ILA LFVC Model Solutions
Fall 2018

1.

Learning Objectives:
3.   The candidate will understand and apply emerging financial and valuation standards, principles and methodologies.

Learning Outcomes:
(3a)   Describe, evaluate and calculate the impact on reserves, income, capital, and processes of emerging developments in Statutory and U.S. GAAP reporting, International Financial Reporting Standards, and Solvency Modernization.

Sources:
LFV-XXX-17: IFRS 17 Insurance Contracts – IFRS Standards Effects Analysis, May 2017, IASB

Commentary on Question:
This question tested the candidates' understanding of IFRS 17 and U.S. GAAP, and the candidates' ability to construct a simple income statement and balance sheet under both standards.

Solution:
(a)   Critique the following statements pertaining to IFRS 17:

 A.   *IFRS 17 allows multinational insurance companies to use different accounting policies to measure similar insurance contracts issued in different jurisdictions.*

 B.   *IFRS 17 requires insurance companies to recognize financial options and guarantees embedded within insurance contracts only when such options and guarantees are in the money.*

 C.   *IFRS 17 allows companies to determine how insurance contracts are aggregated for measurement purposes as long as relevant disclosures are provided.*

 D.   *IFRS 17 requires insurance companies to recognize losses on onerous contracts immediately in profit or loss.*

 E.   *IFRS 17 applies to both reinsurance and insurance contracts, but does not apply to investment contracts with discretionary participation features, which will be covered by IFRS 9.*

1.   Continued

F.   *IFRS 17 requires a company to recognize a group of insurance contracts when the coverage starts.*

Commentary on Question:
Candidates generally correctly critiqued a majority of the statements. Candidates generally struggled with Statement F. If a candidate correctly identified a false statement but failed to provide the correct reason for why the statement was false, no credit was awarded for that statement.

A.   False - This practice was permitted under IFRS 4. IFRS 17 requires multinational insurance companies to use consistent accounting policies to measure similar insurance contracts issued in different jurisdictions.

B.   False - All financial options and guarantees embedded in insurances contracts must be recognized in the measurement of the fulfilment cash flows, in a way that is consistent with observable market prices.

C.   False - Aggregation occurs at initial recognition into one of three groups based upon profitability: onerous, no significant possibility of becoming onerous and all other.

D.   True

E.   False - In addition to reinsurance and insurance contracts, it also applies to investment contracts with discretionary participation features.

F.   False - Recognition occurs at the earliest of coverage start, first premium payment and first occurrence of being onerous.

(b)   Contrast the treatment of term life insurance under IFRS 17 and U.S. GAAP for each of the following:

(i)   Revenue

(ii)   Discount rate

(iii)   Treatment of risk

(iv)   Mortality assumptions

(v)   Acquisition costs

1. Continued

Commentary on Question:
Candidates generally performed well on this part of the question.

(i)   GAAP: revenue includes premium

        IFRS: revenue excludes premium

(ii)   GAAP: discount rates are based on expected yield of assets

        IFRS: discount rates are based on characteristics of the liability cash flows

(iii)   GAAP: utilizes PADs in initial assumptions for long term contracts

        IFRS: utilizes an explicit risk margin liability

(iv)   GAAP: assumptions are locked in at issue for long term contracts and subsequently unlocked only if future losses are expected

        IFRS: assumptions are updated each accounting period

(v)   GAAP: explicitly capitalizes acquisition costs and amortizes them over time

        IFRS: includes acquisition costs in fulfillment cash flows, with an offset in the CSM (implicit amortization over time)

(c)

(i)   Construct an income statement under U.S. GAAP and IFRS 17 using the following format:

U. S. GAAP	Year 1	Year 2
(+) Revenue		
(–) Benefits and Expenses		
(=) Profit		

IFRS 17	Year 1	Year 2
(+) Insurance Revenue		
(–) Incurred Claims & Expenses		
(=) Insurance Service Result		
(+) Investment Income		
(=) Profit		

Show all work.

1. Continued

> (ii) Construct a balance sheet under U.S. GAAP and IFRS 17 using the following format:

U. S. GAAP	Time 0	End of Year 1	End of Year 2
(+) Financial Assets			
(−) Insurance Contract Liabilities			
(=) Equity			

IFRS 17	Time 0	End of Year 1	End of Year 2
(+) Financial Assets			
(−) Insurance Contract Liabilities			
(=) Equity			

> Show all work.

Commentary on Question:
In general, candidates demonstrated better knowledge in constructing an income statements than a balance sheet. Candidates who provided the correct formula but incorrectly calculated the result or calculated no result received partial credit.

(i) Income Statement

U.S. GAAP Income Statement:

Revenue = Premium + Inv Inc
Year 1 = 1,000 + 200 = 1,200
Year 2 = 500 + 250 = 750

Benefits and Expenses = Commission + Expense + Death Benefit + Change in Reserve
Year 1 = 100 + 75 + 25 + 150 + (500 - 0) + (-150 - 0) = 700
Year 2 = 50 + 25 + 300 + (700 - 500) + (-100 + 150) = 625

U.S. GAAP	Year 1	Year 2
Revenue	1,200	750
Benefits and Expenses	700	625
Profit	500	125

1. **Continued**

IFRS 17 Income Statement:

CSM = Contractual Service Margin
CSM at time 0 = - (Present Value of Cash Flows + Risk Margin)
        = - (-950 + 80) = 870
CSM at time 1 = CSM at time 0 – CSM amortized = 870 – 870/3 = 580
CSM at time 2 = CSM at time 1 – CSM amortized = 580 – 870/3 = 290

Incurred Claims & Expenses = Commission + Expense + Death Benefit
Year 1 = 100 + 75 + 25 + 150 = 350
Year 2 = 50 + 25 + 300 = 375

Insurance Revenue = Incurred Claims & Expenses + CSM amortized +
                Risk Margin amortized
Year 1 = 350 + (870 - 580) + (80 - 60) = 660
Year 2 = 375 + (580 - 290) + (60 - 30) = 695

IFRS 17	Year 1	Year 2
Insurance Revenue	660	695
Incurred Claims and Expenses	350	375
Insurance Service Result	310	320
Investment Income	200	250
Profit	510	570

(ii)   Balance Sheet

U.S. GAAP Balance Sheet:

Financial Assets at time t = Financial Assets at time t-1 +
                Premium + Investment Income -
                Commission - Expense - Death Benefit
Time 0 = 0
End of Year 1 = 0 + 1,000 + 200 - 100 - 75 - 25 – 150 = 850
End of Year 2 = 850 + 500 + 250 - 50 - 25 – 300 = 1,225

Insurance Contract Liabilities at time t = Reserve at time t
Time 0 = 0
End of Year 1 = -150 + 500 = 350
End of Year 2 = -100 + 700 = 600

1. **Continued**

U.S. GAAP	Time 0	End of Year 1	End of Year 2
Financial Assets	0	850	1,225
Insurance Contract Liabilities	0	350	600
Equity	0	500	625

IFRS 17 Balance Sheet:

Financial Assets at time t are the same as US GAAP

Insurance Contract Liabilities at time t =
  Present Value of Cash Flows at time t +
  Risk Margin at time t +
  CSM at time t
Time 0 = -950 + 80 + 870 = 0
End of Year 1 = -300 + 60 + 580 = 340
End of Year 2 = -175 + 30 + 290 = 145

IFRS 17	Time 0	End of Year 1	End of Year 2
Financial Assets	0	850	1,225
Insurance Contract Liabilities	0	340	145
Equity	0	510	1,080

2. Learning Objectives:

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

3. The candidate will be able to understand and apply emerging financial and valuation standards, principles and methodologies.

Learning Outcomes:

(2a) Compare and apply methods for life and annuity product liabilities.

(2c) Recommend and justify appropriate valuation assumptions.

(3a) Describe, evaluate and calculate the impact on reserves, income, capital, and processes of emerging developments in Statutory and U.S. GAAP reporting, International Financial Reporting Standards, and Solvency Modernization.

