CURATED PAST EXAM ITEMS
- Questions -

ILA 101 – Pricing and Introduction to Valuation and Risk Management

Important Information:

- These curated past exam items are intended to allow candidates to focus on past SOA fellowship assessments. These items are organized by topic and learning objective with relevant learning outcomes, source materials, and candidate commentary identified. We have included items that are relevant in the new course structure, and where feasible we have made updates to questions to make them relevant.
- Where an item applies to multiple learning objectives, it has been placed under each applicable learning objective.
- Candidate solutions other than those presented in this material, if appropriate for the context, could receive full marks. For interpretation items, solutions presented in these documents are not necessarily the only valid solutions.
- Learning Outcome Statements and supporting syllabus materials may have changed since each exam was administered. New assessment items are developed from the current Learning Outcome Statements and syllabus materials. The inclusion in these curated past exam questions of material that is no longer current does not bring such material into scope for current assessments.
- Thus, while we have made our best effort and conducted multiple reviews, alignment with the current system or choice of classification may not be perfect. Candidates with questions or ideas for improvement may reach out to education@soa.org. We expect to make updates annually.

SOCIETY OF ACTUARIES®

ILA 101

CURATED PAST EXAM QUESTIONS

ALL LEARNING OBJECTIVES

Table of Contents

Fall 2020 LPM Exam

1.

Relevant Sources:

- ILA101-100-25: Life Products and Features
- ILA101-102-25: Understanding Profitability in Life Insurance
- ILA101-106-25: Experience Assumptions for Individual Life Insurance and Annuities
- ILA101-103-25: Ch. 9 of *Life Insurance Products and Finance*, Atkinson and Dallas
- ILA101-104-25: Ch. 11, pp. 499-512 of *Life Insurance Products and Finance*, Atkinson and Dallas
- Predictive Models on Conversion Studies for the Level Term Premium Plans, SOA, Mar 2017

(*9 points*) You are given the following information about Term Co's 5 and 10-year level term life insurance products:

- They are renewable at a higher premium amount beyond the initial level term period pattern
- The issue age range is 18-65
- There is no maximum face amount
- Premium rates per 1,000 do not vary by face amount
- The mortality pricing assumption is based on Term Co experience and varies by gender and attained age

(a) **(LO 2b)** (*1 point*) Critique the mortality pricing assumption.

ANSWER:

1. Continued

(b) (*4 points*) You are given Term Co's 10-year term GAAP results for the prior quarter:

Aggregate Reserve Rollforward	
Beginning of Period Reserves	675,000
Net Premium	370,000
Reserve Released for Maintenance Expenses	(125,000)
Interest Added to Reserves	**X**
Reserve Released for Death Benefits	(220,000)
Reserve Released for Surrenders	(18,000)
End of Period Reserves	695,500

Actual Experience	
Net Premium	390,000
Investment Income	9,500
Death Benefits Paid	245,000
Surrender Benefits Paid	0
Maintenance Expenses Paid	128,000

(i) **(LO 1c)** (*0.5 point*) Calculate X in the Aggregate Reserve Rollforward. Show all work, including writing out relevant formulas used in any calculations.

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

~~(ii) **(NOT RELEVANT)** (*2.5 points*) Create a Source of Earnings analysis for the actual results.~~

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

~~(iii) **(NOT RELEVANT)** (*1 point*) Determine the expected total variance between actual results and projected valuation results. Show all work, including writing out relevant formulas used in any calculations.~~

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

1. Continued

Term Co plans to sell Universal Life (UL) to the same issue ages with face amounts up to one million. Term Co will price this product to achieve the same internal rate of return (IRR) as the 10-year term product. The UL product will use an automated underwriting process for those that qualify ("AUW"). Those that do not qualify for AUW will have identical underwriting as the term product.

(c) **(LOs 1a, 2a)** (*3 points*) Describe considerations that should be incorporated into the following term assumptions before they are used to price the UL product:

(i) Mortality

ANSWER:

(ii) Lapse

ANSWER:

(iii) Interest

ANSWER:

(d) **(LO 1c)** (*1 point*) List considerations when selecting a profitability metric.

ANSWER:

2.

Relevant Sources:

- ILA101-100-25: Life Products and Features
- CIA Educational Note: Selective Lapsation for Renewable Term Insurance Products, Feb 2017
- Term Conversions: Pricing and Reserving, Product Matters, Mar 2017
- Predictive Models on Conversion Studies for the Level Term Premium Plans, SOA, Mar 2017

(*11 points*) ABC Life Insurance Company has been selling term products in the U.S. since 1970. Its products have kept pace with the evolution of term products in the market over the years, other than the lack of a conversion option.

(a) **(LO 2b)** (*2 points*) Evaluate ABC's plan to set term lapse assumptions for 2020 new business based on ABC's historical lapse experience for the level term and post-level term periods.

ANSWER:

(b) **(LOs 1a, 1b, 2b)** (*4 points*) ABC will introduce a conversion option on its term products, allowing policyholders to convert to one of ABC's permanent products before the end of the initial level term period.

(i) (*1 point*) Explain how a conversion option benefits the policyholder.

ANSWER:

(ii) (*1 point*) State two reasons why companies would offer conversion options on their term products.

ANSWER:

(iii) (*2 points*) Explain the advantages and disadvantages of building conversion costs into ABC's term products as opposed to their permanent products.

ANSWER:

2. Continued

(c) (*5 points*) ABC's Pricing Actuary has proposed the following assumptions to price the conversion option of its 10-year term product. ABC uses the same mortality rates for term and permanent life business.

Conversion Rate:	6% at the end of each year in years 1 to 10
Post - Conversion Mortality:	120% of ABC's current point-in-scale mortality rates for all conversions in durations 1-10
Lapse rate:	0% in all years
Interest rate:	0% in all years

Additionally, you are given the following for a policy issued at age 50:

Converted face amount = initial face amount = 500,000

$q_{[50]}$	0.0011
$q_{[50]+1}$	0.0014

$\sum_{t=0}^{\infty} {}_tp'_{[50]+1} * q_{[50]+1+t} = 0.81$

$\sum_{t=0}^{\infty} {}_tp'_{[50]+2} * q_{[50]+2+t} = 0.79$

${}_tp_{[x]+s}$, $q_{[x]+s}$ denote survivorship and mortality for ABC's base mortality assumptions (prior to the conversion offering)

${}_tp'_{[x]+s}$ denotes survivorship of a converted policy

(i) **(LO 2b)** (*3 points*) Calculate the expected conversion cost of this policy for conversions in the first 2 durations using ABC's proposed conversion assumptions. Show all work, including writing out relevant formulas used in any calculations.

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

~~(ii) **(NOT RELEVANT)** (*2 points*) Critique the proposed conversion rate and post-conversion mortality assumptions, based on the findings of the *SOA Report on the Conversion Experience Study for Level Premium Term Plans*.~~

ANSWER:

4.

