

# Exam ILALFMU

**Date:** Tuesday, May 10, 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.

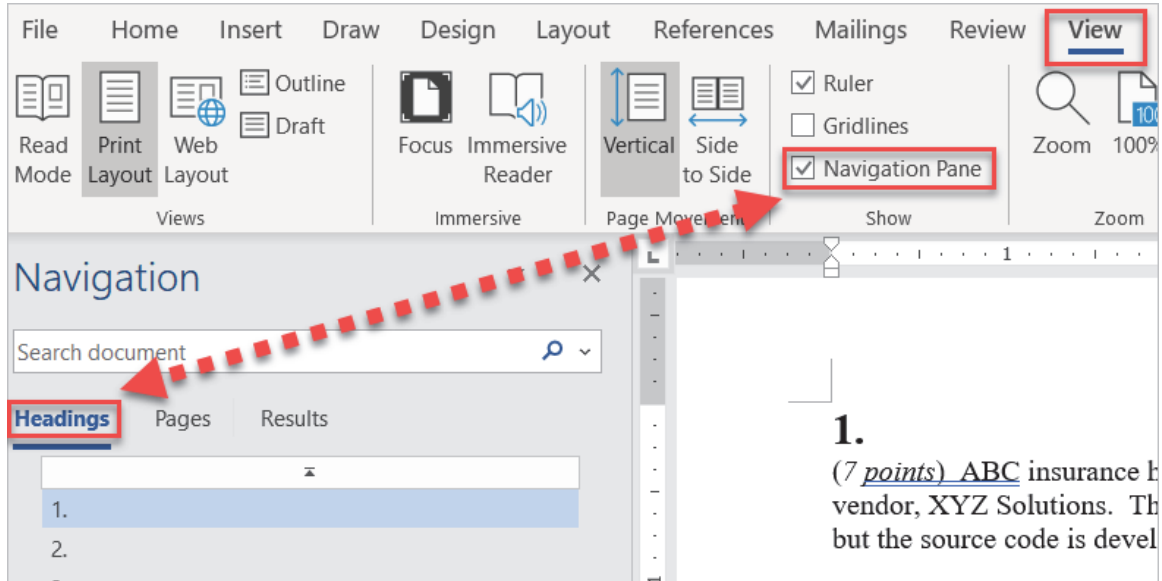
### Written-Answer Instructions

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 time expires.

## Navigation Instructions

Open the Navigation Pane to jump to questions.

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



# 1.

(10 points) ABC Life Insurance is building an Economic Capital (EC) framework. Management is having a discussion regarding whether to use the finite risk horizon approach or the liability run off approach.

(a) (6 points) Compare and contrast the two approaches based on each of the following management considerations:

(i) We use buy-and-hold strategy for fixed interest investment and intend to closely match assets and liabilities.

ANSWER:

(ii) We want to know how many assets are required to cover liabilities with some degree of security.

ANSWER:

(iii) We closely monitor changes in market conditions and respond accordingly. We want to reflect these actions in the Economic Capital framework.

ANSWER:

(iv) We believe that yield curves eventually go back to normal after extreme market events.

ANSWER:

(v) We want to be consistent with the reality of capital management and regulatory reporting that requires capital to be calculated on an annual basis.

ANSWER:

(vi) We hope to easily calibrate EC to a target security level.

ANSWER:

## 1. Continued

ABC has a liability cash flow projection model for reserve calculation. The model uses a population mortality table plus a PAD as base mortality table; it uses average historical mortality improvement derived from data from the past century. The discount rate is prescribed by regulation.

ABC observes mortality volatilities from various sources and decides to modify this model to do a stochastic projection for economic capital.

- (b) (4 points) Recommend changes to the current liability projection model in order to accomplish ABC's intended objective.

ANSWER:
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## 2.

(8 points) ALF Life is transitioning its term and ULSG blocks of business to calculate reserves using VM-20. ALF does not have a clearly defined hedging strategy on these products.

- (a) (2 points) Regarding starting assets and the use of a discount rate, describe 2 approaches that can be used to calculate deterministic reserve.

