ILA LFMC Model Solutions
Fall 2020

1.

Learning Objectives:

4. The candidate will understand U.S. financial and valuation standards, principles and methodologies applicable to life insurance and annuity products.

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:

(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.

(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

LFM-148-20 The Theory of Risk Capital in Financial Firms

LFM-144-20 The Modernization of Insurance Company Solvency Regulation in the US, Klein, Networks Financial Institute Policy Brief, 2012 (exclude Sections 7 and 9)

Commentary on Question:
This question tested the candidates' knowledge of economic capital and financial management.

1. **Continued**

Solution:
(a) With regard to solvency regulation:

   (i) List two reasons U.S. regulators would be interested in international regulatory developments.

   (ii) Explain the shortcomings of the U.S. RBC factor-based approach compared to Solvency II's model-based approach.

Commentary on Question:
Candidates generally answered this part of the question well. Any two valid points in part (i) received full credit.

(i)
- U.S. regulators might be interested in international developments to identify potential improvements in U.S. regulation that they believe have merit.
- U.S. regulators may feel pressure to adopt certain methods to meet international standards or to prevent conflicts over "regulatory equivalency".
- U.S. regulators may wish to avoid federal intrusions into state regulation by adopting reforms that are reasonably consistent with international standards and address any perceived deficiencies in the current regulations.

(ii)
- The RBC approach is a one-size-fits-all approach, whereas a model-based approach can be tailored towards individual company characteristics.
- The RBC formula omits some risks, such as catastrophe and operational, that could be better quantified using a model.
- A model-based approach compels insurers to take a more forward-looking and comprehensive view of their risk and they can determine a regulatory capital amount that is more suited to their circumstances.
- The vast majority of U.S. insurance companies have regulatory capital significantly greater than the minimum amount that would require RBC action levels to be triggered; this calls into question how accurately the RBC formulas are actually measuring companies' financial risks.

(b) Describe the advantages and disadvantages of LHR operating at an economic capital ratio of 150% compared to 400%.

1. Continued

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

- 150% Pros: increases the return on capital by reducing the denominator.
- 150% Pros: Operating at this capital level ratio shows some level of capital efficiency if returns are commensurate
- 150% Cons: Mildly adverse performance may cause the insurer to breach the requirement over the next year and suffer the associated frictional costs and loss to franchise value
- 400% Pros: May increase the franchise value by attracting a greater amount of profitable business
- 400% Pros: Helps protect or enhance the interest of a number of stakeholders and to increase shareholder returns by avoiding costs of failure to meet the company's objectives
- 400% Cons: Can be seen as having a cost to the business relating to tax, investment costs and potentially agency effects, thus reducing shareholder value

(c) LHR is considering ways to reduce the economic capital being held for its block of Single Premium Immediate Annuities (SPIAs). Evaluate the effectiveness of each of the following techniques:

   (i) Diversification of risk through issuance of life insurance policies

   (ii) Securitization of longevity risk through issuance of a 10-year longevity bond

Commentary on Question:
For part (i) candidates received credit for any evaluation on how mortality risks of a life vs. annuity block could be mismatched. Candidates generally did not do well on part (ii).

   (i) Life insurance issuance - mostly ineffective.
   Diversification can provide some capital relief. But negatively correlated risks are rarely perfectly matched.
   Overall changes in mortality may affect life blocks differently from annuity blocks.

   (ii) Securitization through longevity bonds - should be effective.
   If the economic liability is below the attachment point, the insurer will not need to repay some of the principal. In fact, if the economic liability reaches the exhaustion point, the insurer would not need to repay any principal.

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1. **Continued**

> While such a bond is an out-of-the-money risk to the investor, it can immediately reduce an insurer's economic capital.
> While not stated explicitly in the text, it is clear from the text example that the reduction in economic capital is a function of reduction of tail risks in longevity. Credit is given for coherent discussion of this concept.

(d) Critique the following statements:

A. *Unit X is the least profitable business unit due to its large risk capital requirement. If LHR decides to eliminate a business unit, it should eliminate X.*

B. *The required risk capital of the combined X+Y+Z should be allocated across the business units.*

C. *Having unallocated risk capital would indicate LHR is not covering all of its risks.*

Commentary on Question:
Candidates generally critiqued statements A and B well. For statement C, candidates generally neglected to discuss the extreme case of perfect correlation between business units.

A. This is false; you must consider the correlation of risks amongst the units (the combination of units is 700, which is less than adding all 3 units, indicating there is some diversification benefit). A business that is unprofitable on a stand-alone basis may be profitable when there is other business with offsetting risks.

Calculating the marginal risk capital shows unit Z actually has the highest marginal capital. This indicates that eliminating unit Z would actually reduce required risk capital the most.

Unit	Marginal Risk Capital
X	180
Y	100
Z	240
Sum of Marginal Risk Capital	520

B. This is false; the total amount of capital allocated should be 520, the sum of the marginal capital amounts. Allocating all of the risk capital is usually not feasible and it can distort the profitability of each unit.

1. **Continued**

      C. This is false; having unallocated capital indicates that the profitability of the business units is not perfectly correlated. Only in the extreme case of perfect correlation will all capital be allocated. Since not all of LHR's capital is allocated, this indicates a diversification benefit amongst the business units; this diversification actually makes the company less risky than if the units were perfectly correlated.

2. **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:

A.M. Best's - Compendium of Publications

Commentary on Question:

This question tests the candidates' knowledge on how AM Best determines its capital adequacy ratio (BCAR) for a life insurance company, and how it can be used to evaluate alternative business decisions.

Solution:

(a)   AKL Life Insurance Company is a public company that was recently assigned a negative outlook by A.M. Best.

        (i)   Describe the process followed by A.M. Best that results in the rating agency assigning a negative outlook to an insurance company.

        (ii)   List three potential impacts of the negative outlook on AKL's day-to-day operations.

        Commentary on Question:

        For part (i), an outlook is issued in conjunction with a rating, and the process followed by Best is the same regardless of the ultimate assignment. To receive full credit, candidates needed to sufficiently describe the process from the collection of data all the way through to the dissemination of the rating/outlook.

        For part (ii), candidates only needed to list three of the seven potential impacts listed below to receive full credit.

2. **Continued**

    (i)   A rating analyst is assigned to facilitate and oversee the entire process.

        The first step in the process would be data collection and interviews. The analyst would collect internal data from the insurance company, including financial statements, internal models and management reports. The analyst would then conduct interviews with company management to better understand the data and the company's risk position.

        After several rounds of data collection and interviews, the analyst would perform financial analyses that measure the risks in the company, including equity risk, market risk, insurance risk and business risk. While performing these analyses, the analyst would also consider information from external sources, including the economic outlook of the market and industry.

        Based on the results of the financial analyses, the analyst would recommend a rating/outlook to a rating committee, and the committee would rigorously review the recommendation and make a final decision. The analyst would then share the committee's decision with the company first. The company would then decide whether to appeal, accept or withdraw from the decision before any information is released to the public.

    (ii)   Potential impacts of a negative rating are:

- Higher borrowing costs
- Increased regulatory pressure from governments
- Harder to raise capital
- Decreased sales or new business
- Increased lapses or lower persistency
- Negative pressure on stock price and concerns of shareholders
- Shareholders may seek higher returns given negative outlook

(b)   Calculate the BCAR for AKL. Show all work, including writing out relevant formulas used in any calculations.