Sources:

CIA Education Note: Margins for Adverse Devations (MfAD)

LFV—634-18: CIA Standards of Practice: Insurance Sections 2100, 2300, 2500, April 2017

Research Paper, Fixed Income Calibration April 2014

Report of the Task Force on Segregated Fund Liability and Capital Methodologies (Aug 2010)

Commentary on Question:

This question tested the candidates' understanding on how segregated fund guarantee assumptions are developed under Canadian standards of practice. The question required candidates to understand the condition and constraints, and make appropriate recommendations.

Solution:

(a) Outline the segregated fund's valuation methodology under current Canadian standards of practice.

Commentary on Question:

Candidates generally did not relate the valuation methodology to EON's situation.

- Policy liabilities for segregated fund guarantees is calculated using stochastic application of CALM.
- The stochastic returns generated should satisfy the calibration criteria laid out in the standards.

2. **Continued**

- The term of the liabilities chosen should maximize the policy liabilities; which in this case would encompass the potential exercise of the annuitization option.
- EON does not have any hedging program in place. Hence, valuation process should consist of generating stochastic scenarios of the TSX index, projecting liability cash flow over the term of the liabilities which includes cash flow from the exercise of the annuitization option, and a roll-forward of CALM cash flow testing to determine the amount of required assets to reduce to zero at the last liability cash flow .
- In addition, conditional tail expectation (CTE) of the value of the required assets needs to be calculated.
- EON also does not plan to amortize acquisition expenses. Whole contract approach should be used, instead of the bifurcated approach; all net cash flows should be considered in determining the total liability under a whole contract approach.

(b) Using fixed-income returns for segregated fund guarantee valuation:

    (i) Describe the CIA's fixed income calibration criteria for segregated fund liabilities

    (ii) Explain the two alternatives which can be applied to the fixed income calibration criteria.

    (iii) Recommend the most appropriate alternative for EON. Justify your recommendation.

Commentary on Question:
Candidates generally did well on this part of the question. A common omission was the calibration criteria related to fixed income returns and instead focusing in calibration criteria for equity returns only.

(i)
- There are two distinct sets of calibration criteria established based on US broad based fixed income indices and Canada broad based fixed income indices
- The percentile for Left Tail (LT) calibration criteria are 2.5th, 5th and 10th; Right Tail (RT) are 90th, 95th and 97.5th
- The time horizon used for LT calibration criteria are 1, 5, 10 and 20 year; RT is 1 year horizon

2. **Continued**

- The steps to develop calibration criteria are:
  1. Select benchmark yield
  2. Calibrate the models
  3. Simulate fixed income total returns and calculate accumulation factor percentile
  4. Establish calibration criteria
- The inclusion of buffer in calibration criteria is to model uncertainty - for LT, buffer is added to the result, while buffer is subtracted from the result for RT
- CIR and B-S models are used in establishing the calibration criteria

(ii) There are two alternatives available for the application of fixed-income calibration criteria:
- Alternative 1 – Use when stochastic when fixed-income returns are not modelled by stochastically modelling interest rates (for example, when a regime-switching lognormal model form is used),
- Then at each valuation date, the company would then follow a two-step procedure:
  1. Generate scenarios with the calibrated criteria model using the government yield and credit spread prevailing at the valuation date as the initial benchmark yield, and calculate the resulting left- and right-tail percentiles; and
  2. Verify that the left-tail percentiles of the scenarios generated by the valuation model are lower than or equal to those derived from the criteria model in step 1, and that the right-tail percentiles of the valuation model are higher than or equal to those of the criteria in step 1.
- Alternative 2 -Use when fixed-income returns are modelled by stochastically modelling interest rates.
  1. A company would demonstrate that its valuation model meets the calibration criteria for each of the three initial benchmark yields
  2. The company would demonstrate this by verifying, for each of the three initial benchmark yields, that the left-tail percentiles of the scenarios generated by the valuation model are less than or equal to the left-tail criteria in and that the right-tail percentiles generated by the valuation model are greater than or equal to the right-tail criteria

(iii) Alternative 1 is appropriate as EON models interest rates using a regime switching lognormal model. It does not model interest rates stochastically.

(c) Propose mortality, withdrawal and policyholder option margins for adverse deviation for valuing the new segregated fund product under current Canadian standards. Justify your proposals.

2. Continued

Commentary on Question:
Candidates received credit for mentioning the prescribed range of margin for adverse deviation and providing justification based on EON's circumstances on the chosen MfAD level. A common error was using the insurance mortality MfAD for the segregated fund product. A common omission was the mortality improvement MfAD.

Mortality:
- For annuitant mortality, the low and high margins for adverse deviations (MfAD) for the mortality rates would be respectively a subtraction of 2% and 8% of the best estimate
- The mortality improvement assumption would include a best estimate assumption and an associated margin. The margin for adverse deviations related to the mortality improvement assumption is not restricted to the range of 5% to 20% noted in paragraph 2350.01. The actuary's assumption would include mortality improvement, the effect of which is to increase insurance contract liabilities, such that the resulting increase would be at least as great as that developed using prescribed mortality improvement rates as promulgated from time to time by the Actuarial Standards Board.
- The company has a lot of experience regarding annuitant mortality and thus the data has high credibility. However, the new product reflects new terms and conditions which could lead to error of estimation of the best estimate assumption.
- As the intention is to sell the product to the same group of risks and the credibility of the data is high, the margin can be set to the low end of the range.

Withdrawal:
- The low and high margins for adverse deviations would be, respectively, an addition or subtraction, as appropriate, of 5% and 20% of the best estimate withdrawal rates.
- The insurer's withdrawal experience would be pertinent and usually credible. It would not be available for new products and for higher durations on recent products.
- In order to ensure that the margin for adverse deviations increases insurance contract liabilities, the choice between addition and subtraction may need to vary by interest scenario, age, policy duration, and other parameters. In the case of partial withdrawal, two assumptions would be needed, the amount withdrawn and the partial withdrawal rate.

2. Continued

- Withdrawals on this product would be heavily dependent on the equity market in the next 20 years; if the market undergoes a period of losses, it would not be in the interest of the policyholder to withdraw. Future experience is thus difficult to estimate as this is a new type of product, the experience is subject to large fluctuations over time and the cohort of risk lacks homogeneity due to the volatility from the equity markets.
- The withdrawal MfAD should be set at the high end of the range.

Policyholder option
- The standards do not discuss a standard range for margins for adverse deviations for policyholder options. It would be reasonable to assume a margin in the 5% to 20% range of the best estimate on utilization assumption.
- The actuary would make provision for adverse deviations by testing the effect on insurance contract liabilities of plausible alternative assumptions of policy owner exercise of options and adopting one with relatively high insurance contract liabilities.
- The margin could be positive or negative, and could vary by age, scenario used, and other parameters and sensitivity testing can be used to determine the margin for adverse deviation.
- The risks involved with this product is different from the prior products and there is a lack of homogeneity regarding the cohort since the risk regarding the policyholder option is interest rate risk.
- The MfAD should be set at the high end of the range.

3. **Learning Objectives:**

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

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

Learning Outcomes:

(2b) Evaluate, calculate, and interpret liabilities.

(2c) Recommend and justify appropriate valuation assumptions.

(4c) Explain and apply methods in determining regulatory capital and economic capital.

(4e) Explain Canadian regulatory capital framework and principles.

Sources:
LFV-XXX-17: CIA Standards of Practice: Insurance Sections 2100, 2300, 2500, April 2017

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

CIA Draft Report: Task Force Report on Mortality Improvement, 2017

LFV-XXX-17: CIA Draft Educational Note: Life Insurance Capital Adequacy Test (LICAT) and Capital Adequacy Requirements for Life and Health Insurance (CARLI), June 2017

Commentary on Question:
This question tested the candidates' knowledge on valuation and capital standards.

