

Exam ILALFMC

Life Financial Management - Canada

Date: Tuesday, May 11, 2021

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This examination has 11 questions numbered 1 through 11 with a total of 100 points.

The points for each question are indicated at the beginning of the question.

2. While every attempt is made to avoid defective questions, sometimes they do occur. If you believe a question is defective, the supervisor or proctor cannot give you any guidance beyond the instructions provided in this document.

Written-Answer Instructions

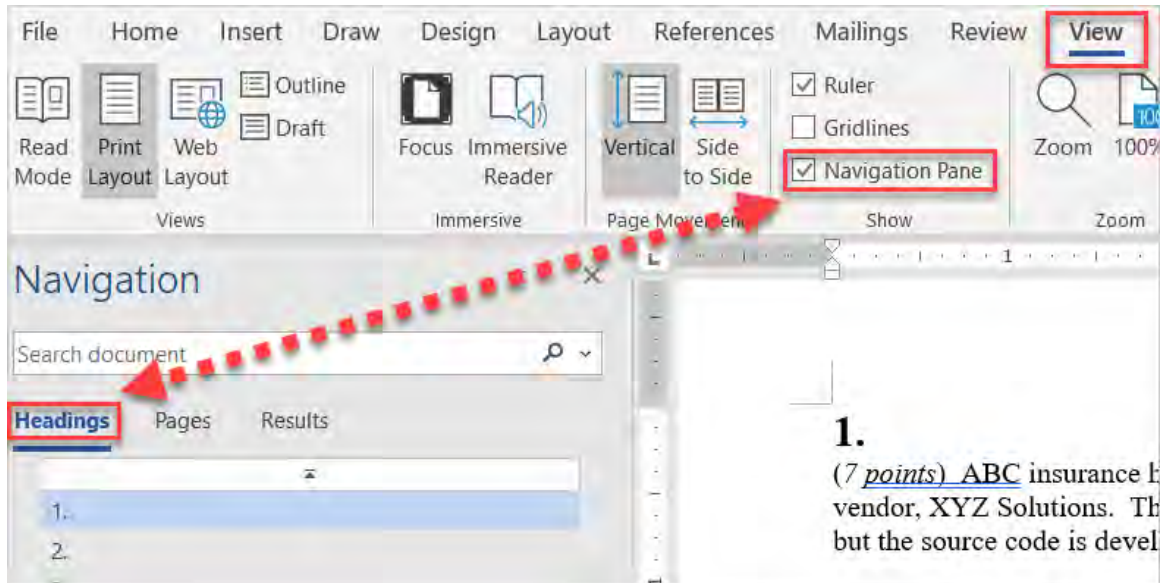
1. Each question part or subpart should be answered either in the Word document or the Excel document as directed within each question. Graders will only look at work in the indicated file.
 - a) In the Word document, answers should be entered in the box marked ANSWER within each question. The box will expand as lines of text are added. There is no need to use special characters or subscripts (though they may be used). For example, β_1 can be typed as beta_1, and x^2 can be typed as x^2.
 - b) In the Excel document formulas should be entered. For example, $X = \text{component1} + \text{component2}$. Performing calculations on scratch paper or with a calculator and then entering the answer in the cell will not earn full credit. Formatting of cells or rounding is not required for credit.
 - c) Individual exams may provide additional directions that apply throughout the exam or to individual items.
2. The answer should be confined to the question as set.
3. Prior to uploading your Word and Excel files, each file should be saved and renamed with your five-digit candidate number in the filename.
4. The Word and Excel documents that contain your answers must be uploaded before time expires.

Recognized by the Canadian Institute of Actuaries.

Navigation Instructions

Open the Navigation Pane to jump to questions.

Press Ctrl+F, or click View > Navigation Pane:



1.

(11 points) Company A and Company B are U.S. life insurance companies. Company A is interested in acquiring Company B. To help determine a selling price, Company B has performed an actuarial appraisal and has also hired an investment bank.

- (a) (1 point) Describe one of the three basic techniques used by investment banks to value life insurance companies.