Relevant Sources:

- ILA101-101-25: Annuity Products and Features
- Variable Annuity Guaranteed Living Benefits Utilization, SOA LIMRA Research, 2018, Executive Summary only (pp. 19-32)
- Credibility Methods Applied to Life, Health, and Pensions, SOA, Feb 2019 (pp. 1-25 only)
- ILA101-106-25: Experience Assumptions for Individual Life Insurance and Annuities

(*11 points*)

~~(a) **(NOT RELEVANT)** (*2 points*) Describe two challenges insurers face in modeling policyholder behavior.~~

~~ANSWER:~~

~~(b) **(NOT RELEVANT)** (*3 points*) With regard to understanding and modeling policyholder behavior, you are given the following current practices for XYZ insurance company:~~

~~**Category**~~	~~**XYZ Current Practices**~~
~~Data collection, analysis, and assumption setting~~	~~• Reviewing company experience analysis~~ ~~• Maintaining an assumption repository for policyholder behavior including information from the administrative system~~
~~Modeling~~	~~• Assumptions are owned by each functional group (Pricing, ALM, Valuation)~~
~~Validation~~	~~• Model steward validates changes and results at high level~~
~~Governance process~~	~~• Based upon resource availability, periodic updates are performed for experience data~~ ~~• Assumption changes are recommended and approved informally within each functional group~~

~~Evaluate whether XYZ's current practices are consistent with industry current practices for each category.~~

~~ANSWER:~~

4. Continued

(c) **(LO 1a, 1b)** (*3 points*) XYZ has completed product development for a new Indexed Annuity product and has experience with a Variable Annuity with a Guaranteed Minimum Withdrawal Benefit (GMWB) product.

Critique the following statements:

A. The cost of adding a GMWB rider is typically higher on an Indexed Annuity than a Variable Annuity.

ANSWER:

B. XYZ must hedge a GMWB on an Indexed Annuity using the same approach currently used on the Variable Annuity GMWB.

ANSWER:

C. XYZ can follow basic CARVM reserving, as covered in Actuarial Guideline 33, for the Indexed Annuity.

ANSWER:

D. Because XYZ does not have a clearly defined hedging strategy, it must use the book value of relevant hedging instruments as the basis for its reserving.

ANSWER:

4. Continued

(d) **(LOs 1a, 1b, 2a, 2b, 2c)** (*3 points*) You are asked to perform a projection of liabilities for XYZ's new Indexed Annuity product and are given:

Indexed Annuity Assumption	**Current Data Source**	**Current Structure (Static or Dynamic)**
Surrenders	Company data	Dynamic
Withdrawals	Company data	Static
GLB Utilization	Company data	Static
Annuitizations	Company data	Dynamic

Evaluate the appropriateness of the data source and structure for each of the above assumptions.

ANSWER:

6.

Relevant Sources:

- Tiller, 4th edition, Chapter 4: Basic Methods of Reinsurance
- Tiller, 4th edition, Chapter 5: Advanced Methods of Reinsurance

(*11 points*) Life Co is a life insurance company exploring various reinsurance options for its life insurance business. Life Co's management has the following company objectives for the current year:

1. Reduce capital,
2. Expand into the annuity business,
3. Achieve expense efficiencies, and
4. Mitigate mortality exposure.

(a) **(LO 5e)** (*4 points*) Compare the effectiveness of the following types of reinsurance for each of the company's objectives.

(i) YRT

ANSWER:

(ii) Coinsurance

ANSWER:

(iii) Modified Coinsurance

ANSWER:

(iv) Funds Withheld Coinsurance

ANSWER:

6. Continued

(b) **(LO 5e)** (*7 points*) Life Co is entering a Mod-Co reinsurance arrangement with Reinsurance Inc.

Life Co	**Year 1**	**Year 2**
Premiums	2,000	0
Expenses	50	10
Commissions	250	0
Reserves	1,500	1,800
Benefits Paid	0	50
Investment Income	10%	10%
Reinsurance Co.	**Year 1**	**Year 2**
Allowance	10%	10%
Mod-Co Interest Rate	5%	5%

(i) (*4 points*) Construct Life Co's Gain from Operations statement for years 1 and 2 under the reinsurance agreement.

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

(ii) (*3 points*) Construct Reinsurance Inc's Balance Sheet for years 1 and 2 under the reinsurance agreement.

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

8.

Relevant Sources:

- Statutory Valuation of Individual Life and Annuity Contracts, Claire, D., Lombardi, L. and Summers, S., 5th Edition, 2018
- US GAAP for Insurers, Freedman, M., and Frasca, R., 3rd Edition, 2024

(*12 points*) You are given:

- JKL Life's 20-year term policies, issued 5 years ago, have a guaranteed level premium for 10 years followed by annually renewable premiums for 10 years.

- JKL's earnings projection under each of the following bases from a portfolio of JKL's inforce term policies issued 4 years ago (i.e., policy year 1 is based on actuals and years 2 through 20 are projections based on pricing assumptions at issue):

Policy Year	US Statutory (CRVM)	US GAAP	CALM	Market Consistent (Solvency II)
1	(24,641)	1,534	8,483	2,368
2	(4,424)	1,546	432	4,192
3	1,932	1,621	616	3,358
4	1,744	1,718	797	2,316
5	3,580	1,738	869	2,015
6	6,038	1,734	912	1,895
7	7,192	1,768	991	1,401
8	8,749	1,800	1,059	871
9	8,626	1,843	1,129	160
10	20,081	(1,176)	(760)	(1,963)
11	(335)	1,148	740	290
12	598	736	483	157
13	181	651	428	124
14	125	630	413	113
15	95	615	402	105
16	74	616	400	99
17	96	621	401	95
18	102	620	398	89
19	145	616	393	84
20	1,900	587	372	77

8. Continued

(a) (*4 points*) JKL's actual experience from this block shows higher mortality than expected in the first 5 years. Assume the earnings are projected again with slightly higher expected mortality rates for years 6 to 10.

Identify which of the following will have the higher expected change in earnings in year 6:

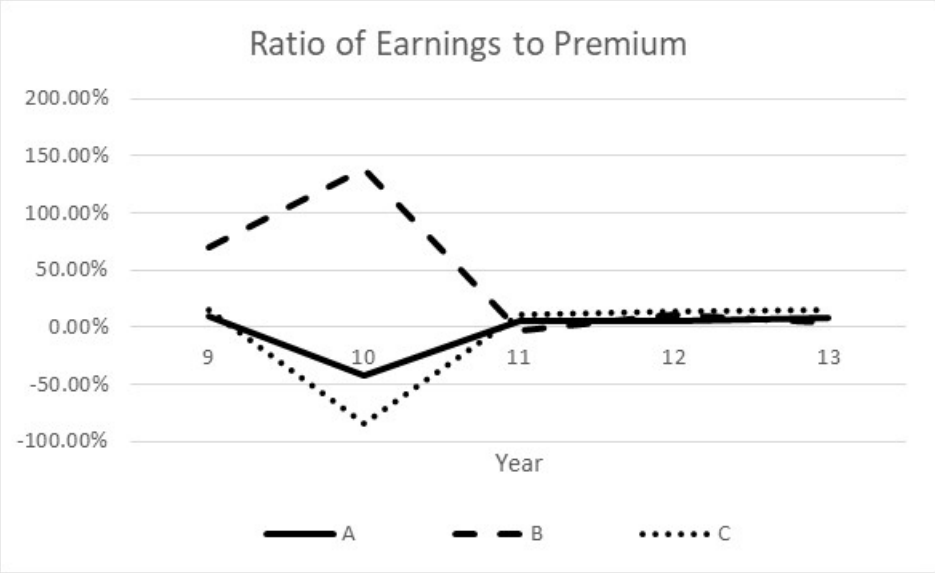
A. (LO 4a) US Statutory
~~B. **(NOT RELEVANT)** CALM~~

Justify your answer.