Commentary on Question:
Generally, candidates calculated the BCAR correctly. Common errors included using one of the following formulas:
- *[(Available Capital - Net Required Capital) / Net Required Capital] x 100*
- *[Available Capital / Net Required Capital] x 100*

2. **Continued**

$$\text{Net Required Capital} = [(15 + 15)^2 + (5 + 5)^2 + (5)^2]^{0.5} + 2$$
$$= 34.02$$

$$\text{BCAR} = [(\text{Available Capital} - \text{Net Required Capital}) / \text{Available Capital}] \times 100$$
$$= [(100 - 34.02) / 100] \times 100$$
$$= 65.98$$

(c) AKL is considering buying a block of term life insurance business and selling a block of variable annuity (VA) business. Each transaction would impact capital as follows:

	Buy term	Sell VA	Both
Change in Net Required Capital	1	-2	-1
Change in Available Capital	-2	1	-1

(i) Recommend whether AKL should buy the term life insurance block, sell the variable annuity block, do both or do neither based on the BCAR score only.

(ii) Identify two considerations other than the BCAR score that should be taken into account when making the recommendation.

Commentary on Question:
The recommendation in part (ii) depends on recalculating the BCAR using the changes in Available Capital and Net Required Capital, and then comparing it to the base BCAR from part (b) above. The transaction that provides the largest BCAR will then be the recommended transaction. Generally, candidates who used the correct formula for BCAR made the correct recommendation. Candidates who used an incorrect formula received partial credit for calculating components correctly and demonstrating an understanding of the concepts.

For part (ii), candidates only needed to identify two of the four considerations listed below to receive full credit.

(i):

$$\text{BCAR} = [(\text{Available Capital} - \text{Net Required Capital}) / \text{Available Capital}] \times 100$$

$$\text{BCAR Neither} = \text{BCAR if neither transaction is done}$$
$$= \text{current BCAR}$$
$$= 65.98, \text{ from part(b)}$$

2. **Continued**

BCAR Buy	=	BCAR if term block is purchased but annuity block is not sold
	=	[(98 - 35.02) / 98] x 100
	=	64.27

BCAR Sell	=	BCAR if annuity block is sold but term block is not purchased
	=	[(101 - 32.02) / 101] x 100
	=	68.30

BCAR Both	=	BCAR if term block is purchased and annuity block is sold
	=	[(99 - 33.02) / 99] x 100
	=	66.64

Based on BCAR score only, AKL should sell the annuity block since the sale would maximize the score

(ii):
- Impact on share price
- Impact on other key metrics such as RBC, profit
- AKL's operational capacities and competencies, expertise, admin systems
- AKL's vision and strategy

3. **Learning Objectives:**
   2. The candidate will understand the professional standards addressing IFRS 17 financial reporting and valuation.

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

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.

(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:
-3 The Next Chapter - Creating an understanding of Special Purpose Vehicles, PWC, 2011

Commentary on Question:
This question tested the candidates' knowledge of special purpose vehicles.

Solution:
(a) For a typical structure of a Special Purpose Vehicle (SPV) used to obtain financing:

   (i) Describe the entities involved.

   (ii) Describe the interactions between them.

   Commentary on Question:
   Candidates who received full credit identified the four main entities and described the interactions between them, particularly with respect to the asset flows between the entities and noted the lower funding cost opportunities by moving certain assets to the SPV versus the corporation. Candidates generally did not describe the flow of assets between the entities or the lower funding cost opportunities.

   The Main Corporation creates a SPV (its affiliate) in order to sell assets on its balance sheet to the SPV and obtaining financing through the SPV.

   The SPV obtains funds to purchase the asset by way of debt financing from independent equity investors.

3. Continued

The SPV starts a circular transaction by transferring the money raised first to the main corporation and then to the investment bank. The assets flow in the opposite direction from the main corporation to the SPV and then to the investment bank and back to the main corporation, thus effectively cancelling each other out.

Since the SPV owns the assets, which then become the collateral for the securities issued, lenders evaluate the credit quality of the collateral and not the credit quality of the corporation. As a consequence, lower funding costs are possible. For example, a non-investment grade issuer might be able to obtain funding at investment-grade levels by isolating the assets in the SPV.

(b) Describe two key benefits and two key risks to a company sponsoring an SPV.

Commentary on Question:
Candidates received full credit if any of the 2 key benefits and 2 key risks below were identified and explained. Candidates generally did well on this part of the question.

Benefits
1. Asset Ownership – An SPV allows the ownership of a single asset often by multiple parties and allows for ease of transfer between parties.
2. Minimal red tape – Depending on the choice of jurisdiction, it is relatively cheap and easy to set up an SPV. The process may take as little as 24 hours, often with no governmental authorization required.
3. Clarity of documentation – It is easy to limit certain activities or to prohibit unauthorized transactions within the SPV documentation.
4. Freedom of jurisdiction – The firm originating the SPV is free to incorporate the vehicle in the most attractive jurisdiction from a regulatory perspective whilst continuing to operate from outside this jurisdiction.
5. Tax benefits – There are definite tax benefits of SPVs where assets are exempt from certain direct taxes. For example, in the Cayman Islands, incorporated SPVs benefit from a complete tax holiday for the first 20 years.
6. Legal protection – By structuring the SPV appropriately, the sponsor may limit legal liability in the event that the underlying project fails.
7. Isolation of Financial Risk– By structuring the SPV as an 'orphan company', the SPV assets may not be consolidated with the firm's on-balance sheet assets and are 'bankruptcy remote' in the event of bankruptcy or a default.
8. Meeting regulatory requirements – By transferring assets off-balance sheet to an SPV, banks are able to meet regulatory requirements by freeing up their balance sheets.

3. Continued

Risks

1. Lack of Transparency. The complexity of SPVs - often in the form of layers upon layers of securitized assets - can make it near impossible to monitor and track the level of risk involved and who it lies with.

2. Reputational Risk. The firm's own perceived credit quality may be blemished by the underperformance or default of an affiliated or sponsored SPV. For this reason, it is not a credible risk that the firm will abandon the SPV in times of difficulty.

3. Signaling Effect. The poor performance of collateral in an SPV attracts a high degree of attention and assumptions are made that the quality of the firm's own balance sheet can be judged on a similar basis.

4. Franchise risk. There is a risk that investors in an affiliated SPV are upset and this affects other relationships between the sponsor and these investors, for instance as holders of unsecured debt.

5. Liquidity and funding risk. The poor performance of an affiliated SPV may affect the firm's access to the capital markets.; moral hazard

6. Equity Risk. The firm might hold a large equity tranche in a vehicle (e.g. an SIV). If the firm does not step in and support or save the vehicle from collapse in difficult situations, the resulting winddown of the SPV and sale of the assets at depressed valuations is likely to erode the firm's equity in the SPV, to a greater extent than the firm stepping in and either affecting an orderly wind-down of the vehicle or bringing its assets back onto its balance sheet.

7. Mark-to-Market risk. The forced sale of assets from an affiliated SPV could depress the value of related assets that the firm holds on the balance sheet. The firm will want to prevent a large negative mark-to-market impact on its own balance sheet.

8. Regulation. The same regulatory standards do not apply to assets contained within an SPV as to the firm's assets on balance sheet. This is a reason that many firms opt for these vehicles in the first place. However, this lax regulation poses an indirect risk to the originating firm.

4.   **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.

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

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

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

Sources:
ILA-FM-C LO1: Canadian Taxation and IFRS 17 - Chapter 10, The Taxation of Life Insurance Policies

Commentary on Question:
This question tested the candidates' knowledge of taxation rules before and after 2017. Candidates generally did well on this question. To receive full credit candidates had to demonstrate an understanding of the impacts and application of the change in tax rules.

Solution:
(a)   Describe how the introduction of the new tax exemption rules in 2017 impacted the level of tax-exempt accumulation within a life insurance policy.

Commentary on Question:
While candidates generally demonstrated knowledge on the changes in taxation rules pre/post 2017, they did not elaborate on the impacts they had on the accumulated fund.

