Life

- RBC C3 Phase 1:
  - Used the same model as asset adequacy analysis
  - Run either 12 or 50 scenarios
  - For each scenario, find the worst-case PV of stat surplus
  - Discount using 105% of 1 yr treasury rate
  - Take weighted average of the ranked scenarios
  - May be exempted by C-3 significance test and C-3 stress test

### Variable Products with guarantees

- C3 Phase 2
  - Calculate the Total Asset requirement (TAR)
  - Assumptions are prudent estimates
  - Find required capital for each scenario as highest PV of negative accumulated surplus
  - Additional asset requirement (AAR) = CTE90 of the above scenario amounts
  - $TAR = AAR + \text{total assets}$
  - $RBC \text{ requirement} = TAR + \text{stat reserves}$

- (c) Company HJR owns a closed block of universal life insurance policies with a minimum credited interest rate guarantee. Briefly explain how a low interest-rate environment would affect HJR's capital levels on this block of business under each of the following capital models. Justify your answer.

- (i) U.S. Risk Based Capital (RBC) model
- (ii) Economic Capital model

## 1. Continued

RBC:

- C3 interest risk based on UL reserve - considered low risk, not much capital change in a low interest environment
- Possible increase in capital due to CFT result because assets are not earning as much investment income (reinvestment risk)

EC:

- EC associated interest rate risk is often significant for companies with UL products with interest rate guarantees
- Changes in persistency due to market-linked events are generally reflected explicitly in EC - persistency is likely to increase when UL product has interest rate guarantees while alternative investments offer low yield

## 2. Learning Objectives:

7. The candidate will be able to evaluate risks faced by a Company by virtue of the Company's products, assets and management strategies and practices and be able to evaluate the appropriateness of various methods of risk mitigation.

### Learning Outcomes:

- (7c) Describe and evaluate the other risks an insurance company faces including operational, marketplace and expense risks.
- (7e) Describe and apply methods of risk mitigation and hedging and to understand the limitations of such methods.

### Sources:

ILA-C116-07: Mapping of Life Insurance Risks, AAA Report to NAIC

ILA-C125-10: Insurance Risk Management Response to the Financial Crisis, CRO Forum, April 2009

### Commentary on Question:

Commentary listed underneath question component.

### Solution:

- (a) BL's management sets its capital at 200% of the AA rating requirement as per a major rating agency. Management's main concerns are liquidity and value creation, and believe this formula gives BL the strong capital position it needs to keep borrowing costs down and satisfy its equity investors.

Evaluate whether setting the capital at this level is sufficient to address management's concerns. Justify your answer.

### Commentary on Question:

This question tests candidates' understanding of the limitations of a high amount of capital. Actuaries often focus on liabilities and forget a balance sheet always has two sides.

Candidates also needed to understand the difference between risk control and risk optimization, and why a high amount of capital may actually hurt the company.

Candidates who did not do well failed to consider what capital means to liquidity and value creation, and instead believed holding a high enough amount of capital per rating agency and/or regulatory specified rules is sufficient.

## 2. Continued

Amount of capital alone is not enough to address management's concerns.

### Liquidity

- A high amount of capital alone does not necessarily mean sufficient liquidity.
- Liquidity needs are sudden, and even valuable assets can become illiquid quickly.
- Management needs to make sure capital is invested in assets that can be readily converted to cash in a time of need.

### Value Creation

- Holding a high amount of capital does tend to reduce borrowing costs, but also increase frictional costs.
- Opportunity costs: there may well have been other more efficient uses of capital, like investing in new products.
- Management needs to go through risk optimization and consider other methods of capital calculations to account for company-specific risks, for example economic capital models.

- (b) BL entered into an index swap with the largest U.S. investment bank, Gator Mallory (GM), in an attempt to hedge its separate account guarantees. Discuss the potential risks associated with this deal, using the Federal Reserve Risk Categories and associated Elements of Insurance Risks as a guide.

### Commentary on Question

BL is attempting to hedge its equity market exposure, but no risk management program is perfect and this question is testing candidates' ability to identify the potential risks these programs introduce.

Note that to help candidates the question tried to describe the swap in more detail, but made a mistake in describing the floating leg which should have been  $\max(0, \text{strike}/\text{current}-1)$ . This was taken into account in grading but generally did not have a material impact on candidates' scores.

For a fixed fee, BL will receive payments when market drops more than 10%. These payments will help offset BL's loss from VA guarantees.

The Model Solution provides an answer that earns full credit, but is certainly not an exhaustive list. Credits were also given to other valid answers.

Candidates who did not do well only listed general risks, instead of discussing risks specifically associated with this deal.

## 2. Continued

- **Credit / Counterparty:** Daily settlements and GM being the largest IB both serve to reduce the risk, but GM may still fail to pay on a daily basis or default altogether.
- **Concentration:** BL is hedging the entire VA block with 1 counterparty.
- **Net Retention / Policyholder Behavior:** this is not a full reinsurance. With a fixed notional, if policyholder behaviors materially defer from model assumptions BL will be exposed to additional risks from this deal.
- **Basis:** S&P500 is unlikely to track the underlying VA perfectly even when all other model assumptions match actual experience. Strike price may also not match the VA guarantees which were sold at various points in time, i.e. entered when the market was at different levels.
- **Operational:** sufficient expertise, system and internal controls are necessary to handle the execution of this deal.
- **Pricing / Underwriting:** BL may not have priced the swap right, i.e. paying too much on the fixed leg.
- **Liquidity:** BL may have trouble with paying daily settlements.
- **Political / Legal:** changes in government policies and regulations regarding hedging programs and derivatives may affect the deal.

### 3. Learning Objectives:

7. The candidate will be able to evaluate risks faced by a Company by virtue of the Company's products, assets and management strategies and practices and be able to evaluate the appropriateness of various methods of risk mitigation.

#### Learning Outcomes:

- (7e) Describe and apply methods of risk mitigation and hedging and to understand the limitations of such methods.

#### Sources:

ILA-C807-09: Market Value Margins for Insurance Liabilities in Financial Reporting and Solvency Applications, E&Y, October 2007

Multi-Stakeholder Approach to Capital Adequacy (exc. Appendix)

#### Commentary on Question:

This question tests candidates' understanding of market value margins for insurance liabilities.

The cognitive level of this question is a combination of retrieval and knowledge utilization.

An important concept to remember for this question is that MVM at model start date ( $t = 0$ ) is the sum of PV (annual costs), where the annual costs are projected all the way out to the end of the projection period. Some candidates only calculated the annual costs for the first year and missed out the last two years.

Most candidates got the three key components of risk margins correct. The area where many candidates lost points on is the BEL calculation, where they failed to use the given BEL(1) value to calculate the BEL(0) value. Most candidates did the DB calculation for year one correctly, however.

#### Solution:

- (a) List and explain the three key components in establishing risk margins under this methodology.

#### Commentary on Question

Most candidates got the three main points but not necessarily all the sub-bullet points.

1. Capital base

The first step is to assess the degree of risk in the underlying claim and benefit payments.

From this, determine how much capital is needed to support the risk that these claim and benefit payments exceed their expected values.

### 3. Continued

2. Time horizon for capital commitment

The next step is to determine the period over which the capital must be committed and hence the capital base in each period until the final claim liability is paid

In the case when actual claim and benefit experience emerges as expected, capital intended to support the risk of deviations in these amounts from their expected value can gradually be released.

3. Required rate of return on capital per period

Finally, for each period during which the capital is held to support the risk associated with the unpaid claims and benefits, the providers of that capital will require an appropriate rate of return.

Part of that return will be earned through the investment of the capital itself in marketable securities, so the rate of return used for this purpose need only reflect the spread over the risk-free return.

The spread should reflect the amount of risk and may also include other "frictional costs" associated with holding capital, if any.