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

8. Continued

(b) (*3 points*) You are given the follow graphs of the annual ratio of earnings to premium projections for years 9-13 assuming that only the pricing shock lapse rate was lowered in year 10 by one third:



Assume the product has no surrender value.

Identify which graph corresponds with each of the following methods:

(i) **(LO 4b)** US GAAP

(ii) **(LO 4a)** US Statutory

~~(iii) **(NOT RELEVANT)** CALM~~

Justify your answers.

ANSWER:

8. Continued

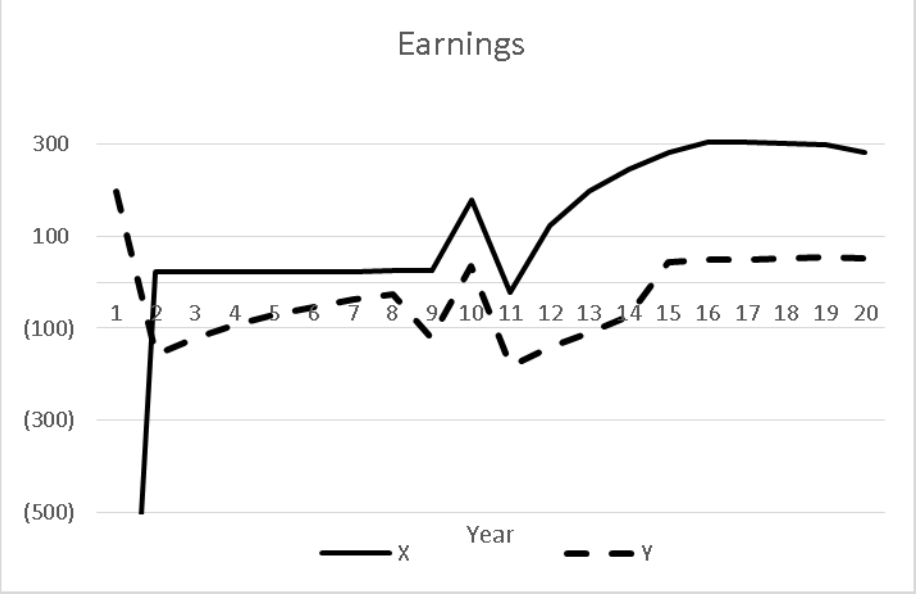
(c) **(NOT RELEVANT)** (*5 points*) JKL's inforce was priced based on the Traditional Approach of a jump to YRT premiums at the end of the level term period. JKL just completed re-pricing based on CALM and Solvency II using the Graded Approach. Under this approach, the post-level-term (PLT) YRT rates will increase gradually over 5 years jumping to the original YRT schedule in year 16.

The following were the pricing assumptions used for the Traditional and Graded Approaches:

Assumptions	**Traditional Pricing**	**Graded Premium Re-Pricing**
Premium (Yr 11+) (% 2015 VBT*)	300%	Grade from 100% to 300% in years 11-16
Mortality (Yr 11+) (% 2015 VBT)	300%	Grade from 100% to 300% in years 11-16
Shock Lapse Rate (Yr 10)	85%	50%
Post Level Lapse Rates (Yr 11+)	Grade to 10% in year 14	
CALM Mortality and Lapse PfADs (Yr 11+)	10%	10%
Risk Margin	50% years 1-9, 200% in Years 10+	Grade from 50% to 200% in years 9-15

* Valuation Basic Table

You are given the following results for the repricing compared to the traditional pricing:



8. Continued

(i) (*2.5 points*) Identify which graph corresponds with each of the following methods:

- CALM
- Market Consistent (Solvency II)

Justify your answers.

ANSWER:

(ii) (*2.5 points*) Recommend which of the two pricing approaches you would use to calculate the PLT premiums under each of the following valuation bases:

- CALM
- Market Consistent (Solvency II)

Justify your answers.

ANSWER:

9.

Relevant Sources:

- Handbook of Fixed Income Securities, Fabozzi, F.J., 9th Edition, 2021
- ILA101-112-25: Revisiting the Role of Insurance Company ALM w/in a RM Framework

(*8 points*) Friendly Annuity Company (FAC) sells a single premium deferred annuity with no surrender charges through independent financial advisors. FAC is a highly-rated company, which has significant capital for stress scenarios but does not have an explicit policy regarding cash flow needs. FAC's strategic asset allocation is:

Asset Class	**Target Allocation**
Treasury Bonds	15%
Agency Mortgage-Backed Securities	30%
Corporate Bonds	30%
Cash	10%
Real Estate	15%

(a) **(LO 5d)** (*1 point*) Rank FAC's asset classes from most to least liquid. Justify your ranking.

ANSWER:

~~(b) **(NOT RELEVANT)** (*4 points*) Propose changes to improve FAC's liquidity risk management.~~

~~ANSWER:~~

9. Continued

(c) **(LO 5a, 5d)** (*3 points*) Critique the following statements:

A. Due to current economic conditions, Treasury bonds will outperform corporate bonds over the next six months. While long term expectations are well grounded, FAC needs an immediate revision to its strategic asset allocation to take advantage of the current pricing anomaly.

ANSWER:

B. Mortgage-backed security valuation requires sophisticated modeling of prepayment rates. FAC has built a model with 53 parameters that fits historical data almost perfectly, which gives a significant advantage over the market.

ANSWER:

C. Adding Real Estate to FAC's strategic asset allocation improves risk diversification and increases the liquidity and Sharpe ratio of the portfolio.

ANSWER:

10.

Relevant Sources:

- ILA101-100-25: Life Products and Features
- Predictive Models on Conversion Studies for the Level Term Premium Plans, SOA, Mar 2017
- ILA101-106-25: Experience Assumptions for Individual Life Insurance and Annuities
- Credibility Methods Applied to Life, Health, and Pensions, SOA, Feb 2019 (pp. 1-25 only)
- CIA Educational Note: Selective Lapsation for Renewable Term Insurance Products, Feb 2017

(*10 points*) LMN Life Insurance Company is updating assumptions for a block of 5-year level term life insurance which is annually renewable after year 5. You are given:

Policy Year	No. of Policies at beginning of policy year	Actual No. of lapses during the policy year
4	8,900	372
5	8,300	7,835
6	450	394

Current Assumption:

Policy Year	Expected Lapse Rate
1	1%
2	2%
3	3%
4	4%
5	90%
6	80%
7+	20%

(a) (*2 points*)

(i) **(LO 1a, 1b)** Describe the pricing goals for the "shock" premium rate for year 6.

ANSWER:

(ii) **(LO 2a, 2b)** Calculate the 95th percentile confidence interval of the policy year 5 lapse rate. Show all work, including writing out relevant formulas used in any calculations.

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

(b) **(LO 2b, 2c)** (*2 points*) Recommend lapse assumptions for policy years 5 and 6 for the upcoming product repricing. Justify your assumptions.

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

10. Continued

(c) **(LO 2a, 2b)** (*2 points*) LMN is developing lapse assumptions for a new 10-year level term product, which is annually renewable after year 10. LMN has not sold 10-year level term products in the past. The Pricing Actuary has set the 10-year level term lapse assumptions based on the 5-year level term experience

Critique the Pricing Actuary's lapse assumption.