Solution:

(a) Determine the best estimate liability of the annuity contract at issue using the valuation assumptions given above. Show all work.

Commentary on Question:
Candidates generally did well on this part of the question. Common errors include not recognizing the portfolio is only rebalanced once at time 10 and using more than two discount factors for discounting.

To determine the best estimate liability of the annuity contract at issue using the valuation assumptions given, need to calculate both expected benefit payment without discounting and the appropriate discounting factors.

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3. **Continued**

E[Ben]
= (1-QX)^20*Benefit Payment = $543,749

Time 0 Portfolio Net Return
= Fixed Income Weight * Fixed Income Return + NFI Weight * NFI Return
= 50% * (Risk Free Rate + Current CS – Asset Depreciation) + 50% * 6%
= 50% * 2.7% + 3%
= 4.35%

Time 10 Portfolio Net Return
= Fixed Income Weight * Fixed Income Return + NFI Weight * NFI Return
= 50% * (Risk Free Rate + Historical CS – Asset Depreciation) + 50% * 6%
= 50% * 3.7% + 3%
= 4.85%

Best Estimate Reserve
= E[Ben]/(1 + Time 0 Net Return)^10/(1 + Time 10 Net Return)^10
= $221,221

(b)   Calculate the total Provision for Adverse Deviation (PfAD). Show all work.

Commentary on Question:
Candidates generally did not do well on this part of the question. The most common error was not identifying the limitation on non-fixed income as a padded assumption. Other common errors include using the insurance mortality MfAD instead of the annuity mortality MfAD; incorrectly calculating the impact of the Market Shift at the balance sheet date; and failing to interpolate and calculate the interest rate under prescribed scenario 1 and credit spread at time 10.

Use all MfAD at high end of standard of practice range, as suggested.
- Mortality MfAD (for annuity) = -8%
- Asset Depreciation MfAD = 100%
- Credit Spread MfAD = 0% at time zero and grade to 10% by time 5
- Capital Gain MfAD = 20%
- Market Shift MfAD = 30% at time zero
- Max NFI content = 20% at time zero
- Max Credit Spread = 0.8% at time 30

Padded[Ben]
= (1-QX*(1+QXMFAD))^20*Benefit Payment
= $571,346

3. Continued

Time 0 Portfolio Net Return Padded
= Fixed Income Weight * Fixed Income Return + NFI Weight * NFI Return
= (1-NFI Max) * (Risk Free Rate + Current BE CS – Asset Depreciation (1+AD MfAD)) + NFI Max * (1- Market Shift) * Capital Gain * (1- Cap Gain MfAD)
= 80% * 2.4% + 14% * 4.8%
= 2.59%

Interest rate at time 10 under Prescribed Scenario 1
= Linear interpolation between time 1 and time 20
= Interest rate at time 1 + 9/19 * (interest rate at time 20 – interest rate at time 1)
= 2% * 0.9 + 9/19 * (0.1 * current interest rate + 0.9 * Ultimate Low – 1.8%)
= 2.41%

Credit Spread at time 5
= Historical Credit Spread * (1-CSMFAD@time 5)-AD*(1+AD MFAD)
= 2% * (1-10%) – 0.3% * (1+100%)
= 1.2%

Credit Spread at time 10
= Linear interpolation of padded credit spread between time 5 and time 30
= 5/25 * (Credit Spread at time 30 – CS at time 5) + CS at time 5
= 5/25 * (0.8% - 1.2%) + 1.2%
= 1.12%

Time 10 Portfolio Net Return Padded
= Fixed Income Weight * Fixed Income Return + NFI Weight * NFI Return
= (1-NFI Max) * (Interest rate at time 10 under Prescribed Scenario 1 + Credit Spread at time 10) + NFI Max * Capital Gain * (1- Cap Gain MfAD)
= 80% * (2.41% + 1.12%) + 20% * 4.8%
= 3.78%

Padded Reserve
= Padded[Ben]/(1 + Time 0 Net Return Padded)^10/(1 + Time 10 Net Return Padded)^10
= $305,199

Total PfAD
= Padded Reserve – Best Estimate Reserve
= $83,978

3. **Continued**

(c)   Determine the LICAT surplus allowance. Show all work.

Commentary on Question:
Candidates generally did well on this part of the question. Candidates were able to identify the type of PfADs that should be included for Surplus Allowance. However, candidates generally were not able to calculate the correct discount rates needed for the interest rate PfAD calculation.

PfADs included in Surplus Allowance are: 1) interest rate risk PfAD from the prescribed scenario and 2) PfADs from all Non-Economics risks (Mortality PfAD in this case).

Padded[Ben]
= (1-QX*(1+QXMFAD))^20*Benefit Payment
= $571,346

Time 0 Portfolio Net Return
= Fixed Income Weight * Fixed Income Return + NFI Weight * NFI Return
= 50% * (Risk Free Rate + Current CS – Asset Depreciation) + 50% * 6%
= 50% * 2.7% + 3%
= 4.35%

Time 10 Portfolio Net Return RF
= Fixed Income Weight * Fixed Income Return + NFI Weight * NFI Return
= 50% * (Interest rate at time 10 under Prescribed Scenario 1+ Historical CS – Asset Depreciation) + 50% * 6%
= 50% * (2.41 + 2% -0.3%) + 3%
= 5.05%

Padded Reserve (SA only)
= Padded[Ben]/(1 + Time 0 Net Return)^10/(1 + Time 10 Net Return RF)^10
= $227,973

Surplus Allowance
= Padded Reserve (SA only) - Best Estimate Reserve
= $6,752

3. **Continued**

(d)   You are given the following information:

Available Capital	50,000
Tier 1 Capital	30,000
Eligible Deposits	10,000
Base Solvency Buffer	55,000
Excess Deposits from an Unregistered Reinsurer	5,000

Calculate the LICAT Total and Core Ratios. Show all work.

Commentary on Question:
Candidates generally did well on this part of the question. Common errors include applying an additional scaler factor on top of the Base Solvency Buffer and incorrectly including the excess deposits from unregistered reinsurer to the eligible deposits.

Total Ratio
= (Available Capital + Surplus Allowance + Eligible Deposits)
/ Base Solvency Buffer
= (50,000 + 6,752 + 5,000) / 55,000
= 121%

Core Ratio
= (Tier 1 Capital + Surplus Allowance + Eligible Deposits)
/ Base Solvency Buffer
= (30,000 + 6,752 + 5,000) / 55,000
= 76%

4. **Learning Objectives:**
1. The candidate will understand financial statements and reports of Canada life insurance companies as well as the professional standards addressing financial reporting and valuation.

Learning Outcomes:
(1a) Construct the basic financial statement or its components for a life insurance company.

Sources:
Canadian Insurance Taxation, Ch 3-6,9,24

Commentary on Question:
This question tested the candidates' knowledge of insurance taxation.

Solution:
(a)
      (i)   Outline considerations in determining premium tax for these two policies.

      (ii)   Determine the premium tax payable in 2017 for these two policies. Show all work and justify your answer.

Commentary on Question:
Candidates generally received partial credit for this part of the question. Candidates generally commented on consideration of tax rate, dividend and reinsurance.

1. Company is a licensed Canadian insurer, so additional federal tax does not apply
2. The policyholder is currently living in Nunavut - therefore use 3% rate
3. Do not tax the premium for the annuity contract
4. Offset for dividends paid
5. No offset for the reinsurance premium in what is submitted for premium tax to province/territory
6. Premium tax reimbursement may be part of treaty as an obligation; Treaty should state this clearly
7. Cash values or change in cash value have no impact on premium tax payable

Premium tax = 3%*(9000-1000) = 240 for the WL policy and 0 for the annuity

4.   Continued

(b)   Taxable income reported for the participating whole life policy with respect to accrual taxation is 400.

The bond yield rate used for the Investment Income Tax (IIT) calculation is 2.39%.