(b)

- (i) Calculate the best estimate liability (BEL) at the model start date. Show all work.
- (ii) Calculate the market value margin (MVM) for this block of business using a one-year exposure horizon. Show all work.

#### Commentary on Question

For the BEL calculation, most candidates did well on the DB calculation. Some candidates used the wrong formula for the BEL(0) calculation.

For the MVM calculation, the common mistake was using the wrong discount rate and calculating only the first year's values.

Note that there was a printing error in the Issue Date of the policies which caused the policies to be out of force at 1/1/2014, while the grid of BEL values showed policies in force at this date. The issue date should have been one year earlier. While the issue date was not critical for answering the question, full marks were given if the incorrect date lead to an incorrect numerical answer, but most candidates demonstrated an understanding of the underlying formulas and concepts.

Calculate BEL

At end of first policy year:

$$\begin{aligned} \# \text{ of deaths}(1) &= \text{mortality rate} \times \# \text{ of lives}(0) \\ &= 3\% \times 2,000 = 60 \end{aligned}$$



### 3. Continued

$$\begin{aligned} \text{DB paid}(1) &= \# \text{ of deaths}(1) \times \text{DB amount} \\ &= 60 \times 100,000 = 6,000,000 \\ \text{PVDB}(1) &= \text{DB paid}(1) / (1 + \text{interest rate}) \\ &= 6,000,000 / (1.04) = 5,769,231 \\ \text{BEL}(0) &= \text{PV DB Year 1} + \text{BEL}(1) / (1 + \text{interest rate}) \\ &= 5,769,231 + 16,169,000 / 1.04 = 21,316,346 \end{aligned}$$

Calculate MVM

At time  $t = 1$ :

$$\begin{aligned} \text{Capital base} &= \text{BEL}(ds) - \text{BEL} \\ &= 17,985,000 - 16,169,000 = 1,816,000 \\ \text{Annual cost} &= \text{capital base} \times \text{cost of capital} \\ &= 1,816,000 \times 7\% = 127,120 \end{aligned}$$

At time  $t = 2$ :

$$\begin{aligned} \text{Capital base} &= \text{BEL}(ds) - \text{BEL} \\ &= 12,627,000 - 10,816,000 = 1,811,000 \\ \text{Annual cost} &= \text{capital base} \times \text{cost of capital} \\ &= 1,811,000 \times 7\% = 126,770 \end{aligned}$$

At time  $t = 3$ :

$$\begin{aligned} \text{Capital base} &= \text{BEL}(ds) - \text{BEL} \\ &= 7,238,000 - 5,428,000 = 1,810,000 \\ \text{Annual cost} &= \text{capital base} \times \text{cost of capital} \\ &= 1,810,000 \times 7\% = 126,700 \end{aligned}$$

$$\begin{aligned} \text{MVM} &= \text{sum of PV(annual costs)} \\ &= 127,120 / (1.04) + 126,770 / (1.04)^2 + 126,700 / (1.04)^3 = 352,073 \end{aligned}$$

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

6. The candidate will be able to integrate data from various sources into model office and asset/liability models.
7. The candidate will be able to evaluate risks faced by a Company by virtue of the Company's products, assets and management strategies and practices and be able to evaluate the appropriateness of various methods of risk mitigation.

#### **Learning Outcomes:**

- (6a) For an ALM model:
  - (i) Select appropriate assumptions and scenarios
  - (ii) Model dynamic behavior of both assets and liabilities
  - (iii) Model and explain various strategies, including hedging
  - (iv) Analyze and evaluate results
  - (v) Recommend appropriate strategies
- (6b) Apply a model office process and make appropriate recommendations.
- (7a) Identify, categorize and evaluate potential sources of risk in products including but not limited to mortality, morbidity and lapse.

#### **Sources:**

Life Insurance Products and Finance, Ch 14 Financial Modeling

ILA-C116-07: Mapping of Life Insurance Risks, AAA Report to NAIC Multi-Stakeholder Approach to Capital Adequacy (excluding Appendix), Conning Research

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

The concept in (a) was to ask a specific question on an ALM topic, attempting to elicit the right specific information. It was deliberate that there were no specific products or company situations mentioned. The concept in (b) was to determine whether candidates know how to use memorized formulas in simplified applications.

The question was approximately 1/3 Comprehension and 2/3 Knowledge Utilization.

Candidates generally performed relatively well on section (b)(i), about average on section (b)(ii) and less well on section (a). Section (a) answers frequently did not describe any form of interaction between assets and liabilities (the essence of ALM) and sometimes were less robust than desired. See further commentary by section.

#### **Solution:**

- (a) With respect to the disintermediation and reinvestment risks:
  - (i) Define each of these risks.
  - (ii) Explain how duration may be used to manage each of these risks.
  - (iii) Explain the impact of changes in both the yields and yield curve shape on these two risks.

## 4. Continued

### **Commentary on Question:**

For section (a) disintermediation, many candidates did not reflect that the company always has an expectation of when the policyholder will want funds and invests accordingly (most surrenders are not surprises, and invested assets do not automatically have to be sold in a properly managed portfolio holding cash) or that disintermediation may happen for reasons other than earnings available in alternatives (ratings downgrade or run-on-the-bank due to solvency concerns).

For section (a) reinvestment, some candidates did not reflect that earnings rate may also decrease due to asset cash flows (calls and prepayments) or the policyholder may pay additional premium when lower earning investments are available (situation companies face when insufficient spread is available compared to guaranteed minimum interest rate).

(i)

Disintermediation:

- Risk that policyholders make earlier than expected withdrawals.
- Unexpected timing or amounts of cash needs may require asset sales at losses.
- Risk that actual cash flows or liquidation asset values do not coincide with cash flow obligations.
- May also occur due to solvency concerns or ratings downgrade.

Reinvestment:

- Risk that company is not able to earn at least the current interest rates on future positive cash flows.
- Risk that rates will fall causing cash flows from an investment, upon reinvestment to earn less than original underlying asset.
- Risk that yields on investments of varying credit quality, liquidity, or maturity do not move in the same direction or magnitude as liabilities backed by those investments.
- Interest rate fluctuations may affect assets and liabilities differently, which may expose the company to statutory insolvency.
- Policyholders may be more likely to increase premium payments when earnings rates are low in flexible premium policies – still earn guaranteed minimum.

(ii)

- If asset and liability durations have been matched then small changes in interest rates will have approximately same effect on assets and liabilities.
- If duration matched, assets & liabilities will move together - offsetting effect.

## 4. Continued

- Need to rebalance asset portfolio periodically to maintain duration matching, due to (among others):
  - Changes in interest rates,
  - Changes in assets due to sales, defaults, calls and prepayments,
  - Emerging differences between expected and actual cash flows.
- Duration measures include: Macaulay duration, Modified duration

### Disintermediation Risk:

- If most significant risk, maintain asset duration < liability duration.
- Provides earlier than needed asset cash flows to help offset unexpected liability cash flows that might result from an increase in interest rates or inaccuracy in duration matching.

### Reinvestment Risk:

- If most significant risk, maintain asset duration = liability duration

(iii)

Lower yields decrease risk of disintermediation and increase reinvestment risk.

- Spread compression or even negative spread between earned and credited interest rates are possible.
- Lower yields tend to increase duration.

Higher yields increase risk of disintermediation and decrease reinvestment risk.

- Spreads may expand beyond target level.
- Higher yields tend to decrease duration.

### Disintermediation Risk under various yield curves:

- Steepening – tends toward higher potential.
- Flattening – tends toward medium/low potential.
- Inversion – high yield with short maturity has very high potential.

### Reinvestment Risk under various yield curves:

- Steepening – tends toward medium/low potential.
- Flattening – low yield has higher potential.
- Inversion – low investment earnings cost to shorten asset duration.

(b) Given assumptions and information provided in the body of the question:

- (i) Calculate the portfolio of bonds and its cost under the cash flow matching strategy. Show all work.
- (ii) Calculate the portfolio of bonds under the duration matching strategy using Macaulay duration at 5%. Show all work.