ANSWER:

~~(d) **(NOT RELEVANT)** (*4 points*) The experience studies actuary recommends use of a predictive analytics model to develop lapse experience studies for the 5 year and 10 year level term products instead of LMN's traditional approach.~~

~~(i) (*2 points*) Describe the different methods and steps used in developing a predictive analytics model versus LMN's traditional approach for experience analysis studies.~~

~~ANSWER:~~

~~(ii) (*2 points*) Evaluate the actuary's recommendation. Justify your answer.~~

~~ANSWER:~~

****END OF EXAMINATION****

Spring 2021 LPM Exam
1.

Relevant Sources:

- Market Trends and Product Designs: Considerations when Interest Rates are Rising, Product Matters, Nov 2021
- ILA101-112-25: Revisiting the Role of Insurance Company ALM w/in a RM Framework
- ILA101-104-25: Ch. 11, pp. 499-512 of Life Insurance Products and Finance, Atkinson and Dallas
- ILA101-105-25: Life Insurance and Annuity Non-forfeiture Practices
- ILA101-106-25: Experience Assumptions for Individual Life Insurance and Annuities

(*8 points*) You are given the following for BXP Life:

- Sells fixed deferred annuities in the U.S with a one-year surrender charge period and no market value adjustment
- There has been an extended period of low interest rates.
- To support competitive pricing in the market during this period, management has invested in 30-year fixed income securities to maximize yield as part of the crediting strategy.

(a) **(LOs 3e, 5a)** (*4 points*)

(i) Describe two risks to BXP due to a significant rise in future interest rates.

ANSWER:

(ii) Recommend strategies to address these risks.

ANSWER:

(b) **(LO 1c, 1d, 2a)** (*4 points*) You are given the following components of Distributable Earnings:

(i) Commissions

(ii) Overhead expenses

(iii) Surrender benefits

(iv) Investment income

Describe the impact of a spike in interest rates to each of the above components. Justify your answer.

ANSWER:

2.

Relevant Sources:

- ILA101-102-25: Understanding Profitability in Life Insurance
- ILA101-103-25: Ch. 9 of Life Insurance Products and Finance, Atkinson and Dallas
- ILA101-104-25: Ch. 11, pp. 499-512 of Life Insurance Products and Finance, Atkinson and Dallas
- ILA101-100-25: Life Products and Features
- ILA101-110-25: Fundamentals of the Principle-Based Approach to Statutory Reserves for Life Insurance, Jul 2019

(*8 points*) AAJ Life Insurance Company is developing "New Term", a 5-year level premium with increasing renewable rates to age 95, term insurance product for sale in addition to the 10-year and 20-year term products they already sell. AAJ uses profit margin and IRR as profitability metrics for this product.

You are given the following illustration for the new product:

Year	**1**	**2**	**3**	**4**	**5**
Premiums	2,000	2,000	2,000	2,000	2,000
Benefits	1,200	1,400	1,700	2,000	2,400
Expenses	100	100	100	100	100
Statutory Reserve	1,000	2,000	4,000	1,500	0
Investment Income	20	50	80	140	40
Tax Reserve	920	1,840	3,680	1,380	0
Tax Rate	21%	21%	21%	21%	21%
Discount Rate	3%	3%	3%	3%	3%

Assume:

- There are no permanent differences between the statutory reserve and tax reserve.
- There is immediate deductibility of losses.
- All cashflows are in the middle of the year.
- 100% Shock lapse at year 5

(a) **(LO 1c)** (*3 points*) Calculate the after-tax profit margin. Show all work.

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

2. Continued

New Term is AAJ's first new term product since the inception of VM-20. Their existing term products use Regulation 830 (XXX) for reserves, and they have AG48 financing structures in place.

(b) (*3 points*) Evaluate term insurance pricing considerations under VM-20 with respect to:

(i) **(LO 1a, 1b)** Product design changes.

ANSWER:

~~(ii) **(NOT RELEVANT)** Profitability impacts from moving from Regulation XXX.~~

ANSWER:

(iii) **(LO 4a)** Profitability impacts of assuming no mortality improvement to future reserve nodes in the deterministic reserve.

ANSWER:

~~(c) **(NOT RELEVANT)** (*2 points*) Describe the impacts the Tax Cuts and Jobs Act will have on the profit margin for the term insurance products.~~

~~ANSWER:~~

3.

Relevant Sources:

- ILA101-106-25: Experience Assumptions for Individual Life Insurance and Annuities
- ILA101-100-25: Life Products and Features

(*10 points*) You are given the following pricing model review report of a variable annuity (VA) pricing model for company DXF that has previously only sold fixed annuities (FA):

VA Pricing Model Review

Policyholder	Issue age	Fund allocation (fixed income funds/equity funds)	Additional death benefit option elected
1	40	0%/100%	Greater of step-up & 5% roll-up
2	50	5%/95%	Greater of step-up & 5% roll-up
3	60	15%/85%	None
4	70	30%/70%	None

Product Features and Pricing Assumptions:

- To improve product profitability, surrender charges are set slightly above the industry average and agent commissions are set slightly below the industry average.
- The expense assumption is based on the DXF's fixed annuity expense study (i.e. 60 per FA contract on an annual basis) and is set at 55 annually per VA contract because VA expenses are expected to be lower than FA expenses.
- The mortality assumption is the same as the fixed annuity block since the VA will be sold to the same customer base as the FA
- Annuitization rates are assumed to be immaterial, because the FA experience demonstrated that very few policyholders choose to annuitize
- Return of premium guaranteed minimum death benefit is standard on all policies.

Results:

- When running a stochastic analysis, the cost of the death benefit guarantees was 0.05% of the account value per year for the return of premium benefit and 0.15% of the account value per year for the step-up benefit. These cost assumptions were vetted and reconstructed by the Financial Risk Management area using their option pricing model.

- In one of the stochastic scenarios, where the first five years' annual equity fund returns were -1%, 6%, 7%, 9%, 1%, the model's calculated values for death benefits were demonstrated to be consistent with the product design.
- The policyholder fund allocation assumption appears to be appropriate given that the company has seen similar elections in brokerage accounts of other products.
- These results will be useful for the Investments area for setting up their hedging strategy.

3. Continued

(a) **(LO 2a)** (*3 points*) Critique three assumptions in the VA Pricing Model Review report.

ANSWER:

~~(b) **(NOT RELEVANT)** (*2 points*) Describe two governance and controls principles from *ASOP 54: Pricing of Life and Annuity Products* that have been demonstrated in the report.~~

ANSWER:

(c) **(LO 1a, 1b, 2a)** (*2 points*) Recommend product features and/or assumption changes, based on behavioral economics insights, required to accommodate each of the following policyholder behavior changes:

(i) A higher percentage allocation to fixed income funds

ANSWER:

(ii) An increase in annuitization rates

ANSWER:

(d) **(LO 1b, 2a)** (*3 points*) You are given the following additional information for Policyholder 1 (i.e. Age 40) in the table above:

- An initial premium of 10,000
- No withdrawals

Calculate the Death Benefit for each of the first five policy years. Show all work.

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

4.

Relevant Sources:

- ILA101-102-25: Understanding Profitability in Life Insurance
- ILA101-104-25: Ch. 11, pp. 499-512 of Life Insurance Products and Finance, Atkinson and Dallas

(*11 points*) JXR wants to deploy a new underwriting program that requires no fluids with the following objectives:

- Reduce new business underwriting expenses by 10 per application,
- Improve the ratio of policies sold to applications submitted due to increased underwriting efficiency and reduced burden on applicants.

