

Exam ILALFMU

Date: Tuesday, November 7, 2023

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This examination has 10 questions numbered 1 through 10 with a total of 80 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.

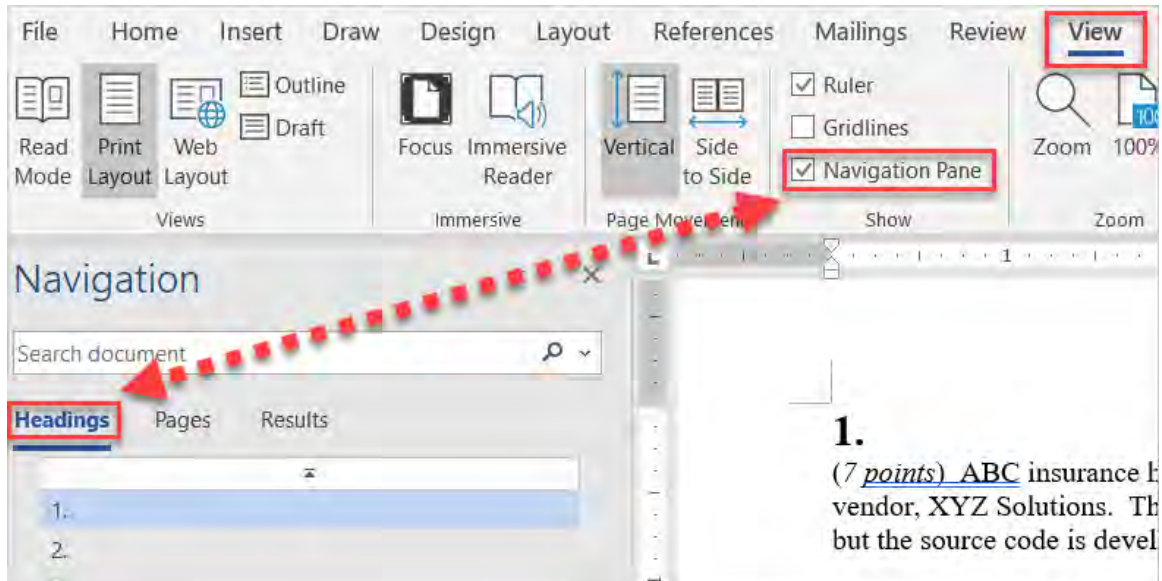
Written-Answer Instructions

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 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.

(9 points) MGP is a financial firm that sells term life insurance, life annuities, mutual funds, and segregated funds. They are introducing a risk capital framework to assist their corporate decision making.

(a) (1 point) Critique the following statements regarding a risk capital framework:

- A. *All else being equal, a firm that invests predominantly in equities will require more risk capital than a firm that invests predominantly in fixed income securities.*

ANSWER:

- B. *As long as there are no changes in a firm's underlying gross assets, changes in any liabilities will have no impact on the amount of risk capital required.*

ANSWER:

1. Continued

(b) (6 points) You are given:

- Marginal risk capital is used to allocate risk capital across business units.
- The continuously compounded risk-free rate of interest is 3%.

Correlation of profits by business unit

	Annuities	Mutual Funds	Seg Funds	Term Life
Annuities	1.00			
Mutual Funds	0.25	1.00		
Seg Funds	0.50	0.20	1.00	
Term Life	0.00	0.00	0.00	1.00

Business Unit Group	Annual Volatility of profits	Liabilities at time 0	Risk-free value of net assets at the end of the first year
Annuities (1)	30.0%	2,000	250
Mutual Funds (2)	40.0%	1,000	200
Seg Funds (3)	25.0%	3,000	500
Term Life (4)	20.0%	8,000	500
1 & 2 & 3	22.2%	6,000	950
1 & 2 & 4	16.2%	11,000	950
1 & 3 & 4	15.2%	13,000	1,250
2 & 3 & 4	15.3%	12,000	1,200
1 & 2 & 3 & 4	14.8%	14,000	1,450

- (i) (2 points) Calculate the variance of business profits of a portfolio consisting of mutual funds and segregated funds.

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

- (ii) (4 points) Calculate the proportion of unallocated risk capital for MGP at the end of the second year.

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

1. Continued

- (c) (2 points) MGP is considering expanding their business to include whole life insurance but is concerned about the impact on risk capital.