## 4. Continued

### Commentary on Question:

For section (b) some candidates mixed concepts, attempting in a cash flow matching strategy to use discounting to determine the bond portfolio composition or not realizing for the Macaulay duration matching strategy that the liability and each bond separately has its own Macaulay duration. For section (b)(i), some candidates doubled the coupon payment or didn't calculate the matching portfolio cost.

#### (i) *Cash flow matching strategy*

Coupon Payment for semi-annual coupon =  $\frac{1}{2} * \text{Annual Coupon Rate} * \text{Par Value}$

Cash flow at maturity = Coupon Payment + Par Value

Bond A: Matures at  $t=0.5$

Coupon Payment ( $t=0.5$ ) = 10 =  $\frac{1}{2} * 2.00\% * 1,000$

Cash flow ( $t=0.5$ ) = 1,010 = 10 + 1,000

Bond B: Matures at  $t=1.0$

Coupon Payment ( $t=0.5$  &  $t=1.0$ ) = 30 =  $\frac{1}{2} * 6.00\% * 1,000$

Cash flow ( $t=0.5$ ) = 30

Cash flow ( $t=1.0$ ) = 1,030 = 30 + 1,000

Liability requirement ( $t=1.0$ ) = 2,060

Liability requirement ( $t=0.5$ ) = 3,090

Work backwards from end to beginning,  $t=1.0$  first:

$t=1.0$ :  $2,060 = B * 1,030$      $B = 2 = 2,060/1,030$

With two of bond B there is also a coupon payment at  $t=0.5$  of  $60 = 2 * 30$

Remaining liability requirement ( $t=0.5$ ) = 3,030 = 3,090 - 60

$t=0.5$ :  $3,030 = A * 1,010$      $A = 3 = 3,030/1,010$

Portfolio of bonds for exact cash flow match is 3 Bond A and 2 Bond B.

Price = PV (Cash flows discounted at Yield to Maturity)

Bond A Price = 1,004.99 =  $1,010 / (1 + .010)^{0.5}$

Bond B Price = 1,017.79 =  $30 / (1 + .012)^{0.5} + 1,030 / (1 + .012)^{1.0}$

Check: Yield to Maturity < Coupon rate, therefore, Price > Par value.

Portfolio cost =  $3 * 1,004.99 + 2 * 1,017.79 = 5,110.18$

#### (ii) *Macaulay duration matching strategy*

Macaulay Duration =  $\frac{t=0 \text{ to } n \sum t v^t CF_t}{t=0 \text{ to } n \sum v^t CF_t}$

Macaulay duration for one cash flow =  $t$ , the time of that cash flow.

## 4. Continued

Separate Macaulay duration each for the liabilities, for Bond A and for Bond B.

$$\text{Mac. Dur. (Liability)} = 0.697 = \frac{0.5*(1/1.05)^{0.5} * 3,090 + 1.0*(1/1.05)^{1.0} * 2,060}{(1/1.05)^{0.5} * 3,090 + (1/1.05)^{1.0} * 2,060}$$

$$\text{Mac. Dur. (Bond A)} = 0.500 = \frac{0.5*(1/1.05)^{0.5} * 1,010}{(1/1.05)^{0.5} * 1,010}$$

$$\text{Mac. Dur. (Bond B)} = 0.986 = \frac{0.5*(1/1.05)^{0.5} * 30 + 1.0*(1/1.05)^{1.0} * 1,030}{(1/1.05)^{0.5} * 30 + (1/1.05)^{1.0} * 1,030}$$

*Check: Bond A duration should be 0.5 because that is the only cash flow.  
Bond B duration should be less than 1 as a small cash flow is earlier.*

*Liability duration should be closer to 0.5 than to 1.0.*

We only have Bond A and Bond B in which to invest:

Bond A% + Bond B% = 1, or use x for Bond A% and (1 - x) for Bond B%,

Duration of Liabilities = x \* Bond A Duration + (1 - x) \* Bond B Duration

$$0.697 = x * 0.5 + (1 - x) * 0.986$$

$$0.697 = x * (0.5 - 0.986) + 0.986$$

$$-0.289 = x * -0.486$$

$$x = 0.595$$

To match Macaulay duration, we need 0.595 of Bond A and 0.405 of Bond B.

## 5. 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.
6. The candidate will be able to integrate data from various sources into model office and asset/liability models.

### Learning Outcomes:

- (3a) For traditional and financial reinsurance, explain the consequences and evaluate the effect on both ceding and assuming companies with respect to:
  - (i) Risk transfer
  - (ii) Cash flow
  - (iii) Financial statement presentation
  - (iv) Tax impact, and
  - (v) Reserve credit requirements.
- (3b) Describe the considerations and evaluate the appropriate reinsurance form from the ceding and assuming company perspectives.
- (6c) Explain limitations of models and possible sources of error:
  - (i) Quality of data
  - (ii) Granularity of the model

### Sources:

Life & Health Reinsurance – Chapters 4 & 5

ASOP #23 Data Quality

### Commentary on Question:

The question tested the candidate knowledge and understanding of various reinsurance arrangements and their impacts.

The question was approximately 40% comprehension and retrieval and 60% knowledge utilization.

Most candidates demonstrated a good level of knowledge on this topic. Note that part (a) also asked for recommendation on the type of reinsurance used, candidates therefore should attempt to make a recommendation in order to get full credit.

### Solution:

- (a) Explain the two types of reinsurance offered by ABC. Recommend the type of reinsurance which would be most suitable for XYZ.

YRT

- Reinsurance premium is not directly related to the product premium.
- The amount reinsured is based on the Net Amount of Risk.

## 5. Continued

- The ceding company is responsible for establishing reserves and paying all benefits.
- YRT transfers mortality and morbidity risk only.
- YRT is easy to administer.

### Coinsurance

- The reinsurance policy is in the same format as that of the direct company.
- The reinsurance company receives a proportionate share of the direct premiums, and establishes its proportionate share of the reserves.
- All risks are shared.
- The ceding company receives an expense allowance from the reinsurer to cover expenses and commissions.
- The reinsurer shares in the surplus strain of new issues.

Recommendation: XYZ should use coinsurance since the block of business is term insurance and there is a limited surplus amount. Coinsurance will also reduce income volatility.

- (b) Calculate the change in XYZ's free surplus at the end of the year under YRT and coinsurance.

### **Commentary on Question:**

Many candidates were able to calculate income under both reinsurance agreements. However, a common mistake among candidates was neglecting to perform the additional calculations to determine free surplus. In order to receive full credit, the candidate should have calculated the EOY Asset, EOY Reserves, and EOY Required Surplus in order to determine the EOY free surplus.