Changes in exempt testing rules:
  - The "endowment date" has increased from age 85 (or 10-year duration) to age 90 (or 15-year duration). This delays the time until the accumulating fund reaches the ultimate tax-exempt room, meaning a decrease in tax exempt accumulation room in later durations.
  - The pay period of the endowment of the accumulating fund has moved from 20 years to 8 years. The exempt test policy accumulating fund will increase faster under the 8-pay period model, meaning there will be greater tax-exempt room in the early durations of the policy.

4. Continued

- The interest rate of the accumulating fund of an exempt test policy has changed from 4% to 3.5%. This delay in accumulation due to lower interest rate will decrease the amount of tax-exempt accumulation in later durations.

(b) You are given the following information for a UL policy issued at age 40:

Level Face Amount = 100,000

Policy Year	Beginning of Year Projected Account Value at Issue
1	0
2	4,445
3	6,000
4	7,815
5	9,490
6+	0

You are given the following actuarial present value functions, where $A_{x:\overline{n}|}$ is the present value of a life insurance policy which endows at attained age x+n:

$$A_{x:\overline{n}|} = x/150 + n/1000, \text{ for when the annual interest rate is 3.5\%}$$

$$A_{x:\overline{n}|} = x/200 + n/400, \text{ for when the annual interest rate is 4.0\%}$$

Determine the tax-exempt status at issue of the above policy:

(i) issued in 2015

(ii) issued in 2020

Show all work, including writing out relevant formulas used in any calculations.

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

4. **Continued**

(i)

Discount Rate	Endowment Age	Duration	Discount rate
100,000* A60:25	60	25	4.00%

End of Pay Period	36,250

End of Policy Year	Policy AF	ETP AF	Tax exempt test
1	4,445	1,813	No
2	6,000	3,625	No
3	7,815	5,438	No
4	9,490	7,250	No
5	-	9,063	Yes
…			

Tax exempt if Policy AF < ETP AF

(ii)

Discount Rate	Endowment Age	Duration	Discount rate
100,000* A48:42	48	42	3.50%

End of Pay Period	36,200

4. **Continued**

End of Policy Year	Policy AF	ETP AF	Tax exempt test
1	4,445	4,525	Yes
2	6,000	9,050	Yes
3	7,815	13,575	Yes
4	9,490	18,100	Yes
5	-	22,625	Yes
…			

Tax exempt if Policy AF < ETP AF

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

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

CIA Educational Note: Estimates of Future Cash Flows under IFRS 17

IAN 100 Application of IFRS 17 (exclude section D)

Commentary on Question:
This question tested the candidates' understanding of key reporting concepts for IFRS 17, and how they are changing compared to IFRS 4.

Solution:
(a) Describe four sources of profits or losses under the IFRS 17 General Measurement Approach.

Commentary on Question:
Candidates generally did well on this part of the question. Most candidates were able to provide and describe four sources of profit. Note that although the solution below includes five sources of profit in loss, only four were required for full credit. Candidates who focused on describing components of an income statement (Insurance Service Revenue, Insurance Service Expense, Insurance Finance income) received full credit if they explained what the income statement terms represented.

5. **Continued**

Insurers typically earn profits through the insurance service provided and investment results from managing financial assets. The total profit or loss of a group of insurance contracts is the difference between total cash inflows and outflows arising from these contracts. Sources of profit include:

1) Actual liability cash-flows that are different than best estimate assumptions. As actual experience emerges and mortality, lapse, morbidity etc. result in different cash-flows than expected in the actuarial assumptions, this will result in profit or loss.

2) Release of the CSM into profit as the company provides the insurance service over the coverage period for non-onerous contracts. The loss from onerous contracts will be recognized when the contracts are issued.

3) Release of the risk adjustment into profit as the company provides the insurance service over the coverage period.

4) Changes in the liability discount rate as market rates change. This will change the Time Value of Money component of the Insurance Liability calculation, with changes flowing through profit or loss.

5) Investment Income (or loss) from assets backing the insurance contract liability.

(b) Critique the following statements with respect to IFRS 17.

A. *IFRS 17 valuation includes both cash flows that relate directly or indirectly to the fulfilment of an insurance contract. Expenses such as claims handling costs, policy administration costs, and overhead are included. However, expenses from abnormal amounts of wasted labour, tax payments, and receipts the insurer does not pay or receive in a fiduciary capacity should be excluded.*

B. *The inclusion of acquisition expenses in the present value of future cash flows reduces the Contractual Service Margin (CSM), and results in the deferral of those expenses to be recognized in profit later. This is similar to the DAC asset that is held on the balance sheet and amortized over time under IFRS 4.*

C. *The IFRS 17 Standard does not specify any particular method to determine coverage units, so the actuary could apply judgment. Coverage units reflect the quantity of the benefits provided under a contract and its expected coverage duration. The quantity of benefits is based on the benefits expected to be incurred by the insurer. Coverage units should be calculated net of reinsurance. For practical reasons, to simplify calculations, coverage units can be based on the present value of benefits provided without discounting.*

5. Continued

> D. *Insurance contract liabilities of short-term insurance contracts will decrease when moving from IFRS 4 to IFRS 17.*

Commentary on Question:
Candidates who only identified if the statement was true or false did not receive any credit since all of the statements were partially true and partially false.

To receive full credit, candidates had to explain why the statements were correct or not.

Candidates generally critiqued the first 3 statements well. Candidates generally did not note that for statement C the quantity of benefits expected to be incurred should be from the policyholder perspective. For statement D, candidates generally discussed PAA, but did not discuss CSM and risk adjustment.

A.
"*IFRS 17 valuation includes both cash flows that relate directly or indirectly to the fulfilment of an insurance contract.*": This statement is incorrect. Only cash flows that are directly related to the fulfilment of an insurance contract should be included in IFRS 17 valuation, indirect cash flows should be excluded.

"*Expenses such as claims handling costs, policy administration costs, and overhead are included.*" Claims, handling costs, policy administration costs, are directly attributable to the fulfilment of an insurance contract and so should be included in the cash flows for IFRS 17 valuation. Any overhead expense that can be directly attributable should also be included.

"However, expenses from abnormal amounts of wasted labour, tax payments, and receipts the insurer does not pay or receive in a fiduciary capacity should be excluded." Expenses from abnormal amounts of wasted labour, tax payments, and receipts the insurer does not pay or receive in a fiduciary capacity will generally not be directly attributable and so should be excluded from the cash flows. Tax payments related to IIT and policy taxes will be directly attributable and so should be included.

5. Continued

B. *"The inclusion of acquisition expenses in the present value of future cash flows reduces the Contractual Service Margin (CSM), and results in the deferral of those expenses to be recognized in profit later. This is similar to the DAC asset that is held on the balance sheet and amortized over time under IFRS 4."*
The inclusion of acquisition expenses in the present value of future cash flows will reduce CSM (assuming that it is a non-onerous contract), since acquisition expenses reduce the expected profit of a contract at issue. Since the CSM is amortized as the insurance service is provided, this effectively results in the expenses being amortized for recognition in profit over the life of the contract. Although this is somewhat similar to the DAC asset there is a key difference. Acquisition expenses reduce the CSM under IFRS 17, reducing the company's total liabilities. The DAC asset is held as a separate asset under IFRS 4.

C. *"The IFRS 17 Standard does not specify any particular method to determine coverage units, so the actuary could apply judgment."*
This statement is correct, determination of coverage units requires application of careful judgement, and consideration of the facts and circumstances to best achieve the principles of reflecting services provided in the period.
"Coverage units reflect the quantity of the benefits provided under a contract and its expected coverage duration."
This statement is correct, coverage units should reflect the quantity of benefits provided under a contract and its expected duration.
"The quantity of benefits is based on the benefits expected to be incurred by the insurer."
This statement is incorrect, the quantity of benefits should be determined from the perspective of the policy holder.
"Coverage units should be calculated net of reinsurance."
This statement is incorrect. Coverage units should be calculated gross of reinsurance since the underlying business and reinsurance are valued and reported separately.
"For practical reasons, to simplify calculations, coverage units can be based on the present value of benefits provided without discounting."
This is correct. IFRS 17 does not specify if the time value of money should be considered when determining the release pattern for CSM, therefore it is left up to the discretion of the reporting entity.