Recommend two criteria for MGP to use in making this decision.

ANSWER:

2

(6 points) MSF Life sells a fixed indexed annuity without a fixed account and without any optional riders.

(a) (1 Point) You are given:

Index return	7%
Participation rate	110%
Index spread	2%
Cap rate	6%
Floor rate	1%

Calculate the index credit for this crediting period.

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

(b) (5 points) You are given:

Option budget	3.0%
Guaranteed interest rate	0.5%
Risk-free interest rate	2.0%
Discount rate	3.5%

Year	Index AV	Guaranteed Value	Mortality	Lapse	Persistence	Decrement Index AV	Decrement Guaranteed Value
0	100,000	100,000			0.94050	100,000	100,000
1	103,060	100,500	1%	5%	0.88454	96,928	94,520
2	106,214	101,003	1%	5%	0.83191	93,950	89,341
3	109,464	101,508	1%	5%	0.78241	91,064	84,445
4	112,813	102,015	1%	5%	0.73586	88,266	79,818
5	116,265	102,525	1%	5%	0.69207	85,555	75,444
6	119,823	103,038	1%	5%	0.65090	82,927	71,310
7	123,490	103,553	1%	5%	0.61217	80,379	67,402
8	127,269	104,071	1%	5%	0.57574	77,910	63,709
9	131,163	104,591	1%	5%	0.00000	75,516	60,218
10	135,177	105,114	1%	100%		0	0

Calculate the GAAP benefit reserve for this policy at the end of year 5. Show all work.

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

3.

(12 points) ALY Life is preparing GAAP financial statements for a block of 1,000 10-year certain and life-contingent SPIA contracts issued on January 1, 2023.

You are given:

- Issue age: 65
- Benefit payment: 110 per year per policy during both life-certain and life-contingent periods
- Benefit payments started on the issue date
- Level maintenance expense: 10 per year per policy
- Initial single premium: 1000 per policy
- Commission rate: 3.0% of premium paid at issue
- Deferrable acquisition expense: 65 per policy
- Non-deferrable acquisition expense: 20 per policy
- Best estimate annual mortality rate
 - 20% for $65 \leq \text{Age} < 92$
 - 100% for $\text{Age} = 92$
- Provision for Adverse Deviation (PAD): 10% on mortality
- Annual reserve discount rate = 4.25%
- Assume no Deferred Profit Liability (DPL)

- (a) (5 points) Calculate the projected Liability for Future Policyholder Benefits (LFPB) at the end of the third policy year.

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

- (b) (4 points) Calculate the projected DAC at the end of the third policy year using the group contract method.

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

3. Continued

(c) (3 points) You are given:

- Experience was equal to expected for 2023-2025
- Actual annual mortality rate increased from 20% to 60% in 2026
- No change to future best estimate mortality rate
- No change to the current discount rate in any year

Calculate the LFPB remeasurement gain or loss in 2026.
Show all work.

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

4.

(7 points) SJG Life is developing a new participating life insurance product with endowment at age 65. You are given the following information for a policy issued on January 1, 2024:

Issue age	55
Level death benefit	1,000,000
Variation of gross premium payments	Level
Dividend fund interest rate	1.75%
Cash value interest rate	3.50%
Valuation interest rate	3.00%
Investment earned rate of interest	4.50%

Assume:

- Premiums are payable at the beginning of each year.
- All benefits are payable at the end of each year:
 - Dividends are payable annually to policyholders
 - Termination dividends are paid to terminating policyholders
 - Cash values are payable upon surrenders
- DAC is amortized based on face amount

Attained Age	Mortality Assumptions (Rates per 1000)			
	Pricing	Valuation	Cash Value	Dividend
55	28.545	57.090	42.818	45.672
56	33.385	63.590	48.328	51.508
57	39.039	70.980	54.655	58.204
58	45.207	78.620	61.324	65.255
59	52.074	86.790	68.564	72.904
60	59.894	95.830	76.664	81.456
61	68.894	105.990	85.852	91.151
62	79.137	117.240	96.137	101.999
63	90.636	129.480	107.468	113.942
64	103.349	142.550	119.742	126.870
65	117.210	156.280	132.838	140.652

4. Continued

- (a) (5 points) Calculate the following at the end of the third policy year, based on GAAP accounting rules for participating life insurance.
- (i) Liability for future policyholder benefits
 - (ii) Terminal dividend liability

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

- (b) (2 points) SJG Life is considering the development of a non-participating endowment at age 65 product.