Calculate before tax income before reinsurance, in order to get the tax rate.

$$\begin{aligned} \text{Before tax income} &= \text{Premium} + \text{Investment Income} - \text{Death Claims} - \text{Expenses} - \\ &\text{Increase in Reserves} = 7,200 \end{aligned}$$

$$\text{Free Surplus} = \text{Assets} - \text{Reserves} - \text{Required Surplus}$$

$$\text{Free surplus before reinsurance} = 64,500 - 20,000 - 40,000 = 4,500$$

### YRT

$$\text{Net premium} = 100,000 - 40,000 = 60,000$$

$$\text{Investment income} = 2,000 \text{ (given)}$$

$$\text{Net claims} = 50,000 - 0.75 * 50,000 = 12,500$$

$$\text{Expenses} = 25,000$$

$$\text{Increase in reserves} = 20,000 \text{ (since no reserve credit)}$$

$$\text{Before tax income net of reinsurance} = 4,500$$



## 5. Continued

After tax income net of reinsurance = Before tax income net of reinsurance \*  
(after tax income before reinsurance/before tax income before reinsurance) =  
 $4,500*(4,500/7,200) = 2,813$

EOY Asset = BOY Asset + Premium + Investment Income – Claims – Expenses  
– Tax =  $40,000 + 60,000 + 2,000 - 12,500 - 25,000 - (4,500 - 2,813) = 62,813$

EOY Reserves = 20,000

EOY Required Surplus = Required Surplus before reinsurance\*(0.5\*net face  
amt/gross face amt + 0.5\*net reserve/gross reserve) =  
 $40,000*(0.5*0.25 + 0.5*1) = 25,000$

Free surplus net of reinsurance =  $62,813 - 20,000 - 25,000 = 17,813$

Change in free surplus =  $17,813 - 4,500 = 13,313$

### Coinsurance

Net premium =  $100,000 - 0.75*100,000 = 25,000$

Investment income = 2,000 (given)

Net claims =  $50,000 - 0.75*50,000 = 12,500$

Expenses = Expenses – Expense Allowance =

$25,000 - 0.25*(0.75*100,000) = 6,250$

Increase in reserves =  $20,000 - 0.75*20,000 = 5,000$

Before tax income net of reinsurance = 3,250

After tax income net of reinsurance =  $3,250*(4,500/7,200) = 2,031$

EOY Asset =  $40,000 + 25,000 + 2,000 - 12,500 - 6,250 - (3,250 - 2,031) = 47,031$

EOY Reserves = 5,000

EOY Required Surplus =  $40,000*(0.5*0.25 + 0.5*0.25) = 10,000$

Free surplus net of reinsurance =  $47,031 - 5,000 - 10,000 = 32,031$

Change in free surplus =  $32,031 - 4,500 = 27,531$

- (c) Explain the responsibilities of ABC's actuary under ASOP #23 with respect to false data and incomplete or inconsistent data.

### **Commentary on Question:**

Most candidates understood that the actuary should review the data but is not required to audit the data or determine if it has been intentionally falsified.

Candidates who received full credit were those who wrote a thorough response and hit most of the major details in the solution.

## **5. Continued**

Completely accurate and comprehensive data is never available. The actuary is not required to determine if data is falsified. The actuary is not required to audit the data or perform additional data compilations for the sole purpose of finding questionable data. The actuary should disclose reliance on information supplied by XYZ.

The actuary should review the data provided by XYZ to determine if it is sufficient for performing cash flow testing, if more review is needed, and to check for consistency. Since the XYZ business is so small, there is unlikely to be another source of data. The actuary should disclose any potential existence of uncertainty or bias in the data. If the lack of data quality issue cannot be rectified, the ABC actuary can refuse to sign the opinion.

## 6. Learning Objectives:

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

### Learning Outcomes:

- (1d) Explain fair value accounting principles.
- (1e) Describe international accounting standards.

### Sources:

ILA-C127-11 July 2010 Exposure Draft - Insurance Contracts, IASB, pages 19 to 84

### Commentary on Question:

The question tested candidates' understanding of the proposed valuation model under IFRS 4, and verify that understanding with a numerical example.

The cognitive level is: retrieval for part (a), analysis for part (b), and knowledge utilization for part (c).

To receive maximum points, the candidates needed to be able to define the initial measurement under IFRS 4, with sufficient details on each of the key components, as well as provide an appropriate solution to the numerical part of the question.

Most candidates were able to answer at least part of the question, but few provided a good answer to all parts. The numerical portion in part (c) was generally well answered, while the description of the process to use for a reinsured portfolio was generally poor. Specific comments for each part are provided below.

### Solution:

(a)

#### Commentary on Question:

The description of the initial measurement varied in the level of detail and quality. Many candidates simply listed the building blocks, which was not sufficient given the candidates were asked to define these items. Most candidates understood the purpose of the residual margin. It was not as clear with the risk adjustment, which some candidates considered to be outside of the PV of fulfillment cash flows. Less candidates were able to provide appropriate considerations for the discount rate.

- (i) Define the Initial Measurement and its key components.

The initial measurement of an insurance contract is equal to the sum of the PV of fulfillment cash flows and the residual margin.

The PV of the fulfillment cash flows is comprised of:

- An explicit, unbiased and probability-weighted estimate of future cash outflows less future cash inflows
- A discount rate that adjusts the cash flows for the time value of money

## 6. Continued

- The risk adjustment, which is an explicit estimate of the effects of uncertainty about the amount and timing of the future cash flows
- Only incremental acquisition costs are included in the cash flows

The residual margin eliminates any gain at inception of the contract. It is needed when the expected present value of the future cash outflows plus the risk adjustment is less than the expected present value of the future cash inflows (i.e. when the PV of fulfilment CFs is negative).

- (ii) List the considerations in determining the discount rate used in the calculations of the Initial Measurement.

The discount rate should:

- Be consistent with observable current market prices for instruments with cash flows whose characteristics reflect those of the insurance contract liability
- Exclude any factors that influence the observed rates but are not relevant to the insurance contract liability

If the cash flows of an insurance contract do not depend on the performance of specific assets, the discount rate shall reflect the risk free yield curve in the appropriate currency of the instruments with an adjustment for illiquidity.

If the amount, timing, or uncertainty of the cash flows depend on the performance of specific assets, the measurement of the insurance contract shall reflect that dependence.

(b)

### **Commentary on Question:**

Many candidates were able to say whether the statements are true or false, but the corrected false statements were often not fully accurate. Only a small number of candidates were able to explain the process if the portfolio is reinsured. Many candidates simply wrote that net cash flows are used, which is not right as the direct and ceded cash flows are looked at separately, using the same principles.

- (i) Assess whether the following statements are true or false. If false, correct the statement to ensure it is true:
1. In order for the embedded derivative (ED) to be separated from its host contract under IAS 39, the ED's economic characteristics should be closely related to its host contract.

## 6. Continued

2. If separated, the embedded derivative should be measured at fair value under IAS 39.
3. The risk adjustment shall be the chief actuary's best estimate of provision for adverse deviation for the insurance contract.

Statement 1 is false. The ED should be separated from the host contract if the economic characteristics of the ED are not closely related to the host contract, and if a separate instrument with the same terms as the ED would meet the definition of a derivative and be within the scope of IAS 39.

Statement 2 is true.

Statement 3 is false. The risk adjustment is the maximum amount the insurer would rationally pay to be relieved of the risk that the ultimate fulfillment cash flows exceed those expected.

- (ii) Explain the process used to determine the present value of the cash flows if the insurance portfolio is reinsured.

The ceding company measures the reinsurance contract at initial recognition as the sum of the PV of fulfilment cash flows plus the residual margin.

The ceding company estimates the PV of the fulfilment cash flows of the reinsurance contract in the same manner as the corresponding part of the PV of the fulfilment cash flows for the underlying insurance contracts.

The ceding company would consider the risk of non-performance by the reinsurer.

The residual margin cannot be negative.

- (c) Calculate the insurance liability, under International Financial Reporting Standards (IFRS):

### **Commentary on Question:**

This part was generally well answered by candidates. One common mistake was to use all acquisition costs rather than only using incremental acquisition costs.

Several candidates assumed that the initial annual premium was not included in the expected present value of premiums. No points were lost for this.

## 6. Continued

(i) At initial recognition, and

$$\begin{aligned}\text{EPV of Cash Outflows} &= \text{EPV of Claims} + \text{Incremental Acquisition Costs} \\ &= 2,500 + 60 = 2,560\end{aligned}$$

$$\text{EPV of Cash Inflows} = \text{EPV of Premiums} = 3,000$$

$$\begin{aligned}\text{PV of Fulfilment CFs} &= \text{EPV of Cash Outflows} + \text{Risk Adjustment} \\ &\quad - \text{EPV of Cash Inflows} \\ &= 2,560 + 150 - 3,000 = -290\end{aligned}$$

PV of Fulfilment CFs is negative, so need to set-up a residual margin to eliminate the gain at inception

$$\text{Residual Margin} = - \text{PV of Fulfilment CFs} = 290$$

$$\begin{aligned}\text{Insurance Liability} &= \text{PV of Fulfilment CFs} + \text{Residual Margin} \\ &= -290 + 290 = 0\end{aligned}$$

(ii) Immediately after initial recognition under IFRS.

