

# ILA LFMC Model Solutions

## Spring 2021

### 1. Learning Objectives:

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

### Learning Outcomes:

- (6a) The candidate will be able to describe, apply and evaluate considerations and matters related to:
- Insurance company mergers and acquisitions
  - Sources of earnings
  - Embedded Value determinations
  - Rating agency considerations

### Sources:

LFM-106-07 Insurance Industry Mergers and Acquisitions, Chapter 4 (Sections 4.1-4.6)

### Commentary on Question:

*This question tested the candidates' knowledge of actuarial appraisals.*

### Solution:

- (a) Describe one of the three basic techniques used by investment banks to value life insurance companies.

### Commentary on Question:

*Candidates received full credit for describing one of the methods below.*

#### Method 1: Comparable Company Analysis

- > apply relevant financial statistics of the selling company to the appropriate "multiples" of comparable public companies
- > comparable companies will ideally have regulatory/accounting/tax frameworks and business segments that are similar to the selling company
- > outcome is subjective since no two companies are identical

#### Method 2: Comparable Transaction Analysis

- > apply relevant financial statistics of the selling company to the appropriate "multiples" of comparable insurance merger transactions
- > comparable transactions should be relatively recent and will ideally involve companies whose size, regulatory/accounting/tax

## 1. Continued

frameworks and business segments are similar to the selling company  
> outcome is subjective since no two transactions are identical

Method 3: Discounted Cash Flows

> use the weighted average cost of capital to discount future after-tax cash flows  
> cash flows for the foreseeable future (typically 5 years) are estimated by using the selling company's assumptions, subject to certain adjustments specified by the acquiring company  
> Comparable Transaction Analysis is typically used to estimate cash flows beyond the foreseeable future

(b) Critique the following statements regarding actuarial appraisals:

- A. *In essence, an actuarial appraisal is an analysis of cash flows, where the cash flow is based on GAAP earnings and changes in economic capital.*
- B. *Assumptions should include a reasonable but not excessive provision for adverse deviation.*
- C. *Mortality anti-selection is reflected to the extent that it is expected on lines of business with high lapse rates.*
- D. *It is common to use a single yield curve which does not change over time, where the curve reflects actual market yields at the time the actuarial appraisal is performed. However, if these yields are abnormally low or high, they will typically be adjusted towards a long term expectation over time.*
- E. *Effective tax rates on future business are often well below the tax rate applied to taxable income (currently 21% for U. S. companies) due to the DAC proxy tax and differences between GAAP and tax reserves.*
- F. *If a fundamental change in business operations is expected after the transaction, operating expense assumptions are typically determined based on the “target unit expenses without an unallocated expense” approach.*
- G. *Mortality improvement is not reflected on life insurance.*

### **Commentary on Question:**

*Candidates did well on this part of the question. Candidates needed to provide some explanation or rationale for their critique to receive full credit.*

# 1. Continued

*Candidates generally did not do well with statements E (tax rates) and F (expenses). Common errors include not correctly identifying that tax rates in Statement E vary due to differences between STAT (not GAAP) and Tax reserves; and discussing DAC, not DAC Tax.*

A: partially true

- > It is true that an actuarial appraisal is a cash flow analysis
- > However, cash flow is based on statutory (not GAAP) earnings and changes in statutory (not economic) capital

B: false

- > Assumptions should be best estimate; there is no PAD
- > Risk should be reflected in the cash flow discount rate

C: true

D: partially true

- > The first sentence is true
- > The second sentence is false; while the yields may be adjusted towards a long term expectation, they typically are not, and sensitivity analysis is performed instead

E: false

- > The effective tax rates are often well above, not well below, the tax rate applied to taxable income
- > The reasons for the effective tax rates being higher are the DAC proxy tax and differences between statutory (not GAAP) and tax reserves

F: true

G: false

- > Mortality improvement should be considered
- > If the impact is material, a sensitivity test would typically be used to quantify the impact

(c) You are given the following information from Company B's actuarial appraisal:

	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>
<b>After tax earnings (in-force and future business)</b>	6	3	8	10	15
<b>Required capital</b>	15	20	22	25	33

## 1. Continued

<b>Adjusted book value</b>	40
<b>Discount rate</b>	10%
<b>Before tax investment earnings rate on capital</b>	5%
<b>Tax rate</b>	21%
<b>Terminal valuations at end of Year 5</b>	
<b>Net present value of after tax earnings for Years 6 and later (in-force and future business)</b>	155
<b>Net present value of required capital charges for Years 6 and later</b>	28

Calculate the actuarial appraisal value of Company B. Show all work.

### **Commentary on Question:**

*Candidates generally did well on this part of the question. Because there are several ways in which to calculate the appraisal value (e.g., using the NPV function within Excel or breaking down the calculations into more pieces), credit was given for a clear understanding of how to calculate the appraisal value. It should be noted that if a candidate missed part of a calculation but then carried that value through other formulas consistently and correctly, no credit was lost.*

*There were a few common errors. (1) The terminal valuations at end of year 5 (i.e., \$155 of in-force/future business and \$28 of required capital charges) were often discounted for 6 years, not 5, or they were not discounted at all. (2) The cost of capital rate (i.e.,  $c$ ) was not calculated correctly*

### Relevant Formulas

$c$  = cost of capital rate = discount rate - after tax investment earnings rate on capital

ABV = adjusted book value = excess capital + required capital

VIB = value of inforce business = net present value of after tax earnings on inforce business

VFB = value of future business = net present value of after tax earnings on future business

CRC = cost of required capital = net present value of cost of required capital charges

AAV = actuarial appraisal value = ABV + VIB + VFB - CRC

### Calculations

$$v = 1 / 1.10$$

$$c = 0.1 - [0.05 \times (1 - 0.21)] = 0.0605$$

$$ABV = 40$$

## 1. Continued

$$VIB + VFB = (6 \times v) + (3 \times v^2) + (8 \times v^3) + (10 \times v^4) + (15 \times v^5) + (155 \times v^5) = 126.33$$

$$CRC = c \times [(15 \times v) + (20 \times v^2) + (22 \times v^3) + (25 \times v^4) + (33 \times v^5)] + [28 \times v^5] = 22.48$$

$$AAV = 40 + 126.33 - 22.48 = 143.85$$

(d) You are given:

- Company A and Company B use the same administration system.
  - Company A has a larger distribution channel than Company B.
  - Company A and Company B have a similar capital structure, but Company A has a lower CAPM beta.
- (i) Recommend three adjustments Company A should make to the actuarial appraisal developed by Company B.
- (ii) Describe the directional impact of each recommended adjustment on the actuarial appraisal value

### Commentary on Question:

*Candidates generally did well on this part of the question, recognizing that Company A could increase the overall actuarial appraisal value (AAV) due to economies of scale, higher projected future sales, and using Company A's lower discount rate. Some candidates misinterpreted the question and responded from the view of Company B. To receive full credit, candidates needed to provide recommendations for adjustments in part (i) not just provide comments on adjustments.*

(i)

> Adjust the values of in-force and future business to recognize the anticipated synergies and economies of scale resulting from Company A having the same administration system

> Adjust future business values to recognize the anticipated additional sales resulting from Company A having a larger distribution channel

> Decrease the discount rate since Company A has a lower weighted average cost of capital

(ii)

> Administration system adjustment: increase actuarial appraisal value

> Distribution channel adjustment: increase actuarial appraisal value

> Discount rate adjustment: increase actuarial appraisal value

## 2. Learning Objectives:

5. The candidate will understand how to explain and apply the methods, approaches and tools of financial management in a life insurance company context.

### Learning Outcomes:

- (5a) The Candidate will be able to:
- Explain and apply methods in determining regulatory capital and economic capital
  - Explain and evaluate the respective perspectives of regulators, investors, policyholders and insurance company management regarding the role and determination of capital
  - Explain Canadian regulatory capital framework and principles
  - Explain and apply methods in capital management

### Sources:

Economic Capital for life Insurance Companies, SOA Research paper, Oct 2016 (exclude sections 5 and 7)

Economic Capital A Case Study to Analyze Longevity Risk, Silverman, JRM, 2010

### Commentary on Question:

*This question tested the candidates' understanding of the Economic Capital Liability Runoff approach.*

### Solution:

- (a) A life insurance company is currently developing an Economic Capital model for its life in-force block, which includes UL, term and whole life products, using the Liability Runoff Approach. The intended applications of the model are for establishing the risk management and risk appetite.

Critique each of the following proposed approaches. Recommend improvements where applicable.