   (i)   Describe the process for determining the bond yield rate used for the IIT calculation.

   (ii)   Determine the 2017 Investment Income Tax payable for these two policies. Show all work and justify your answer.

Commentary on Question:
Candidates generally did not do well on this part of the question. Most candidates applied the correct tax rate and factor without justifying the components of the calculation.

The IIT Yield should be based on the moving average rate for the 60 months before the current taxation year on domestic Canadian Dollar Government of Canada Bonds outstanding on the last Wednesday of the month that have a remaining term to maturity exceeding 10 years.   As given, use 2.39% as the IIT Bond Yield.
Generally the IIT is 15% of an insurer's taxable Canadian Life investment income for the year with a % applied
An insurer's life investment income is the product of the IIT Yield and the insurer's average maximum tax actuarial reserves (MTAR) for its taxable life insurance policies for the year, adjusted by a factor as noted below
55% (for post Mar 3/88 issues) is applied to recognize insurer expenses & profits relating to gross investment revenue.
MTARs = Statutory Reserves; the MTARs used for post 1995 life insurance policies are based on CALM as reported in the insurer's financial statements but excluding projected income taxes and capital taxes (other than Investment Income Tax)
Use average MTAR reserves, not year-end reserves;
Reinsurance is ignored; Taxable life insurance policies only include direct written policies;
Therefore, MTAR = Average Gross Stat Reserve = (33,100 + 33,500) / 2 = 33,300
Apply a reduction of 100% of the amount reported for dividends and policyholder taxable income. In general, an insurer's Canadian Life Investment Income is reduced by a percentage of the amount reported to policyholders as taxable income in respect of proceeds of disposition, policy dividends, or amounts arising under the annual accrual rules
Next, deduct both the dividend and the accrual tax amount - both of which were taxable income

4. **Continued**

IIT = 15% (55% * 2.39% * 33,300 - 1000 - 400) = -144 for the Life policy
Per tax regulations, annuity contracts are excluded from IIT, so there is no IIT for the SPDA

(c)   Assuming the following:

- ABC Life has no investment income in 2017
- The Single Premium Deferred Annuity has a period of coverage of 25 years.

(i)   Construct the 2017 pre-tax statutory income statement for ABC Life.

(ii)   Determine the business income for tax purposes by adjusting the pre-tax statutory income.

Commentary on Question:
Most candidates were able to obtain partial credit in part (i) by calculating some components (e.g. premiums, change of reserves, expenses) correctly. A few candidates considered Premium tax and IIT in the calculation.
Candidates generally struggled with part (ii). Candidates generally were not able to make any correct adjustment. Few candidates were able to calculate the correct expense commission.

(inflow) Premiums (gross premiums less reinsurance premiums) = (9,000 - 3,000) + 250,000 = 256,000
(inflow) Investment Income = 0
(outflow) Premium Tax 240
(outflow) Dividends = 1,000
(outflow) Expenses (includes commissions & IIT) = 2,500 + (-144) = 2,356
Change in Net Actuarial Liabilities = (245,000 - 0) + (32,000 - 31,600) = 245,400
The pre-tax statutory reported Income = 256,000 - 1,000 - 2,356 - 245,400 - 240 = 7,004

Calculation of Business Income for Tax purposes
No change to Premiums = 256,000
No change to Dividends = 1,000; Deduction is permitted for dividends payable and paid to the extent that there was no deduction in the previous year
(outflow) Expenses for commissions =100(2,500 / 25 = 100); Policy Acquisition expenses refers to costs incurred (directly / indirectly) relating to the acquisition of new and renewal insurance business, for tax purposes, acquisition expenses are deferred and amortized over the policy coverage period.   T
IIT = -144 (negative IIT is a loss carry-forward for future IIT offset); Life Insurers may deduct the investment income tax payable for the year

4. Continued

Change in Actuarial Liabilities = (245,000 - 0) + (33,500 - 33,100) = 245,400; An insurer is allowed to deduct prescribed reserves; The prescribed reserves are MTARs, which in this case is the same as the statutory reserves as described in part (b) above.

Business income for tax purposes = 256,000 - 1,000 - 100 - (-144) - 245,400 = 9,644

5.

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

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

Learning Outcomes:
(2a) Compare and apply methods for life and annuity product liabilities.

(2b) Evaluate, calculate, and interpret liabilities.

(2c) Recommend and justify appropriate valuation assumptions.

(4a) Assess financial performance, including analyzing and interpreting the financial performance of a product line or company.

Sources:
CIA Educational Note: Expected Mortality: Fully Underwritten Canadian Individual Life Insurance Policies: July 2002

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

CIA Final Communication of a Promulgation of Prescribed Mortality Improvement Rates and Associated Margins for Adverse Deviation within the Practice Specific Standards on Insurance Contract Valuation: Life and Health (Accident and Sickness) Insurance (Subsection 2350) July 2017

CIA Educational Note: Margins for Adverse Deviations (MfAD)

Commentary on Question:
This question tested the candidates' knowledge of mortality and underwriting concepts.

Solution:
(a) Determine if CDN's mortality experience falls within the error margin at the 95th percent confidence interval for:

    (i)   Annual experience

    (ii)   Cumulative experience

5. **Continued**

With the information given, the allowable error margin can be calculated using the following:
r_error = Z_p/sqrt(n_F)

Cumulative experience:
95% confidence interval (CI): Z_p = 1.96
Error margin = 1.96 / sqrt (1586) = 4.9%

Annual Experience:
Error margin = 1.960 / sqrt (1586/5) = 11.0%

Alternatively,
2013: 95% Error margin = 1.960 / sqrt (366) = 10.2%
2014: 95% Error margin = 1.960 / sqrt (350) = 10.5%
2015: 95% Error margin = 1.960 / sqrt (313) = 11.1%
2016: 95% Error margin = 1.960 / sqrt (286) = 11.6%
2017: 95% Error margin = 1.960 / sqrt (271) = 11.9%

2013, 2014, and 2017 are outside of the individual annual allowable error margin
2015, 2016 and the five year cumulative experience are within the error margin

(b)   You are given the following:

- Simplified Underwriting would miss conditions present in 5% of the population.
- An additional 2% of people with existing conditions would seek insurance given the relaxed standards.
- Mortality for people with these conditions is double the average rate.
- CDN raised their assumed mortality rate to 5%, from 4.65% for policies sold using the direct channel.

Critique the Chief Actuary's statement. Show all work.

5. Continued

Commentary on Question:
Candidates did well on this part of the question. Common mistakes include using 200% for the additional mortality rate for the population with conditions; failing to recognize the goal is to calculate the mortality rate under simplified underwriting instead of improved underwriting; and not able to link the results of the calculation to properly evaluating the comments made by the Chief Actuary. Candidates received partial credit for providing the correct formula and reasonable commentary.

Q(NEW) = Q(OLD) × [1 − A − B − C × (A + B)] ÷ (1 −A − B)

Where:
Q(NEW) is the mortality under improved underwriting
Q(OLD) is mortality under simplified underwriting
A = 5%, % of conditions being missed under simplified underwriting
B = 2%, additional % of people seeking insurance given simplified underwriting
C = 100%, additional mortality for people with conditions over average mortality

Q(OLD) = 4.65% / ((1-5%-2%-100% × (2% + 5%)) / (1-5%-2%))
= 5.03%

The Chief Actuary's statement and the new mortality rate of 5% for policies sold through direct channel is reasonable, given the calculation above. The mortality experience for policies sold via direct channels with simplified underwriting is higher than mortality experience sold through the captive market, which would contribute to poor A/E experience.

(c) Calculate the valuation mortality for 2018 for a female age 45 for the two following products. Show all work and justify any assumptions made.

   (i)   10-year term insurance

   (ii) Payout annuity

Commentary on Question:
Candidates generally did not correctly apply the formula for padded mortality with mortality improvement, especially with respect to how the mortality improvement MfAD should be applied. The other common mistake was not recognizing the need for using maximum MfAD under the conditions provided, but partial credit was given for use of other MfAD levels when the formula was applied correctly.