The initial premium and acquisition costs have been paid and are no longer part of the liability.

$$\text{EPV of Cash Outflows} = \text{EPV of Claims} = 2,500$$

$$\begin{aligned}\text{EPV of Cash Inflows} &= \text{EPV of Premiums} - \text{Initial Annual Premium} \\ &= 3,000 - 200 = 2,800\end{aligned}$$

$$\begin{aligned}\text{Insurance Liability} &= \text{EPV of Cash Outflows} + \text{Risk Adjustment} \\ &\quad - \text{EPV of Cash Inflows} + \text{Residual Margin} \\ &= 2,500 + 150 - 2,800 + 290 = 140\end{aligned}$$

## **7. Learning Objectives:**

1. The candidate will understand basic financial statements and reports of Can. life insurance companies and be able to analyze the data in them.
  
5. The candidate will understand the Risk Based Capital (RBC) regulatory framework and the principles underlying the determination of Regulatory RBC and Economic Capital.

### **Learning Outcomes:**

- (1e) Describe international accounting standards.
  
- (5b) Compute MCCSR for a life insurance company, including:
  - (i) Identification of significant risk components
  - (ii) Identification of specialized product MCCSR requirements
  - (iii) Interpreting results from a regulatory perspective
  
- (5c) Explain and apply the concepts, approaches and methods for determining Economic Capital.

### **Sources:**

ILA-C606-12: OSFI: Guideline Minimum Continuing Capital and Surplus Requirements for Life Insurance Companies 1-5, 8 (Dec 2009)

ILA-C629-11 Conversion to IFRS by Federally Regulated Entities, March 2010  
Economic Capital for Life Insurance Companies, SOA Research Paper, Feb 2008, Ch. 1, 3, 4, 5, 6

### **Commentary on Question:**

Cognitive level of question is Analysis in part (a), Knowledge Utilization in part (b), and Retrieval in part (c).

In part (a) understanding how conversion to IFRS impacts company's available capital under MCCSR was tested. This part was generally poorly done when it came to actually performing the calculation where it was important to know how carrying value is defined and that values as of December 31, 2010 must be used. In the second part almost everyone missed that only gains and only for investment properties not backing policy liabilities under CALM should be considered. None got that the net impact to available capital is zero.

Part (b) was testing if MCCSR rules regarding rating agencies and ratings were understood and can be applied. Majority of candidates misunderstood that one agency must be picked and used for all bonds.

The first part of part (c) was generally well done. The second part where a recommendation needed to be made was very poorly done.

## 7. Continued

### Solution:

(a)

- (i) Explain the difference in accounting treatment of Own Use vs. Investment Properties under IFRS.

Own use properties are valued at Cost whereas Investment properties are valued on a Fair Value basis. OSFI requires that for own use properties any fair value gains or losses upon transition to IFRS not be included in regulatory capital.

After-tax FV gains/losses at conversion are frozen and deducted until property is sold and therefore values as of Dec. 31, 2010 must be used.

- (ii) Calculate the IFRS conversion impact to regulatory capital from Own Use properties as of March 31, 2011.

IFRS Carrying Value for Own Use = Cost - Accumulated Depreciation

IFRS Carrying Value for Property 1 = 200 - 121 = 79

IFRS Carrying Value for Property 2 = 155 - 95 = 60

FV Gains/Losses at conversion is equal to IFRS Carrying Value minus CGAAP BV

FV G/L for Property 1 = 79 - 280 = -201

FV G/L for Property 1 After-tax =  $-201 * (1 - .26) = -149$

FV G/L for Property 2 = 60 - 218 = -158

FV G/L for Property 2 After-tax =  $-158 * (1 - .26) = -117$

The total adjustment to Regulatory Capital =  $-149 + -117 = -266$

- (iii) Evaluate adjustments to MCCSR available capital related to Investment properties for ABC as of March 31, 2011.

Accumulated net after-tax fair value gain (ONLY GAIN) on investment properties backing Surplus (NOT backing policy liabilities under CALM) are reversed from Retained Earnings (MCCSR Tier 1) and added back to Tier 2 Capital. The net impact to Regulatory Capital is zero.

The deduction from Tier 1 and addition to Tier 2 is equal to  $50 * (1 - .26) = 37$

(b)

- (i) List the considerations for determining credit ratings that drive asset default factors used in determining the MCCSR C1 component.

Ratings from four agencies: S&P, Moody's, Fitch, and DBRS can be used.



## 7. Continued

Internal ratings can only be used if external ratings are not available. However, the lowest factor allowed for Internal Ratings is 2% (rating BBB). Only solicited external ratings are allowed. If there is two ratings the lower rating (higher factor) should be used. If three ratings are available the middle one should be used. If four ratings are available the second best should be used.

- (ii) Calculate the C1 – Asset Default Risk for the portfolio of Long Term Bonds.

Bond 1: All external ratings are solicited, pick the middle one: A

Bond 2: ARA 2 rating cannot be used since it is unsolicited. Pick worse of the two solicited ratings: B

Bond 3: Both external ratings are unsolicited and therefore cannot be used. Internal rating should be used but must be capped at BBB.

C1 for Bond 1 = 1% \* 1000 = 10

C1 for Bond 2 = 8% \* 500 = 40

C1 for Bond 3 = 2% \* 2000 = 40

- (c) ABC's senior management has asked you to consider an Economic Capital (EC) model for its bond portfolio.

- (i) Define the main credit sub-risks within an EC framework

Spread risk is related to the change in market value of assets due to change in spread. It reflects the change in value due to movement or volatility of the credit curve relative to the risk free interest rate term structure.

Default risk is the risk of not receiving principal or interest over outstanding loans.

Concentration risk is the additional risk of partial or total losses of value due to large exposures to the same issuer.

Other risk categories to be considered are migration risk, spread volatility risk, settlement risk.

- (ii) An external consultant recommends a one-year mark-to-market stress testing approach to quantify default risk. Assess the appropriateness of this recommendation.

## 7. Continued

One-year mark-to-market stress testing approach to quantify default risk is not appropriate. One-year mark-to-market stress testing approach often focuses on changes in the spread, which tends to be the biggest driver of change in MVs over a one-year horizon. A run-off stochastic modeling approach is better suited for modeling default risks directly. A factor based approach is considered too crude for either default or spread risk. Modeling interaction of credit default risk and liabilities is complex. Proprietary software is an option for advanced credit risk modeling, particularly for products where credit risk is shared between the insurer and the policyholder.

## 8. Learning Objectives:

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

### Learning Outcomes:

- (4c) Explain and create a product line “gains by source” analysis.
- (4d) Apply methods of valuation to business and asset acquisitions and sales including explaining and applying the methods and principles of embedded value.

### Sources:

ILA-C603-07: OSFI Guideline D-9: Sources of Earnings Disclosure, December 2004

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

Life Insurance Products and Finance, Chapter 16

### Commentary on Question:

Commentary listed underneath question component.

### Solution:

- (a) Describe the characteristics of a good Source of Earnings analysis.

#### Commentary on Question:

This question tested the candidates’ knowledge of what makes a good SOE. Most candidates were able to answer this question well. There were some candidates who described generically what the SOE is (e.g. compare actual vs. expected), as opposed to characteristics of what a good SOE would look like (e.g. reconciles to reported earnings without material balancing items).