D. *Insurance contract liabilities of short-term insurance contracts will decrease when moving from IFRS 4 to IFRS 17.* There are too many unknown variables to know if IFRS 17 will have a higher or smaller liability than IFRS 4. Some items to consider for short-term liabilities:
i) When using the Premium Allocation Approach for short term products under IFRS 17 a company is not required to discount the liability for incurred claims, if it expects them to be settled in a year or less.

5. Continued

        ii) The risk adjustment under IFRS 17 may be higher or lower than the PfADs held under IFRS 4.

        iii) Consideration should be given to the impact of the CSM, which results in different recognition of profit and loss under IFRS 4 vs IFRS 17.

(c)   Recommend an appropriate IFRS 17 contract boundary for the following annuity product. Justify your answer.

- Single premium fixed annuity with a deferral period of 10 years.
- Annuity benefits are based on the book value at the end of the deferral period with a minimum of 30 basis points (bps) annuitization rate.
- Risk Free Rate = 40 bps

Commentary on Question:
Candidates generally did not do well on this part of the question and did not demonstrate an understanding of what a contract boundary is under IFRS 17. Candidates that did recommend a contract boundary did not provide sufficient justification. Full credit was given to candidates who proposed a contract boundary of the lifetime of the policyholder if they considered the 30 bps guarantee to be a substantive obligation.

The contract boundary should be determined based on the following questions:
1) Does the entity have the right to compel the policyholder to pay the premiums?
2) Does the entity have a substantive obligation to provide the policyholder with services? A substantive obligation ends when the entity has the practical ability to reassess the risks of the particular policyholder and set a price or benefit that fully reflects those risks.

For this question, the obligations of the entity will be the determining factor in the contract boundary, with the question being if the 30 bps minimum guarantee prevents the entity from fully reflecting risks when they price the annuity 10 years from now. Given the company's ability to include a liquidity premium on top of the risk-free rate (which is currently higher than the guaranteed 30 bps), the 30 bps guarantee does not appear to be a substantive obligation.

Since the 30 bps guarantee is not a substantive obligation, I recommend a 10 year contract boundary for the accumulation phase of the annuity. The payout phase of the annuity should be considered a new contract.

6. **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:
IFRS 17 Insurance Contracts – IFRS Standards Effects Analysis, May 2017, IASB (sections 1, 2, 4 & 6.1-2 only)

IFRS 17 Spreadsheet Model
PwC In depth A look at current financial reporting issues IFRS 17 June 2017

Commentary on Question:
This question tested the candidates' understanding of the contractual service margin in IFRS 17.

Solution:
(a) You are given the following information about groups of insurance contracts that were issued in prior years:

IFRS 17 Group	CSM at beginning of current year	Impact of Current Year Assumption Changes on the Fulfilment Cash Flows		
		Mortality	**Lapse**	**Discount Rates**
A	50,000	25,000	(4,000)	8,000
B	10,000	15,000	(2,000)	6,000

IFRS 17 Group	Interest Rate for Current Year			Coverage Units	
	At Current Period Start	**At Current Period End**	**At Initial Recognition**	**Current Service**	**Future Service**
A	4.2%	4.0%	5.0%	5,000,000	60,000,000
B	4.2%	4.0%	4.5%	3,000,000	50,000,000

The IFRS 17 general measurement approach is used for this block of business.

Calculate the CSM for each of Groups A and B at the end of the current year. Show all work, including writing out relevant formulas used in any calculations.

6. **Continued**

Commentary on Question:
This part of the question tested the candidates' knowledge of calculating the CSM at subsequent measurement. Successful candidates demonstrated a clear understanding of the parts that make up CSM.
Candidates generally did well on this part of the question. Most candidates were able to identify all the components required in calculation of the CSM and recognize that CSM cannot be negative.
Common errors included (1) calculating the amortization rate incorrectly by taking only the current service coverage unit/future service coverage unit, and (2) calculating the CSM amortization amount prior to the interest accretion and changes in non-financial assumptions.

EOY CSM = BOY CSM + New contracts added to the group + Interest Accreted on the CSM +/- Changes to the FCF relating to future coverage due to Non-Financial Assumptions - Amortization of the CSM

The CSM must be calculated separately for each group.
There are no new contracts provided in the question, so this step is ignored in the CSM Reconciliation below.

	IFRS17 Group A	IFRS17 Group B	Comments regarding the components
BOY CSM	50,000	10,000	
Interest Accreted = locked-in interest rate * BOY CSM	2500	450	Assuming the General Model approach is used, interest is accreted based on the locked-in rate at initial recognition
Changes Related to Non-Financial Assumptions = - (impact of mortality + impact of lapse)	-21,000	-13,000	Discount rate change is a financial assumption, and does not affect the CSM. For the changes related to future FCF due to non-financial assumptions, since the net change in the liability is positive, it reduces the CSM
CSM Before Amortization (Sum of above 3 rows, floored at 0)	31,500	0	CSM cannot be negative, so is floored at 0.
CSM Amortization Rate = By Group: Current Service/(Current Service + Future Service)	7.692%	5.660%	This rate is based on coverage units, and is the ratio of current services/(the CSM before amortization was already 0, then there is no CSM to amortize for the period current + future services)

CSM Amortization = CSM Before Amortization * CSM Amortization Rate by Group	2423.08	0	If CSM before amortization is already 0, then there is nothing to amortize for the period.
EOY CSM = CSM Before Amortization – CSM Amortization	29,077	0	Floored at 0, since CSM cannot be negative.

(b) You are given the following information for a Single Premium 3-Year Term Life insurance product:

Face Amount:	100,000
Single Premium:	1,000
Annual Expected Mortality Rate	0.1%
Annual Expected Lapse Rate	5.0%
Risk Free Rate	0.4%
Liquidity Adjustment	0.1%
Asset Earned Rate	1.5%
Risk Adjustment (as % of expected claims)	20.0%
Annual Attributable Maintenance Expense	75
Attributable Acquisition Expense (excluding Commissions)	200

Assume:

- The single premium is received at the start of year 1
- Acquisition expenses and commissions are incurred at the start of year 1
- Claims and maintenance expenses are incurred at the end of each year
- The IFRS 17 general measurement approach is used for this block of business.

Determine the maximum amount of commission that can be paid at time of issue without making this contract onerous at inception under the IFRS 17 standard. Show all work, including writing out relevant formulas used in any calculations.

Commentary on Question:
This part of the question tested the candidates' knowledge of the relationship between an onerous contract and its CSM. Successful candidates understood that CSM had to be non-negative, and that onerous contracts had no CSM. Candidates also had to calculate the best estimate liability and risk adjustment and when combined, know how they make up the CSM.

6. Continued

Common errors included the following:
- *Not accounting for survivorship in the $75 directly attributable maintenance expenses each year.*
- *Calculating the End of Year Coverage Units (survivorship) incorrectly.*
- *Applying the risk adjustment factor to the expenses instead of just the claims.*
- *Not including the directly attributable acquisition expense.*
- *Using the top down approach and calculating it as the asset earned rate less the liquidity adjustment.*
- *Only taking the first year's cash flows in calculating the CSM.*

Fulfillment cash flows = Best Estimate Liability + RA
= PV(Cash Outflows) - PV(Cash Inflows) + Risk Adjustment

where the PV(Cash Outflows) will also include the time 0 commissions.

