

# Exam ILALFMC

## Life Financial Management - Canada

Date: Tuesday, November 8, 2022

### 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.

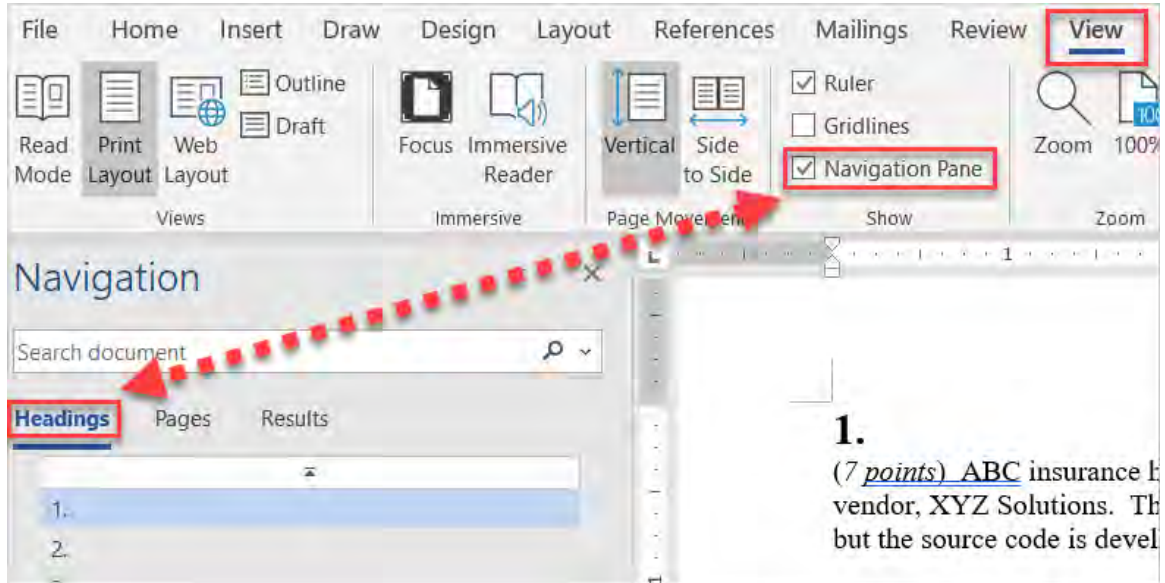
#### Written-Answer Instructions

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,  $\beta_1$  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 the five-minute upload period expires.

## Navigation Instructions

Open the Navigation Pane to jump to questions.

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



**1.**

(8 points) You are given the following:

Values in the period		
	GAAP Basis	Actual Results
Beginning of Period Reserve per policy	100	100
Gross Premium per policy	325	325
Net Premium per policy	300	300
Mortality Rate	0.0020	0.0030
Investment Interest Rate on Reserves	4.00%	4.25%
Lapse Rate	2%	0%
Maintenance Expense per Policy	15	8
Beginning of Period Policies in Force	5,000	
Policy Death Benefit per policy	100,000	

Assume:

- All premium is collected at the beginning of period
- All deaths and lapses occur at end of period
- There are no surrender benefits
- Expenses are paid at the beginning of the period for policies in-force at the beginning of period.

(a) (2 points) Construct an Analysis in Change in Reserves for the GAAP expectation and actual results.

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

(b) (1 point) Explain how the Analysis in Change in Reserves would change if the reserve was calculated using the present value of cash flows approach without margins instead of GAAP.

ANSWER:

## 1. Continued

- (c) (4 points) Construct a Source of Earnings analysis for the GAAP expectation and actual results.

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

- (d) (1 point) Explain the main drivers of differences between expectations and actuals.

ANSWER:

## 2.

(7 points) ABC Life Insurance, a large multinational corporation, has a U.S. based subsidiary reporting the following reserves for a block of term life product portfolio issued between 2010 and 2014 (in millions):

NAIC Statutory Reserve	60
Deficiency Reserve included in Statutory Reserve	38
Asset Adequacy Reserve for this block	0

(a) (2 points) ABC Life is evaluating the use of an off-shore affiliate captive for reinsuring this portfolio.