ANSWER:

- (b) (2 points) Describe the purpose of the following exclusion tests:

- (i) Deterministic Exclusion Test (DET)

ANSWER:

- (ii) Stochastic Exclusion Test (SET)

ANSWER:

- (c) (2 points) Critique the following statements:

A. *Term products are eligible for DET while ULSG is not. While premiums are low during the level period, there will always be more than enough premium post level period to fund the policy so that there's no need to calculate a deterministic reserve.*

ANSWER:

B. *ALF's term and ULSG products are eligible for SET.*

ANSWER:

## 2. Continued

- (d) (2 points) You are given one of the projected scenarios from ALF's cash flow model.

<b>Projection period</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>Statement value of assets</b>	2,000	400	-200	-650	1,000
<b>One – Year Treasury Rate</b>	N/A	1.00%	1.20%	1.50%	2.00%

Calculate the scenario reserve. Show all work.

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

### 3.

(7 points) BBA Life insurance company is a multinational corporation.

(a) (4 points) Describe how capital for insurance risk should be addressed in the following:

(i) United States

ANSWER:

(ii) Canada

ANSWER:

(iii) European Union

ANSWER:

You are given the following for the Canadian entity (in billions):

Tier 1 Capital	1.3
Tier 2 Capital	1.2
Surplus Allowances	0.2
Eligible Deposits	0.4
Base Solvency Buffer	3.0

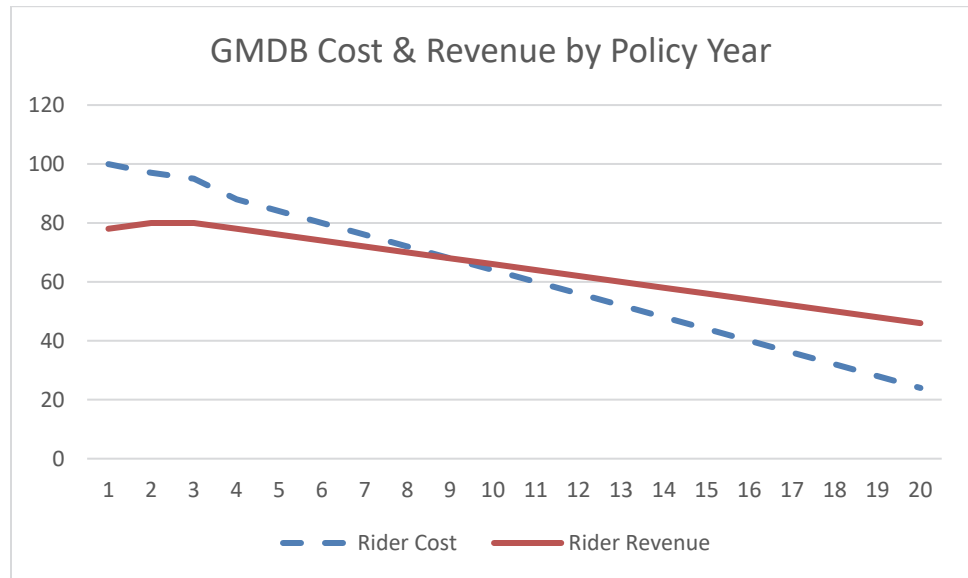
(b) (3 points) Determine whether the Total Ratio and Core Ratio meet the Office of the Superintendent of Financial Institutions (OSFI)'s minimum requirement and supervisory target, respectively. Show all work.

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

**4.**

(11 points) XYZ Life, a US based company, started selling variable annuity (VA) products with guaranteed minimum death benefits (GMDB) in 2010. They currently offer two versions of the GMDB riders: a 5% roll-up guarantee and a return of premium guarantee. No other GMxBs are offered on XYZ’s VA products. Rider fees are collected as a constant percent of account value.

- (a) (3 points) You are given the following graph of expected rider revenues and cost by policy year for the return of premium GMDB.