A contract that is onerous will have 0 CSM. Thus the **maximum amount of commission that can be paid is the amount that will make the CSM = 0**.
CSM = max(-(FCF + RA), 0), thus we need to make FCF + RA = 0.

Coverage Units Reconciliation	Year 0	Year 1	Year 2	Year 3
BOY Coverage Units =BOY CU(t) = EOY CU(t-1)		100,000	94,900	90,060
Deaths = 0.1% * BOY CU(t)		100.00	94.90	90.06
Lapses = 5% * BOY CU(t)		5,000	4,745	4,503
EOY Coverage Units = BOY CU – Deaths - Lapses		94,900	90,060	85,467
Probability of Survival Pt = Pt-1*(1-Q(death)t-Q(lapse)t)	1	94.90%	90.06%	85.47%
E(Claims) = Deaths		100.00	94.90	90.06
Maintenance Expenses** =75*BOY CU(t)/100,000		75	71.175	67.545075
Attributable Acqn Expenses (provided)	200			
Risk Adjustment (20% * E(Claims)		20.00	18.98	18.01

6.   Continued

**Since the maintenance expenses are directly attributable, they should be weighted by the coverage units/probability of being alive at the end of each year.

Discount rate to use = risk free rate + liquidity adjustment = 0.4% + 0.1% = 0.5%. There is not enough information to use the top-down approach.
Calculating the present values of the above cash flows back to time 0, discounted at the 0.5% per year:

PV of Expected Claims	282.18
(+) PV of Expenses	411.64
(-) Premium	1000
(=) PV (Cash Outflows - Cash Inflows)	(306.18)
(+) PV (Risk Adjustment)	56.44
CSM = max(0, - BEL + RA)	249.74

<- The maximum amount that the commission can be is this amount, as anything larger would make the CSM negative

Check (taking the components above to confirm that using the 249.74 commissions gets the CSM to $0):

PV of Expected Claims	282.18
(+) PV of Expenses	411.64
(+) Commissions (from above)	249.74
(-) Premium	1,000.00
(=) PV (Cash Outflows - Cash Inflows)	(56.44)
(+) PV (Risk Adjustment)	56.44
CSM = max(0, - BEL + RA)	0.00

7. **Learning Objectives:**
2. The candidate will understand the professional standards addressing IFRS 17 financial reporting and valuation.

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

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.

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

OSFI B-3 Sound Reinsurance Practices and Procedures

Commentary on Question:
This question tested the candidate's knowledge on reinsurance. Candidates did well in recognizing the principles to assist FRIs in developing prudent approaches to managing reinsurance risks. However, most candidates failed to elaborate these principles in detail.

Regarding IFRS 4, candidates clearly understood the regulatory requirement for ceded liabilities. However, few candidates correctly explained the classification of reinsurance contracts.

Solution:
(a) Describe the four principles of a sound Reinsurance Risk Management Policy.

Commentary on Question:
In general, candidates did well in identifying the four principles but did not provide sufficient description to demonstrate complete knowledge.

7. Continued

Principle 1: A Federally Regulated Insurer should have a sound and comprehensive reinsurance risk management policy (RRMP) that is overseen by senior management.

- The policy should include purpose and objectives for seeking reinsurance, risk diversification objectives, risk concentration limits and ceding limits and the practices and procedures for managing and controlling its reinsurance risks
- A RRMP should include the roles and responsibilities related to the RRMP, process for ensuring that the RRMP is updated regularly, policy on the use of registered and unregistered reinsurance
- Senior management should oversee the RRMP design, implementation and annual review.
- Senior management is responsible to ensure the RRMP is supported by business operations, including that appropriate policies, procedures and internal controls.

Principle 2: A Federally Regulated Insurer should perform a sufficient level of due diligence on its reinsurance counterparties on an on-going basis to ensure that the FRI is aware of its counterparty risk and is able to assess and manage such risk.

- Due diligence should reflect the level of exposure to the counterparty
- Consider counterparty's ability to meet liabilities under exceptional but plausible adverse events
- FRI should conduct its own due diligence in addition to using third party assessments
- When performing its due diligence, the FRI consider the reinsurance counterparty's claims payment record, expected future claims obligations, balance sheet strength, funding sources (capital and liquidity), management, retrocession arrangements
- Update due diligence regularly throughout the life of the reinsurance contract.
- Conduct more thorough due diligence for unregistered reinsurers. Consider regulatory and supervisory regime plus legal and insolvency frameworks applicable to the unregistered reinsurer.

Principle 3: The terms and conditions of the reinsurance contract should provide clarity and certainty on reinsurance coverage.

- Ensure reinsurance contract is executed prior to the effective date of reinsurance coverage. Contract wording should clearly reflect all material terms and conditions agreed to by all parties.

7. **Continued**

- Where a comprehensive reinsurance contract is not executed prior to the effective date, interim reinsurance coverage outlined in less formal document (e.g., slip, cover note, letter of proposal, binding letter of intent)
- Sometimes, FRI may enter into a supplemental or subordinated reinsurance contract, a side letter, or other types of arrangements that are ancillary to, and form part of, the main reinsurance contract.

Principle 4: A ceding FRI should not be adversely affected by the terms and conditions of a reinsurance contract.

- A binding reinsurance agreement should ensure funds are available to cover policyholder claims in the event of either the cedant's or reinsurer's insolvency
- Ceding FRIs should ensure that all reinsurance contracts contain an insolvency clause clarifying that the reinsurer must continue to make full payments to an insolvent cedant without any reduction resulting solely from the cedant's insolvency.
- Reinsurance contracts should not contain other types of terms or conditions that may *limit* a troubled or insolvent cedant's ability to enforce the contractual obligations of a reinsurer.
- For funds withheld arrangements, the contract must clearly provide that, in the event of the cedant's or reinsuer's insolvency, the funds withheld, less any surplus due back to the reinsurer, must form part of the property of the cedant's general estate.

(b) Critique the following statements with respect to the valuation of gross policy liabilities and reinsurance recoverables under IFRS 4:

A. *An insurer can offset reinsurance recoverables against the related gross liabilities; ceded liabilities are not required to be disclosed for financial reporting or regulatory purposes.*

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

C. *A simple "gross-up" of the net liability can be used to determine the gross liability for all elements of an insurer's net liability. The reinsurance recoverables can then be calculated as the difference between the gross and net liabilities.*

7. Continued

    D. Any provision for impairment of the reinsurance recoverables should be included in the gross liability

    E. Direct written contracts are to be classified as insurance contracts, financial instruments or service contracts. The corresponding ceded reinsurance contract must follow the classification of the direct contract.

    F. It is expected that margins would be consistent between the gross liability and the net liability.

Commentary on Question:
Generally, candidates clearly demonstrated an understanding of the treatment of ceded liabilities under IFRS 4. However, few candidates recognized the reinsurance contract is not necessary to follow the classification of the direct contract in statement E.

A. It is incorrect. Insurer shall not offset reinsurance recoverable against the related gross liabilities. Ceded liabilities are required to be disclosed.

B. It is correct.

C. It is incorrect. It is unlikely that a gross-up methodology would be appropriate for all elements of the net liability. For example, it would not be appropriate for temporary tax timing differences as the effect on the gross liability would not be proportionate to the effect on the net liability.

D. It is incorrect. The provision related to recoverability should be included in the net liability.

E. It is incorrect. The classification of direct written contracts and the corresponding ceded reinsurance contract may differ. Examples include some financial reinsurance arrangements.

F. It is correct.

8.
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: Valuation of Universal Life Insurance Contract Liabilities

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

Commentary on Question:
This question tested the candidates' knowledge on developing valuation assumptions.