5. **Continued**

Given the following considerations:
- Use of industry mortality table without taking into consideration company's own experience
- Volatility in the A/E experience and relatively short monitoring period
- Inconsistent underwriting practice

The maximum amount of MfAD is recommended to be used here, which means:
- 15/ex per 1000 for 10 year term insurance
- -8% for Payout Annuity

For 10 year term insurance (death sensitive)

Padded Mortality
= Base Mortality × (1-(Mortality Improvement – Mort Imp MfAD × (1- Diversity Factor)) + .015/ex
= 0.002×(1-(0.0188-0.002×(1-0.2)))+0.015/40
= 0.002341

For Payout Annuity (death supported)

Padded Mortality
= Base Mortality × (1-(Mortality Improvement + Mort Imp MfAD × (1- Diversity Factor)) × (1 + Mort MfAD)
= 0.002 × (1-0.08) × (1- (0.0188 + 0.002 × (1- 0.2)))
= 0.001802

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

Learning Outcomes:
(4a)   Assess financial performance, including analyzing and interpreting the financial performance of a product line or company.

(4f)   Explain and apply methods in earnings management and capital management.

Sources:
CIA: Sources of Earnings: Determination and Disclosure, August 2004

LFV-603-13: OSFI Guideline D-9 -Source of Earning Disclosure

LFV-137-16: Kraus 2011 – EVARAROC vs. MCEV Earnings – A Unification Approach

Commentary on Question:
This question tested the candidates' knowledge of source of earnings.

Solution:
(a)
        (i)   Define SOE analysis.

        (ii)   Outline the benefits of SOE.

        Commentary on Question:
        Candidates were generally able to successfully define an SOE analysis. Some
        candidates were successful in describing the benefits of an SOE analysis while
        other candidates incorrectly described the characteristics of an SOE analysis
        instead of the benefits.

        Definition of Source of Earnings Analysis:
        1. Methodology for identifying and quantifying various sources of Canadian
        GAAP income of an insurance company
        2. Presentation of net income in a different format from the traditional income
        statement, with emphasis on these sources
        3. Components include expected profit on in-force business, experience
        gains/losses, changes in assumptions or in methodology, the impact of new
        business, income on capital and surplus, impact from error corrections and
        management actions.

6. Continued

Benefits of a Source of Earnings Analysis:
1. Provides an important overall control on the integrity of the company's reported earnings by providing insight into the validity of the company's data, systems, and financial statement preparation process.
2. Provides stakeholders, including shareholders, policyholders, directors, management, financial analysts and regulators, with a better understanding of the business and the financial results and may identify opportunities for improving profitability.

(b)

(i) Construct a Source of Earnings statement for 2017.

(ii) Recommend actions to improve earnings based on the results of the SOE.

Commentary on Question:
Candidates were generally able to construct the SOE Statement correctly and partial credit was given accordingly. Candidates generally struggled to allocate the items given to the correct SOE category. Partial credit was given for the components that were calculated correctly. Full credit was given for any two reasonable action items. Most candidates were able to provide two reasonable actions. Full credit was given if the actions were consistent with the SOE analysis even if the SOE statement numbers were not calculated correctly.

6. Continued

(i)

	Item ($millions)	Expected 2017	Actual 2017	Impact on Net Income 2017
EEIF	PfADs released (split into Expected Earnings on Inforce and Experience Related)	0.1	N/A	0.1
NB	Pricing Gains/Losses	0.0	-1.0	-1.0
EGL	Premium	15.0	14.9	-0.1
EGL	Product-related Investment Income	0.5	0.5	0.0
EGL	Benefits Paid on Decrements	1.5	1.7	-0.2
EGL	Reserves Released on Decrements	0.3	0.4	0.1
EGL	Expenses	0.2	0.1	0.1
EGL	PfADs released (split into Expected Earnings on Inforce and Experience Related)	0.0	0.1	0.1
IS	Surplus-related Investment Income	0.4	0.2	-0.2
IS	Surplus expense	0.7	0.4	0.3
MAAC	Impact from all Assumption Changes	0.0	-5.0	-5.0
MAAC	Impact from Renegotiating Reinsurance Treaty	0.0	0.3	0.3
MAAC	Error correction	0.0	0.4	0.4
	Total			-5.1

	SOE Statement ($ Millions)	2017
EEIF	Expected Earnings on Inforce (starting point)	0.1
NB	New Business Impact	-1.0
EGL	Experience Gains/Losses	0.0
IS	Income on Surplus	0.1
MAAC	Methodology and Assumptions Changes	-4.3
	Total	-5.1

(ii) Examples of recommended actions to improve earnings are:
1. Negative new business impact indicates new business strain, so company could use reinsurance with high first year commission/allowance to reduce the strain.
2. Some components of experience impacts but mainly assumption change impacts are negative. These illustrate that experience on the inforce business is worse than expected. Actions to improve earnings could include repricing the product and improving underwriting.
3. Surplus investment income is below expectation, so company should investigate the cause of low return. If the poor performance is not market/economic environment driven, then the company should modify the reinvestment strategy for surplus assets.

6. Continued

(c) Describe how the earning analysis will change under the MCEV approach versus the traditional SOE approach.

Commentary on Question:
Candidates generally did not do well on this part of the question. Successful candidates were able to compare/contrast the components of each approach. Most candidates had difficulty mapping the components of each approach. Some candidates described the components of the MCEV but failed to compare/contrast MCEV to the SOE approach.

- SOE components are expected earnings on inforce businesses, impact of new business, experience gains and losses, management actions and changes in assumptions, other, and earnings on surplus.
- MCEV components are opening adjustment, new business value, unwinding MCEV, operating variances, economic variances, and closing adjustment.

1. Both approaches include a new business impact.
2. Unwinding MCEV captures the rollover of the inforce business, and the expected profit on inforce business component captures a similar item.
    o The unwinding or rollover of the in-force business corresponds to the expected contribution of existing business to MCEV earnings. It consists of three main elements:
    (a) Expected existing business contribution using the reference rate (i.e., market spot rate)
    (b) Expected existing business contribution in excess of the reference rate
    (c) Transfer from VIF and RC to FS
    o Expected profit on in-force business captures
    i) Release of provisions for adverse deviations
    ii) Expected net management fees
    iii) Expected net earnings on deposit
    iv) Scheduled amortization of balance sheet allowances for acquisition or other capitalized expenses.
3. MCEV captures variance in experience except that it splits out the economic and operating variances separately.
    o Economic variance in MCEV captures the experience variances between actual experience and economic assumptions such as investment return.
    o The operating variances are divided into non-economic variances affected by
    (a) experience variances, i.e., changes resulting from the variance between the actual experience and that anticipated, and
    (b) assumption changes i.e., impacts resulting from the changes in experience assumptions.

7. **Learning Objectives:**
1. The candidate will understand financial statements and reports of Canada life insurance companies as well as the professional standards addressing financial reporting and valuation.

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

Learning Outcomes:
(1c) Describe, apply and evaluate regulatory documentation and disclosure requirements.

(1d) Describe, apply and evaluate the appropriate accounting treatments for insurance products, assets, derivatives and reinsurance.

Sources:
CIA Research Paper, IFRS Disclosure Requirements for Life Insurers (December, 2010)

CIA Educational Note: Valuation of Gross Policy Liabilities and Reinsurance Recoverables, December 2010

LFV-XXX-17: OSFI Draft Guideline – Life Insurance Capital Adequacy Test (LICAT), Chapter 10, Sept 2017

LFV-XXX-17: CIA Standards of Practice: Insurance Sections April 2017

CIA Educational Note: CALM Implication of AcSB Section 3855 Financial Instruments--Recognition & Measurement (June 2006)

Commentary on Question:
This question tested the candidates' knowledge of reinsurance.