Critique the following statements:

- A. *If the assumed volatility increased, the rider cost line would steepen causing the calculated reserve to decrease.*

ANSWER:

- B. *If the corresponding graph was created for the 5% rollup GMDB, both the revenue and cost lines would increase over time due to the higher level of risk.*

ANSWER:



#### 4. Continued

- C. *It is unnecessary to use the full stochastic model to measure the cost of the return of premium GMDB since the guaranteed amount never changes.*

ANSWER:

XYZ needs to update their statutory reserve calculations to meet the requirements for the 2020 revisions to VM-21.

- (b) (3 points) Describe which factors will cause the following prescribed assumptions in VM-21 to vary with respect to XYZ's VA products with GMDB:

- (i) Full surrender rate

ANSWER:

- (ii) Partial surrender rate

ANSWER:

- (iii) Mortality rate

ANSWER:

- (c) (2 points) Describe two methods that are available to XYZ if they choose not to use the Direct Iteration Method.

ANSWER:

#### 4. Continued

- (d) (3 points) You are given the following Standard Projection calculations for five policies at the model point level and at the aggregate level:

	<b>GPVAD</b>	<b>Present value of net liabilities</b>	<b>Cash surrender value</b>
<b>Policy 1</b>	20	210	200
<b>Policy 2</b>	10	190	180
<b>Policy 3</b>	0	200	220
<b>Policy 4</b>	50	295	250
<b>Policy 5</b>	6	155	150
<b>Aggregate</b>	75	1050	1000

Determine which of the two methods for quantifying the impact of aggregation in the standard projection described in the AAA practice note “Implementation of Requirements for Principle-Based Reserves for Variable Annuities – 2021 Edition of VM-21” has a larger impact.

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

## 5.

(9 points) TOB, a U.S. life insurance company, recently entered into a 50% coinsurance agreement with offshore reinsurer DEF on a new Universal Life product.

You are given the following product cash flow projections:

Year	Expected Direct Gross Premium	Expected Reinsurance Reimbursement	Ceding Commission
1	162,000	17,010	72,900
2	144,000	15,120	7,200
3	126,000	13,230	6,300
4	108,000	17,280	5,400
5	90,000	14,400	4,500
6	72,000	15,480	3,600
7	54,000	11,610	2,700
8	36,000	7,740	1,800

Assume:

- Interest rate is 6.75%.
- The coinsurance agreement meets the definition of a long-duration contract.
- Expected cashflows occurred at end of the year for present value calculations.

(a) (7 points) Calculate the following as required by FASB ASC 944 (formerly FASB 113) based on TOB's product cashflow projections:

(i) Reinsurance Benefit Reserve Adjustment at the end of each year.

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

(ii) Reinsurance Expense Reserve Adjustment at the end of each year.

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

(iii) Cost of Reinsurance after Interest at the end of each year.

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

**5. Continued**

- (iv) Fill in the effects of the net cost of reinsurance on TOB's year 1 balance sheet and income statement in the applicable cells below.

	<b>Year 1</b>			
	<b>Balance Sheet</b>		<b>Income Statement</b>	
	<b>Debit</b>	<b>Credit</b>	<b>Debit</b>	<b>Credit</b>
<i>Recognition of the Cashflows</i>				
Cash				
Premiums Ceded				
Benefits Incurred				
Amortization of Acquisition Costs				
<i>Recognition of the Adj. to net COR</i>				
Reinsurance Recoverable				
Benefits Incurred				
Amortization of Acquisition Costs				
Deferred Policy Acquisition Costs				

Show all work.

**5. Continued**

(b) (2 points) Describe the differences in the accounting treatment of the cost of reinsurance with the following changes to the reinsurance transaction:

(i) YRT

ANSWER:

(ii) Reinsurance of an existing block of business

ANSWER:

(iii) Modified Coinsurance

ANSWER:

**6.**

(12 points) SJG Life has a block of 5-Year level term insurance policies subject to ASU 2018-12, where all business is assumed to lapse at the end of year 5. You are given the following information:

- Experience over the five years is expected to be as follow:

<b>Year</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>Premium</b>	10,000	8,499	7,476	6,801	6,321
<b>Benefits and Expenses Paid</b>	3,806	4,738	5,407	5,561	5,806

- Discount Rate (locked-in and current are the same for all periods): 5.50%
- Premiums are assumed to be paid at the beginning of the year.
- Benefits and expenses paid are assumed to be incurred at the end of the year.