Solution:
(a)   Describe four special considerations in determining economic best estimate valuation assumptions under CALM for UL policies that are not required for traditional whole life policies.

Commentary on Question:
This part of the question tested the candidates' knowledge of the best-estimate economic assumptions used in the valuation of UL products. Candidates generally did not do well on this part of the question, with most candidates not focused on economic assumptions. Only four of the five considerations listed below were required to be described for full credit.

In addition to expected assumptions for investments, asset defaults, reinvestment strategies, and inflation, special considerations needed for UL under CALM that are not required for traditional whole life policies include:

1) Scenario Testing of Interest Rate Risk
Both deterministic and stochastic modeling can be used. Stochastic modeling is helpful in assessing exposure to certain risks such as interest guarantees and bonuses linked to interest rates. If stochastic modeling proves impractical, the actuary would, at a minimum, test additional interest scenarios.

8. **Continued**

2) Scenario Testing of Non-Fixed Income Assets
In the presence of substantial equity investments supporting insurance contract liabilities, the actuary may choose PfADs on non-fixed investment returns by scenario testing. However, the provision resulting from applying the methodology in paragraph 2340.13 constitutes a minimum provision if scenario testing is not employed.

3) Considerations for Investments Supporting Policy Owners' Fund
- Asset/liability matching may be difficult when the insurance contract liability is less than the amount of funds in the investment option.
- The actuary would project the investment returns for the assets supporting the policy owner funds. The actuary might blend some or all of the equity-linked funds in setting the expected investment return assumption by making assumptions about policy owners' fund mix in future years.
- The actuary might model each equity fund separately and make explicit assumptions about fund transfers made by policy owners to achieve a target mix in future years. In this case, the actuary would make an assumption about the extent to which these funds are correlated.

4) Considerations for Investments Supporting Insurance Contract
- When the insurance contract liability is less than the amount of funds in the investment option (e.g., UL contracts with YRT COI charges and minimal interest rate guarantees and the policy owner funds are matched with an equal amount of assets), the insurance funds are then supported by negative assets that are equivalent to the present value of future gains (e.g., mortality charges less mortality costs, expense charges less actual expenses, actual crediting spreads less actual expenses covered by spread, etc.).
- A sizeable insurance component may build up for UL contracts with Level COI charges. The resulting insurance cash flows usually have a very long duration and could be supported by long-term fixed income assets or by non-fixed income assets.

5) Inflation

For UL, inflation rate may have an effect on policy owner benefits such as death benefits and critical illness benefits linked to the Consumer Price Index (CPI).

8. Continued

(b) Explain how the valuation assumptions including margins differ between the two blocks of business for the following assumptions:

    (i)   Mortality

    (ii)   Expenses

    (iii)   Lapses

    (iv)   Premium persistency

Commentary on Question:
This part of the question tested the candidates' knowledge of valuation assumptions for different products. Candidates were generally able to explain how best-estimate assumptions would differ, but few candidates were able to properly describe the considerations for determining margins. Many candidates stated that margins should be higher when the best-estimate assumption is more adverse, which may not always be true. For example, if the product with simplified underwriting has fully credible experience and the product with full underwriting is new and there is no prior experience.

Generally, candidates did well for parts (i) and (iii). In part (ii) many candidates commented on the fact UL A would have lower expenses because it had simplified underwriting, even though the question was pertaining to valuation assumptions. Part (iv) was generally not well done, with many candidates misunderstanding the concept of premium persistency. Most candidates stated that the minimum funded product would have lower premium persistency, when the opposite is likely true.

    (i)   Mortality

UL A should use a higher best estimate mortality assumption than UL B because it has more anti-selection due to the following:
- Simplified underwriting
- Marketed as a minimum funded product, i.e. protection oriented

Therefore, UL A should use a higher best estimate mortality assumption than UL B.

UL B may require a mortality improvement assumption if it is death supported, which is possible with UL products that have a level COI, level NAAR, and heavily YRT reinsured.

8. Continued

With respect to margins, UL B may require a negative margin depending on if it is death supported. The opposite would be true for mortality improvement for the same reason. The size of the margin would potentially be commensurate with the quality and quantity of experience data available for each type of product which may depend on the company's historical experience.

(ii)   Expenses

Expense assumption should cover standard maintenance plus fund related costs.
*   Higher expense for UL B due to more investment choices. Likely more exempt testing as well since it is crucial for tax-preferred cash value buildup.
*   Higher expense for UL B due to more investment switches, but will depend on economic market conditions. In higher interest rate scenarios, more switches can be expected on UL B.
*   Less fund build up in UL A is expected since it was sold as a T100 replacement.

With respect to margins, a wider margin might be required if the business is volatile (e.g. new and growing), or if the company has historically had difficulty managing expenses (e.g. poor cost containment, overruns).

(iii)   Lapses

UL A should have higher lapses than UL B for the following reasons:
*   UL A has lower surrender charges which run off faster than UL B.
*   UL B has a persistency bonus which encourages increased persistency.
*   UL B has level COI charges which generally have lapse characteristics similar to T100, i.e. lapse supported
*   UL A sold for death benefit protection and has increasing YRT charges. Will lead to anti-selective lapses as the COIs increase. The policyholder may assess if future elevated COIs are worth paying in exchange for the death benefit, depending on their remaining life expectancy. It will only make sense for those with less time left to live

With respect to margins, the adjustment will be in different directions if UL A is lapse sensitive and UL B is lapse supported. Additionally, if regulation (tax, capital, etc.) impact the value of certain classes of products such as Level COI UL or the economic environment increases the value of certain guarantees or bonuses that are difficult to predict, these might warrant wider margins for UL B. Other factors may include the extent to which the company has credible experience on either product and the degree of sensitivity to deviations in lapse experience.

8. **Continued**

(iv)   Premium Persistency

UL A may have higher premium persistency than UL B:
- Minimum funded policies means premiums need to be paid regularly to keep policies funded.
- UL B will likely feature higher amounts paid in early years until fully funded. The bonus structure encourages high funding in the first ten years as allowable within the exempt test/MTAR line of the policy.

In terms of margins, it's possible that the margin for premium persistency is implicitly tied to the lapse/withdrawal assumption, i.e. net deposits. To reflect that one margin applies to two distinct underlying assumptions, the margin would therefore be wider than the standalone margins, and would vary between UL A and B based on considerations for differences in lapse/withdrawal and premium persistency.

9.

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:

Report of the Task Force on Segregated Fund Liability and Capital Methodologies (Aug 2010) [Can-1-32]

CIA Educational Note: Reflection of Hedging in Segregated Fund Valuation – May 2012 [Can-1-13]

Commentary on Question:

This question tested the candidates' knowledge of the valuation of segregated fund guarantees.

Solution:

(a) With respect to methods of valuing segregated fund policy liabilities:

 (i) Explain why avoiding excessive and unnecessary pro-cyclicality is a desirable feature.

 (ii) List five other desirable features.

 Commentary on Question:
 For part (i) candidates were expected to define pro-cyclicality and describe why it is undesirable in valuation. In general, candidates did not relate long duration liabilities to short term market variability nor explain why a market crash may result in increased guarantees and increase in hedging costs.

 For part (ii) full credit was received if candidates explained features without listing the actual names.

9. **Continued**

       (i)   Pro-cyclicality is the idea that value of the guarantee increases when markets crash due to the increased in-the-moneyness and the fact that market volatility increases after a crash. This impacts the expected guarantee payoff and the cost of hedging. Segregated fund guarantees are often long duration and the unhedged liabilities are driven by long-term views on investment returns. Given the contracts are long-duration liabilities, it may not make sense to fully reflect short-term volatility that arises from market crashes, which is not expected to persist.