Characteristics of a good SOE:

- Easy for external users to understand
- Comparable to other companies’ SOE
- Reconciles to reported earnings without material balancing items
- Produced in a timely manner
- Includes all material components of reported earnings
- Consistent with the way earnings are reported and the way the business is managed
- Well documented and validated
- Methodology is consistently applied from period to period
- Technically robust, earnings can be consistently explained between reporting periods
- Can be used by management to help in decision making by identifying drivers to earnings

## 8. Continued

- (b) You are a Senior Actuary with XYZ Life Insurance Company and you are reviewing the variance between the financial results for 2010 and 2011 for a particular block of business. Your actuarial student has commented that the bulk of the variance in pre-tax earnings results is attributable to the drop in gross premium of 20M and an increase in surrenders of 15M.

Perform a Source of Earnings Analysis using Pre-Tax Net Income and evaluate the accuracy of the actuarial student's comment. Show all work.

### Commentary on Question:

The purpose of this question is to test the candidates' understanding of the structure of the SOE, and the various line items that lead to pre-tax earnings. The candidate is also tested on his/her ability to interpret the results inside the SOE to identify drivers of earnings. Most candidates did well in putting together the numerical exhibits, although some candidates struggled with figuring out which types of investment income (i.e. reserves vs. surplus) and expenses (surplus vs. not) fall under which categories. Most candidates were able to give reasonable interpretations of the results, and identify earnings drivers.

	2010	2011
<b>Premium</b>		
Actual Premiums	160	140
<u>Expected Premiums</u>	<u>147</u>	<u>128</u>
Premium Margin	13	12
<b>Interest</b>		
Investment income on reserves	74	63
<u>Required interest on reserves</u>	<u>58</u>	<u>55</u>
Interest Margin	16	8
<b>Claims</b>		
Actual Claims	-16	-13
Expected Claims	-20	-15
Expected Best Est Reserve Released on Claim	-4	-3
<u>Actual Best Est Reserve Released on Claim</u>	<u>-3</u>	<u>-3</u>
Claim Margin	3	2
<b>Surrenders</b>		
Actual Surrenders	-45	-60
Expected Surrenders	-60	-75
Expected Best Est Reserve Released on surrender	-40	-45
<u>Actual Best Est Reserve Released on surrender</u>	<u>-45</u>	<u>-55</u>
Surrender Margin	20	25

## 8. Continued

<b>Expenses</b>		
Actual renewal expenses	-10	-15
<u>Expected expenses</u>	<u>-12</u>	<u>-16</u>
Expense margin	2	1
<b>Expected Profit</b>		
Release of PfADS	15	15
<b>New Business</b>		
New Business Expenses	-32	-30
<u>New Business Reserve Change</u>	<u>10</u>	<u>17</u>
New Business Strain	-22	-13
<b>Changes in method and assumptions</b>		
Changes in methodology	-5	0
<u>Changes in assumptions</u>	<u>9</u>	<u>5</u>
Total changes in method and assumptions	4	5
<b>Income on surplus</b>		
Investment income on surplus	11	14
Debt-service costs	-5	-7
<u>Surplus-related expenses</u>	<u>-3</u>	<u>-3</u>
Income on Surplus	3	4
<b>Pre-tax Earnings (sum of components above)</b>	<b>54</b>	<b>59</b>

The student's comment is incorrect:

- Change in premium was anticipated under expected assumptions, and as such offset by reserve changes associated with premiums
- Change in surrenders actually produced an increase to earnings, as actual change in surrender was more than offset by reserve changes

The three main earnings drivers were:

- New business strain improvement
- Surrenders providing less strain
- Interest margin on reserves incurring losses

- (c) Determine the distributable earnings for 2011. Show all work.

## 8. Continued

### Commentary on Question:

This question tested the candidates' knowledge of the definition of Distributable Earnings. Most candidates were able to identify some of the components in the definition, but a number of candidates forgot investment income on required capital. Most candidates were aware that increase in required capital was part of the definition, and were able to correctly calculate the number.

Dist Earnings = After tax earnings + Investment Income on Beg of Year Required Capital + Change in Required Capital

After tax earnings = Before tax earnings from part b - Taxes from part b = 59 - 21 = 38

From part (b), the final earnings included investment income on required surplus as well as investment income on free surplus. Therefore, need to back out investment income on free surplus from the above amount.

2011 Investment Income on free surplus = Investment income on free surplus - debt service costs - Expenses on free surplus = 12 - 7 - 2 = 3

Change in Req Cap = 19 - 26 = -7

Dist Earnings = 38 - 3 - 7 = 28

- (d) Determine the minimum assets that must be transferred at year end 2011 to sell this block of business if the Embedded Value at year end 2011 is 50.2 M. Ignore transaction costs and taxes. Show all work.

### Commentary on Question:

This question was very well done in general. The question tests the candidate understanding of the relationship between Embedded Value and assets transferred in a sale of a block of business. There were differences in how candidates expressed the equation, but most candidates had the right idea.

Question specifies that transaction costs and taxes should be ignored, and that EV is 50.2.

From part c, required capital is 26.

Assets = Reserve + Required Capital - EV = Reserve + 26 - 50.2

There is no need to give a numerical final answer as reserve was not given.

## 9. Learning Objectives:

1. The candidate will understand basic financial statements and reports of Can. life insurance companies and be able to analyze the data in them.
5. The candidate will understand the Risk Based Capital (RBC) regulatory framework and the principles underlying the determination of Regulatory RBC and Economic Capital.

### Learning Outcomes:

- (1e) Describe international accounting standards.
- (5b) Compute MCCSR for a life insurance company, including:
  - (i) Identification of significant risk components
  - (ii) Identification of specialized product MCCSR requirements
  - (iii) Interpreting results from a regulatory perspective

### Sources:

ILA-C629-11 Conversion to IFRS

ILA-C606-12 MCCSR

### Commentary on Question:

Commentary listed underneath question component.

### Solution:

- (a) SMURFCO, a small Canadian life insurance company, recently acquired three blocks of business from another company.

### Commentary on Question:

Parts (i) and (ii) were generally well done.

Parts (iii) and (iv) were poorly done.

- (i) List the four criteria that must be met in order for a policy to be classified as participating for MCCSR purposes.

Four criteria for participating policy classification:

1. The policies must pay meaningful dividend
2. The company's participating dividend policy must be publicly disclosed and must make it clear that policyholder dividends will be adjusted to reflect actual experience.
3. The company must regularly review the policyholder dividend scale in relation to the actual experience of the participating account.
4. The company must be able to demonstrate to OSFI that it follows the dividend policy and practices referred to above.

## 9. Continued

- (ii) After acquisition by SMURFCO, Block 2 is redesigned to be classified as participating and adjustable. Reserves and net amount at risk are unchanged with the redesign. Calculate the change in Block 2's mortality capital.

$$\text{Volatility Risk} = S = 2.5 \times A \times B \times E/F$$

Post re-class: only B component is affected => going from  $\max(\ln(D), 1)$  to  $\max(1/2\ln(D), 1)$

$$\text{Revised } S = 200/2 = 100$$

$$\text{Catastrophe Risk} = K = \text{Alpha} \times C \times E/F$$

Post re-class to qualifying par Alpha is equal to 0.05, changed from 0.1

$$\text{Revised } K = 70/2 = 35$$

$$\text{Revised Mortality Capital} = S + K = 100 + 35 = 135$$

$$\text{Change in Mortality Capital} = 270 - 135 = 135$$

Total Company Volatility Risk  $S = \text{SQRT}$  of Sum of Squares of Volatility Component for the three blocks

$$S = \text{SQRT}(100^2 + 200^2 + 1000^2) = 1,024.70$$

Total Company Catastrophe Component is equal to Sum of Catastrophe Components for the three blocks

$$K = 50 + 70 + 300 = 420$$

$$\text{Aggregate SMURFCO Mortality Capital} = 1,024.70 + 420 = 1,444.70$$

- (iii) SMURFCO wants to reduce their mortality risk exposure. The CFO suggests ceding Block 3 to an unregistered reinsurance company. Calculate the maximum amount by which SMURFCO mortality capital can be reduced on account of a deposit made by an unregistered reinsurer.