ANSWER:

- (b) (3 points) Critique the following statements regarding actuarial appraisals:

A. *In essence, an actuarial appraisal is an analysis of cash flows, where the cash flow is based on GAAP earnings and changes in economic capital.*

ANSWER:

B. *Assumptions should include a reasonable but not excessive provision for adverse deviation.*

ANSWER:

C. *Mortality anti-selection is reflected to the extent that it is expected on lines of business with high lapse rates.*

ANSWER:

D. *It is common to use a single yield curve which does not change over time, where the curve reflects actual market yields at the time the actuarial appraisal is performed. However, if these yields are abnormally low or high, they will typically be adjusted towards a long term expectation over time.*

ANSWER:

1. Continued

E. Effective tax rates on future business are often well below the tax rate applied to taxable income (currently 21% for U. S. companies) due to the DAC proxy tax and differences between GAAP and tax reserves.

ANSWER:

F. If a fundamental change in business operations is expected after the transaction, operating expense assumptions are typically determined based on the “target unit expenses without an unallocated expense” approach.

ANSWER:

G. Mortality improvement is not reflected on life insurance.

ANSWER:

1. Continued

- (c) (4 points) You are given the following information from Company B's actuarial appraisal:

	Year 1	Year 2	Year 3	Year 4	Year 5
After tax earnings (inforce and future business)	6	3	8	10	15
Required capital	15	20	22	25	33

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

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

The response for this part is to be provided in the Excel document.

1. Continued

(d) (3 points) You are given:

- Company A and Company B use the same administration system.
- Company A has a larger distribution channel than Company B.
- Company A and Company B have a similar capital structure, but Company A has a lower CAPM beta.

(i) Recommend three adjustments Company A should make to the actuarial appraisal developed by Company B.

ANSWER:

(ii) Describe the directional impact of each recommended adjustment on the actuarial appraisal value.

ANSWER:

2.

(9 points)

- (a) (7 points) A life insurance company is currently developing an Economic Capital model for its life in-force block, which includes UL, term and whole life products, using the Liability Runoff Approach. The intended applications of the model are for establishing the risk management and risk appetite.

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

- A. *The liability runoff approach is being performed using a stochastic simulation with 3,000 real world economic scenarios. The scenarios being used were originally developed in the context of Variable Annuity Pricing.*

ANSWER:

- B. *The current valuation assumptions consist of best estimate assumptions plus margins for adverse deviations. Risk driver categories are aligned with these margins, covering a variety of economic and non-economic assumption sub-categories.*

ANSWER:

- C. *Current inforce data is used to generate projected liability cash flows. Lapse assumptions vary by scenario for UL products. Mortality and expense assumptions for all products and lapse assumptions for non-UL products are on a best estimate basis and do not vary by scenario, with the exception of expense inflation, which is scenario-dependent.*

ANSWER:

2. Continued

D. Projected asset cash flows are generated for each scenario, such that the level of assets required at the beginning of a given scenario satisfies key obligations including paying policyholder cash flows, debt payments, and dividends.

ANSWER:

E. The required assets at the valuation date are ranked to form a distribution. The plan is to use a CTE99 metric applied to the distribution, based upon the segregated fund pricing methodology which uses CTE.

ANSWER:

F. The economic capital is defined by applying the CTE99 metric to the total assets required and deducting the current statutory liabilities.

ANSWER:

G. It has been suggested that the development team use a correlation matrix approach to calculate the between-risk diversification benefits.

ANSWER:

(b) (2 points) Describe ways that Economic Capital can be applied in the following areas:

(i) Capital Adequacy

ANSWER:

(ii) Performance Measurement

ANSWER:

3.

(10 points) ABC Insurance is a Canadian-based company reporting under IFRS 4. ABC is performing an annual review of the expected mortality assumption for underwritten life insurance policies in their valuation.

- (a) (2 points) Describe the steps you would take to validate the data from ABC's mortality experience study.

ANSWER:

- (b) (2 points) The current mortality assumption varies by gender but does not vary by age. Evaluate whether the current data supports adding age bands as a new factor using the information provided below:

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

ANSWER:

- (c) (2 points) Propose changes to the current data and/or process so that joint life mortality can be studied separately from single life mortality.