Solution:
(a) Describe the necessary changes required to reflect these reinsurance contracts in the following:

   (i) IFRS Balance Sheet

   (ii) IFRS Disclosure Requirements

   (iii) LICAT Credit and Operational Risk Capital

   (iv) DCAT

7. Continued

Commentary on Question:
This part of the question tested the candidates' understanding of how reinsurance is reported in financial statements and how reinsurance affects capital requirements. Candidates were expected to address how reinsurance is reflected in financial statements and capital, demonstrating sufficient understanding. Candidates who failed to either expand further or to thoroughly cover all aspects received partial credits only.

For part (i), candidates generally correctly stated gross liabilities are shown separately. Some candidates also correctly stated that a reinsurance provision is required given the low credit rating of QRS. To receive full credit, however, candidates had to demonstrate how to set the gross liability and suggest a methodology to produce a gross reserve, which candidates generally did not.

For part (ii), some candidates correctly recognized that the reinsurers' credit ratings need to be included in the disclosure. Fewer candidates mentioned that maximum exposure to a reinsurer need to be disclosed. Most candidates failed to summarize that both quantitative and qualitative disclosure of credit, liquidity and market risks are required under IFRS17.

For part (iii), it is not required to remember the specific factor to receive a full credit. Most candidates correctly identified the operational risk formula. For credit capital, many candidates received partial credit for identifying some of the components that go into the formula.

For part (iv), most candidates received partial credit for recognizing that reinsurance needs to be included in DCAT's adverse scenarios. Some candidates described integrated scenarios. Few candidates mentioned ripple effects and corrective management actions.

(i)
- Show gross and net liabilities separately.
- Approximate the gross liability using a method similar to the net liability. Could take the gross cashflows and discount them using the CALM yield on the net liability.
- There should be a provision set up for the reinsurance at QRS given the credit rating of C.
- Gross up miscellaneous net liabilities (IBNR, CALM manuals, etc.) using a simpler method.

7. Continued

(ii)
- IFRS 7 requires both qualitative and quantitative disclosure of credit, liquidity and market risks.
- Should consider splitting the disclosure of reinsurers by credit rating or maximum exposure to a reinsurer

(iii)
- For LICAT capital include 0.7% for reinsurance receivables with a registered reinsurer, 2.5% for reinsurance assets, 5% for unregistered receivables under 60 days late, 10% for receivables over 60 days late.
- Operational risk capital is set at 2.5% of ceded premium.

(iv)
- Should consider threats to capital adequacy under plausible adverse scenarios that include reinsurance.
- Should test integrated Scenarios where adverse reinsurance movement would accompany another adverse shock (ie, mkt crash + reinsurer insolvency).
- Ripple Effects - In assuring consistency within each scenario, the actuary would consider ripple effects. Ripple effects would include both policy owner action and the insurer's expected response to adversity.
- Corrective Management Actions - For each of the plausible adverse scenarios that would result in a threat to satisfactory financial condition, the actuary would identify possible corrective management actions that would lessen the likelihood of that threat, or that would mitigate that threat, if it materialized.

(b) During DCAT, the Chief Actuary has suggested that DEF Life test the following reinsurance related scenarios:

Scenario A: Reinsurer QRS reduces it quota share to 10% and Reinsurer XYZ increases its quota share to 30%.

Scenario B: Reinsurer QRS's credit rating changes from C to BBB.

Assess the impact to Gross and Net Liabilities under these scenarios

7. Continued

Commentary on Question:
This part of the question tested candidates' understanding of reinsurance provisions and how they are affected by credit ratings. Candidates did relatively well. To receive full credit a candidate had to correctly identify that the gross liability was unchanged; the net liability decreased; and provide a rationale that explained why net liability went down.

Scenario A;
- No impact on the gross liability.
- The provision on reinsurance recoverability should go down due to a higher ceded % going to the higher rated XYZ.
- The net liability goes down due to the provision going down.

Scenario B:
- No impact on the gross liability.
- The provision on reinsurance recoverability should go down due to QRS having an improved credit rating.
- The net liability goes down due to the provision going down.

(c) DEF is considering reclassifying a portfolio of "Held To Maturity" bonds as either "Available for Sale", "Held for Trading", or "Fair Value Option".

Assess the viability and impact on DEF's Balance Sheet and Income Statement for each option.

Commentary on Question:
This part of the question tested candidates' knowledge of appropriate accounting treatments for insurance assets. Candidates generally did well in demonstrating their understanding of Available for Sale (AFS) and Held to Trading (HFT) but failed to recall that Fair Value Option (FVO) should be used only on derivatives and options and thus was not allowed.

Assets designated as Available for Sale (AFS) will be carried on the balance sheet at fair value. Changes in fair value (or unrealized gain/loss) will be recorded as Other Comprehensive Income (OCI), while realized gain/loss will go through net income in the income statement.

HFT Assets carried on the balance sheet at Fair Value. Changes in Fair value will be reported as regular income.

7. Continued

The asset accounting changes will result in new tax timing differences (i.e., ones that didn't exist in the pre-3855 regime) which will need to be valued. This may complicate the determination of the value of tax differences.

Fair Value Option (FVO) is not allowed as it is used for derivatives and options only. Any financial instrument may be designated as FVO at time of first recognition.

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

Learning Outcomes:
(4c)   Explain and apply methods in determining regulatory capital and economic capital.

(4d)   Explain and evaluate the respective perspectives of regulators, investors, policyholders and insurance company management regarding the role and determination of capital.

(4e)   Explain Canadian regulatory capital framework and principles.

Sources:
OSFI Draft Guideline – Life Insurance Capital Adequacy Test (LICAT), Chapters 1-3, 5-9, 11, Sept 2017

CIA Draft Educational Note: Life Insurance Capital Adequacy Test (LICAT) and Capital Adequacy Requirements for Life and Health Insurance (CARLI), June 2017

Commentary on Question:
This question tested the candidates' knowledge of LICAT.

Solution:
(a)   Calculate the interest rate risk requirement for QWX under LICAT. Show all work.

Commentary on Question:
Candidates were generally able to calculate the Interest Rate Risk requirement for each scenario/product and identify the worst case. Some candidates picked the worst scenario for each product to arrive to the final result identifying the aggregated worst scenario.

For Product A
The Interest Rate Risk (IRR) Capital under the 4 adverse scenarios are:
Scenario 1 IRR = 100-20 = 80;
Scenario 2 IRR = 100-15 = 85;
Scenario 3 IRR = 100 - 80 = 20;
Scenario 4 IRR = 100 - 70 = 30.

8. **Continued**

Product B
The Interest Rate Risk (IRR) Capital under the 4 adverse scenarios are:
Scenario 1 IRR = 30-10 = 20;
Scenario 2 IRR = 30-20 = 10;
Scenario 3 IRR = 30 - 15 = 15;
Scenario 4 IRR = 30 - 5 = 25

To calculate the aggregate interest rate risk capital for the company, the worst scenario would have to be selected at the LICAT geography level. For Canada and US, the same adverse scenario is used to calculate IRR in both geographies and is the scenario for which the combined IRR is the greatest.

Product A and B's combined IRR under 4 adverse scenarios is:
Scenario 1= 100 (80 + 20);
Scenario 2 = 95 (85+10);
Scenario 3 = 35 (20+15),
Scenario 4 = 55 (30+25).
Therefore, the IRR for the company is 100 based on its worst scenario which is scenario 1.

Interest Rate Risk (IRR) Requirement under each scenario	Product A	Product B	Product A + B
Scenario 1	80	20	100
Scenario 2	85	10	95
Scenario 3	20	15	35
Scenario 4	30	25	55
IRR			100

(b)   Calculate the following for the Canadian Whole Life Product:

(i)   Insurance risk requirement

(ii)   Diversified risk requirement

(iii)   Undiversified risk requirement

Show all work.