You are given the following information about the program:

- Available for all new life insurance applications for a 5-year non-renewable term product.
- There is a maximum issue age and a maximum face amount.
- Uses traditional (e.g., prescription drug history) and non-traditional (e.g., credit history and/or public records) information.

Program Assumptions

Expense Assumptions (current)	**Cost**
Acquisition Expense per App	40
Acquisition Expense per premium	30%
Maintenance Expense per premium	5%

Sales Assumptions (in units)	**Current UW**	**New UW**
Applications	2	1.5
Issued Policies	1	1

Additional Assumptions	**Rate**
Discount Rate	3%
Tax Rate	25%
Average Premium per policy	26

Assume:

- No option and guarantee costs
- No required capital friction charge
- No non-hedgeable risk charge in all years

4. Continued

Current Income Statement (per policy)

	1	2	3	4	5
Premium Income (BOY)	26.00	25.86	25.62	25.27	24.83
Investment Income (EOY)	-2.49	2.20	0.69	0.49	0.23
Claims (EOY)	0.12	0.14	0.22	0.26	0.29
Expenses (BOY)	109.10	1.29	1.27	1.26	1.23
Increase in Reserves (EOY)	48.73	-1.43	-7.64	-15.76	-23.90
Pre Tax Net Income	-134.44	28.06	32.45	40.01	47.44
Tax on Income	-33.61	7.02	8.11	10.00	11.86
Net Income	-100.83	21.05	24.34	30.01	35.58

Income Statement with New Program (per policy)

	1	2	3	4	5
Premium Income (BOY)	26.00	25.86	25.62	25.27	24.83
Investment Income (EOY)	-1.29	2.20	0.69	0.49	0.23
Claims (EOY)	0.17	0.19	0.30	0.35	0.40
Expenses (BOY)	W	1.29	1.27	1.26	1.23
Increase in Reserves (EOY)	48.73	-1.43	-7.64	-15.76	-23.90
Pre Tax Net Income	X	28.01	32.37	39.91	47.33
Tax on Income	Y	7.00	8.09	9.98	11.83
Net Income	Z	21.01	24.28	29.94	35.49

Note: EOY = End of Year; BOY = Beginning of Year

(a) **(LO 1c)** (*6 points*)

(i) (*2 points*) Calculate net income in year 1. Show all work.

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

(ii) (*1 point*) Calculate the internal rate of return. Show all work.

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

4. Continued

(iii) (*1 point*) Calculate the value of new business. Show all work.

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

(iv) (*2 points*) Recommend whether JXR should proceed with the new underwriting program if it will cost 1 million to implement. Justify your answer.

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

~~(b) **(NOT RELEVANT)** (*2 points*) Define the following post level term structures:~~

~~(i) Traditional approach~~

~~ANSWER:~~

~~(ii) Simplified re-underwriting~~

~~ANSWER:~~

~~(iii) Graded~~

~~ANSWER:~~

~~(iv) Continuing class~~

~~ANSWER:~~

~~(c) **(NOT RELEVANT)** (*3 points*) Explain how adding a post level term renewal feature with simplified re-underwriting to the non-renewable product would impact product design and profitability.~~

~~ANSWER:~~

5.

Relevant Sources:

- ILA101-102-25: Understanding Profitability in Life Insurance
- Life, Health & Annuity Reinsurance, Tiller, John E. and Tiller, Denise, 4th Edition, 2015

(*10 points*) You are given the following information for KXW Life:

	Life Business	**Annuity Business**
PV of future profits	2,000	1,000
Time value of financial options and guarantees	50	0
Mortality risk costs	10	0
Regulatory capital requirement	400	160
Required Capital	500	200
Additional taxes and investment costs incurred by shareholders	40	30
Market value of capital allocated to the business	700	350
Free surplus	100	50

(a) **(LO 4d)** (*1 point*) Describe why the capital held by KXW may differ from the regulatory capital requirement.

ANSWER:

~~(b) **(NOT RELEVANT)** (*4 points*) Calculate the Market Consistent Embedded Value (MCEV) of KXW. Show all work.~~

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

5. Continued

(c) **(LOs 1c, 5e)** (*5 points*) The following sensitivity tests on the MCEV of KXW's life and annuity block are available:

Set #	Sensitivity	% change in MCEV
1	**Risk-free rates decrease 100bps**	-8.0%
	Risk-free rates increase 100bps	+2.5%
2	**Mortality improvement of 5% for life business**	+3.0%
	Mortality improvement of 5% for annuity business	-1.2%

(i) (*1 point*) Describe the purpose of MCEV sensitivity testing.

ANSWER:

(ii) (*2 points*) Explain possible reasons for the relative asymmetric magnitude of each set of sensitivities.

ANSWER:

(iii) (*2 points*) Recommend two methods of risk transfer that KXW can use to manage the overall level of risk and amount of required capital. Justify your response using the sensitivity tests provided above.

ANSWER:

7.

Relevant Sources:

- ILA101-113-25: Ch. 7 (sections 7.2-7.5 & 7A) of Derivatives Markets, McDonald, 3rd Edition
- Handbook of Fixed Income Securities, Fabozzi, F.J., 9th Edition, 2021
- ILA101-106-25: Experience Assumptions for Individual Life Insurance and Annuities
- ILA101-101-25: Annuity Products and Features

(*9 points*) HLC Life is launching an innovative single premium annuity product where payments to the annuitant are tied to the current market interest rate. You are given:

- Three-year period certain
- Payments start one year after the date of the single premium
- Annual payments are equal to the single premium multiplied by the current market interest rate
- 100 million of single premium sales projected

(a) **(LO 5b, 5d)** (*3 points*) Critique the following statements in relation to creating an asset portfolio to back the above liabilities:

A. The classical immunization can be used to duration match the asset portfolio with the duration of the liability.

ANSWER:

B. An alternative strategy is to use the cash-flow matching to eliminate all risks.

ANSWER:

C. An interest-rate swap can be used to provide a better match between assets and liabilities.

ANSWER:

7. Continued

(b) **(LOs 1a, 5b)** (*3 points*) HLC decides to use an immunization strategy to manage the assets backing the annuity block.

Analyze the impact to the immunization strategy for each of the following events:

(i) Annuitant mortality has increased

ANSWER:

(ii) Interest rates rise

ANSWER:

(iii) Short-term bonds used in the immunization portfolio become unavailable for reinvestment

ANSWER:

~~(c) **(NOT RELEVANT)** (*2 points*) HLC Life also enters into an interest rate swap with the following specifications:~~

- ~~The floating-rate payments are made annually at year end.~~
- ~~The term of the swap is 3 years~~
- ~~The notional amount is 100 Million~~
- ~~Current yield curve:~~

~~**Year**~~	~~**Spot Rate**~~
~~**1**~~	~~3.00%~~
~~**2**~~	~~3.50%~~
~~**3**~~	~~3.20%~~

~~Calculate the implied swap rate. Show all work.~~

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

7. Continued

(d) (*1 point*) Propose two product changes that can mitigate interest rate risk. Justify your answer.

ANSWER:

8.

Relevant Sources:

- ILA101-112-25: Revisiting the Role of Insurance Company ALM w/in a RM Framework
- Handbook of Fixed Income Securities, Fabozzi, F.J., 9th Edition, 2021
- ILA101-113-25: Ch. 7 (sections 7.2-7.5 & 7A) of Derivatives Markets, McDonald, 3rd Edition

(*10 points*) SXR Life is a small insurance company without a robust investment department and has limited knowledge regarding a variety of topics. Currently SXR is 100% invested in Investment Grade Corporate Bonds.