- (a) (4 points) Calculate the liability for future policyholder benefits (LFPB) at the end of year 2.

Show all work.

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

- (b) (4 points) Due to the COVID Pandemic, the actual benefits and expenses/expected benefits and expenses paid ratio in year 3 equaled 115%. As a result, the assumption for benefits and expenses paid in year 3 were adjusted accordingly. No other assumptions were modified.

Calculate the LFPB at the end of year 3. Show all work.

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

**6. Continued**

(c) (4 points) Determine the following impacts to the GAAP income statement in Year 3 due to the revised LFPB:

(i) Remeasurement gain or loss

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

(ii) Change in reserves

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

(iii) Total benefit expense

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

(iv) Change to GAAP income due to revision of assumption (assume change to investment income equals 0)

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

Show all work.

## 7.

(10 points) You are given for a Single Premium Fixed Deferred Annuity:

Item	Value and Units
Single Premium	10,000
Initial Guaranteed Interest Rate	5%
Initial Guaranteed Rate Term	4 years
Ultimate Guaranteed Minimum Interest Rate	2%
Surrender Charge by policy year	10%, 8%, 6%, 4%, 2%
Front-End Load (% of Premium)	1.5%
Statutory Valuation Interest Rate	3%
Contract expires after 7 <sup>th</sup> anniversary	

- (a) (3 points) Calculate the CARVM reserves, assuming the mortality rate is 0 and no partial withdrawals are available prior to contract maturity. Show your work.

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

- (b) (4 points) The following additional features are being considered for the annuity product:

- A. Policyholder can withdraw a certain portion of their account value each year without penalty
- B. An annuitization option that can be exercised based on account value
- C. A guaranteed death benefit that equals the account value

With respect to CARVM:

- (i) Explain how each feature should be modeled.

ANSWER:

- (ii) Explain how incidence rates for each feature should be set.

ANSWER:



## 7. Continued

(c) (3 points) Critique the following statements about CARVM for fixed annuities:

A. *The statutory valuation rate is set at the product level.*

ANSWER:

B. *Non-elective benefits (other than mortality) where the contract holder may have a financial benefit not to report the claim should use an incidence rate of 0%.*

ANSWER:

C. *Non-elective benefits are considered in a separate benefit stream.*

ANSWER:

D. *For contracts where annuitization is guaranteed at current purchase rates, the basic reserve shall be no less than 93% of the amount used to purchase annuitization benefits at time of valuation.*

ANSWER:

## 8.

(7 points)

(a) (4 points) Critique the following statements with respect to VM-21:

A. *Annuity contracts with an in-the-money GMWB rider have a higher likelihood to surrender for cash value and thus are projected to have an increased lapse rate.*

ANSWER:

B. *Products within the scope of VM-21 include products such as variable deferred annuity contracts with a GMxB, variable immediate annuity without a GMxB, and a separate account product that guarantees an index without a GMxB.*

ANSWER:

C. *If the Alternative Method is elected for variable deferred annuity contracts with a GMxB feature, the CTE amount should be floored at the aggregated cash surrender value.*

ANSWER:

D. *The projection of accumulated deficiencies should include all the expected cash flows for the entire group of contracts, such as hedging and federal income tax.*

ANSWER:

E. *For general account asset projections, the forward interest rates implied by the swap curve in effect as of the valuation date could be used without adjustments to reflect the current market expectations about the future interest rates.*

ANSWER:

## 8. Continued

- (b) (3 points) GVB Company has a small block of variable deferred annuities. The total CTE is 840,000. The table below includes the available information for each policy.