- A. *The liability runoff approach is being performed using a stochastic simulation with 3,000 real world economic scenarios. The scenarios being used were originally developed in the context of Variable Annuity Pricing.*
- B. *The current valuation assumptions consist of best estimate assumptions plus margins for adverse deviations. Risk driver categories are aligned with these margins, covering a variety of economic and non-economic assumption sub-categories.*

## 2. Continued

- C. Current inforce data is used to generate projected liability cash flows. Lapse assumptions vary by scenario for UL products. Mortality and expense assumptions for all products and lapse assumptions for non-UL products are on a best estimate basis and do not vary by scenario, with the exception of expense inflation, which is scenario-dependent.*
- D. Projected asset cash flows are generated for each scenario, such that the level of assets required at the beginning of a given scenario satisfies key obligations including paying policyholder cash flows, debt payments, and dividends.*
- E. The required assets at the valuation date are ranked to form a distribution. The plan is to use a CTE99 metric applied to the distribution, based upon the segregated fund pricing methodology which uses CTE.*
- F. The economic capital is defined by applying the CTE99 metric to the total assets required and deducting the current statutory liabilities.*
- G. It has been suggested that the development team use a correlation matrix approach to calculate the between-risk diversification benefits.*

### **Commentary on Question:**

*Candidates generally did not do well on this part of the question, especially with respect to statements A, B, and D. Some candidates critiqued the approach without providing justification or just rephrased the question by rearranging some words. To receive full credit, candidates had to provide valid reasons to support the critique.*

*Common errors include the following:*

*Statement A (Economic Scenarios) – Candidates suggested using more scenarios or not appropriate because it is developed in the context of Variable Annuity Pricing.*

*Statement B (Risk Driver) –The question stated the current valuation assumption includes a Margin for Adverse Deviation. The question did not state economic capital assumptions are padded. Candidates mis-interpreted the question and answered to use best estimate assumptions for economic capital. This was not the focus of the question.*

*Statement D (Asset cash flow) –Candidates failed to identify the assumptions or types of cash flow missing in the approach.*

## 2. Continued

A Economic Scenario – It is good to use 3,000 scenarios as the paper suggests to use 1000 or more scenarios. The scenario distribution is a realistic assessment of the future risks and returns. Since the scenarios were originally developed for pricing, they represent a “best view” and are appropriate to use.

B Risk Driver – Company needs to select the risk drivers that represent the key risks. The process involves understanding of risk drivers and their relationship. It may be appropriate for practical reasons to use Valuation PfADs but they should be assessed whether it makes sense to look at things on a more aggregate or more granular level. Example, if mortality PfADs combine base or improvement, should the risk driver look at them separately?

C Liability Cash flow – If the company is writing significant new business, it is necessary to include new business in the projection. It is good that the approach vary lapse assumptions by scenario for key products. This will help to better understand the tail risk. However, the current approach did not quantify capital for mortality and expense risks. One approach is to develop stress test on these assumptions to determine the associated amount.

In addition, the liability cash flows should consider including realistic management actions.

Company can also develop a fully integrated stochastic model incorporating non-economic assumptions (example mortality, policyholder behavior) to better understand interaction between risks.

D Asset Cash flow – The cash flow should include investment returns earned on those assets (including investment strategy and re-investment considerations)

E CTE Metric – CTE is effective for capturing tail risks, especially if there are extreme edge case scenarios. The shortcoming of using CTE metric over VAR is that it is more difficult to communicate the results to senior management, and it may be more difficult to work with from a practical perspective.

Risk appetite statements and fundamental corporate philosophies should ultimately drive the decision of selecting a confidence level. It would be good to understand the chosen level of confidence relative to Valuation and Capital calculations.

CTE99 is likely too conservative as compared to Var99.5.

F Valuation of liabilities – The most important measure is the total assets required. This would be higher than the liabilities. Hence, the split of required assets between liabilities and economic capital is not important from this perspective.

Economic Capital = Total assets required – current value of liabilities (mean of the distribution or best estimate liabilities)

## 2. Continued

G Correlation matrix – Under the correlation matrix approach, standalone capital is calculated for individual risk factors and then aggregated by multiplying the capital results through a correlation matrix. The advantage of this approach is its ease of calculation. Another approach is to use scenario aggregation which involves the use of integrated scenarios containing multiple risk factors (example economic assumptions and lapse assumptions). This would implicitly account for correlation.

- (b) Describe ways that Economic Capital can be applied in the following areas:
  - (i) Capital Adequacy
  - (ii) Performance Measurement

**Commentary on Question:**

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

- (i) Capital adequacy is the core use of Economic Capital to provide a measure of capital that captures the risk of the insurer's own portfolio. Effective use of Economic Capital requires the Economic Capital to be integrated into the capital management process. Acceptance of the Economic Capital by regulators and rating agencies is necessary for achieving its business benefits.
- (ii) In order to use Economic Capital to measure performance, it needs to be incorporated in some related measure of return. One approach involves using Economic Capital as a denominator to calculate the return on risk-adjusted capital (RORAC). An alternative approach involves the inclusion of Economic Capital as the measure of required capital within a value-based measure, such as embedded value (EV).

### 3. Learning Objectives:

1. The candidate will understand and apply pre-IFRS 17 valuation principles to individual life insurance and annuity products issued by Canadian life insurance companies.

#### Learning Outcomes:

- (1a) The Candidate will be able to:
- Compare and apply methods for life and annuity product reserves
  - Evaluate, calculate, and interpret liabilities
  - Recommend and justify appropriate valuation assumptions

#### Sources:

CIA Educational Note: Expected Mortality: Fully Underwritten Canadian Individual Life Insurance Policies: July 2002 (exclude appendices)

CIA Final Communication of a Promulgation of Prescribed Mortality Improvement Rates (July 2017)

#### Commentary on Question:

*This question tested the candidates' knowledge of mortality and mortality improvement assumptions and their review.*

#### Solution:

- (a) Describe the steps you would take to validate the data from ABC's mortality experience study.

#### Commentary on Question:

*Candidates generally answered this part of the question well. Candidates who received full credit described the four steps of mortality experience study data validation. Few candidates described the first step. Candidates generally described the last three steps well.*

1. Review the extract specifications with knowledgeable systems people.
2. Summarize data, and validate it against other sources (e.g. Are death benefits paid consistent with financial statements? Is the mix of business by size, underwriting class, etc. consistent with sales statistics?)
3. Review study results for reasonableness against past studies, as well as intuitive tests (e.g. non-smokers are expected to have better mortality experience than smokers).
4. Where inconsistencies in the data can be clearly identified, the data would be adjusted. The problem blocks of experience would be excluded from the study to remove any study bias if solutions to the inconsistencies are not evident, and results would be materially affected.

### 3. Continued

- (b) The current mortality assumption varies by gender but does not vary by age. Evaluate whether the current data supports adding age bands as a new factor using the information provided below:

Age band	Exposure Count	Number of Deaths (2010-2019)
<55	9,000	600
55-74	39,000	2,200
75+	20,000	1,900

**Commentary on Question:**

*Candidates generally identified both the credibility of the information and the connection between the age bands factor and the mortality result for the evaluation. Candidates who received full credit concluded the evaluation with both supporting considerations identified and explained. Candidates who calculated the mortality rate of each age band but did not describe the intuitiveness of the trend received partial credit.*

1. Credibility of the information

The number of deaths in each age band is not fully credible. Age bands can be further grouped together to make them credible. The Normalized Method is the preferred credibility method and 3,007 deaths needed for full credibility.

2. The differentiation should make intuitive sense.

The actuary should be able to explain the connection between the age bands factor and the mortality result. Age bands does not seem to make sense to be a differentiating factor based on the information provided, as the mortality rate by count in <55 age band is higher than in the 55-74 age band, which is not intuitive to explain.

Given that the current data is lack of credibility and does not make intuitive sense, we conclude that it does not support adding age bands as a new factor.

- (c) Propose changes to the current data and/or process so that joint life mortality can be studied separately from single life mortality.

**Commentary on Question:**

*Candidates generally answered this part of the question well. Most candidates considered a few issues of mortality studies involving joint lives and proposed changes. Few candidates considered the choice of expected mortality or the application of mortality improvements.*

### 3. Continued

1. **First Death Reporting**  
Make sure the data is accurate and tracks the death of each individual life. This is usually tracked reasonably well for joint first to die (JFS) policies, because usually there's reduced payouts upon death of primary member. This approach may be impractical for joint last to die (JLS) policies if material number of first deaths are not reported.
2. **Choice of Expected Mortality**  
Due to the lack of multiple life industry studies, it is common practice to use single life mortality tables instead. The actuary should make sure the table selections are appropriate.
3. **Incidence of Substandard Lives**  
A significant number of joint last to die policies are issued with one substandard life. Therefore, joint last to die policies have a higher incidence of substandard lives than a single life portfolio. Consider adjusting equivalent single ages (may make tracking substandard experience difficult) or applying a rating to the single life mortality.
4. **Credibility**  
Refining data into credible subgroups is more difficult for joint last to die policies than for single life business. The early duration credibility for joint last to die business is significantly lower than a similarly sized block of single life policies due to the low probability of claim. So, larger in-force blocks are needed relative to single life policies. In addition, the number of policy combinations is much larger than single life business.
5. **Use of Approximations**  
Exercise caution when using an expected table developed using the equivalent single age or the joint equivalent age method. Using equivalent single age approach for joint last to die policies will show very favourable experience in early durations but unfavorable experience for latter durations. Determine if any approximations would be needed, especially given credibility concerns.
6. **Application of Mortality Improvements**  
Determine how/if single life mortality improvement will be applied and use caution in application of single life mortality improvement factors to joint last to die claim experience.

### 3. Continued

- (d)
- (i) List factors that should be considered when setting an appropriate level of aggregation across insurance products.

**Commentary on Question:**

*Candidates generally answered this part of the question well.*

When considering an appropriate level of aggregation for different insurance products, the actuary would consider different factors such as

- the plan of insurance and benefits provided
- the socioeconomic profile of the insureds
- the insurer's underwriting practice for the plan of insurance
- the age distribution
- the country of issue and residence
- the insurer's distribution system and other marketing practice

The structure and impact of any reinsurance arrangement would not be a reason alone to differentiate between products with a similar profile.