       (ii)   Desirable features of valuing segregated fund policy liabilities:
1. Practical
2. Economically sound
3. Comprehensive
4. Comparable
5. Results in an appropriate emergence of profits
6. Avoid excessive and unnecessary pro-cyclicality

(b)   With respect to hedging in the context of CALM valuations:

       (i)   Describe the steps required for a first-principles application of CALM with a dynamic hedging program.

       (ii)   Describe the risks and costs of hedging to reflect in valuation.

Commentary on Question:
Candidates generally did well on part (i). For part (ii), most candidates did not describe enough risks and costs required for full credit.

       (i)   **Steps for a first-principles approach to CALM dynamic hedging:**
1. Generate real-world stochastic scenarios of market assumptions; investment returns and interest rates.
2. For each scenario,
    a. Project liability cash flows over the term of the liabilities using actuarial assumptions that include MfADs,
    b. At each time step, calculate the Greeks (those being hedged),
    c. Using the information from step b, project the rebalancing of the hedge portfolio and the resulting hedge portfolio cash flows,
    d. Perform a roll-forward CALM cash flow test to determine the amount of required assets which reduce to zero at the last liability cash flow, taking into account the cash flows from the hedge portfolio calculated in step c.
3. Calculate the CTE (60% to 80%) of the value of required assets.

9. **Continued**

      (ii)   The following are risks and costs associated of hedging that should be reflected in valuation:

1. Basis risk: Basis risk arises from the imperfect alignment between hedging instruments and fund returns underlying segregated fund guarantees. Hedging programs typically use derivative instruments which derive their value from market indices, while the segregated fund products offer managed fund investment options whose goal is often to outperform some benchmark. Hedging instruments do not replicate the element of active management and may also fail to exactly replicate the indices they are tracking.
2. Liquidity risk: Non-commission-type costs associated with transactions required to rebalance the portfolio.
3. Transaction costs and commissions: Hedging programs can have significant amounts of trading which generate transaction costs.
4. Counterparty risk: Additional credit risk associated with derivatives specifically related to the hedging program.
5. Volatility risk: Dynamic hedging strategies such as delta hedging eliminate market/delta risk but introduce volatility/vega risk. In volatile markets, the cost of rebalancing the portfolio can increase substantially.
6. Risks intentionally not hedged: For practicality/materiality purposes, insurers may choose not to hedge certain risks, such as gamma risk
7. Risks not explicitly modelled: Would need to be included in the valuation in some fashion.
8. Discrete vs continuous rebalancing: In practice, dynamic hedging strategies are designed such that they rebalance at discrete intervals, which is different than theoretical strategies based upon continuous rebalancing. Less frequent rebalancing in modelling versus in practice would imply conservatism in the valuation.
9. Operational risk: Hedging programs can introduce new operational risk due to their complexity.

(c)   NewCo Life recently introduced their first segregated fund product with guarantees. NewCo will dynamically hedge most, but not all, aspects of the liability.

       For valuation, NewCo is considering using either the Adapted Risk Neutral Method or the Hedge Cost Method as an approximation to the First Principles Stochastic-on-Stochastic Method.

      (i)   List the pros and cons of both approximation methods.

      (ii)   Recommend an approximation method. Justify your answer.

9. Continued

Commentary on Question:
For part (i), most candidates were able to list the pros and cons of both the Adapted Risk Neutral (ARN) method and the Hedge Cost (HC) Method. In part (ii) candidates were expected to choose and provide sufficient rationale between ARN and HC. Candidates were given credit for recommending the HC method if appropriate justification was provided. Some candidates chose another method, and received appropriate credit based on rationale.

(i) **Pros and Cons of each approximation:**
   a. Adapted Risk Neutral Method
      i. Pros:
         1. Does not require a stochastic-on-stochastic projection
         2. Does not require development of proxy functions
      ii. Cons:
         1. Lack of convergence to CALM when only partial hedging is employed
         2. Amount of hedges held is not explicitly calculated
   b. Hedge Cost Method:
      i. Pros:
         1. No stochastic inner loop required
         2. Useful when analyzing CTE(0)
      ii. Cons:
         1. Produces a distribution of outcomes that is significantly different from the true outcomes
         2. Amount of hedges held is not explicitly calculated

(ii) **Recommend an approximation method:**

I recommend NewCo use the Adaptive Risk Neutral (ARN) method.

ARN can be appropriate when material hedging is performed against a risk neutral liability. HCM uses real world scenarios where adverse scenarios will be those with poor investment returns, similar to a no-hedge scenario. Since NewCo is hedging most of the risks for this product, ARN is an appropriate approximation.

ARN may require adaptations for aspects of the risk neutral liability not being hedged. HCM requires assumptions to be developed for hedge costs and hedging program benefits. The number of assumptions / adaptations needed is less under ARN. This is beneficial since NewCo does not have experience with the product nor corresponding hedging program.

9. **Continued**

Neither ARN nor HCM require SOS calculations. From computational efficiency, the two methods are relatively equivalent.

ARN provides good alignment with asset / liability movement and reduces income volatility. HCM produces a distribution of outcomes that is significantly different from true outcomes. With HCM, emergence of profit and tracking of hedge error is not expected to follow actual patterns. ARN better meets the objective of reducing income volatility than HCM.

The actuary should use caution when using HCM over a long period of time. Similar caution not stated for the ARN method.

10. **Learning Objectives:**
4.	The candidate will understand U.S. financial and valuation standards, principles and methodologies applicable to life insurance and annuity products.

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

LFV-646-18: OSFI Draft Guideline – Life Insurance Capital Adequacy Test (LICAT), Chapters 1 – 3, 5 – 9, 11, Sept 2017

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

Solution:
(a)	Calculate the following, with respect to LICAT:

(i)	The total mortality risk capital requirement.

(ii)	The lapse risk capital requirement.

(iii)	The operational risk capital requirement.

(iv)	The diversified risk capital requirement.

(v)	The total insurance risk capital requirement.

Show all work, including writing out relevant formulas used in any calculations.

Commentary on Question:
This part of the question tested the candidates' understanding on the key risk components of LICAT. The question requires the candidates to show all work including writing out relevant formulas. Partial credit was received if the definition/formula for the risk components were correctly written out.

(i)	**Mortality Risk Requirement** $= \sqrt{MVR^2 + MCR^2} + MLR + MTR$
Mortality Volatility Risk (MVR) = 2.7*A*E/F,
where A is the Deviation of the upcoming year's projected net death claims,
	E is the Total net amount for risk for all policies,
	F is the Total net face amount for all policies.
MVR = 2.7*3,875*2,000,000/3,500,000 = 5,979

10. **Continued**

Mortality Level Risk (MLR) is the difference between the present value of shocked cash flows and the present value of best estimate cash flows, determined separately for life and death supported business.

Shock factor = Min(25%, 11% + 20% * volatility RC/next year's expected claims) = MIN(25%,11%+20%*5,979/40,000) = 14%

MLR = shock factor * Change in PV of CFs for each 10% increase in mortality assumptions/10% = 14%*2,300/10% = 3,218

Mortality Trend Risk (MTR): The candidates need to identify this is a life supported product. For life supported product, the trend risk shock for life supported business is a permanent 75% decrease to the Best Estimate Assumption for mortality improvement for 25 years, followed by no mortality improvement (i.e., a 100% decrease) thereafter.

PV of CFs for 10% reduction in Future Mortality Improvement in the first 25 years: 400
MTR = 400/10%*75% = 3,000

Mortality Catastrophe Risk (MCR): Shock is an absolute increase of 1 death per 1000 (in Canada) in year following the report date.
MCR = PV shocked CFs (1/1000) - PV BEL CF = 22,500 – 20,000 = 2,500

Total Mortality Risk Requirement $= \sqrt{MVR^2 + MCR^2} + MLR + MTR$
= 12,698

(ii) **Lapse Risk Requirement** $= \sqrt{VR^2 + CR^2} + LR + TR$
Lapse Level and Trend (LR+TR) is calculated for level and trend risk combined. The combined shock is a permanent ±30% change in Best Estimate Assumptions for lapse rate at each age and duration.