SXR sells a small portfolio of products including 10-year and 15-year Term Life Insurance, Universal Life Insurance, Single Premium Immediate Annuities, and Critical Illness Insurance.

SXR is in growth mode and would like to expand their product offering to include Deferred Annuities, and Long Term Care insurance.

SXR is considering the addition of the following assets to their investment portfolio:

- Municipal Debt
- High Yield Corporate Bonds
- Commercial Paper
- Real Estate

(a) **(LO 5a, 5d)** (*4 points*) Assess the appropriateness of the above assets for:

(i) The current product portfolio

ANSWER:

(ii) The addition of Long Term Care insurance to the current product portfolio

ANSWER:

~~(b) **(NOT RELEVANT)** (*3 points*) Describe liquidity stress tests which may be performed for the Long Term Care insurance product to address liquidity risk.~~

~~ANSWER:~~

8. Continued

(c) **(LO 5a, 5b)** (*3 points*) You are proposing the use of an asset liability approach for SXR.

(i) (*2 points*) Propose a specific approach to asset allocation strategy that meets the demands of the growth strategy that SXR Life would like to pursue.

ANSWER:

(ii) (*1 point*) Explain the advantages for using the asset liability approach instead of the asset only management approach.

ANSWER:

9.

Relevant Sources:

- Handbook of Fixed Income Securities, Fabozzi, F.J., 9th Edition, 2021, Ch.10 Corporate Bonds

(*6 points*)

(a) **(LO 5d)** (*4 points*) You have been assigned to manage a new portfolio backing a new product with initial capital of 1,400,000. You decide to invest half into equities and the other half into a single bond. The Linked Internal Rate of Return (LIRR) method is used to approximate the Time-Weighted Rate of Return (TWR) by using an annual Money-Weighted Rate of Return (MWR). You are given the following information about the portfolio:

- Equities do not pay dividends
- Bond 1 is a 4-year Corporate with 4% coupon issued on January 1, 2021 for 700,000 par value
- A 400,000 deposit is made into the portfolio on January 1, 2023 and is immediately invested into a 1-year Corporate newly-issued bond with a 5% coupon
- Coupons are paid semi-annually
- Proceeds of bond coupons and maturities are reinvested into equities
- End-of-Period Market Values (MV) of the portfolio:

Period	MV
Q2 2021	889,000
Q4 2021	912,450
Q2 2022	926,450
Q4 2022	951,773
Q2 2023	1,400,950
Q4 2023	1,455,045
Q2 2024	1,484,146
Q4 2024	1,537,353
Q2 2025	1,552,726
Q4 2025	1,568,254

Assess how well the 5-year approximation of TWR compares to the true TWR at the end of 2025. Justify your answer and show all work.

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

9. Continued

(b) **(NOT RELEVANT)** (*2 points*) Your company offers a level death benefit term product with a 5-year level premium period followed by annually increasing premiums based on best estimate assumptions. You are given a projection for the first five years of liability cashflow (in thousands):

Year	**1**	**2**	**3**	**4**	**5**
Cashflow	-1,694	2,130	328	-518	-1,224

Assume investment income is the primary source of liquidity and liquidity risk should be minimized.

Describe two disadvantages of modeling mortgage-backed securities (MBS) as the only investment based on the projected liability cashflow. Justify your answers.

ANSWER:

10.

Relevant Sources:

- ILA101-112-25: Revisiting the Role of Insurance Company ALM w/in a RM Framework
- ILA101-113-25: Ch. 7 (sections 7.2-7.5 & 7A) of Derivatives Markets, McDonald, 3rd Edition
- Statutory Valuation of Individual Life and Annuity Contracts, Claire, D., Lombardi, L. and Summers, S., 5th Edition, 2018 , Ch 11: Valuation Methodologies

(*5 points*) TXL Life's pricing model includes assets for the VM-20 deterministic reserve (DR). TXL does not have credible experience for the lapse rates assumed in pricing so extra lapses were assumed at the end of years 5 and 10 in its pricing assumptions.

TXL sensitivity tested the year-5 lapse assumption, and its pricing model produces the following annual cashflows (in thousands):

Year	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Base	433	179	363	-83	-555	-902	362
Lapse Increase	-423	-19	149	-172	-518	-748	222
Lapse Decrease	1,322	437	624	47	-553	-1,027	519

(a) **(LO 5a, 5b)** (*2.5 points*) Describe three potential impacts on the expected total investment yield if lapses increase. Justify your answer.

ANSWER:

(b) **(LO 4a)** (*2.5 points*) Describe the expected impact on the discount rate for the VM-20 DR calculation if lapses decrease. Justify your answer.

ANSWER:

Fall 2021 LPM Exam

1.

Relevant Sources:

- Table Development, Feb 2018 (excluding Appendices C, D, F, G & H)
- Credibility Methods Applied to Life, Health, and Pensions, SOA, Feb 2019 (pp. 1-25 only)
- ILA101-106-25: Experience Assumptions for Individual Life Insurance and Annuities
- Experience Study Calculations, SOA, Oct 2016 (revised Mar 2024), sections 2-4, 11, 12, 15, 17 & 18 (excluding 18.2, 18.8 & 18.9)
- The Art and Science of Life Insurance Distribution, Bennett, Douglas J., and Zultowski, Walter H., 2014, Ch. 3 and 4

(*10 points*) LBD Life has been selling insurance for decades through career agency, direct selling, and independent advisors. You have been asked to create mortality tables for the company's life core Universal Life insurance product.

a) **(LO 2d)** (*3 points*)

i. (*1 point*) Describe the five steps of the Table Development Flow Chart.

ANSWER:

ii. (*2 points*) List important considerations for three of the Table Development Flow Chart steps.

ANSWER:

b) (*3 points*) You are concerned about the mortality variation by distribution channel and with the mortality table development due to the advancing age of the block.

i. **(LO 2a, 3a)** Compare the differences in mortality by LBD Life's distribution channels.

ANSWER:

ii. **(LO 2a, 3a)** Describe ways to address any mortality variation from different distribution channels.

ANSWER:

iii. **(LO 2d, 2e)** Describe potential issues with the mortality table development due to the advancing age of the block.

ANSWER:

1. Continued

LBD Life is developing an aggregate mortality assumption for attained age 90+ and experience for very old ages is limited. The Society of Actuaries has a credible mortality table that reaches Age 105.

c) **(LO 2c, 2d)** (*2 points*) Recommend an approach to finalize the mortality rates for:

(i) Ages 90-95

ANSWER:

(ii) Ages 96-105

ANSWER:

~~(d) **(NOT RELEVANT)** (*2 points*) Describe the four methods of ending a mortality table beyond age 105.~~

~~ANSWER:~~

2.