- (ii) ABC Life has grouped its business into death sensitive and death supported blocks. The change in liabilities of applying the margin without diversification to the base mortality improvement rates for each block of business are shown below:

Age band	Scenario 1: Mortality improvement rate reduced by margin for adverse deviation	Scenario 2: Mortality improvement rate augmented by margin for adverse deviation
<55 death sensitive	+1000	-400
<55 death supported	-1200	+700
55-74 death sensitive	+1600	-800
55-74 death supported	-900	+1100
75+ death sensitive	+1700	-1400
75+ death supported	-1300	+900

Calculate the minimum margin for adverse deviation for base mortality improvement rates allowed after reflecting diversification between death supported and death sensitive blocks of business. Justify your answer and show all work.

### 3. Continued

**Commentary on Question:**

*To receive full credit, candidates had to calculate the diversification factor to show that it is within the range of diversification benefits permitted. Candidates generally received partial credit for correctly calculating the margin with diversification benefits for each age band.*

The resulting impact of adding or deducting the margin for adverse deviations adjusted for diversification to the base mortality improvement rates for purposes of determining the minimum valuation assumption, would be to increase liabilities by an amount at least as high as the maximum of (increase in liabilities on the death sensitive blocks of business, increase in liabilities on the death supported blocks of business) using the margin for adverse deviations without diversification for each age group.

Age Band <55: Maximum of (+1000, +700) = +1000

Age Band 55-74: Maximum of (+1600, +1100) = +1600

Age Band 75+: Maximum of (+1700, +900) = +1700

Margin with diversification = 1000 + 1600 + 1700 = 4300

Margin with no diversification = 1000 + 700 + 1600 + 1100 + 1700 + 900 = 7000

Diversification Factor =  $1 - \text{Margin with diversification} / \text{Margin with no diversification} = 1 - 4300/7000 = 39\%$ , which is within the range of diversification benefits permitted.

Diversification factors would be between 0% and 50% of the margin for adverse deviations and would not be higher than 50%.

Therefore, the minimum margin for adverse deviation for base mortality improvement rates allowed after reflecting diversification between death supported and death sensitive blocks of business is 4300.

#### 4. Learning Objectives:

2. The candidate will understand the professional standards addressing IFRS 17 financial reporting and valuation.

#### Learning Outcomes:

- (2a) The Candidate will be able to describe, apply and evaluate the appropriate IFRS 17 accounting and valuation standards for life insurance products.

#### Sources:

CIA Educational Note: Selective Lapsation for Renewable Term Insurance Products, Feb 2017

#### Commentary on Question:

*This question tested the candidates' knowledge on the impact of lapsation on mortality.*

#### Solution:

- (a) With regard to the "Selective Lapsation for Renewable Term Insurance Products" note:
  - (i) Describe the general approach used by the Dukes-MacDonald selective lapsation model to reflect mortality deterioration.
  - (ii) Describe why each of the following factors must be considered when setting a mortality deterioration assumption:
    - Skewness of lapses
    - Shape of the underlying mortality table
    - Death during the grace period

#### Commentary on Question:

*For part (i) candidates generally were able to identify that (1) the approach tracks lapse and persistent cohorts which can be further segmented into select or average mortality, and (2) the model is based on knowing the underlying lapse rates.*

*For part (ii) candidates generally identified that the factors must be considered when setting a mortality deterioration assumption but did not provide sufficient justification.*

- (i) The general approach used by Dukes-MacDonald selective lapsation model to reflect mortality deterioration:
  - Keep track of notional cohorts that lapse and those that persist; (e.g. cohorts may be described by various names: Total, Underlying, Select, Average, Residual/Persisting)
  - Further segment the notional cohorts that lapse into those with select mortality or average (i.e., attained age) mortality

## 4. Continued

- Apply the principle of conservation of deaths to the cohorts to solve for the mortality of the residual persisting
- Are based on underlying base mortality tables that do not contain experience from products exhibiting high period between premium increases
- Are based on knowing the underlying lapse rates (i.e., lapses consistent with the base mortality table)
- Decrement the cohorts at their respective mortality rates and at the underlying lapse rates
- Assume no grace period
- Assume that all lapses other than the underlying lapses occur just prior to the end of the policy year
- Excess mortality grades to nil after the select period of the base table

(ii)

### Skewness of Lapses:

- All methods assume excess lapses occur at the end of the policy year
- In reality, some of the excess lapses will occur at the beginning of the following policy year
- The consequence is that the mortality in the following year is likely understated

### Shape of the underlying mortality table:

- The run-off pattern of the excess mortality is dependent on the shape of the underlying mortality table
- An unusual run-off pattern is possible if there are discontinuities in the underlying table

### Death during the grace period:

- The policy remains in effect for a grace period after the last premium is paid
- 'Free' life insurance coverage is provided during the grace period
- Deaths during the grace period is of more concern when lapse rates are high

(b) You are given the following for policy year 11:

<b>Total Lapse rate</b>	85%
<b>Underlying lapse rate</b>	5%
<b>Selective proportion</b>	80%
<b><math>G(t)^1</math> (Grading period)</b>	15 years
<b>R (mortality level parameter)</b>	0.4
<b><math>G(1)</math></b>	1

## 4. Continued

Assume the best estimate mortality assumption is 100% of the CIA 97-04 table (as given in the Excel spreadsheet for select ages and durations). Further assume there are no Margins for Adverse Deviations (MfADs) and no mortality improvement.

Calculate the expected mortality rate in policy year 11 for a policy issued to a Male Non-Smoker Age 45 for each of the following methods:

- (i) VTP 2
- (ii) Dukes-MacDonald 1
- (iii) Dukes-MacDonald 2
- (iv) Becker-Kitsos

Show all work.

### **Commentary on Question:**

*Candidates generally did not do well on this part of the question. Few candidates demonstrated understanding of the different methods or how to apply the general formula to derive the different methods.*

Select lapse (S)

$$\begin{aligned} &= (\text{Total Lapse Rate} - \text{Underlying Lapse Rate}) \times \text{Selective Proportion} \\ &= (85\% - 5\%) \times 80\% = 64\% \end{aligned}$$

Average lapse (A)

$$\begin{aligned} &= \text{Excess Lapse} - \text{Select Lapse} \\ &= (\text{Total Lapse Rate} - \text{Underlying Lapse Rate}) - \text{Select Lapse} \\ &= (85\% - 5\%) - 64\% = 16\% \end{aligned}$$

For each technique, determining the correct usage of the selective / average / ultimate parameters.

General formula:  $((1-A-U) \cdot q_{[x+t]} - S \cdot q_{[x]+t}) / (1-A-U-S)$

$$q_{[x+t]} = 2.14$$

$$q_{[x]+t} = 0.87$$

- (i) VTP2 = 6.204  
Only use 'A' and 'S'
- (ii) Dukes-MacDonald 1 = 7.559  
All parameters are used

## 4. Continued

(iii) Dukes-MacDonald 2 = 4.762  
Only use 'S' and 'U'

(iv) Becker-Kitsos = 3.713

Use 'S' and 'U', introduce 'R' factor, additional mortality

$$R = 0.4$$

$$G(t) = 15$$

$$\begin{aligned} \text{Additional mortality adjustment} &= 1 * R * (q_{[x+t]} - q_{[x]+t})/q_{[x]+t} \\ &= 1 * 0.4 * (2.14 - 0.87)/0.87 \end{aligned}$$

Expected Mortality Rate

$$= ((1-U)*q_{[x+t]} - S*q_{[x]+t}*(1+\text{Add. Mort Adj}))/((1-U-S))$$

## 5. Learning Objectives:

1. The candidate will understand and apply pre-IFRS 17 valuation principles to individual life insurance and annuity products issued by Canadian life insurance companies.

### Learning Outcomes:

- (1a) The Candidate will be able to:
- Compare and apply methods for life and annuity product reserves
  - Evaluate, calculate, and interpret liabilities
  - Recommend and justify appropriate valuation assumptions

### Sources:

CIA Educational Note: Investment Assumptions Used in the Valuation of Life and Health Insurance Contract Liabilities, Sep 2015

Final Communication of Updated Promulgations of the Ultimate Reinvestment Rates and Calibration Criteria for Stochastic Risk-Free Interest Rates (July 2019)

### Commentary on Question:

*This question tested the candidates' knowledge of CALM.*

### Solution:

- (a) Explain the approach used by the Actuarial Standards Board (ASB) to set the ultimate reinvestment rates for the purposes of projecting CALM scenarios.

#### Commentary on Question:

*Few candidates were able to identify the key points, and most candidates did not consider the proposed promulgation criteria.*

- Ultimate risk-free rates were developed to be consistent with a range of risk-free rates which meet the proposed promulgation criteria.
  - URR median set using median value of observed one-year and 20-year maturity values.
  - URR low and high rates were set using distribution of yields generated by a stochastic model that meet the proposed promulgation criteria.
- (b) Determine the net credit spread after margins for each asset for the following durations, where duration 0 is the valuation date. Show all work.
- (i) Duration 0
  - (ii) Duration 5
  - (iii) Duration 30

## 5. Continued

### **Commentary on Question:**

*Candidates generally did well on this part of the question. Common errors included not applying the reduction of margin and using the same credit spread for all durations.*

For both assets:

- Best estimate at valuation date remains unchanged
- Best estimate at duration 5 reduced by 10% (credit spread)

For asset A:

Net margin at all durations reduced by 9 bps (asset default = 6 bps \* 150%)

No change after duration 5 since the net spread is below 80 bps

Therefore

Duration 0:  $50 - 9 = 41$

Duration 5:  $60 * (1 - 10\%) - 9 = 45$

Duration 30:  $60 * (1 - 10\%) - 9 = 45$

For asset B:

Net margin at all durations reduced by 30 bps (asset default = 20 bps \* 150%)

No change after duration 5 since the net spread is below 80 bps

Therefore

Duration 0:  $140 - 30 = 110$

Duration 5:  $120 * (1 - 10\%) - 30 = 78$

Duration 30:  $120 * (1 - 10\%) - 30 = 78$

- (c) Identify steps necessary to construct a forward yield curve from a par yield curve, including any relevant inputs that will be needed.