Describe how the calculation of GAAP benefit reserves would differ.

ANSWER:

5.

(10 points) XYZ Life has a block of 20-year level term policies issued in 2018.

- (a) (1 point) ABC Life sold an identical level term product to a policyholder population with the same demographics, but ABC Life's premium is lower than XYZ Life's.

Evaluate which company's net premium reserve will more likely dominate its PBR reserves.

ANSWER:

- (b) (3 points) Critique the following statements under PBR Reserves

A. *The mortality margin for adverse deviation is based on actuarial judgement and analysis, with support shown in the PBR Actuarial Report.*

ANSWER:

B. *The expense margin for adverse deviation is prescribed based on credible company experience.*

ANSWER:

C. *The lapse margin for term products should decrease the lapse assumption.*

ANSWER:

D. *VM-20 prohibits future mortality improvement but allows a company to recognize a percentage of its post-level term profits based on a prescribed formula.*

ANSWER:

5. Continued

E. *The investment rate margin is implicitly prescribed based on VM-20 required treasury rates, gross spreads, defaults, recoveries, and guardrails on the reinvestment strategy for fixed income.*

ANSWER:

F. *The sum of the individual margin impacts equals the total impacts of all margins.*

ANSWER:

(c) (2 points) Explain the impact on XYZ Life's net premium reserve of the following:

(i) Changing the post-level premium-to-benefit ratio to 150% from the VM-20 prescribed ratio

ANSWER:

(ii) Changing the post-level premium-to-benefit ratio to 100% from the VM-20 prescribed ratio

ANSWER:

(d) (4 points) As part of its US Statutory valuation, XYZ Life performed the stochastic exclusion test.

- Baseline scenario reserve = 300 million
- Maximum reserve of 16 scenarios prescribed by VM-20 scenario generator = 350 million
- Baseline scenario present value of benefits and expenses = 2,500 million

(i) Determine whether XYZ Life passed the stochastic exclusion test.

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

5. Continued

- (ii) Explain whether this product contains significant interest rate risk.

ANSWER:

- (iii) Explain why a company might calculate the stochastic reserve despite passing the stochastic exclusion test.

ANSWER:

6.

(7 points)

(a) (2 points) Critique the following statements:

A. *For a deferred annuity contract with the option to annuitize at the guarantee or current annuitization purchase rates, the basic CARVM reserve shall be no less than 80% of the amount used to purchase annuitization benefits at the time of valuation.*

ANSWER:

B. *Structured settlements are not permitted to use substandard mortality when calculating statutory reserves.*

ANSWER:

C. *A cash refund annuity would have a lower reserve at issue than an installment refund annuity.*

ANSWER:

6. Continued

(b) (5 points) You are given the following for a deferred annuity policy:

- Term: 10-year
- Contract is terminated after the initial term
- Guaranteed Interest Rate: 3%
- Issue date: July 1, 2020
- Valuation date: June 30, 2021
- Account value of 103,000 on June 30, 2021
- Policyholder will turn 46 on July 1, 2021
- Valuation interest rate is 3.25%
- All benefits are paid at the end of the period

Year	Surrender Charge %
1	9%
2	8%
3	7%
4	6%
5	5%
6+	0%

Calculate the CARVM reserve at the valuation date using the mortality table provided in Excel. Show all work.

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

7.

(7 points) BFB Life Insurance company has a block of universal life (UL) business issued between 2000-2022.

(a) (2 points) Compare the following under Universal Life Insurance Model Regulation and VM-20's Net Premium Reserve (NPR).

(i) Guaranteed Maturity Premium

ANSWER:

(ii) r-ratio

ANSWER:

(iii) Reserve calculation assumptions

ANSWER:

(iv) Minimum reserve floor

ANSWER:

(b) (3 points) Critique the following statements pertaining to BFB's business.

A. *Under VM-20, mirror reserves are no longer required. Under VM-20, BFB can use their own experience-based mortality assumption as long as the mortality assumption credibility is above 99%.*

ANSWER:

B. *When calculating the Deterministic Reserve, starting assets must be between 98% and 102% of modeled net reserves.*

ANSWER:

7. Continued

- C. *After VM-20 went into effect, the formulaic Net Premium Reserve (NPR) completely replaced CRVM*

ANSWER:

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

Present Values	In millions
Benefits with margins	150
Expenses with margins and commissions	25
Premiums with margins	80
Aggregate CRVM reserve	120
Aggregate AG38 reserve	200
Aggregate NPR reserve	40

Calculate the following:

- (i) VM-20 reserve, assume the information given is from policies issued in 2022.