Policy ID	Standard projection amount	Cash value
1	26,582	26,850
2	301,438	292,658
3	160,681	159,090
4	742,727	707,359
5	91,148	82,862
6	46,349	45,890

Calculate the VM-21 reserve for each policy.

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

## 9.

(7 points) DJS Life insurance company sells variable deferred annuities with a Guaranteed Minimum Income Benefit (GMIB) rider which has a waiting period of 10 years. Some policyholders have exercised their options and annuitized their contracts.

You are given the following information for a policyholder at the time of annuitization:

- Year of annuitization: 2016
- Age at annuitization: 65
- Fund available for annuitization: 200,000
- Benefit payment: 1,000 per month
- Acquisition expense: 0
- Maintenance expense: 50 per year
- Best-estimate mortality: A2000
- Prescribed mortality: 1994 GAR
- Statutory interest rate: 3.0%
- Current portfolio yield: 6.0%

Annual annuity factors table:

Age	GAAP factors		Statutory factors	
	@ 3%	@ 6%	@ 3%	@ 6%
65	15.00	14.76	16.45	16.15
66	14.20	13.96	15.65	15.35
67	13.50	13.26	14.95	14.65
68	12.80	12.56	14.25	13.95
69	12.10	11.86	13.55	13.25
70	11.40	11.16	12.85	12.55

(a) (2 points) Describe the considerations in setting the following policyholder behavior assumptions for valuing guaranteed minimum income benefits:

(i) Annuitization rates

ANSWER:

(ii) Lapse rates

ANSWER:

## 9. Continued

(b) (5 points) Calculate the following reserves for the policy when the policyholder attains age 69.

(i) US GAAP reserves

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

(ii) US statutory reserves

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

(iii) Tax reserves

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

## 10.

(10 points) A consultant is developing a proposal to use embedded value analysis for explaining the value of the company's business. The following statements from the consultant have been highlighted for your review before they will be included in the report to the company's CFO.

Critique each statement.

- A. *The traditional, formula-based approaches of US statutory reserving provide a commonly used basis for assessing company solvency, but they fail to distinguish movements in reserve margins from economic earnings in a reporting period.*

ANSWER:

- B. *Embedded Value is a more effective accounting basis that addresses the criticisms of current accounting methods.*

ANSWER:

- C. *Embedded Value is the same as the actuarial appraisal value of a company when used for mergers and acquisitions.*

ANSWER:

- D. *When calculating the Adjusted Net Worth, both the Required Capital and Free Surplus are assumed to earn market rates of return.*

ANSWER:

- E. *It is common to use a Risk Discount Rate that is consistent with the reporting entity's cost of equity capital, provided that the rate reflects the risks inherent in the business.*

ANSWER:

## 10. Continued

- F. *It is essential to have a clearly defined process for the selection of assumptions in the calculation of the Embedded Value.*

ANSWER:

- G. *All non-economic assumptions used in the Embedded Value calculation should be based on industry data plus a provision for adverse deviations.*

ANSWER:

- H. *When calculating the Time Value of Financial Options and Guarantees (TVFOG) using stochastic scenarios, it is recommended to use “real-world” scenarios.*

ANSWER:

- I. *The accurate calculation of the final Embedded Value is more important to investors than adequate disclosure of the movement.*

ANSWER:

- J. *There is substantial subjectivity on the part of the company for the disclosure of sensitivity tests for assumptions used in their Embedded Value calculations.*

ANSWER:

## 11.

(9 points) A life insurance company is developing its first universal life policy with no secondary guarantees and no riders in 2022. To simplify the calculations, a proposal has been submitted to use the guaranteed maturity premium (GMP) as the guideline level premium (GLP).

(a) (6 points) Explain what conditions must be met in order for the proposal to be valid for the following:

(i) Interest rate

ANSWER:

(ii) Endowment date

ANSWER:

(iii) Cost of insurance

ANSWER:

(iv) Expenses

ANSWER:

At contract issue, the GLP and GMP are identical, however the face amount is increased on the eighth anniversary.

(b) (3 points) Discuss how the increase in face amount will affect each of the GLP and the GMP.

ANSWER:

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