ANSWER:

3. Continued

(d) (4 points)

- (i) (2 points) List factors that should be considered when setting an appropriate level of aggregation across insurance products.

ANSWER:

- (ii) (2 points) ABC Life has grouped its business into death sensitive and death supported blocks. The change in liabilities of applying the margin without diversification to the base mortality improvement rates for each block of business are shown below:

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

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

ANSWER:

4.

(8 points)

(a) (4 points) With regard to the “Selective Lapsation for Renewable Term Insurance Products” note:

(i) (2 points) Describe the general approach used by the Dukes-MacDonald selective lapsation model to reflect mortality deterioration.

ANSWER:

(ii) (2 points) Describe why each of the following factors must be considered when setting a mortality deterioration assumption:

- Skewness of lapses
- Shape of the underlying mortality table
- Death during the grace period

ANSWER:

4. Continued

- (b) (4 points) MXP Life issues a 10-year renewal term product, where the guaranteed premiums are renewed every 10 years based on attained age. Premiums are guaranteed at issue until the maximum insured age of 75.

You are given the following for policy year 11:

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

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

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

- (i) VTP 2

The response for this part is to be provided in the Excel document.

- (ii) Dukes-MacDonald 1

The response for this part is to be provided in the Excel document.

- (iii) Dukes-MacDonald 2

The response for this part is to be provided in the Excel document.

- (iv) Becker-Kitsos

The response for this part is to be provided in the Excel document.

Show all work.

5.

(9 points)

- (a) (1 point) Explain the approach used by the Actuarial Standards Board (ASB) to set the ultimate reinvestment rates for the purposes of projecting CALM scenarios.

ANSWER:

- (b) (3 points) You are given the following information regarding the best estimate credit spread and asset depreciation assumptions for two assets:

Duration	Credit Spread		Asset Depreciation
	0	5+	All Durations
Asset A	50 bps	60 bps	6 bps
Asset B	140 bps	120 bps	20 bps

- Margin on credit spread = 10%
- Margin on asset depreciation = 50%
- A reduction in credit spreads results in an increase in policy liabilities.

Determine the net credit spread after margins for each asset for the following durations, where duration 0 is the valuation date. Show all work.

- (i) Duration 0

ANSWER:

- (ii) Duration 5

ANSWER:

- (iii) Duration 30

ANSWER:

5. Continued

- (c) (2 points) Identify steps necessary to construct a forward yield curve from a par yield curve, including any relevant inputs that will be needed.

ANSWER:

- (d) (3 points) A stochastic model generates the following interest rate results:

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

Determine if these rates meet each of the following calibration criteria, consistent with the requirements in the CIA Standards of Practice:

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

Show all work.

The response for this part is to be provided in the Excel spreadsheet.

6.
(8 points)

For an in-force block of whole life insurance policies with a critical illness rider you are given:

- All the policies are issued on the same day.
- All the policies are included in one IFRS 17 group.
- The locked-in discount rate at contract issue is 3%.
- Deaths are the only decrements and occur at year end.
- The whole life base policy has 8 remaining years of coverage.
- The Contractual Service Margin (CSM) opening balance for the whole life base policies is 500.
- The critical illness rider has 5 remaining years of coverage.
- The CSM opening balance for critical illness rider is 100.
- Assume coverage units are not discounted. Coverage and tP_x for each year are provided in the following table:

Year	Whole life base coverage Maximum Coverage	Critical Illness Rider Maximum Coverage	tP_x
1	100,000	10,000	1.0000
2	100,000	10,000	0.9500
3	100,000	10,000	0.9030
4	100,000	10,000	0.8570
5	100,000	10,000	0.8150
6	100,000	0	0.7740
7	100,000	0	0.7350
8	100,000	0	0.6980

6. Continued

(a) (7 points) Calculate the profit or loss recognized through the CSM every year using each of the following approaches:

(i) Simple sum of contractual coverages

The response for this part is to be provided in the Excel document.

(ii) Notional CSM

The response for this part is to be provided in the Excel document.

Show all work.

(b) (1 point) Recommend an approach of coverage unit development for this in-force block based on the above result. Justify your answer.

ANSWER:

7.