(i) Evaluate the advantages and disadvantages of this approach.

ANSWER:

(ii) Describe two potential captive structures.

ANSWER:

(b) (2 points) Explain each of the following regulations in relation to the use of captives or foreign affiliates by ABC's U.S. subsidiary:

(i) Actuarial Guideline XLVIII (AG-48)

ANSWER:

(ii) Principle Based Reserves (VM-20)

ANSWER:

## 2. Continued

(c) (3 points) Critique the use of captive insurance companies in the following circumstances:

A. *A reinsurance company has acquired a block of term life insurance written in 2007. It has done this by accepting the business using 100% coinsurance.*

ANSWER:

B. *A large life insurance company is writing its newest product of term life insurance.*

ANSWER:

C. *A carrier has a large block of Universal Life (UL) policies that was written in 2016.*

ANSWER:

### 3.

(11 points)

(a) (6 points) You have determined the CALM liabilities for a block of life insurance as at September 30, 2021.

(i) (2 points) Identify two approaches for determining an interest rate vector which can be used to reproduce policy liabilities which have been determined under CALM using a seriatim discount calculation.

ANSWER:

(ii) (1 point) Identify an approach for solving for an explicit mismatch margin expressed in basis points.

ANSWER:

(iii) (3 points) Explain the approach for completing the Detailed Roll-Forward method to estimate the CALM liability as at December 31, 2021.

ANSWER:

### 3. Continued

- (b) (5 points) You have a liability of 1,000 denominated in Canadian Dollars (CAD) and payable at the end of 10 years. The assets backing this liability are denominated in US Dollars (USD) and the currency risk is not hedged.

You are given the following information at the valuation date:

- Exchange Rate: 1.00 USD buys 1.25 CAD
- U.S. 10-year risk-free rate: 3.00%
- Canadian 10-year risk-free rate: 2.75%
- One standard deviation of the changes in the exchange rate over a ten-year period is 0.15
- The minimum margin for adverse deviation for currency risk is 5%

- (i) (4 points) Calculate the best estimate liability and the provision for adverse deviation (PfAD) for the currency risk in CAD at the valuation date. Show all work.

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

- (ii) (1 point) Assume that you have entered into a forward contract which fixes the exchange rate for 1.00 USD at 1.20 CAD at the end of the 10 years. Assume that all other information provided above remains unchanged.

Recalculate the total liability including PfAD under this assumption.

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



#### 4.

(8 points) JKL Life is a Canadian life insurance company that sells both Level Cost of Insurance (COI) and YRT COI UL products.

You are given the following:

- JKL Life’s underwriting practice has been historically consistent for both products and regarded as industry-leading.
- The Level COI product has low-to-moderately credible mortality experience data, while the YRT product has fully credible mortality experience data.
- Policyholders are allowed to add term riders to their policies at any time without additional underwriting, however historically not many policyholders have exercised this option.

(a) (5 points) Critique and, if applicable, recommend changes to the following practices in setting current best estimate valuation assumptions for the UL products:

A. *Base mortality is calculated using internal data, and is differentiated by issue age, duration, gender, and smoking status. The same mortality assumptions are used for both UL products and the term riders.*

ANSWER:

B. *Mortality improvement is projected using the CIA’s prescribed “MI-2017” table.*

ANSWER:

C. *With respect to lapse assumptions:*

- *For Level COI and YRT COI, early duration lapse rates are set based on available data, varying by issue age and duration.*
- *For Level COI, the ultimate lapse rate for durations 10+ is set at 2%.*

ANSWER:

#### 4. Continued

D. *If the fund balances are zero in a projection year, the policy owners are assumed to pay additional premiums to keep their policies in force.*

ANSWER:

E. *The option to exercise the term rider addition is not considered in the setting of assumptions due to the minimal take up rate.*

ANSWER:

(b) (3 points) Recommend margins for adverse deviations for the following assumptions for each of JKL Life's UL products:

(i) Base mortality rates

ANSWER:

(ii) Policy lapse rates

ANSWER:

## 5.

(7 points) MCB Insurance is a life insurance company that sells whole life insurance and income annuities.