8. Continued

Commentary on Question:
Candidates were generally able to idenfity the correct formulas for this part of the question. Although candidates demonstrated various levels of understanding, some candidates missed the constraint on Insurance Risk, and some candidates incorrectly included operational risk in their calculation of market risk.

(i)

	Gross component (IRi)	Level and trend components (LTi)	IRi-0.5*LTi
Mortality	1,000	800	600
Lapse sensitive	200	50	175

(IRi-0.5*LTi) x (IRi-0.5*LTi)	Mortality	Lapse sensitive
Mortality	360,000	105,000
Lapse sensitive	105,000	30,625

(IRi-0.5*LTi) x (IRi-0.5*LTi) x Correlation Factors	Mortality	Lapse sensitive
Mortality	360,000	26,250
Lapse sensitive	26,250	30,625

Insurance Risk Requirement (I) - Formula from section 11.2.1 from the guideline

$$I = \sqrt{\sum_{i,j=1}^{7} \rho_{ij} \times (IR_i - 0.5 \times LT_i) \times (IR_j - 0.5 \times LT_j)} + PC$$

I may not be lower than the highest value of $IR_i - 0.5 \times LT_i + PC$ for any insurance risk i included in the correlation matrix
I = Max(I, 600+175) = 666

(ii)
A = Credit risk + Market risk = 120 + 90 = 210
Note: Operational risk should not be included.

Diversified risk requirement:

$$D = \sqrt{A^2 + AI + I^2}$$

= 792

(iii) Undiversified risk requirement:
U = IR Mortality + IR Lapse + A = 1000 + 200 + 210 = 1410

8. Continued

(c)   QWX Life ignores mortality improvement in the valuation of liabilities. Critique whether this practice is justifiable under LICAT.

Commentary on Question:
Candidates generally did not do well on this part of the question. Some candidates were able to discuss the issue of trend risk but were unable to adequately address this issue in the situation described.

The Canadian Actuarial Standards Board (ASB) has promulgated assumptions for future mortality improvement that form a minimum basis for the valuation of liabilities. For blocks where future mortality improvement would decrease liabilities, it is not uncommon to ignore mortality improvement in the valuation of liabilities rather than applying a best estimate assumption with an offsetting MfAD.

When applied to LICAT, a best estimate assumption of no future mortality improvement would lead to a nil required capital component for mortality (or longevity) trend risk, which may not be consistent with the objective of LICAT. In such cases, where material, the actuary would consider using an explicit best estimate mortality improvement assumption for LICAT purposes.

This applies both to the determination of the required capital component for mortality (or longevity) trend risk and the quantification of the PfAD for mortality improvement risk that is included in the surplus allowance

9.   **Learning Objectives:**
1.   The candidate will understand financial statements and reports of Canada life insurance companies as well as the professional standards addressing financial reporting and valuation.

Learning Outcomes:
(1b)   Describe the structure of the Canada Annual Statement and explain the purpose of its statements, key exhibits and schedules.

Sources:
CIA Standards of Practice section 2300

CIA Education Note: Investment Assumptions Used in the Valuation of Life and Health Insurance Contract Liabilities

CIA Education Note: Use of Actuarial Judgment in Setting Assumptions and Margins for Adverse Deviations

Commentary on Question:
This question tested candidates' knowledge of the CALM prescribed scenarios, assumption setting, and applying actuarial judgements in scenario testing.

Solution:
(a)
(i)   Determine which graph represents short-term rates and which graph represents long-term rates. Justify your answer.

(ii)   Identify the corresponding CIA prescribed scenario for scenarios A through E in the graphs above. Justify your answer.

Commentary on Question:
Candidates were generally able to identify the short- and long-term rates with adequate justification. Few candidates identified all the prescribed scenarios. Candidates generally demonstrated knowledge of base scenario and scenarios 1 and 2. Candidates generally did not demonstrate knowledge of the remaining scenarios.

(i)

- Scenarios B and D are oscillating scenarios, which are CIA scenarios 3, 4, 5, or 6.
- For scenarios 3 and 4, the short-term (ST) rates are 60% of the long-term (LT) rates after year 10. So the ST rates move in a similar direction and pattern to the LT rates. For scenarios 5 and 6, the ST rates move in a pattern of 40% to 120% of the LT rates.

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9. Continued

- When comparing oscillating scenario D between graphs X and Y, graph X exhibits the non-smooth oscillation of scenario 4 or 5. Thus, graph X is the ST risk free rates and as a result graph Y is the LT risk free rates.

(ii)

- Scenario 1 grades to the LT URR low at year 40 and stays there. LT scenario A grades to 1% at year 40 and stays there. Thus, A is scenario 1. Scenario 1 grades to ST URR Low at year 40 and stays there. Thus, reading scenario A on graph X, ST URR low is 4%. Thus, LT URR median is 4% as given in the question.
- Scenario 2 grades to the LT URR high at year 40 and stays there. Since no LT curve grades to 6% at year 40 and remains there, scenario 2 is not one of the samples.
- Scenario 3 oscillates between LT URR-high at year 20 and 60 and LT URR-low at year 40. Thus, the LT URR high is 6% and the LT URR low is 1% from graph Y.
- LT rates oscillate between the LT URR-high and LT URR-low. At years 20 and 60, the LT rates are equal to the LT URR-high for scenarios 3 and 5 and the LT rates are equal to URR-low for scenarios 4 and 6. Thus B is scenario 3 or 5, and D is scenario 4 or 6. For LT rates, scenarios 3 and 5 are identical, and scenarios 4 and 6 are identical.
- Since the ST B moves in a similar pattern to LT B, B is scenario 3. Since ST D does not move in a similar pattern to LT D, D is scenario 6. As a result, scenarios 4 and 5 can be removed from consideration.
- The remaining CIA scenarios are Base, 7 and 8. The base scenario grades to the URR-median at year 60. Scenario 7 grades to 80% of the LT URR-median. Scenario 8 grades to 120% of the LT URR-median. In graph Y, E grades to 4% at year 60, the LT URR-median. Thus E is the base scenario.
- The remaining scenario, C, is either scenario 7 or 8. Scenario 7 grades to 80% of the URR median. Scenario 8 grades to 120% of URR median. LT URR median is 4%. 120% of 4% is 4.8%. 80% of 4% is 3.6%. C grades to a number close to 4.8%. Thus C is scenario 8.

(b)   In developing the risk free rates for Catan, the following recommendation was made:

Continue to use the ASB's promulgated ultimate rate of returns (URR). Update the risk free implied forward rates using the exchange rate at the balance sheet date.

Critique the recommendation.

9. **Continued**

Commentary on Question:
Candidates generally did not do well on this part of the question. Candidates emphasized the impact to the URR from the movement of exchange rates and did not consider any other factors needed to be considered when making adjustments to the URRs, such as rate history and market information.

The approach is not appropriate. The URRs promulgated by the Actuarial Standards Board would be appropriate for valuations using Canadian risk-free reinvestment assumptions.
An actuary developing URRs for emerging markets would consider the Canadian URR as a starting point and make adjustments considering:
- Rate history
- Market information
- Economic circumstances
- Political conditions

Different oscillation periods or other changes in the structure of the interest rate scenarios as appropriate.

(c) The following alternatives are being considered in determining the appropriate policy liabilities:

(i) Assume the mismatch will move to the target mismatch position over time.

(ii) Assume the mismatch will move to the maximum mismatch position over time.

(iii) Assume the mismatch will remain at the four-period average mismatch position.

Critique each alternative.

Commentary on Question:
Candidates generally did not do well on this part of the question. Some candidates were able to address some issues for each alternative approach and described the impact on liability, but not for all alternatives.

(i) There is no history to demonstrate this is possible on a consistent basis. It would result in insufficient liabilities and is not appropriate.

(ii) There are a lot of volatilities in actual mismatch; but a constant mismatch would produce stable results period over period, the maximum mismatch position is inconsistent with the target but may be in line with past experience as the company is often above the target, and closer to the maximum allowed.