(9 points)

- (a) (4 points) A company has a liability of 1,000 payable on December 31, 2028 with no exit value.

You are given the following reference portfolio:

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

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

- (i) (1 point) List the advantages and disadvantages in using a reference portfolio to determine the IFRS 17 discount rates.

ANSWER:

- (ii) (2 points) Calculate the IFRS 17 discount rate on December 31, 2023 using a top-down approach. Explain your approach.

ANSWER:

- (iii) (1 point) Calculate the IFRS 17 discount rate on December 31, 2023 using a bottom-up approach. Explain your approach.

ANSWER:

7. Continued

- (b) (5 point) BMS Life issues a new universal life insurance product with an 80% confidence level that the premium less a profit charge will cover the benefit payments. Benefit payments are assumed to be normally distributed. At issue, you have the following:

PV Fulfilment Cash Flows	-125
Premium Margin	12%
Variance of benefit payments	3,000

You are given the following Standard Normal Cumulative Probability Table.

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

- (i) (2.5 points) Calculate the best estimate benefit claim cost at issue. Show all work.

The response for this part is to be provided in the Excel spreadsheet.

- (ii) (2.5 points) It has been determined that the new universal life insurance product will be reinsured by DDT Re on a yearly renewable term basis. DDT Re has priced the reinsurance premium using its lower mortality experience and lower income tax rates relative to BMS Life. DDT Re uses the same discount rate as BMS Life.

Critique each of the following statements:

- A. *BMS Life's fulfillment cash flows reflect DDT Re's lower mortality assumption and lower income tax.*

ANSWER:

- B. *BMS Life measures the direct contract and the reinsurance contract using the variable fee approach. DDT Re measures the reinsurance contract using the premium allocation approach.*

ANSWER:

7. Continued

C. BMS Life's risk adjustment reflects DDT Re's counterparty risk.

ANSWER:

D. DDT Re will have a longer contract boundary than BMS Life due to DDT Re's lower mortality assumption.

ANSWER:

8.

(11 points)

- (a) (1 point) Explain the difference in the profit emergence for life insurance contracts under IFRS 4 and IFRS 17.

ANSWER:

- (b) (2 points) Explain whether the variable fee approach (VFA) can be used as the measurement approach under IFRS 17 for each of the following contracts:

- (i) Whole life with critical illness riders

ANSWER:

- (ii) Payout variable annuities

ANSWER:

- (iii) Segregated funds with guaranteed minimum income benefits

ANSWER:

- (iv) Coinsurance contract on a participating life closed block

ANSWER:

8. Continued

- (c) (8 points) A 3-year term-life contract will be issued on January 1st, 2023. The following expected cash flows are provided:

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

The discount rate is 3%.

- (i) (2 points) Calculate the contractual service margin or loss component at issue as appropriate. Show all work.

The response for this part is to be provided in the Excel spreadsheet.

- (ii) (4 points) The company implements an assumption change at the end of first year and reflects those changes to its CSM or loss component for the current reporting period. You are given the following revised information for this policy as at the end of year 1:

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

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

The response for this part is to be provided in the Excel spreadsheet.

8. Continued

- (iii) (2 points) Determine the Year 1 Statement of Profit and Loss in the format below for this contract based on the information you calculated. Assume the insurance service result and insurance finance expense for risk adjustment are not disaggregated. Assume all assets backing this contract are in cash. Show all work.

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

The response for this part is to be provided in the Excel spreadsheet.

9.

(6 points)

- (a) (3 points) You are given the following values for a UL policy issued on January 1, 2016 by a Canadian insurance company and surrendered on December 31, 2017:

	Premium	Investment Income	Cost of Insurance	Surrender Charge (% of Fund Value)	Net Cost of Pure Insurance
2016	500	50	40	2%	35
2017	300	80	40	1%	40

Determine the amount of taxable income attributable to the policyowner upon surrender. Show all work.

The response for this part is to be provided in the Excel spreadsheet.

- (b) (3 points) Ann purchased a deferred non-registered 10-year annuity certain in 1990. Her first monthly payment will be received soon. As the owner of the contract, she can vary the payment frequency and payment amount in any future year. There is no loan under the contract. Ann would like to keep her current taxable retirement income low.
- (i) Recommend a payment option for Ann. Justify your recommendation.