The maximum amount by which the mortality component may be reduced on account of a deposit made by an unregistered reinsurer is limited to a maximum of:  $M0 - M1$

$M0$  is the mortality component calculated net of registered reinsurance only

$M1$  is the mortality component calculated net of both registered reinsurance and the specific reinsurance agreements backed by the deposit

$$M0 = 1,444.70 \text{ (calculated above)}$$

$$M1 = \text{SMURFCO Aggregate Mortality Capital Net of (excluding) Block 3}$$

$$\text{Volatility Risk for } M1: S = \text{SQRT}(100^2 + 200^2) = 223.61$$

$$\text{Catastrophe Risk for } M1: K = 50 + 70 = 120$$

$$M1 = 223.61 + 120 = 343.61$$

$$M0 - M1 = 1,444.7 - 343.61 = 1,101.09$$



## 9. Continued

- (iv) The unregistered reinsurance company is unfamiliar with IFRS 4 requirements. Describe the main points the valuation actuary should be aware of, as described in the CIA Educational Note Valuation of Gross Policy Liabilities and Reinsurance Recoverables.

IFRS 4 considerations by the Valuation Actuary:

Gross liability (direct liability) is the liability calculated without reflections of reinsurance arrangements

Net liability or liability net of reinsurance recoverable is the liability calculated with reflection of reinsurance arrangements.

Reinsurance recoverable (reinsurance asset) is the excess of the gross liability over the liability net of reinsurance recoverable.

The net amount of the direct liability together with the reinsurance asset [reinsurance recoverable] would equal the original net CALM liability.

The actuary's report should describe the valuation and presentation of policy liabilities and reinsurance recoverables for the insurer's balance sheet and income statement, the actuary's opinion on the appropriateness of those liabilities and recoverables and on the fairness of their presentation...

The allocation of the net liability into a direct liability [gross liability] and a reinsurance asset [reinsurance recoverable] would be based on the underlying cash flows, together with a reasonable assumption about the nature of the related assets.

the value of the reinsurance recoverable needs to be reduced if the reinsurance recoverable is impaired

The allocation of the net liability into a direct liability [gross liability] and a reinsurance asset [reinsurance recoverable] would be based on the underlying cash flows, together with a reasonable assumption about the nature of the related assets.

Margins should be included in both the net liability and the reinsurance recoverable

- (b) SMURFCO has decided to incorporate Future Mortality Improvements (FMI) into the valuation of its existing product lines.  
Calculate the following:

**Commentary on Question:**

Majority of candidates failed to select the right set of reserves to use (excluding FMI). Candidates also did poorly in coming up with reserves excluding FMI with a higher lapse MFAD.

## 9. Continued

- (i) MCCR Risk and C3 Risk.

Reserves excluding FMI must be used for all MCCR calculations.

Life Insurance reserves excluding FMI (no Lapse MfAD) =  $1000 + 50 = 1050$

Annuity reserves excluding FMI (no Lapse MfAD) =  $800 - 40 = 760$

Policy Liabilities excluding FMI with higher Lapse MfAD can be approximated by using the relationship of the two sets of reserves with FMI.

For Life Insurance PL with higher Lapse MfAD excl FMI =  $1100/1000 * 1050 = 1155$

For Annuities PL with higher Lapse MfAD excl FMI =  $875/800 * 760 = 831.25$

Lapse Risk for Life Ins =  $1155 - 1050 = 105$

Lapse Risk for Annuities =  $831.25 - 760 = 71.25$

Total Lapse Risk =  $105 + 71.25 = 176.25$

C3 Risk = Factor \* Reserves excluding FMI

C3 Risk for Life Insurance =  $0.02 * 1050 = 21$

C3 Risk for Annuities =  $0.01 * 760 = 7.6$

Total C3 Risk =  $21 + 7.6 = 28.6$

- (ii) The adjustment to reported Retained Earnings resulting from recognition of future mortality improvements and any related change to Available Capital.

Adjustment to Retained Earnings is the pre-tax change in Policy Liabilities

Adjustment =  $-50 + 40 = -10$

The earnings impact is post tax

Earnings Impact =  $(50 - 40) * (1 - .30) = 7$

Change in Available Capital =  $-10 + 7 = -3$

## 10. 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.

### Learning Outcomes:

(2a)

- (i) Describe Valuation Methods
- (ii) Recommend appropriate valuation assumptions

### Sources:

CIA Educational Note: Best Estimates Assumptions for Expenses – November 2006

CIA Educational Note: Margins for Adverse Deviations (Mfad) – November 2006

CIA Use of Actuarial Judgment in Setting Assumptions and Margins for Adverse Deviations, November 2006

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

### Commentary on Question:

Commentary listed underneath question component.

### Solution:

- (a) Identify the common types of expenses that should be considered by the valuation actuary in setting the policy liabilities including for each type of expenses: (i) the main unit used, (ii) whether inflation applies, and (iii) whether a margin for adverse deviation applies.

### Commentary on Question:

Candidates were unable to identify the types of expenses to include in valuation. Most of the candidates were able to list the administration related expenses but unable to list other types of expenses (i.e. investment related, corporate and overhead expenses etc.). Many candidates also responded that acquisition expenses should be included which is not correct.

Types of expenses to include in valuation:

Administration related

- Usually expressed as an amount per policy inforce
- Inflation assumption applies
- MfAD applies
- Commissions and distribution expenses usually modeled directly as a percentage of premium
- Inflation does not apply to commissions
- MfAD does not apply to commissions

## 10. Continued

### Benefit related

- Usually expressed as an amount per claim/termination
- Inflation assumption applies
- MfAD applies

### Investment related

- Usually expressed as basis points of the market value
- MfAD applies

### Taxes other than income taxes

- Premium tax as a percentage of premiums
- Investment income tax modeled using the Part XII formula
- Inflation does not apply to taxes
- MfAD does not apply to taxes

### Corporate and overhead expenses

- Included as an amount per policy inforce
- Inflation assumption applies
- MfAD applies

- (b) Determine the total maintenance expenses to be included in the calculation of the valuation expense assumption. Show all work.

### Commentary on Question:

In general, candidates did relatively well on this part. “Corporate overhead – human resources” should be included in the calculation but were excluded by many candidates.

Policy illustrations - for inforce policies	500
Re-pricing of adjustable inforce policies	300
Premium billing and collection	2,000
Annual statements	800
Experience studies	300
Reinsurance administration	400
Policy loans	100
Claims administration - administration	700
Claims administration - litigation	200
Corporate overhead - human resources	1,000
Actuarial/Accounting - Financial Reporting	400
<b>Total maintenance expenses to be included</b>	<b>6,700</b>

## 10. Continued

(c)

### **Commentary on Question:**

Many candidates failed to answer (i) based on the direction from the Canadian Institute of Actuaries in using actuarial judgement in setting assumption. Candidates were able to point out that setting assumption would be based on historical experience and actuary must be convinced that most recent experience is permanent change. However, candidates were unable to point out other principles that should be considered (for example, assumption setting must be supported with evidence and must reflect emerging trends). For (ii) and (iii), candidates would need to sufficiently justify their recommendations.

(i) Based on the direction from the Canadian Institute of Actuaries in using actuarial judgement in this situation, respond to your CEO's suggestion.

- Assumption based on historical, but must be appropriate on a prospective basis. Actuary must be convinced that most recent experience is permanent change. In this case, there are many years of experience at around \$50, need more years at lower level to be credible.
- Must be supported with evidence. Actuary would anticipate only a reduction that is forecasted with confidence.
- Must reflect emerging trends, and not random fluctuations.
- Want to remove undue year by year fluctuations. Changing down and then up again would produce unnecessary fluctuations.

(ii) Recommend a best estimate assumption. Justify your answer.