Relevant Sources:

- Life Insurance for the Digital Age: An End-to-End View, Product Matters, Nov 2017
- Report on Premium Persistency Assumptions Study of Flexible Premium Universal Life Products, May 2012

(*10 points*) Your company sells Universal Life insurance with the following features:

- Sold by independent agents
- Paper application form containing 60 questions spread across 15 pages
- Vitals (such as blood pressure and pulse), urine, and blood sample to be collected by third party examiner visiting the insured's home
- 10-year no lapse guarantee (NLG):
  - A minimum monthly NLG premium based on the insured's age, sex, and smoker status is determined at issue
  - The policy will remain in force if the sum of the cumulative premiums paid is greater than the sum of the NLG premiums required
- Minimum guaranteed credited interest rate of 2%
- Current credited interest rate of 3%
- No riders are available

(a) (*4 points*) Critique each of the following statements:

A. **(LO 3a)** *Accelerated underwriting will make it easier to sell our product because it offers the benefit of fully underwritten rates without all the hassle of blood tests and lengthy applications to fill out.*

ANSWER:

~~B.~~ ~~**(NOT RELEVANT)** *Life settlements are mutually beneficial since the policyholder could have otherwise lapsed their policy and the insurer would lose a stream of future premiums that will instead continue to be paid.*~~

~~ANSWER:~~

C. **(LO 3a)** *Premium financing is a low risk way to expand availability of insurance to older individuals, provided that adequate medical underwriting is performed.*

ANSWER:

2. Continued

The proposed pricing assumption for premium persistency is to use weighted average factors across two assumed funding patterns:

- Single premium to fund the policy until attained age 75
- Level premium required to keep the policy in force until attained age 100 at the current credited interest rate

(b) **(LO 2b)** (*2 points*)

(i) Critique the use of weighted average premium persistency factors for pricing.

ANSWER:

(ii) Propose a sensitivity test that helps to understand the risk associated with using an approach of employing a weighted average premium persistency assumption for pricing purposes. Justify your proposal.

ANSWER:

The portfolio investment returns are expected to decrease; consequently a commensurate reduction in the credited interest rate is being considered.

(c) (*4 points*)

~~(i) **(NOT RELEVANT)** Compare the filing requirements for the proposed reduction in the credited interest rate against those for an increase in the cost of insurance (COI) rates under New York Regulation 210.~~

~~ANSWER:~~

(ii) **(LO 2b)** Recommend two ways to incorporate dynamic assumptions into a pricing model to more accurately capture the impact of the interest rate environment.

ANSWER:

4.

Relevant Sources:

- ILA101-107-25: Lapse Supported Insurance Analysis
- ILA101-100-25: Life Products and Features

(*12 points*) ABC Life has historically sold a variety of Universal Life (UL) products in the US and is currently working on the development of a new Term insurance product.

~~(a) **(NOT RELEVANT)** (*1 point*) Describe the key intangible marginal cost affecting the profitability of the firm in the context of macro pricing and how it should be considered in decision making.~~

~~ANSWER:~~

~~(b) **(NOT RELEVANT)** (*2 points*) Describe one of the methods to determine the optimal price structure of a new product form that maximizes profitability.~~

~~ANSWER:~~

4. Continued

You received an email from a member of your pricing team regarding the new Term product. Note each comment below is a part of the same email.

(c) (*6 points*) Critique each of the following comments from the email:

~~A. **(NOT RELEVANT)** *I used the Actuarial Standard of Practice 24 definition of lapse support to verify we can use the non-guaranteed values in the illustration for the new Term product. The product is still profitable assuming higher lapses in later years therefore meets the ASOP's requirement.*~~

ANSWER:

B. **(LOs 1a, 1b, 2b)** *The marketing department head has requested we reduce the price in order to increase sales. The reduced price will result in a higher perceived value and thus lower lapses.*

ANSWER:

C. **(LOs 1a, 1b, 2b)** *The marketing department assured me that the agents selling the product have high persistency. Given this, we can reduce the lapse rate in all years.*

ANSWER:

D. **(LOs 1a, 1b, 2b)** *Since we expect high persistency, we should offer a return of premium rider. The return of premium rider makes the product look cheaper, as well.*

ANSWER:

4. Continued

E. **(LOs 1a, 1b, 2b)** *We will not need to include the reduction in the lapse assumption within the reserve calculation.*

ANSWER:

F. **(LOs 1a, 1b, 2b)** *Since the product is not lapse supported, the path of the reserves does not matter and I have therefore excluded it from my analysis.*

ANSWER:

The marketing team has heard from agents that persistency for the UL product is high. Marketing has asked your team to consider reducing lapse assumptions to help with more competitive premiums. Before making this change you review the Setting Assumptions ASOP Exposure Draft.

(d) ~~**(NOT RELEVANT)** (*3 points*) Recommend additional considerations your team should make prior to implementing the assumption change.~~

~~ANSWER:~~

6.

Relevant Sources:

- ILA101-109-25: PLACEHOLDER – New illustration paper

(*9 points*) You are the dividend actuary for a mutual company that sells Participating Whole Life products with the following currently payable dividend scale specifications:

- The annually set scale is based on contribution principle of distributable surplus certified by the board of directors
- Dividend calculation method follows the three factor formula
- Policyholder equity considerations include attained age, policy duration, and underwriting risk class
- Pegging has been an ongoing practice
- The scale has followed a single portfolio method with several blocks of policies
- Policy loans have fixed rates and are without direct recognition
- Fixed policy loan rates are lower than the current portfolio book yield

The following experience and other outcomes were realized during the annual review period:

- The Covid-19 pandemic contributed to an anomalous mortality A/E ratio of 125%
- During the four years prior to the pandemic, the mortality A/E ratio graded from 90% to 105%
- The portfolio book yield has dropped 10 basis points every year
- The company incurred significant realized capital gains on asset sales in the last three months
- Based on the latest expense study, management has decided to move product development and market costs from acquisition to company overhead
- Due to a strain on economic conditions, lapse rates have increased
- As a result of lower divisible surplus and a resulting tightening of retained earnings, management has decided to cease pegging

~~(a) **(NOT RELEVANT)** (*4 points*) Analyze considerations when using the three factor formula to set the dividend scale, based on the information above.~~

~~ANSWER:~~

6. Continued

Management plans to implement an update program in response to a potentially rapidly rising interest rate environment. The program includes the following provisions:

- Applies to all new policies and will be optional for in force policies
- The program will move from book yield to market yield approach on the portfolio assets
  - Market yield will be approximated using the Moody's Corporate Bond Index as a benchmark
- The policy loan rate will be variable and set equal to the Moody's Corporate Bond Index with a maximum limit of 8% and without direct recognition
- Reinstate pegging only for the update program participants

(b) (*5 points*)

(i) **(NOT RELEVANT)** (*4 points*) Evaluate the update program.

ANSWER:

(ii) **(LO 3d)** (*1 point*) Evaluate the use of the currently payable scale in the illustration of new policies.

ANSWER:

8.

Relevant Sources:

- ILA101-101-25: Annuity Products and Features
- ILA101-113-25: Ch. 7 (sections 7.2-7.5 & 7A) of Derivatives Markets, McDonald, 3rd Edition

(*13 points*) JPB Life is expanding its annuity portfolio and developing a new Fixed Deferred Annuity. The Chief Actuary proposes using asset portfolio yield as a basis for the crediting strategy would be optimal in the current low interest rate environment.

(a) **(LO 1a, 1b)** (*3 points*) Describe risks JPB Life could face if interest rate rises rapidly.

ANSWER:

JPB Life currently has 500 million of assets under management, predominately invested in corporate bonds. Due to the appeal of the current low interest rate environment, JPB Life is planning to borrow 250 million to fund future business growth. The investment manager decided to use LIBOR as the benchmark rate.

~~(b) **(NOT RELEVANT)** (*2 points*) Evaluate the investment manager's proposal.~~

~~ANSWER:~~

(c) **(LO 5b)** (*2 points*) Recommend a financial instrument for JPB Life to hedge against any increases in the cost of borrowing in a rising interest rate environment. Justify your answer.