### **Commentary on Question:**

*Most candidates were able to touch on some of the steps needed, but few were able to cover all steps with enough details.*

The steps necessary to construct a forward yield curve from a par yield curve are as follow:

- External input - long duration URR median
- Interpolate the par yield curve for durations where yields are not stated
- Derive the equivalent spot rates
- Calculate an adjusted spot rate by interpolating from duration 20 to the long URR median at duration 80

## 5. Continued

- Determine the implied forward spot rates
  - Determine the equivalent implied forward par yields
- (d) Determine if these rates meet each of the following calibration criteria, consistent with the requirements in the CIA Standards of Practice:

Percentile		Short term	Long term	Slope
10%		1%	4%	1%
90%		4%	5%	2%

Show all work.

### Commentary on Question:

*Candidates generally did well on this part of the question. In general, candidates that did not do well on this part of the question miscalculated the 10<sup>th</sup> and 90<sup>th</sup> percentiles, or did not calculate the slope.*

Scenario #	A Short term	B Long term	B - A Slope
1	2.00%	3.00%	1.00%
2	3.00%	3.50%	0.50%
3	5.00%	6.00%	1.00%
4	4.50%	5.00%	0.50%
5	6.00%	6.50%	0.50%
6	2.50%	4.00%	1.50%
7	4.00%	5.50%	1.50%
8	1.00%	1.50%	0.50%
9	3.20%	4.50%	1.30%
10	4.00%	4.50%	0.50%
11	4.30%	4.00%	-0.30%

For the left side, where the ‘True’ conclusion represents that the observed value is less than or equal to criteria

10 <sup>th</sup> percentile	Short term	Long term	Slope
Observed	2.00%	3.00%	1.00%
Criteria	1.00%	4.00%	1.00%
Conclusion	FALSE	TRUE	TRUE

## 5. Continued

For the right side, where the 'True' conclusion represents that the observed value is greater than or equal to criteria

<b>90<sup>th</sup> percentile</b>	Short term	Long term	Slope
<b>Observed</b>	5.00%	6.00%	1.50%
<b>Criteria</b>	4.00%	5.00%	2.00%
<b>Conclusion</b>	TRUE	TRUE	FALSE

## 6. Learning Objectives:

2. The candidate will understand the professional standards addressing IFRS 17 financial reporting and valuation.
3. The candidate will understand Canadian taxation applicable to life insurance companies and products.

## Learning Outcomes:

- (2a) The Candidate will be able to describe, apply and evaluate the appropriate IFRS 17 accounting and valuation standards for life insurance products.
- (3a) The Candidate will be able to describe and apply the taxation regulations applicable to Canadian life insurance companies and life insurance products.

## Sources:

CIA Educational Note: IFRS 17 Coverage Units for Life and Health Insurance Contracts, Dec 2019

International Actuarial Note 100: Application of IFRS 17

CIA Educational Note: Comparison of IFRS 17 to Current CIA Standard of Practice, Sept 2018

## Commentary on Question:

*This question tested the candidates' knowledge of IFRS 17. Candidates generally understood the concepts of the CSM, and were able to calculate the profits under two methods and provided appropriate recommendation.*

## Solution:

- (a) Calculate the profit or loss recognized through the CSM every year using each of the following approaches:
  - (i) Simple sum of contractual coverages
  - (ii) Notional CSM

Show all work.

## Commentary on Question:

*Candidates generally showed a better understanding of part (i) than part (ii). Common mistakes include omitting the element of interest in the calculation of CSM and omitting  $tPx$  in the calculation of current service. For part (ii), some candidates had trouble with the Notional CSM method and did not calculate the CSM by the Whole Life and CI rider separately, and instead combined them at the beginning instead. Few candidates received the full credit since they did not calculate the profit & loss recognition.*

## 6. Continued

Simple sum of Contractual Coverages								
Year	1	2	3	4	5	6	7	8
Coverage	110,000	110,000	110,000	110,000	110,000	100,000	100,000	100,000
tPx	1.0000	0.9500	0.9030	0.8570	0.8150	0.7740	0.7350	0.6980
Current Service	110,000	104,500	99,330	94,270	89,650	77,400	73,500	69,800
Current + future se	718,450	608,450	503,950	404,620	310,350	220,700	143,300	69,800
<b>CSM amort factor</b>	15.3%	17.2%	19.7%	23.3%	28.9%	35.1%	51.3%	100.0%
CSM1 (CI Rider)	100							
CSM2 (WL)	500							
Opening CSM	600	523.38	446.50	369.24	291.71	213.67	142.90	71.69
i CSM	18	15.70	13.39	11.08	8.75	6.41	4.29	2.15
<b>CSM Amortized</b>	94.62	92.59	90.65	88.61	86.79	77.18	75.49	73.84
<b>P&amp;L Recognised</b>	76.62	76.88	77.25	77.53	78.04	70.77	71.21	71.69
Ending CSM	523.38	446.50	369.24	291.71	213.67	142.90	71.69	0.00
Notional CSM Approach								
<u>CI Rider</u>								
Coverage	10,000	10,000	10,000	10,000	10,000	-	-	-
tPx	1.0000	0.9500	0.9030	0.8570	0.8150			
Current Service	10,000	9,500	9,030	8,570	8,150			
Current + future se	45,250	35,250	25,750	16,720	8,150	-	-	-
<b>CSM amort factor</b>	22.1%	27.0%	35.1%	51.3%	100.0%			
CSM1	100							
Opening CSM	100	80.24	60.37	40.38	20.27			
i CSM	3	2.41	1.81	1.21	0.61			
<b>CSM Amortized</b>	22.76	22.27	21.81	21.32	20.88			
Ending CSM	80.24	60.37	40.38	20.27	0.00			
<u>Whole Life base policy</u>								
Coverage	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000
tPx	1.0000	0.9500	0.9030	0.8570	0.8150	0.7740	0.7350	0.6980
Current Service	100,000	95,000	90,300	85,700	81,500	77,400	73,500	69,800
Current + future se	673,200	573,200	478,200	387,900	302,200	220,700	143,300	69,800
<b>CSM amort factor</b>	14.9%	16.6%	18.9%	22.1%	27.0%	35.1%	51.3%	100.0%
CSM2	500							
Opening CSM	500	438.50	376.80	314.82	252.62	190.03	127.09	63.76
i CSM	15	13.15	11.30	9.44	7.58	5.70	3.81	1.91
<b>CSM Amortized</b>	76.50	74.86	73.29	71.64	70.17	68.64	67.14	65.67
Ending CSM	438.50	376.80	314.82	252.62	190.03	127.09	63.76	0.00
Total IFE	18.00	15.56	13.12	10.66	8.19	5.70	3.81	1.91
<b>Total CSMA</b>	99.26	97.13	95.09	92.96	91.05	68.64	67.14	65.67
<b>P&amp;L Recognised</b>	81.26	81.57	81.98	82.30	82.87	62.94	63.33	63.76
Total Ending CSM	518.74	437.17	355.19	272.89	190.03	127.09	63.76	0.00
<b>Difference in P&amp;L</b>	4.64	4.68	4.73	4.77	4.82	-7.83	-7.88	-7.93

- (b) Recommend an approach of coverage unit development for this in-force block based on the above result. Justify your answer.

### Commentary on Question:

*Candidates generally did well on this part of the question and were able to provide reasonable justification.*

Notional CSM is recommended because profit recognition associated with the rider is more closely related to the coverage period of the CI rider; otherwise, CI profits are deferred to years after CI rider has expired.

## 7. Learning Objectives:

2. The candidate will understand the professional standards addressing IFRS 17 financial reporting and valuation.

### Learning Outcomes:

- (2a) The Candidate will be able to describe, apply and evaluate the appropriate IFRS 17 accounting and valuation standards for life insurance products.

### Sources:

CIA Educational Note: IFRS 17 Discount Rates for Life and Health Insurance Contracts, Jun 2020

CIA Educational Note: IFRS 17 Risk Adjustment for Non-Financial Risk for Life and Health Insurance Contracts, Jul 2019

### Commentary on Question:

*This question tested the candidates' knowledge of IFRS 17.*

### Solution:

- (a) You are given the following reference portfolio:

As at December 31, 2023	5-Year Corporate Bond	5-Year NHA Mortgage-Backed Securities
Fair Market Value	600	200
Asset Spread	1.20%	0.50%
Expected Credit Loss Experience	0.15%	0.00%
2023 Credit Loss Experience	0.23%	0.00%

The risk-free rate as at December 31, 2023 is 2.0%.

- (i) List the advantages and disadvantages in using a reference portfolio to determine the IFRS 17 discount rates.
- (ii) Calculate the IFRS 17 discount rate on December 31, 2023 using a top-down approach. Explain your approach.
- (iii) Calculate the IFRS 17 discount rate on December 31, 2023 using a bottom-up approach. Explain your approach.