- (a) (3 points) Outline the process to determine the mortality improvement valuation assumption for both the life insurance and income annuity blocks.

ANSWER:

- (b) (2 points) Identify the information you require to justify a maximum mortality improvement MfAD diversification factor for MCB's mortality assumptions.

ANSWER:

- (c) (2 points) You are given:

### Mortality Rates

Age	Male
65	0.01018
66	0.01129
67	0.01250
68	0.01384

### Prescribed Mortality Improvement Rates

Age	Year		
	2020	2021	2022
65	.0154	.0147	.0141
66	.0151	.0144	.0137
67	.0152	.0145	.0139
68	.0157	.0150	.0143

Assume

- Valuation date is Dec 31, 2020
- Mortality MfAD is 6.5%
- Mortality Improvement MfAD rate for ages 60 to 90 is 0.5%

Calculate the projected valuation mortality rate for an annuity product of a 65 year old male in 2 years if the diversification factor is 25%. Show all work.

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

**6.**

(10 points) Quadra Life is a mid-sized, federally regulated, Canadian stock insurance company with sells Participating Life products. You have been asked to provide support for the conversion to IFRS 17.

- (a) (1 point) Provide the definition of “insurance contract with direct participation features” under IFRS17.

ANSWER:

- (b) (1 point) Identify two approaches for estimating future cash flows of participating contracts for items where the experience is shared with policyholders.

ANSWER:

- (c) (2 points) Describe how you would model a change in expense cash flows for participating contracts, distinguishing between the cases where:

- (i) expense experience is shared with the policyholders.

ANSWER:

- (ii) expense experience is not shared with policyholders.

ANSWER:

## 6. Continued

- (d) (6 points) Quadra Life demutualized 10 years ago. You are given the following information for the following three participating products:

### Par Product A:

- Limited to existing policyholders at the time of demutualization.
- Policyholders are paid dividends based on interest, mortality and expense gains of the par policyholders with a minimum guaranteed interest return of 2%.
- Actual returns on the closed par fund are projected to be well above the guaranteed interest rate.
- Gains in the closed par fund are to be split evenly between the shareholders and policyholders.

### Par Product B:

- Open to new participants after the time of demutualization.
- Dividends are based on a share of the Company's earnings plus a flat 5% return on cash values.
- The Company is expected to remain profitable, and dividends are projected to increase over the next 5 years.

### Par Product C:

- Open to new participants after the time of demutualization.
- Dividends are based on the investment return of the open par fund subject to a 5% minimum return.
- Investment returns on the open par fund have been negative, and dividend payments are projected to remain at the minimum level for the next 5 years.

- (i) Assess the eligibility of each product to be valued under the Variable Fee Approach (VFA).

ANSWER:

- (ii) Propose changes to the products to meet the VFA criteria if they are not currently eligible.

ANSWER:

## 7.

(8 points) Company BCS sells a Universal Life (UL) product:

- The death benefit is 50,000 plus the account value balance.
- At the end of 5 years, the policy terminates and the benefit paid is the account value balance.

The reserves for the policy are calculated under IFRS 17.

You are given:

	<b>Descriptions</b>
Expected Mortality	0% for the first 4 years, 10% at the end of year 5
Expected Lapse	0%
Premium	3,000 at the beginning of the year for 5 years
Cost of Insurance deducted at the beginning of each year	4% of Net Amount at Risk
Annual Management Fee deducted at the end of the year	1% of account value at the end of the year
Credited interest on Account Value	7%
Discount Rate	5%

(a) (1 point) Identify the cash flows included for the UL product under the:

(i) Whole Contract view

ANSWER:

(ii) Core Cash Flows view

ANSWER:

## 7. Continued

(b) (5 points) Calculate the Best Estimate Liability at issue using:

(i) The Whole Contract view

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

(ii) The Core Cash Flows view

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

(c) (2 points) Describe the approach for deriving the discount rates applied to cash flows that do not vary with returns on underlying items using the following two approaches:

(i) Top down approach

ANSWER:

(ii) Bottom up approach

ANSWER:

**8.**

(10 points) Company TPL sells a 10 year level term product which can be renewed at guaranteed premiums rates at the option of the policyholder. You are the actuary in charge of converting the modeling of reserves from CALM to IFRS 17. You are given the following output from the valuation system in Year 1 following transition:

	<b>Group A – Inforce at Transition (values at the beginning of year 1)</b>	<b>Group B – New Business Issued in Year 1 following transition (values at initial recognition)</b>
PV of premiums	13,000,000	1,300,000
PV of benefits	11,000,000	1,100,000
PV of directly attributable maintenance expenses	700,000	70,000
Directly attributable acquisition expenses	1,200,000	120,000
Risk Adjustment	1,000,000	100,000
Contractual Service Margin (CSM) at Transition	500,000	Not Applicable

<b>Year</b>	<b>T10 Coverage Units – Group A (thousands)</b>	<b>T10 Coverage Units – Group B (thousands)</b>
1	20,000,000	2,000,000
2	19,000,000	1,900,000
3	18,000,000	1,800,000
4	17,000,000	1,700,000
5	16,000,000	1,600,000
Total	250,000,000	25,000,000

Assume:

- No changes in non-financial or financial assumptions
- No experience variances
- Coverage Units are the policy face amount
- The Contractual Service Margin for Group A at the end of Year 1 is 241,500



## 8. Continued

(a) (2 points) Determine each of the following for Group B at initial recognition:

- (i) The profitability classification of the group (with respect to Level of Aggregation).

ANSWER:

- (ii) The impact to the Insurance Service Result.

ANSWER:

(b) (1 point) Explain possible reasons why the CSM at initial recognition for Group B is not proportional to the CSM at Transition for Group A.

ANSWER:

## 8. Continued

(c) (5 points) Explain the impact on the CSM or loss component at the end of year 1 and the Insurance Service Result in year 1 of each of the following separately:

(i) Actual death claims are increased by 1,000,000 in Group A.

ANSWER:

(ii) Actual attributable maintenance expenses are increased by 100,000 in Group A.

ANSWER:

(iii) Additional premium-related expenses of 100,000 in Group A.

ANSWER:

(iv) A favourable change in non-financial assumptions of 1,000,000 in Group A.

ANSWER:

(v) A favourable change in non-financial assumptions of 150,000 in Group B.

ANSWER:

(d) (1 point) Explain how the calculation of the IFRS 17 liabilities would change for new business if the renewal premium rates after 10 years were no longer guaranteed and could be repriced at that time.

ANSWER:

(e) (1 point) Explain why the Risk Adjustment for Group A at transition may be different from the current Margins for Adverse Deviation (MfAD) under IFRS 4.

ANSWER:

## 9.

(10 points)

- (a) (1 point) Explain the difference between an investment-return service and an investment-related service under IFRS 17.

ANSWER:

- (b) (4 points) Discuss considerations in determining coverage units under IFRS 17 for the following products:

- (i) A Whole Life insurance contract with:

- Guaranteed Cash Surrender values; and
- An Accidental Death Benefit equal to two times the basic coverage

ANSWER:

- (ii) An Individual Participating Life contract which qualifies as an insurance contract with direct participating features. Policyholders have the option of applying dividends to purchase Term additions or Paid-Up additions.

ANSWER:

- (iii) An Immediate Annuity

ANSWER:

## 9. Continued

(c) (5 points) You are given the following information for a 10-year Universal Life (UL) product:

- The death benefit is the face amount plus the account value
- The contract qualifies as a contract without direct participating features
- Coverage units are not discounted

You are given the following assumptions:

<b>Assumptions</b>	
Annual decrement (lapse and death combined, all at year end)	4% each year
Locked-in rate at initial recognition	3% flat for all years
Face amount	1,000
Account Value	Initial value of 400, expected annual growth rate of 5%
CSM at initial recognition	300

Calculate the Contractual Service Margin balance over the 10-year period.