LR + TR = 20,500 – 20,000 = 500

Lapse volatility (VR) shock maybe quantified as: PV of cash flows (lapse shocked at +/-60% in first year) – PV of cash flows (lapse Shocked at +/-30% in first year),

VR = 21,300 – 20,500 = 800

10. Continued

Lapse catastrophe (CR) is an absolute increase of 20 percentage points in the Best Estimate Assumption for lapse for the first year.

CR = 21,000 – 20,000 = 1,000

Total Lapse Risk Requirement $= \sqrt{VR^2 + CR^2} + LR + TR$
$= 1,781$

(iii) **Operational Risk Requirement** = Business volume required capital + Large increase in business volume required capital + General required capital
- Business volume required capital = 2.5% * Direct written premium = 2.5%*5,000 = 125
- Large increase in business volume required capital = 0
- General required capital = 2.5% * ceded premium + 5.75% * (credit risk + insurance risk + market risk) = 5.75% * (1,200 +3,000+14,478) = 1,074

where Total insurance risk = 12,698 + 1,781 = 14,478 from part (i) and (ii) above.

Operational Risk Requirement = Business volume required capital + Large increase in business volume required capital + General required capital = 125 + 0 +1,074 = 1,199

(iv) **Diversified (within risk) Insurance risk requirement =**

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

Mortality -0.5*(MLR+MTR) = 9,589
Lapse -0.5*(MLR+MTR) = 1,531

ρ_{ij}	Mort	Lapse
Mort	1	0.5
Lapse	0.5	1

Diversified Insurance risk requirement (I) = MAX (Diversified (within risk) Insurance risk requirement, highest insurance risk requirement – 0.5*LT) = 10,438

10. Continued

      (v)   **Total Insurance risk requirement = $(\sqrt{A^2 + A \times I + I^2})$**
             A = market risk requirement + credit risk requirement = 4,200
             D = 13,055.72

(b)

      (i)   Calculate the Core LICAT ratio.

      (ii)   Calculate the Total LICAT ratio.

      (iii)   Comment on the capital standing of this company.

      Show all work, including writing out relevant formulas used in any calculations.

Commentary on Question:
For part (iii) candidates were expected to comment on the regulator's supervisory target and minimum targets for full credit.

Base Solvency Buffer = 1.05 * Total Capital Requirement = 1.05*(Diversified total risk requirement + Operational risk requirement) = 14,967.46

Available Capital = Tier 1 + Tier 2 = 30,000

      (i)   Core LICAT Ratio = (Tier 1 capital + 70% x (Surpluse Allowance+Eligible Deposit))/Base Solvency Buffer = 156%

      (ii)   Total LICAT Ratio = (Available Capital + Surpluse Allowance + Eligible Deposit)/Base Solvency Buffer = 213%

      (iii)   Insurers are required, at minimum, to maintain a Total LICAT Ratio of 90% and a Core LICAT Ratio of 55%. The regulator also requires a supervisory target of Total LICAT Ratio of 100% and Core LICAT Ratio at 70%. This company is of good capital standing.

11. **Learning Objectives:**
4.   The candidate will understand U.S. financial and valuation standards, principles and methodologies applicable to life insurance and annuity products.

Learning Outcomes:
(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:
LFV-833-19: Fundamentals of the Principle Based Approach to Statutory Reserves for Life Insurance, Rudolph

In Depth - Detailing the new accounting for long-duration contracts of insurers, PWC, May 2019

Commentary on Question:
This question tested the candidates' knowledge of VM-20 and ASU 2018-12. Candidates had to identify what is incorrect and why, or the correction needed for both VM-20 and ASU 2018-12 to get full credit.

Solution:
Critique the following statements regarding VM-20 and ASU 2018-12:

A.   *For life insurance contracts, VM-20 and ASU 2018-12 only apply to policies issued after the regulations' effective dates.*

B.   *The ASU 2018-12 policyholder benefit liability for a traditional whole life insurance contract will be calculated as the higher of the net premium reserve and the policy cash value.*

C.   *Under ASU 2018-12, DAC for UL contracts will be changed to be amortized on a straight-line basis. There is no change in the amortization method for other contract types.*

D.   *Scenario reserves are required for all life policies under VM-20.*

E.   *Deterministic reserves should be calculated based on prescribed assumptions under VM-20.*

F.   *Under ASU 2018-12, the net premium ratio for the policyholder benefit liability should be calculated on a seriatim basis and updated quarterly.*

G.   *The discount rates used for ASU 2018-12 reserve calculations should be based on the company's expected portfolio yield without margin.*

11. Continued

    H. Best estimate assumptions should be used for the policy benefit liability under ASU 2018-12 and the deterministic reserve under VM-20.

    I. The ceded net premium reserve under VM-20 is calculated the same as the ceded deterministic reserve.

    J. Annuity contracts are excluded from VM-20 and ASU 2018-12.

Commentary on Question:
A. Most candidates answered for ASU 2018-12 correctly. Candidates demonstrated that they thought VM-20 was the same as ASU 2018-12, which is incorrect. Some candidates understood full retrospective vs modified retrospective method, however, they could not correctly identify which method was used for VM-20 and ASU 2018-12.
B. Some candidates did not know what the policyholder benefit liability was and answered "True".
C. Candidates generally critiqued this statement correctly.
D. Most candidates identified only policies that did not pass the test needed stochastic reserve calculated. To get full credit, candidates needed to identify the test.
E. Most candidates identified that deterministic reserves are not fully based on prescribed assumptions. To receive full credit, candidates had to identify that the deterministic reserves is based on relevant and credible company experience.
F. To received full credit, candidates had to identify both errors in the statement.
G. Candidates generally identified that the discount rate assumption is upper-med grade fixed income instrument yield. However, few candidates identified that the discount rate reflects liability duration characteristics not based on the company's expected portfolio yield.
H. Candidates generally identified that the margin is included in VM-20. However, few candidates indicated DR is based on anticipated experience assumption
I. Candidates generally did not do well on this statement. Few candidates identified the difference between NPR and DR.
J. Candidates generally did not do well on this statement.

A. False. Full credit for VM-20 apply to new issues only while ASU 2018-12 applies to both in-force and new issues.

B. False. GAAP policyholder benefit liability is calculated based on net level premium approach; there is no policy cash value floor.

11. Continued

C. False. Straight line amortization for DAC is required for all, not just UL. This is a change for all contract types.

D. False. Scenario reserves are not required for all life policies. Only policies that did not pass stochastic exclusion test need stochastic reserve calculated

E. False. Assumption for deterministic reserves is based on relevant and credible company experience, not prescribed.

F. False. Net premium ratios are required to be reviewed, and updated if necessary, at least annually. Net premium ratios are set at "group" level, not seriatim.

G. False. Discount rate assumption for future policy benefit discount is upper-med grade fixed income instrument yield that reflects duration characteristic of the contract. Based on liability, not company's invested assets.

H. False. Best estimate assumption is used for ASU 2018-12 (no PAD). VM-20 DR is based on anticipated experience assumption - margins are included for assumptions of material risk that are not stochastically modeled

I. False. NPR is formula based and Dr is based on cashflows. Ceded may not be the same since ceded reserve, or reserve credit, is calculated as difference between pre- and post-reinsurance VM-20 minimum reserves.

J. False. Some annuity contracts are part of ASU 2018-12. Specifically, payout annuities and investment contracts with mortality, longevity, or morbidity risks. Variable annuity contracts are part of VM-21, not VM-20.