### Commentary on Question:

*For the top-down approach, common mistakes included (i) calculating the discount rate using only the Corporate Bond yield instead of blending the Corporate bond and NHA NBS based on their fair market value in the reference portfolio; and (ii) calculating the adjusted spread above risk-free rate based on the reference portfolio and not adding the risk-free rate back to the discount rate.*

## 7. Continued

- (i) **Advantages** in using a reference portfolio to determine the IFRS 17 discount rates:
- Using a reference portfolio makes the construction of discount rate curves operationally simpler.
  - Separation between insurance contract reference portfolio and actual asset portfolios, easier to make adjustments to align liquidity.
  - Actual trading activity will not affect the discount rates.

**Disadvantages** in using a reference portfolio to determine the IFRS 17 discount rates:

- Can increase earnings and/or balance sheet volatility if there are differences between underlying assets held and the custom reference portfolio.

- (ii) **Top-Down method:** Gross yield is calculated based on the reference portfolio provided. The gross yield is then adjusted by removing factors not relevant to the insurance contracts such as credit spread, and market risk adjustment if non-fixed income assets are included in the reference portfolio. The reference portfolio must reflect the characteristics of the insurance contracts.

Credit spread needs to be calculated using Credit Loss Model approach. Since no non-fixed income assets are included in the reference portfolio, market risk adjustment is not required for this reference portfolio.

Credit spread calculation:

- Expected Credit Loss is provided  
ECL (Corporate Bond) = 0.15%  
ECL (NHA NBS) = 0.00%
- Unexpected Credit Loss  
Assume a 100% margin (or any other margin the candidate chooses that is reasonable).  
UCL (Corporate Bond) = 0.15% \* 100% = 0.15%  
UCL (NHA NBS) = 0.00%

IFRS 17 discount rate based on the reference portfolio is then calculated by blending the adjusted yields of the Corporate Bond and the NHA NBS by the fair MV.

$$= \frac{600}{600+200} \times (2.0\% + 1.2\% - 0.15\% - 0.15\%) + \frac{200}{600+200} \times (2.0\% + 0.5\%)$$

$$= 2.80\%$$

## 7. Continued

- (iii) **Bottom-Up method:** Start with the risk-free rates and add back a liquidity premium. The liquidity premium can be determined using a market-based approach.

Since the NHA MBS provided has no credit risk and has the same duration as the liability, it can be used to determine the liquidity premium.

Liquidity premium = spread over risk free rate = 0.5%

Therefore, the discount rate = risk-free rate + liquidity premium = 2% + 0.5% = 2.5%

- (b) You are given the following Standard Normal Cumulative Probability Table.

<b>z</b>	0.000	0.253	0.526	0.842	1.282
<b>P(Z ≤ z)</b>	0.5	0.6	0.7	0.8	0.9

- (i) Calculate the best estimate benefit claim cost at issue. Show all work.
- (ii) It has been determined that the new universal life insurance product will be reinsured by DDT Re on a yearly renewable term basis. DDT Re has priced the reinsurance premium using its lower mortality experience and lower income tax rates relative to BMS Life. DDT Re uses the same discount rate as BMS Life.

Critique each of the following statements:

- A. *BMS Life's fulfillment cash flows reflect DDT Re's lower mortality assumption and lower income tax.*
- B. *BMS Life measures the direct contract and the reinsurance contract using the variable fee approach. DDT Re measures the reinsurance contract using the premium allocation approach.*
- C. *BMS Life's risk adjustment reflects DDT Re's counterparty risk.*
- D. *DDT Re will have a longer contract boundary than BMS Life due to DDT Re's lower mortality assumption.*

## 7. Continued

### Commentary on Question:

*This part of the question tested the candidates' understanding of the fulfillment cash flows. Most candidates were able to calculate the Risk Adjustment using the correct confidence level.*

*Common errors in the critiques include the following:*

- *Not commenting on whether income tax should be reflected in FCF or not.*
- *Agreeing that DDT Re can model the reinsurance contract using PAA due to YRT contract.*
- *Identifying counterparty risk as a financial risk.*

- (i) With a 80% confidence level, from the standard Normal Table, find  $P(Z \leq 0.8) = 0.842$

$$\text{Therefore, Risk Adjustment (RA)} = \sigma (\text{benefit payment}) \times P(Z \leq 0.8) = \sqrt{3000} \times 0.842 = 46.12$$

$$\text{PV (FCF)} = \text{RA} + \text{PV (Benefits)} - \text{PV (Premiums)}$$

$$\begin{aligned} \text{Given that the premium margin} &= 12\%, \\ \text{PV (Premiums)} &= 1.12\% \times (\text{RA} + \text{PV (Benefits)}) \end{aligned}$$

Therefore,

$$\begin{aligned} \text{PV (FCF)} &= \text{RA} + \text{PV (Benefits)} - \text{PV (Premiums)} \\ &= (\text{RA} + \text{PV (Benefits)}) - 1.12\% \times (\text{RA} + \text{PV (Benefits)}) \\ &= -0.12\% \times (\text{RA} + \text{PV (Benefits)}) \end{aligned}$$

$$\text{PV (FCF)} = -125, \text{RA} = 46.12$$

Therefore,

$$-125 = -0.12\% \times (46.12 + \text{PV (Benefits)})$$

$$\text{PV (Benefits)} = 995.55$$

- (ii) A: This is incorrect. The fulfillment cash flows for the direct and reinsured portions of the block should be modelled separately under IFRS 17. BMS should reflect its own mortality assumptions in the direct FCF. The reinsurance premium will be lower reflecting the reinsurer's lower mortality experience. Income tax should not be reflected in FCF.

## 7. Continued

B: This is incorrect. Reinsurance contract should not be modelled using variable fee approach. BMS's direct contract may be modeled using VFA provided the criteria for using VFA are met. DDT Re should use general model since this is a long-term contract. Note that the fact that the reinsurance contract is on a yearly renewable term does not mean this is a short-term contract.

C: This is correct.

D: This is incorrect. Contract boundary is the period when there are substantive rights and obligations exist between the reinsurer and BMS. Contract boundary is not determined by the experience of the reinsurer. The boundary of a reinsurance contract held is the same as the boundary of the corresponding reinsurance contract issued.

## 8. Learning Objectives:

2. The candidate will understand the professional standards addressing IFRS 17 financial reporting and valuation.

### Learning Outcomes:

- (2a) The Candidate will be able to describe, apply and evaluate the appropriate IFRS 17 accounting and valuation standards for life insurance products.

### Sources:

LFM-649-20: International Actuarial Note 100: Application of IFRS 17 (excluding section C: Ch.11 & section D)

CIA Educational Note: Comparison of IFRS 17 to Current CIA Standards of Practice, Sep 2018

LFM-141-18: IFRS 17 Insurance Contracts – IFRS Standards Effects Analysis, May 2017, IASB (sections 1, 2, 4 & 6.1-2 only)

LFM-656-21: PwC - In transition: The latest on IFRS 17 implementation, Feb 2020

LFM-655-21: IFRS Standards Exposure Draft Amendments to IFRS 17, Jun 2019

### Commentary on Question:

*This question tested candidates' understanding of reporting concepts for IFRS 17 and the differences compared with current IFRS 4.*

### Solution:

- (a) Explain the difference in the profit emergence for life insurance contracts under IFRS 4 and IFRS 17.

#### Commentary on Question:

*Candidates generally did well on this part of the question. Most candidates were able to explain the difference in the profit emergence under IFRS 4 and IFRS 17 to receive full credits.*

Under IFRS 17, insurance entity is required to hold unearned profit in CSM and realized it over service provided period. Profit emergence under IFRS 17 is smoother compared with IFRS 4. The changes in estimation of future cashflows will flow through CSM adjustment before hitting income.

For IFRS 4, entities recognize new business gain or profit at inception and income from subsequent period from the release of PfADs. The experience variances and assumption updates are recognized right away.

## 8. Continued

- (b) Explain whether the variable fee approach (VFA) can be used as the measurement approach under IFRS 17 for each of the following contracts:
- (i) Whole life with critical illness riders
  - (ii) Payout variable annuities
  - (iii) Segregated funds with guaranteed minimum income benefits
  - (iv) Coinsurance contract on a participating life closed block

**Commentary on Question:**

*Candidates generally did well on this part of the question. Candidates that did not provide any justification did not receive credit. A common error for part (iv) was providing judgement based on qualification of Par block instead of a coinsurance contract.*

- (i) No  
There is no direct participation in underlying investments for this product
- (ii) Yes, if the payment is based on underlying pool of investments participated by the policyholders with DPF involved.

Candidates answered No with validated explanation (ex. no clear information if the payment is fixed or varied with market movement with DPF involved) also received full credits.

- (iii) Yes  
The product meets all three VFA criteria
  1. The contractual terms specify that the policyholder participates in a share of a clearly identified pool of underlying items
  2. The entity expects to pay to the policyholder an amount equal to a substantial share of the fair value returns from the underlying items
  3. The entity expects a substantial proportion of any change in the amounts to be paid to the policyholder to vary with the change in fair value of the underlying item
- (iv) No  
Reinsurance contracts never use VFA under IFRS 17. The general measurement model or Premium Allocation Approach are used for reinsurance contracts.