It is not appropriate to lower the unit expense to \$46. When the trend is unclear, keep the same basis. Recommend to keep the current assumption of \$51 based on not enough evidence to support the observed experience is permanent.

(Alternative recommendation: The larger drop for this year might be partially taken into account. Bring the rest in the following year assuming the experience from 2011 is repeated in 2012.)

(iii) Recommend a Margin for Adverse Deviation. Justify your answer.

The low and high MfADs for expense is 2.5% and 10% of best estimate.

As both low and high margin indicators are present, recommend an MfAD within the range above and support by sound reasons (see below) is acceptable.

## 10. Continued

In favor of lower margin:

- Recent expense study
- Not assuming future reductions in unit costs
- Rapid growth – will it continue
- Have the expenses caught up with the growth or will we see higher expenses eventually

In favor of higher margin:

- Volume of new business and inforce are unstable
- Rapid growth – will it continue
- Have the expenses caught up with the growth or will we see higher expenses eventually

## 11. Learning Objectives:

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

### Learning Outcomes:

- (1c) Compute the basic taxable income of a life insurance company.

### Sources:

Canadian Insurance Taxation, Chapter 3, Liability for Income Tax

Canadian Insurance Taxation, Chapter 4, Income for Tax Purposes – General Rules

Canadian Insurance Taxation, Chapter 6, Reserves

Canadian Insurance Taxation, Chapter 11, Investment Income Tax

Canadian Insurance Taxation, Chapter 28, Provincial Premium Tax

### Commentary on Question:

Commentary listed underneath question component.

### Solution:

- (a) Calculate income tax payable by DBM to the Canadian government for the year 2011. Show all work.

Taxable Income on Canadian Business:

Taxable Canadian Income =  $3000 + 10000 - 500 + 400 - 2000 + 20000 = 30900$

Taxable Income on US Business = 30000

(Comment: Only non-insurance business income is taxable)

Total Taxable Income = 60900

Income Tax Payable before US Credit =  $60900 * .3 = 18270$

Credit on US Tax Paid on non-Insurance business only =  $30000 * .25 = 7500$

(Comment: Most candidates did not know the US tax paid is a credit)

Income tax payable after credit =  $18270 - 7500 = 10770$

- (b) Your CFO has noted that the Canadian MTARs are similar to the Stat Reserves. She recalls that at her previous company, in 2001, these values were generally very different.

Construct a report outlining the differences in the MTAR calculations for life insurance policies that occurred between 2001 and 2011.

## 11. Continued

### **Commentary on Question:**

To receive full marks, candidates would need to correctly mention

1. Business was split between pre-96 and post-95 in 2001 and their corresponding MTARs;
2. The distinction was removed in 2007/2008 amendment.

In 2001, business was split between pre-96 and post-95 issues

- The MTAR for pre-96 business was one-half preliminary term
- The MTAR for post-95 business was the amount reported on the insurer's financial statements
- Exclude projected income and capital taxes (except IIT)

For financial years starting on or after October 1, 2006

- CICA Handbook changes to fair value accounting for financial instruments

2007 Amendments

- No longer a distinction between pre-96 and post-95 business
- All policies calculated based on financial statement reserves, excluding projected income and cap taxes (except IIT)
- Changes due to these amendments and CICA changes amortized straight line into income for 5 years

- (c) Due to a bizarre problem with your administration system, you are faced with losing the addresses (both at time of issue and current) of either your Universal Life policyholders or Deposit Annuity policyholders written by your Canadian operations.

Assess the impact on the company's tax calculations from losing this policyholder address information, and make a recommendation on this basis as to which product's address information is less detrimental to lose. Justify your answer.

### **Commentary on Question:**

Most candidates missed the IIT Tax Issues. Also, candidates would need to mention the premium tax rates differ by province of residence at time of premium payment. Overall, most candidates got the correct conclusion.

Addresses needed for premium tax calculations and rates differ by province of RESIDENCE at time of premium payment (only applicable for insurance, not annuity).

IIT Tax Issues - apportionable to Quebec residents not deductible from Quebec provincial taxes, only payable if policyholder resident of Canada at time of issue and only applies to insurance, not annuities.

Since more issues relate to insurance over annuities, it is less detrimental to lose the annuity information.



## 12. 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.

### Learning Outcomes:

(2a)

- (i) Describe Valuation Methods
- (ii) Recommend appropriate valuation assumptions

### Sources:

CIA Report: Use of Stochastic Techniques to Value Liabilities under Canadian GAAP: August 2001

### Commentary on Question:

Commentary listed underneath question component.

### Solution:

- (a) Discuss the advantages and limitations of the Whole Contract stochastic approach of valuation, and ways in which these limitations can be overcome without resorting to the full component approach.

### Commentary on Question:

This question was attempting to test general knowledge of stochastic modeling technique, focusing more on the Whole Contract approach. Candidates that did well on this question were able to describe the Whole Contract approach by listing advantages and disadvantages and to describe alternative approaches to overcome the limitations of the Whole Contract approach.

### Whole Contract stochastic approach of valuation

- Consistency among valuations assumptions and components. The whole contract is valued using one set of assumptions. This will provide the ability to project the cash flows for the entire contract under each scenario to be tested. This requirement has the benefit of reflecting how the actual experience of the contract will emerge.
- Incorporate the correlation among components (reflect natural hedges or risk mitigation between elements of the contracts being valued).
- Conflicts may exist between different components in components, actuary must resolve any conflicting assumptions before performing the valuation.

The approach to solve the limitations of the Whole Contract Approach is to use a hybrid approach.

### Hybrid Approach 1 (DAC focused approach)

The focus is to recover the DAC

## 12. Continued

Step 1: Net Valuation Requirement = Value(Future Guarantee Costs and Expenses) – Value(Total Future Fee Income)

Step 2: Determine DAC Balance

Unamortized DAC = min(scheduled unamortized DAC, max recoverable amount using full fee income)

Step 3: Determine Guarantee Reserve

Guarantee Reserve = max(0, Net Valuation Requirement + Unamortized Cost)

Hybrid Approach 2 (Fee Income Bifurcated Approach)

This approach focuses on bifurcating the fee income between the guaranteed benefits and DAC components.

Step 1: Develop assumption to bifurcate the fee income

Determine basis points to allocate to offset the investment guarantee cost

Step 2: Guarantee Reserve = max(0, Value Future Guarantee Cost – Value of basis point Fee income assigned to guarantee cost)

Step 3: Determine DAC Balance

Unamortized DAC = min(scheduled unamortized DAC, recoverable amount using value of basis points fee income assigned to offset DAC)

- (b) Discuss how the MFADs for the stochastic variables in the reserving model are defined, and the considerations made when setting the level of MFAD for these variables.

### Commentary on Question:

The purpose of this question is to determine if the candidate understands how to set the MfAD for stochastic modeling, how to set the level of CTE to be applied and what components are involved in the estimation of the range. In general, candidates were able to demonstrate that they know the basic concept of determining an appropriate range for the MfAD, but they were not able to provide enough details and did not discuss the decision making process when setting MfAD at the higher or lower range. Candidates that did well were able to provide more details in describing the risks involved.

MfADs for stochastic variables are set using CTE levels. The MfAd is the difference between the CTE level selected and the CTE (0). CTE(0) is the best estimate.

The conservative CTE level should be between CTE(60) and CTE(80)

CTE Level = X+Y+Z

X = 60 (Volatility Risk)

## 12. Continued

Y - Between 0 and 10, Model risk, to capture that the model may not be accurate

Z, Between 0 and 10, parameter uncertainty

The actuary should set the CTE towards the higher end if:

- One or most non-scenario tested assumptions can reasonably be expected to vary according to future states of the world
- For practical reasons can't run enough scenarios
- Model parameters based on experience data which has limited credibility
- Model uses approximations whose conservatism is not well understood in the scenarios whose results are further from mean
- Model does not consider all risk factors