9.   Continued

(iii)   The current average mismatch is close to the maximum allowable. There are a lot of volatilities in actual mismatch, which would produce volatile results period over period. This approach is not appropriate.

10. Learning Objectives:

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

5. The candidate will understand the nature and uses of basic reinsurance arrangements used by life insurance companies.

Learning Outcomes:

(5a) The candidate will understand the various forms of reinsurance, and be able to, with respect to both the ceding and assuming parties, analyze and evaluate:
   (i) Risk transfer considerations
   (ii) Cash flow mechanics
   (iii) Accounting and financial statement impacts
   (iv) Reserve credit considerations

Sources:

Life, Health and Annuity Reinsurance, Tiller: Chapter 4

Life, Health and Annuity Reinsurance, Tiller: Chapter 5

Commentary on Question:

This question tested the candidates' understanding of reinsurance, particularly different forms of reinsurance arrangements and their impacts on different components of a balance sheet.

Solution:

(a) Compare and contrast yearly-renewable-term (YRT) and modified coinsurance (Mod-co) reinsurance arrangements.

Commentary on Question:

Candidates generally did will on this part of the question. Candidates that did well commented on risk transfer, surplus relief, cost and level of administrative difficulty, and premiums. To receive full credit, candidates were required to compare and contrast each attribute for both arrangements (e.g. YRT is X while Mod-Co is not X).

- **Risk Transfer**
  o Mortality/morbidity risks only under YRT vs. all risks under Mod-Co
- **Amount Reinsured**
  o YRT based on the NAAR ceded vs. percentage of face amount for Mod-Co

10. Continued

- **Surplus Strain**
  - o Mod-Co transfers surplus strain on the reinsured portion of new issues while YRT does not
  - o Mod-Co provides greater surplus relief vs. YRT
- **Premiums**
  - o For YRT, the premium rates are not directly related to the premium rates of the original plan of insurance
  - o For Mod-Co, the reinsurer receives its portion of the gross premium on all policies ceded
- **Cost of Reinsurance**
  - o YRT reinsurance is usually less costly for the ceding company vs. Mod-Co because administration may be simpler, the lapse and investment risks are smaller, and required capital is less

(b)   Assess which reinsurance arrangement is more effective at reducing the strain from new business on 2018 income. Show all work.

Commentary on Question:
This part of the question tested the candidates' understanding of the financial impacts of each type of reinsurance agreement on a company's statutory income statement. Candidates who did well were able to identify each piece that goes into the income statement and how it would be affected by the different agreements. Common errors include the exclusion of the annual policy fee from the gross premium; miscalculating (or excluding) the premium tax reimbursement for the reinsurance allowance; and not calculating components without reinsurance.

10. Continued

	Without Reinsurance		YRT		Modco	
Revenue						
Premiums						
Gross	A	5,020	A	5,020	A	5,020
Ceded			H	225	O	3,500
Net		5,020	I	4,795	P	1,520
Investment Income		0		0		0
Reinsurance Allowance		0	J	3.38	Q	3,553
Mod-co Adjustment		0		0	R	262.5
TOTAL REVENUE		**5,020**	K	**4,798.38**	S	**5,335**
Benefits						
Reserve Increase:						
Gross	B	375	B	375	B	375
Ceded		0	L	262.5		0
Net		375	M	113		375
Mod-co adjustment						
TOTAL BENEFITS		**375**		**113**		**375**
Expenses						
Commissions	C	4,518	C	4,518	C	4,518
First Year Expenses	D	400	D	400	D	400
Premium Tax	E	75.3	E	75.3	E	75.3
TOTAL EXPENSES	F	**4,993**	F	**4,993**	F	**4,993**
GAIN FROM OPERATIONS	G	**(348)**	N	**(307)**	T	**(33)**

Without Reinsurance

A) Gross Premium = Annual Policy Fee + Face Amount * Premium Rate per 1,000/1,000 = 20 + 500,000 * 10/1,000 = 5,020

B) Gross Reserves = Face Amount * Mean Reserves per 1000/1000 = 500,000 * 0.75/1000 = 375

C) Commissions = Gross Premium * Commissions = 5,020 * 90% = 4,518

D) First year expenses given = $400

E) Premium Tax = Gross Premium * Premium Tax = 5,020 * 1.50% = 75.3

F) Total Expenses = Commissions + FY Expenses + Premium Tax = 4,518 + 400 + 75.3 = 4,993

G) Gain from Operations = Total Revenue - Total Benefits - Total Expenses = 5,020 - 375 - 4,993 = (348)

10. Continued

YRT
H) Ceded Premium = YRT Premiums per 1000 * Amount Reinsured/1,000 + Annual Cession Fee = 0.60 * 350,000/1,000 + 15 = 225
I) Net Premium = Gross Premium - Ceded Premium = 5,020 - 225 = 4,795
J) Reinsurance Allowance = Ceded Premium * Premium Tax = 225 * 1.50% = 3.38
K) Total Revenue = Net Premium + Reinsurance Allowance = 4,795 + 3.38 = 4,798.38
L) Ceded Reserve = Amount Reinsured * Mean Reserves per 1000/1000 = 350,000 * 0.75/1000 = 262.5
M) Net Reserve = Gross Reserve - Ceded Reserve = 375 - 262.5 = 113
N) Gain from Operations = Total Revenue - Total Benefits - Total Expenses = 4,798.38 - 113 - 4,993 = (307)

Mod-Co
O) Ceded Percentage * Face Amount * Premium Rate per 1,000/1000 = 70% * 500,000 * 10 /1000 = 3,500
P) Net Premium = Gross Premium - Ceded Premium = 5,020 - 3,500 = 1,520
Q) Reinsurance Allowance = Ceded Premium * (Premium Tax + Expense Allowance) = 3,500 * (1.50% + 100%) = 3,553
R) Mod-Co Adjustment = Gross Reserve * Ceded Percentage = 375 * 70% = 262.5
S) Total Revenue = Net Premium + Reinsurance Allowance + Mod-Co Adjustment = 1,520 + 3,553 + 262.5 = 5,335
T) Gain from Operations = Total Revenue - Total Benefits - Total Expenses = 5,335 - 375 - 4,993 = (33)

Since Mod-Co gain from operations is largest, it is more effective at reducing new business strain.

(c) Construct a post reinsurance balance sheet for this block similar to the above, assuming the treaty structure is:

(i) Mod-Co

(ii) Mod-Co with Funds Withheld

(iii) Part-Co

Commentary on Question:
This part of the question tested the candidates' knowledge of different reinsurance arrangements on balance sheet components. A common error was miscalculating the initial reinsurance allowance. Candidates generally struggled with the Part-Co calculations.

10. Continued

Initial Reinsurance Allowance = 500 * 0.5 * 0.05 = 12.5

Mod-Co:
- The cedant receives cash and the reinsurer pays cash
- Bonds and reserves stay with the cedant

Mod-Co Funds Withheld:
- Cash is not impacted
- Bonds and reserves stay with the cedant
- A receivables/payable is set-up at the cedant/reinsurer

Part-Co:
- No impact to cash or bonds
- The initial coinsurance reserve is set equal to the initial reinsurance allowance

	ModCo Balance	Cedent	Reinsurer
i.	(+) Cash	12.5	-12.5
	(+) Bonds	500	0
	(-) Reserves	500	0
	(+) Receiv / payable	0	0
	(=) Surplus	12.5	-12.5

	ModCo Funds Withheld Balance	Cedent	Reinsurer
ii.	(+) Cash	0	0
	(+) Bonds	500	0
	(-) Reserves	500	0
	(+) Receiv / payable	12.5	-12.5
	(=) Surplus	12.5	-12.5

	PartCo Balance	Cedent	Reinsurer
iii.	(+) Cash	0	0
	(+) Bonds	500	0
	(-) Reserves	487.5	12.5
	(+) Receiv / payable	0	0
	(=) Surplus	12.5	-12.5