## 8. Continued

- (c) A 3-year term-life contract will be issued on January 1<sup>st</sup>, 2023. The following expected cash flows are provided:

<b>Year</b>	<b>1</b>	<b>2</b>	<b>3</b>
<b>Premium (Beginning of year)</b>	300,000	290,000	280,000
<b>Claims (End of year)</b>	200,000	210,000	220,000
<b>Risk Adjustment at beginning of year</b>	260,000	170,000	90,000

The discount rate is 3%.

- (i) Calculate the contractual service margin or loss component at issue as appropriate. Show all work.
- (ii) The company implements an assumption change at the end of first year and reflects those changes to its CSM or loss component for the current reporting period. You are given the following revised information for this policy as at the end of year 1:

<b>Year</b>	<b>1</b>	<b>2</b>	<b>3</b>
	<b>Actual</b>	<b>Expected</b>	<b>Expected</b>
<b>Premium (Beginning of year)</b>	300,000	285,000	275,000
<b>Claims (End of year)</b>	150,000	200,000	210,000
<b>Risk Adjustment at beginning of year</b>		170,000	90,000

Rollforward the contractual service margin or loss component from beginning of year 1 to the end of year 1. Show all work.

- (iii) Determine the Year 1 Statement of Profit and Loss in the format below for this contract based on the information you calculated. Assume the insurance service result and insurance finance expense for risk adjustment are not disaggregated. Assume all assets backing this contract are in cash. Show all work.

<b>Statement of Profit and Loss</b>	<b>Year 1</b>
Insurance Revenue	
Insurance Service Expense	
Total Insurance Service Result	
Total Insurance Finance Expense	
Total Net Income before tax	

## 8. Continued

### **Commentary on Question:**

*Part (i) of the question tested candidates' understanding of CSM or Loss Components calculation under IFRS 17. Candidates generally did well on this part of the question. Candidates were required to conclude the contract was onerous to receive full credit.*

*Part (ii) of the question tested candidates' understanding of the Roll Forward (RF) of Loss Component (LC) under IFRS 17. Candidates were generally unable to identify that the RF for onerous contracts was based on systematic allocation method instead of amortization method under CSM. Most Candidates were able to calculate the assumption changes from future projection years and applied the impact accurately in LC RF to receive partial credit. Partial credit was received if candidates identified the LC was floored at zero and changed to CSM at the end of the period.*

*For part (iii) candidates were generally able to identify and calculate the insurance revenue as expected claim and release of risk adjustment, and insurance service expense as actual claim to receive partial credits. The solution provided below was based on no CSM amortization in the P&L statement. Candidates that appropriately amortized the CSM from part (ii) received full credit. Candidates generally did not consider the loss component allocation and reversal of losses due to assumption change in the P&L statement.*

(i)

<b>PV of Premium</b>	845,480
<b>PV of Claims</b>	593,451
<b>PV of Best Estimate CF</b>	-252,029
<b>PV of Fulfilment CF</b>	7,971

$$\text{PV of Premium} = 300,000 + 290,000/1.03 + 280,000/(1.03^2) = 845,480$$

$$\text{PV of Claims} = 200,000/1.03 + 210,000/1.03^2 + 220,000/1.03^3 = 593,451$$

$$\text{BEL (Best Estimate Liability)} = \text{PV of Claims} - \text{PV of Premium} = -252,029$$

$$\text{FCF} = \text{Risk Adjustment} + \text{BEL} = 260,000 + (-252,029) = 7,971$$

The CSM is negative of FCF and floor at 0. It is an onerous contract at initial recognition, with a loss component of 7,971

## 8. Continued

(ii)

### **Loss Component Rollforward**

Loss Component opening balance	7,971
Loss Component Allocation: Interest	13
Loss Component Allocation: Expected Claims	(1,868)
Loss Component Allocation: Risk Adjustment	(841)
Loss Component after Allocation	5,276
Changes in estimates of PV of future CF	(9,280)
<b>LC closing balance</b>	-
<b>CSM</b>	4,005

Loss Component is based on systematic allocation factor which is initial loss component divided by total of future liability CFs and Risk Adjustment (*Other Systematic Allocation methods used by candidates received full credit.*)  
 $= 7971 / (593,451 + 260,000) = 0.00934$

Loss Component Allocation for Interest is the whole amount of insurance finance expense related to the liability for remaining coverage = (The estimates of the present value of the future cash flows on initial recognition + the cash inflows received at the beginning of Year 1) \* the current discount rate \* Loss Component Allocation Percentage =  $(-252,029 + 300,000) * 3% * 0.934% = 13$

Loss Component Allocation for Expected Claims which is the release of expected insurance service expense for the incurred claims for the year = Expected Claim \* Loss Component Allocation Percentage =  $-200,000 * 0.934% = -1,868$

Loss Component Allocation for Risk Adjustment which is change in the risk adjustment for non-financial risk caused by the release from the risk = Risk Adjustment Release \* Loss Component Allocation Percentage =  $(170,000 - 260,000) * 0.934% = -841$

The sum of 1868 and 841 as 2,708 is the total loss component runoff included in the RF.

Loss Component after Allocation = Loss Component opening balance + Loss Component Allocation for Interest + Loss Component runoff =  $7,971 + 13 + (-2708) = 5,276$

## 8. Continued

Assumption Change impact = PV of Best Estimate Cash Flow at time 1 post assumption change – PV of Best Estimate Cash Flow at time 1 before assumption change =  $-159,870 - 150,590 = -9,280$

-159,870 for post change at time 1  
 = PV of Claims – PV of Premium  
 =  $(200,000/1.03 + 210,000/1.03^2) - (285,000 + 275,000/1.03)$

150,590 for pre change at time 1  
 = PV of Claims – PV of Premium  
 =  $(210,000/1.03 + 220,000/1.03^2) - (290,000 + 280,000/1.03)$

The changes in estimates of PV of future CF = (9,280), this would reverse the Loss Component of 5,276 to 0, then establish a CSM of  $-(9,280) + 5,276 = 4,005$ . (*Candidates who further amortized this CSM in the period according to the Draft Amendments received full credit as well.*)

Therefore, the Loss Component closing balance = 0 and the CSM closing balance = 4,005

(iii)

Statement of P&L	Year 1
<b>Insurance Revenue</b>	
- Expected Claims after loss component allocation	197,292
- Change in the risk adjustment after loss component allocation	90,000
- CSM recognised in profit or loss for the services provided	-
<b>Total Insurance Revenue</b>	<b>287,292</b>
<b>Insurance Service Expense</b>	
- Incurred claims	(147,292)
- Losses on onerous contracts and reversal of those losses	5,276
<b>Total Insurance Service Expense</b>	<b>(142,016)</b>
<b>Total Insurance Service Result</b>	<b>145,276</b>
<b>Insurance Finance Expenses</b>	<b>(1,439)</b>
<b>Total Net Income Before Tax</b>	<b>143,837</b>

## 8. Continued

### Insurance Revenue

- Expected Claims after loss component allocation = Expected Claims – Loss Component Runoff calculated from ii) =  $200,000 - 2,708 = 197,292$
- Change in the risk adjustment after loss component allocation =  $260,000 - 170,000$  which is the release of the risk adjustment in year 1.
- CSM recognised in profit or loss for the services provided = 0

### Insurance Service Expense

- Incurred claims = Actual Claims – Loss Component Runoff calculated from ii) =  $150,000 - 2,708 = 147,292$
- Losses on onerous contracts and reversal of those losses = 5,276, from part (ii)

Total Insurance Service Result = Insurance Revenue + Insurance Service Expense, where the Insurance Service Expense is presented as a negative amount.

Insurance Finance Expenses = -(The estimates of the present value of the future cash flows on initial recognition + the cash inflows received at the beginning of Year 1) \* the current discount rate =  $-(252,029 + 300,000) * 3\% = (1,439)$

Risk Adjustment is not included as we assume the insurance finance expense for risk adjustment are not disaggregated.

Total Net Income Before Tax = Total Insurance Service Result + Insurance Finance Expenses, where the Insurance Finance Expenses is presented as a negative amount.

## 9. Learning Objectives:

3. The candidate will understand Canadian taxation applicable to life insurance companies and products.

### Learning Outcomes:

- (3a) The Candidate will be able to describe and apply the taxation regulations applicable to Canadian life insurance companies and life insurance products.

### Sources:

Canadian Insurance Taxation, 4th Ed: Chapter 10, The Taxation of Life Insurance Policies

Canadian Insurance Taxation, 4th Ed: Chapter 11, The Taxation of Annuities

### Commentary on Question:

*This question tested the candidates' knowledge of policyholder taxation of life and annuity products.*

### Solution:

- (a) Determine the amount of taxable income attributable to the policyowner upon surrender. Show all work.

### Commentary on Question:

*Candidates generally did well in calculating taxable Income. To receive full credit, candidates had to show the calculation of Proceeds of Disposition and Adjusted Cost Base as the components to calculate Taxable Income.*

Fund value = Previous fund value + premium + interest - cost of insurance

Fund value (2016) = 500 + 50 - 40 = 510

Fund value (2017) = 510 + 300 + 80 - 40 = 850

Proceeds of Disposition (POD) = CSV = Fund Value (2017) \* (1 - Surrender Charge) = 850 \* (1 - .01) = 842

Adjusted Cost Base (ACB) = Premiums - Net Cost of Pure Insurance (NCPI)  
(formula pg 148: Item 'B' - Item 'L')

Premiums = 500 + 300 = 800

NCPI = 35 + 40 = 75

ACB = 800 - 75 = 725

Taxable income on surrender = POD - ACB = 842 - 725 = 117

## 9. Continued

- (b) Ann purchased a deferred non-registered 10-year annuity certain in 1990. Her first monthly payment will be received soon. As the owner of the contract, she can vary the payment frequency and payment amount in any future year. There is no loan under the contract. Ann would like to keep her current taxable retirement income low.
- (i) Recommend a payment option for Ann. Justify your recommendation.
- (ii) List any restrictions that might apply for your recommendation.