ANSWER:

- (ii) List any restrictions that might apply for your recommendation.

ANSWER:

10.

(9 points)

- (a) (2 points) Outline the ASU 2018-12 simplified DAC amortization model for insurance contracts classified as “long duration” under US GAAP.

ANSWER:

- (b) (3 points) Compare the IFRS 17 discount rate guidance with the ASU 2018-12 criteria for determining yield used in discounting the liability for future policy benefits.

ANSWER:

10. Continued

(c) (4 points) For a life insurance contract issued January 1, 2023, by a U.S. insurer, you are provided the following information:

- ASU 2018-12 applies to this contract.
- There are no expenses.
- The locked-in original contract issuance discount rate is 3%.
- At the end of year 2:
 - Actual benefits paid and premiums received did not match initial expectations. An experience study resulted in revised projected cash flows for the remainder of the contract.
 - The revised discount rate is 3.5%.

This table represents the present value of future cashflows using original projected cash flows under original assumptions, as determined on January 1, 2023:

Time	PV using discount rate of 3%		PV using discount rate of 3.5%	
	Benefits	Gross Premiums	Benefits	Gross Premiums
At Issue	432.44	661.57	428.13	655.55
Start of Year 2	343.92	488.59	341.38	485.20
Start of Year 3	242.60	320.57	241.42	319.05

This table represents the present value of future cashflows using the actual cashflows in the first two years followed by revised projected cash flows in other years, as determined at end of day, December 31, 2024.

Time	PV using discount rate of 3%		PV using discount rate of 3.5%	
	Benefits	Gross Premiums	Benefits	Gross Premiums
At Issue	493.11	638.20	488.13	632.43
Start of Year 2	396.27	469.59	393.31	466.36
Start of Year 3	281.30	306.07	279.90	304.64

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

The response for this part is to be provided in the Excel spreadsheet.

11.

(10 points)

- (a) (4 points) Critique the following statements with regards to Sound Reinsurance Practices and Procedures, as applicable to a Canadian federally regulated insurer:

A. *Senior management has delegated design and implementation of the reinsurance risk management policy to business line leaders.*

ANSWER:

B. *Business line leaders are responsible for oversight of the reinsurance risk management policy. Each business line leader assesses their operations against the reinsurance risk management policy and reports to senior management once every two years.*

ANSWER:

C. *Sufficient due diligence on registered reinsurer counterparties, where reinsurance treaties are already in place, is performed on an on-going basis. Due diligence includes an assessment of financial strength and capabilities of the reinsurance counterparty, supplemented with rating agencies assessments.*

ANSWER:

D. *Reinsurance contract language is as broad as needed to reasonably capture general reinsurance terms and conditions. The reinsurance contracts outline where the agreement may adversely affect the ceding company.*

ANSWER:

11. Continued

- (b) (2 points) Polar Bear Life Insurance (PBLI) would like to set up a YRT reinsurance treaty for all of its term life products. They have selected to reinsure with XYZ, a registered reinsurer in Canada. The reinsurance arrangement meets Sound Reinsurance Practice and Procedures. A 50% reinsurance treaty is being proposed. You are given:

Available Capital	530
Surplus Allowance	50
Eligible Deposit	0
Base Solvency Buffer (before reinsurance)	500
Base Solvency Buffer (after reinsurance)	450
Diversification Benefits	0
Reinsurance Assets and Receivables	0

- (i) (1.5 points) Calculate PBLI's LICAT Total Ratio before and after incorporating the reinsurance agreement with XYZ. Show all work.

ANSWER:

- (ii) (0.5 points) Recommend whether PBLI should pursue reinsurance with XYZ from a capital perspective.

ANSWER:

11. Continued

(c) (4 points) Describe key impacts of reinsurance to each of the following components of the LICAT Total Ratio, noting the difference between registered and unregistered reinsurance where applicable:

(i) Available Capital

ANSWER:

(ii) Surplus Allowance

ANSWER:

(iii) Eligible Deposit

ANSWER:

(iv) Base Solvency Buffer

ANSWER:

****END OF EXAMINATION****