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

- (ii) AG-48 reserve, assume the information given is from policies issued in 2016.

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

8

(8 points)

(a) (5 points) You are given:

Coverage	Insured	Coverage Period	Premium per Year	Death Benefit
Base policy	Policyowner, age 20 at issue	Whole life	2,004	100,000
Accidental death benefit rider	Policyowner	Attained age 65	120	10,000
Child term rider	Child age 0 at issue	Attained age 25	108	10,000
Term life insurance rider	Business Partner, age 20 at issue	25 years	600	10,000

- All premiums are paid at the beginning of each policy year.
- $1000 A_{20} = 111.99$
- $\ddot{a}_{20:\overline{25}|} = 16.07$
- $\ddot{a}_{20:\overline{45}|} = 21.04$
- $\ddot{a}_{20:\overline{7}|} = 6.23$

(i) Assume no other changes are made to the policy's benefits.

Determine if the policy is a modified endowment contract, assume premiums are paid throughout the 7-pay test period without any modification.

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

8. Continued

(ii) You are given:

- At the beginning of the 5th policy year, the owner elects to reduce the primary benefit face amount to 50,000 and cancels all riders.
- Premiums are reduced to 1,080 per year.

Determine if the policy is a modified endowment contract, assume premiums are paid throughout the 7-pay test period.

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

(b) (3 points) You are given:

Line of Business	Non-Variable Life		Variable Universal Life	
	Term Life	Whole Life	General Account	Separate Account
Account Value			20,000	80,000
Net Surrender Value	45,000	150,000	14,000	74,000
Statutory Reserve	50,000	225,000	21,000	75,000

Calculate the total tax reserve for the company.

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

9.

(8 points) DJS, a Canadian life insurer, is looking to understand the impacts of moving from IFRS 4 to IFRS 17. You are given:

	Year 1	Year 2	Year 3
Premiums	22,500.0	0.0	0.0
Investment income	2,250.0	1,922.0	2,516.0
Insurance revenue	480.0	508.5	579.0
Incurred claims and other expenses (IFRS 17)	-12.0	0.0	0.0
Incurred claims and other expenses (IFRS 4)	-255.0	-256.5	-27,120.0
Change in insurance contract liabilities	-24,072.0	-1,116.0	25,188.0
Other comprehensive income	0.0	0.0	0.0

(a) (5 points) Calculate the comprehensive income for all years under the following:

(i) IFRS 4

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

(ii) IFRS 17

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

(b) (3 points) Evaluate the following statements:

A. *IFRS 17 will have minimal impact on DJS's LICAT ratios.*

ANSWER:

B. *When moving from IFRS 4 to IFRS 17, DJS will not need to reevaluate whether a contract is an insurance contract, a reinsurance contract, or an investment contract with discretionary features.*

ANSWER:

9. Continued

- C. *In contrast with short-term insurance contracts, updating the assumed interest rate for long-term insurance contracts with guaranteed returns from 4 to 6% will increase the current value of the contract under IFRS 17.*

ANSWER:

- D. *IFRS 17 requires DJS to measure insurance contract liabilities using a discount rate based on the 'expected return on assets held' to match the insurance contract liabilities.*

ANSWER:

10

(6 points)

- (a) (1 point) Describe objectives in creating a Source of Earnings Analysis.

ANSWER:

- (b) (4 points) You are given the following for a block of single premium deferred annuities (SPDA):

	Actual	Plan
Average annual assets	150,000,000	100,000,000
Annual yield	5.00%	2.50%
Annual non-investment expenses	1,500,000	1,250,000

- Assume expenses vary directly with average annual assets.

Calculate the following Source of Earnings components:

- (i) Investment income variance

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

- (ii) Variance due to yield

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

- (iii) Variance due to assets

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

- (iv) Non-investment expense variance

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

- (v) Variance due to expense ratio

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

10. Continued

- (c) (1 point) List additional drivers of earnings for the SPDA.

ANSWER:

****END OF EXAMINATION****