### **Commentary on Question:**

*This part of the question tested the candidates' knowledge of taxation for Prescribed Annuity Contract treatment. Candidates generally demonstrated the understanding that accrued income is taxed on proportional basis for PAC but struggled to describe the benefits of electing this treatment. Full credit was received by listing four correct restrictions of Prescribed Annuity Contracts for part (ii).*

(i) Ann can elect Prescribed Annuity Contract (PAC) treatment on her annuity. Electing PAC treatment has two advantages in that a fixed portion of each retirement payment is taxable, and accrued income is, on average, taxed later than would be the case under the accrual method.

- In the accumulation period of an annuity, the accrued income is calculated as accumulating fund - adjusted cost basis on policy anniversary.

- The method of taxation during the payout period is generally the same as the method that applies during the accumulation period, unless the contract becomes PAC.

Accrual taxation applies to all annuities last acquired after December 2, 1982. The accrual method recognizes that for earlier annuity payments, there is a higher amount of invested principal earning interest and therefore a higher interest portion.

The result is that substantially higher amounts of income become subject to tax in the early years of the payout period of an annuity subject to the accrual rules. This is not a desirable result when annuity contract is being used to provide retirement income.

The accrued income is taxed on proportional basis for PAC.

- (ii)
- Cannot be a loan under the contract
  - Must have been purchased by a financial institution.
  - Annuitant must be an individual and not a trust
  - Must have equal payments at regular intervals. She may not be able to take advantage of the option to change frequency and amounts in future years
  - Must be in payout phase

## 10. Learning Objectives:

2. The candidate will understand the professional standards addressing IFRS 17 financial reporting and valuation.
4. The candidate will understand U.S. financial and valuation standards, principles and methodologies applicable to life insurance and annuity products.

### Learning Outcomes:

- (2a) The Candidate will be able to describe, apply and evaluate the appropriate IFRS 17 accounting and valuation standards for life insurance products.
- (4a) The Candidate will be able to describe U.S. valuation and capital frameworks, and explain their impact on the valuation of reserves, capital and financial statements.

### Sources:

LFM-149-21: Insurance Contracts, PwC (Accounting Guide for Insurance Contracts), 2019, (Sections 1.1, 3.5, 5.1-5.10; Figures IG 2-1, IG 2-2)

CIA Educational Note: IFRS 17 Discount Rates for Life and Health Insurance Contracts, Jun 2020

LFM-650-20 FASB in Focus - ACCOUNTING STANDARDS UPDATE NO. 2018-12 Targeted Improvements to the Accounting for Long-Duration Contracts Issued by Insurance Companies

### Commentary on Question:

*This question tested the candidates' knowledge of IFRS 17 and US financial reporting standards.*

### Solution:

- (a) Outline the ASU 2018-12 simplified DAC amortization model for insurance contracts classified as "long duration" under US GAAP.

### Commentary on Question:

*This part of the question tested the candidates' knowledge of simplified DAC. To demonstrate knowledge, candidates had to outline the simplified DAC amortization model, which requires a more thorough discussion of the provisions below, and not merely state what DAC amortization is. Candidates providing at least 4 of the items below received full credit.*

*Candidates generally provided only 1-2 of the items below. Most candidates understood that DAC is amortized using a straight-line basis. Some candidates noted that DAC must reflect actual experience, and that amortization cannot be a function of profit emergence.*

## 10. Continued

*Some candidates noted that no interest accrues on unamortized DAC, not subject to impairment or recoverability testing, or shadow DAC no longer exists under this model. However, since the question does not ask for a comparison between this guidance and the old guidance, no credit was received for these responses.*

The ASU 2018-12 simplified DAC amortization model for insurance contracts classified as “long duration” under US GAAP comprises of the following key concepts:

- **Deferred Acquisition Cost (DAC) is amortized using a straight-line basis** over the expected term of the related contracts.
  - **The amortization can be done on either at the individual level or grouped contract level.** The amortization may be done at the grouped contract level as long as it approximates straight-line amortization at an individual contract level. The grouping should likewise be consistent with the grouping used to estimate the liability for future policy benefits for the corresponding contracts.
  - **Assumptions used in the computation of DAC should be consistent with those used to determine the liability** for future policy benefits or related balances for associated contracts.
  - **Amortization amounts are not allowed to be a function of revenue or profit emergence.**
  - **DAC must reflect actual experience.** Unamortized DAC must be reduced for actual experience in excess of expected experience. Changes in future assumptions are applied by adjusting the amortization rate prospectively rather than through a retrospective catch-up adjustment.
  - **For deferred annuity contracts, expected term of the accumulation phase** is considered for DAC amortization. The payout phase should not be combined with the accumulation phase for this purpose.
- (b) Compare the IFRS 17 discount rate guidance with the ASU 2018-12 criteria for determining yield used in discounting the liability for future policy benefits.

### **Commentary on Question:**

*This part of the question requires comparisons between IFRS 17 and ASU 2018-12 guidance, which means exploring the similarities and differences between the two. To receive full credit, candidates had to provide at least 6 combined similarities and differences.*

*Most candidates provided differences between the two standards. Few candidates provided similarities. Candidates who attributed a particular item only to one of the standards but not both (e.g. “ASU 2018-12 reflect duration or timing characteristics”) received partial credit. Candidates generally recognized that both IFRS 17 and ASU 2018-12 require the use of observable current market inputs or prices.*

## 10. Continued

*Candidates were generally more successful identifying the differences. Most candidates noted that ASU 2018-12 explicitly prescribes Single A as the credit rating, while most candidates did not note that IFRS 17 has no such guidance. Most candidates recognized that IFRS 17 reflects the characteristics of the insurance contracts, including liquidity, and that ASU 2018-12 does not include a liquidity adjustment. Few candidates noted that IFRS 17 applied to products with varying cash flows, as well.*

*Several candidates noted that IFRS 17 provides a choice of disaggregating discount rate changes between P&L and OCI, while ASU 2018-12 only prescribes OCI for such changes. Partial credit was provided for this response.*

The **similarities** between the IFRS 17 discount rate guidance with the ASU 2018-12 criteria are as follows:

- Both **disconnect the discount rate from the underlying asset** or investment return or performance;
- Both require that the discount rate **reflect duration or timing** characteristics;
- Both require the use of **observable current market inputs or prices**;
- Both provide guidance on **extrapolating points on the yield curve beyond the observable period** or those with observable/active markets

The **differences** are as follows:

- IFRS 17 **does not include specific guidance** as to the credit rating or inherent risk in the discount rate, but ASU 2018-12 **explicitly prescribes** this (Single A interest yields);
- IFRS 17 **requires reflecting the liquidity characteristics of the insurance contract**, while ASU 2018-12 **does not include a liquidity adjustment**;
- IFRS 17 takes into consideration **more of the characteristics of the insurance contracts** (timing, currency, liquidity), whereas ASU 2018-12 only takes into consideration the **duration or timing**;
- IFRS 17 provides guidance for **products with varying cash flows** such as universal life contracts, while the updated ASU 2018-12 discount rate guidance applies only to **non-participating traditional insurance contracts**

- (c) Calculate the liability remeasurement loss which would be recorded in the year-end 2024 accounting entries. Show all work.

## 10. Continued

### **Commentary on Question:**

*This part of the question required candidates to apply their understanding of ASU 2018-12 in the computation of the liability remeasurement loss for a long duration contract liability.*

*The calculation can be broken down into three steps. Candidates generally received full credit for steps 1 and 2. Common mistakes for step 3 included utilization of the incorrect discount rate, using the present value at the start of year 3 instead of year 2, and misinterpreting the present values provided in the tables and attempting to re-calculate present values.*

*Candidates were required to demonstrate that changes in the discount rate flow through differently than changes in non-economic assumptions, and as such these calculations use the original locked-in discount rate of 3%. Candidates were penalized for using the revised 3.5% discount rate in the calculation.*

*There were no penalties for rounding or not, and credit was given for step 3 if errors from steps 1 or 2 were carried through properly.*

**Step 1: calculate original Net Premium Ratio** (3%, time 0, original assumptions)

Net Premium Ratio = (PV Benefits @ 3% at time 0) ÷ (PV Gross Premium @ 3% at time 0)

Net Premium Ratio = 432.44/661.57 = 65.4%

**Step 2: calculate Revised Net Premium Ratio** (3%, time 0, actual historical & revised future assumptions)

Revised Net Premium Ratio = (PV Actual Historical & Revised Future Benefits @ 3% at time 0) ÷ (PV Actual Historical & Revised Future Gross Premium @ 3% at time 0)

Revised Net Premium Ratio = 493.11/638.20 = 77.3%

**Step 3: PV to beginning of year 2 & calculate Liability Remeasurement Loss (LML)**

LML = [ (PV historical/revised benefits @ 3%) - (PV revised net premiums @ 3%) ]

less [ (PV original benefits @ 3%) - (PV original net premiums @ 3%) ]

## 10. Continued

PV revised net premiums @ 3% = (PV of year 2-4 historical/revised gross premium @ 3%) \* 77.3% = 469.59 \* 77.3% = 362.83

PV original net premiums @ 3% = (PV of year 2-4 original gross premium @ 3%) \* 65.4% = 488.59 \* 65.4% = 319.37

LML = (396.27 - 362.83) - (343.92 - 319.37) = 33.44 - 24.55 = 8.89

**The liability remeasurement loss recorded in the year-end 2024 accounting entries would be \$8.89.**

## 11. Learning Objectives:

1. The candidate will understand and apply pre-IFRS 17 valuation principles to individual life insurance and annuity products issued by Canadian life insurance companies.
5. The candidate will understand how to explain and apply the methods, approaches and tools of financial management in a life insurance company context.