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

## 10.

(8 points)

(a) (2 points)

- (i) Discuss the circumstances under which a Canadian Life Insurance company is subject to premium taxes.

ANSWER:

- (ii) Explain the impact of paying premium taxes on the company's net income for tax purposes.

ANSWER:

## 10. Continued

- (b) (6 points) Oakville Life is a Canadian-resident life insurer which sells business in Canada and the United States.

Discuss the potential impact on the Canadian taxable income of Oakville Life for each of the following events:

- A. *Incurred But Not Reported (IBNR) claims on Canadian life insurance policies for the following year are expected to increase.*

ANSWER:

- B. *A Canadian group insurance policyholder uses their experience rating refunds to reduce upcoming premium payments.*

ANSWER:

- C. *The cost to Oakville Life of mandatory underwriting for Canadian life annuities increases.*

ANSWER:

- D. *Universal Life sales increase for Oakville Life's United States-based insurance business.*

ANSWER:

- E. *Oakville Life reduces premium rates on their Canadian Term Life products in the hopes of selling more policies.*

ANSWER:

- F. *Oakville Life increases interest rates charged on policy loans for their Canadian policies.*

ANSWER:

# 11.

(13 points)

(a) (9 points)

MNG, a Canadian Life Insurance Company, has two blocks of individual life insurance policies, Business A and Business B.

You are given the following information:

Abbreviations:

PV: Present Value; BE: Best Estimate; BEL: Best Estimate Liability; CF: Cashflows

Designation of risk	Business A	Business B
Mortality risk	Death-supported	Life-supported
Lapse risk	Lapse-supported	Lapse-sensitive

PVs at 5.3% discount rate	Business A	Business B
BE CF	1,070	-210
Padded CF	1,075	-205

Shock to BE mortality assumption in all policy years	BEL	
	Business A	Business B
+25%	980	-160
+19.6%	1,000	-175
+14.8%	1,030	-184
-25%	1,100	-200
-15%	1,115	-220
-8.7%	1,130	-240
0% + 1 additional death per thousand	1,069	-200

Shock to BE mortality improvement assumption	BEL	
	Business A	Business B
- 75% for 25 years, followed by -100% (i.e. no mortality improvement) thereafter.	1,050	-196
+75% at all policy years	1095	-220

## 11. Continued

Shock to BE lapse assumption	BEL	
	Business A	Business B
±30% in all policy years	1,085	15
±60% in the first year	1,072	-160
±30% in the first year	1,071	-180
-40% in the first year	1,080	-245
+20% in the first year followed by a permanent +10% in all subsequent policy years	1,075	-200
An absolute addition of 20% to the lapse rate in the first policy year	1,055	-185

Other Values	Business A	Business B
Standard deviation of the upcoming year's projected net death claims	1.5	1.2
The following year's net expected claims	13	17
Total net actuarial liability for all policies	1,500	-90
Total net face amount for all policies	1,100	10,600

- (i) (4 points) Calculate the mortality risk solvency buffer for the company, without diversification credit between life-supported and death-supported business.

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

- (ii) (2 points) Calculate the diversification credit between life-supported and death-supported business

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

- (iii) (3 points) For the company:

- Calculate the lapse risk solvency buffer

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

- Calculate the expense risk solvency buffer

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



## 11. Continued

(b) (4 points) Assume that:

- All policies are individually underwritten Canadian life business
- Tax rate = 20%
- No change in negative reserve reduction limit

You are given the three following independent events:

- Event 1: Negative reserve changed from 1000 to 1200. No change in net reserve.
- Event 2: Credit spread PfAD increased by 20.
- Event 3: Interest rate PfAD increased by 30.

Describe the impact on the following for each independent event:

(i) Total LICAT ratio

ANSWER:

(ii) Tier 1 capital ratio

ANSWER:

**\*\*END OF EXAMINATION\*\***