### Learning Outcomes:

- (1a) The Candidate will be able to:
- Compare and apply methods for life and annuity product reserves
  - Evaluate, calculate, and interpret liabilities
  - Recommend and justify appropriate valuation assumptions
- (5a) The Candidate will be able to:
- Explain and apply methods in determining regulatory capital and economic capital
  - Explain and evaluate the respective perspectives of regulators, investors, policyholders and insurance company management regarding the role and determination of capital
  - Explain Canadian regulatory capital framework and principles
  - Explain and apply methods in capital management

### Sources:

LFM-632-12: OSFI B-3 Sound Reinsurance Practices and Procedures

LFM-645-19: OSFI Guideline – Life Insurance Capital Adequacy Test (LICAT), Chapters 1-11, October 2018

### Commentary on Question:

*This question tested the candidates' knowledge of reinsurance and LICAT.*

### Solution:

- (a) Critique the following statements with regards to Sound Reinsurance Practices and Procedures, as applicable to a Canadian federally regulated insurer:
- A. Senior management has delegated design and implementation of the reinsurance risk management policy to business line leaders.*
  - B. Business line leaders are responsible for oversight of the reinsurance risk management policy. Each business line leader assesses their operations against the reinsurance risk management policy and reports to senior management once every two years.*

## 11. Continued

- C. *Sufficient due diligence on registered reinsurer counterparties, where reinsurance treaties are already in place, is performed on an on-going basis. Due diligence includes an assessment of financial strength and capabilities of the reinsurance counterparty, supplemented with rating agencies assessments.*
- D. *Reinsurance contract language is as broad as needed to reasonably capture general reinsurance terms and conditions. The reinsurance contracts outline where the agreement may adversely affect the ceding company.*

### **Commentary on Question:**

*This part of the question tested the candidates' knowledge of Sound Reinsurance Practices and Procedures and to be able to apply and analyze in difference scenarios.*

*Statement A: Candidates generally knew that the statement was not correct. Some candidates were able to identify the role of senior management. Some confused the role of senior management with the role of the Board. Few candidates expanded on the reason why senior management cannot delegate to business line.*

*Statement B: Candidates generally knew that the statement was not fully correct. Most candidates identified that senior management should review the Reinsurance Risk Management Plan (RRMP) annually. Few candidates identified the responsibility of business line officers.*

*Statement C: Candidates generally knew that the statement was not fully correct. Most candidates identified that performing a sufficient level of due diligence is correct and were able to point out at least one of the places where the statement was not correct.*

*Statement D: Candidates generally did well critiquing this statement.*

Statement A: Not Correct. Delegating to business line will not support the following:

- Senior management should oversee the development and implementation of the reinsurance risk management policy.
- The reinsurance risk management policy (RRMP) should reflect the nature, scale and complexity of a federally regulated insurer's (FRI) business and have regard for its risk appetite and risk tolerance.
- The RRMP should document the significant elements of the FRI's approach to managing risks through reinsurance, including objectives, risk diversification objectives, risk concentration limits, ceding limits and practices & procedures for managing and controlling reinsurance risks.

## 11. Continued

- The FRI must address the adequacy & effectiveness of reinsurance to adequately address exposures to large and catastrophic losses.

Statement B: Partially Correct.

- Not correct: Senior management should oversee the reinsurance risk management policy.
- Not correct: Senior management is responsible for ensuring the RRMP is operationalized.
- Correct: Business line officers and managers are charged with the day-to-day responsibility of the RRMP.
- Not correct: At a minimum, senior management should review the RRMP annually. Every two years not sufficient.

Statement C: Partially Correct

- Perform a sufficient level of due diligence on its reinsurance counterparties on an on-going basis is correct.
- Not correct, as it should include regulated and nonregulated reinsurers.
- Not correct, as it should include current and prospective reinsurance counterparties.
- Correct: Business line officers and managers are charged with the day-to-day responsibility of the RRMP.

Statement D: Not correct

- Ensure the terms and conditions of the reinsurance contract provide clarity and certainty on coverage, instead of broadly set to cover general reinsurance terms and conditions.
- Ceding company should not be adversely affected by the terms and conditions of a reinsurance contract.

(b)

- (i) Calculate PBLI's LICAT Total Ratio before and after incorporating the reinsurance agreement with XYZ. Show all work.
- (ii) Recommend whether PBLI should pursue reinsurance with XYZ from a capital perspective.

### **Commentary on Question:**

*Candidates generally understood how to calculate the LICAT total ratio. Common errors include not recognizing the 1.05 factor was already embedded in the Base Solvency Buffer and incorrectly multiplying the ceded percentage onto available capital and/or surplus allowance.*

## 11. Continued

*Candidates generally understood that an increase in the total ratio strengthens the capital position which is a positive for the company.*

(i) LICAT Total Ratio before incorporating XYZ reinsurance agreement  
= (Available Capital + Surplus Allowance + Eligible Deposits) / Base Solvency Buffer  
= (530 + 50 + 0) / (500)  
= 116%

LICAT Total Ratio after incorporating XYZ reinsurance agreement  
= (Available Capital + Surplus Allowance + Eligible Deposits) / (Base Solvency Buffer after reinsurance)  
= (530 + 50 + 0) / (450)  
= 129%

(ii) The Total Ratio increased after incorporating XYZ reinsurance agreement. The reinsurance agreement helps to increase the LICAT Total Ratio, which will strengthen the capital position of the company. From capital perspective only, PBLI may consider pursuing reinsurance with XYZ with the benefit of capital relief.

(c) Describe key impacts of reinsurance to each of the following components of the LICAT Total Ratio, noting the difference between registered and unregistered reinsurance where applicable:

- (i) Available Capital
- (ii) Surplus Allowance
- (iii) Eligible Deposit
- (iv) Base Solvency Buffer

**Commentary on Question:**

*Candidates generally did not do well on this part of the question. Candidates earned full credit by demonstrating how reinsurance will impact each component and explaining the impact of registered vs. unregistered reinsurance,*

## 11. Continued

- (i) Available Capital
  - a. Gross Tier 1 asset is to deduct all requirements for liabilities ceded under unregistered reinsurance arrangements, net of any applicable credits.
  - b. Tier 2 asset includes all amounts deducted from Gross Tier 1 for negative reserves, offsetting policy-by-policy liabilities ceded under unregistered reinsurance arrangements, and aggregate negative reserves ceded under unregistered reinsurance arrangements.
  - c. Encumbered assets are impacted by the marginal capital requirement which is based on BSB calculated net of all reinsurance for both registered and non-registered reinsurance.
  - d. Negative reserves are calculated net of all reinsurance.
  - e. Marginal insurance risk requirement (MIRR) is calculated net of all reinsurance.
  - f. There's also a negative reserve adjustment for eligible YRT treaties, which goes to Tier 2 capital.
  - g. Tier 1 capital instruments issued by subsidiary may be included in the capital of parent insurer based on a third-party Share limit that is based on the Base Solvency Buffer net of all reinsurance (registered and non-registered).
  
- (ii) Surplus Allowance
  - a. Non-economic Provisions for Adverse Deviations (PfADs) are calculated net of registered reinsurance.
  - b. Economic PfADs for risk-free rates are calculated net of all reinsurance included in surplus allowance.
  
- (iii) Eligible Deposit
  - a. Under unregistered reinsurance, excess deposits placed by the reinsurer that can be applied against losses under a specific reinsurance agreement may be recognized as eligible deposit.
  - b. Examples of eligible deposits include claims fluctuation reserves, deposits, or loss positions retained by a ceding insurer that serve to reduce the assuming insurer's risk under a reinsurance agreement.
  - c. For registered reinsurance, there is no recognition of eligible deposit on excess deposits and claims fluctuation reserves.
  
- (iv) Base Solvency Buffer
  - a. Under registered reinsurance, all LICAT risk components are calculated net of reinsurance. For non-registered reinsurance, interest rate risk calculation is projected net of reinsurance.

## 11. Continued

- b. Reinsurance credit risk is calculated as 2.5% of reinsurance assets from a registered reinsurer factors applied to reinsurance receivables. Unregistered reinsurance gets a higher factor than registered reinsurance.
- c. There is some impact of reinsurance / unregistered on the currency risk.
- d. Operational Risk includes General required capital, which has a factor applied to other insurance risk components net of all reinsurance. There is also a 2.5% factor applied to ceded reinsurance premiums.
- e. Under a Modco agreement, or if the asset is secured by a collateral, or a LOC guarantee, then the asset credit risk may be transferred to the reinsurer.
- f. All impacts due to reinsurance will also flow into the calculation for aggregation and diversification of risk. Risk diversification credit is calculated net of registered reinsurance.