ANSWER:

8. Continued

(d) **(LO 5b)** (*6 points*) You are given the following information:

Days to Maturity	Zero Coupon Bond Price
90	0.99009
180	0.97943
270	0.96525
360	0.95328

(i) (*2 points)* Calculate the difference between the implied forward rate of a 270-day loan commencing on day 90 and the implied forward rate of a 90-day loan commencing on day 90.

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

(ii) (*4 points*) Identify a strategy to replicate the cash flows of a 10 million 90-day loan commencing on day 180 using zero coupon bonds.

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

9.

Relevant Sources:

- ILA101-113-25: Ch. 7 (sections 7.2-7.5 & 7A) of Derivatives Markets, McDonald, 3rd Edition
- Life, Health & Annuity Reinsurance, Tiller, John E. and Tiller, Denise, 4th Edition, 2015, Ch. 4: Basic Methods of Reinsurance

(*11 points*) You are the Chief Actuary of XYZ Insurance Company, a US subsidiary of a European holding company. XYZ's liability in force business is exclusively comprised of fixed Universal Life.

XYZ's current asset portfolio backing these policies has large segments of:

- Long-term lower rated Bullet bonds
- Euro-denominated Bullet bonds

XYZ wishes to avoid selling or transferring such assets during this calendar year.
To help mitigate risk, XYZ is considering entering an interest rate swap with a notional value of 100 million and the following forward rates:

	Forward Rate
Q1 2021	2.0%
Q2 2021	5.0%
Q3 2021	8.0%
Q4 2021	11.0%

Assume 90 days in all quarters.

a) ~~**(NOT RELEVANT)** (*4 points*)~~

i. ~~(*1 point*) Define the swap rate.~~

~~ANSWER:~~

ii. ~~(*2 points*) Calculate the present value of the floating rate payment.~~

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

iii. ~~(*1 point*) Calculate the swap rate.~~

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

9. Continued

XYZ Insurance is also considering other derivatives that will mitigate interest rate risk. One option is using a swaption.

b) ~~**(NOT RELEVANT)** (*2 points*) Explain key factors that would increase the value of a pay-fixed interest rate swaption.~~

~~ANSWER:~~

c) **(LO 5b)** (*3 points*) Recommend two other potential derivative strategies that address risks not covered by XYZ's interest rate swap; include an assessment of the cash flow needs.

ANSWER:

Recent updates to experience studies have indicated:

- XYZ's mortality underwriting has been excellent
- XYZ's policyholder persistency is much more sensitive to interest rate levels than previously believed
- XYZ's asset performance is strong

d) **(LO 5e)** (*2 points*) Propose a reinsurance structure to address XYZ's policyholder persistency risk and optimize its capital position. Justify your proposal.

ANSWER:

****END OF EXAMINATION****

Spring 2022 LPM Exam
1.

Relevant Sources:

- Table Development, Feb 2018 (excluding Appendices C, D, F, G & H)
- ILA101-102-25: Understanding Profitability in Life Insurance
- ILA101-106-25: Experience Assumptions for Individual Life Insurance and Annuities

(*7 points*)

(a) **(LO 1c)** (*2 points*)

(i) List the three components of a life insurer's earnings analysis.

(ii) List the drivers and indicators for each component.

ANSWER:

ABC Life is conducting a mortality experience study on a policy count basis. The study period is from Jan 1, 2020 to Dec 31, 2020, which was during the COVID-19 pandemic. The following information is provided for the study:

Policyholder	Entry Date	Exit Date	Exit Cause
1	May 15, 2020	12/31/2020	End of study period
2	Jan 1, 2020	8/15/2020	Lapse
3	Apr 15, 2020	12/31/2020	End of study period
4	Jan 1, 2020	12/1/2020	Death
5	Mar 15, 2020	7/15/2020	Death
6	Jan 1, 2020	12/31/2020	End of study period
7	Feb 15, 2020	12/31/2020	End of study period
8	Aug 15, 2020	10/15/2020	Lapse

An actuarial student performed the study and calculated a relatively high mortality rate. However, results are expected to decrease in coming years as we exit the pandemic.

(b) **(LO 2d)** (*3 points*)

(i) (*2 points*) Calculate the total exposure using the daily rate exposure method for the study population assuming an annual adjustment of 365.25. Show all work.

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

(ii) (*1 point*) Explain why using the daily rate exposure method, rather than the annual rate exposure method, is more accurate in this case.

ANSWER:

1. Continued

(c) **(LO 2a)** (*2 points*) Recommend experience assumption methodology improvements to enhance the quality of the experience study. Justify your answer.

ANSWER:

2.

Relevant Sources:

- Term Conversions: Pricing and Reserving, Product Matters, Mar 2017

(*11 points*) Your company is launching a new 10-year level premium term product with annually increasing renewable premiums after 10 years. The pricing actuary has developed three potential premium scales for the product.

You have been provided the following:

Premium Scale	Lifetime IRR	GAAP ROI at Issue
A	20%	11%
B	18%	14%
C	15%	12%

~~(a) **(NOT RELEVANT)** (*2 points*) Recommend the most suitable premium scale for the term product using the given lifetime IRR and GAAP ROI. Justify your response.~~

~~ANSWER:~~

~~(b) **(NOT RELEVANT)** (*2 points*) Explain possible reasons for the difference in values between lifetime IRR and GAAP ROI, even when experience emerges as expected.~~

~~ANSWER:~~

2. Continued

The term product also allows the policyholders to convert to a whole life policy without additional underwriting. Conversion can only be exercised within the first 10 policy years. Your team is reviewing the cost of term conversions. You are given the following:

Annual Lapse Rate (policy years 1-10)	2.5%
Conversion Mortality Multiple	1.1
Discount Rate	3%

Duration	q_x
1	0.038
2	0.044
3	0.051
4	0.059
5	0.068
6	0.078
7	0.090
8	0.104
9	0.120
10	0.138

(c) **(LO 2b)** (*4 points*)

(i) (*3 points*) Calculate the term conversion premium rate per thousand of face amount at issue using the given assumptions.

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

(ii) (*1 point*) Explain what concerns could exist about the cost of term conversions.

ANSWER:

2. Continued

It has now been 15 years since the inception of the product. The block is closed, and you are performing analysis on the post-level term profitability of the product.

~~(d) **(NOT RELEVANT)** (*3 points*)~~

~~(i) (*1 point*) Explain what concerns could exist about post-level term profitability.~~

~~ANSWER:~~

~~(ii) (*2 points*) Recommend a possible solution to address concerns about post-level term profitability. Justify your answer.~~

~~ANSWER:~~

3.

Relevant Sources:

- ILA101-100-25: Life Products and Features
- Life Insurance Acceleration Riders, SOA Reinsurance News, Jul 2013, pp. 35-38
- ILA101-107-25: Lapse Supported Insurance Analysis

(*11 points*) KAG Life is evaluating whether to add a 20-year guaranteed level premium term rider and a chronic illness acceleration rider to their universal life with secondary guarantees (ULSG) product.

ULSG product features and assumptions:

- Issue ages: 18-85
- Mortality set at 100% of recent credible company ULSG experience with six underwriting classes, including substandard
- Lapse rates set at 4% in the first year, grading to an ultimate rate of 2% over five years
- Fully underwritten with face amount offerings of 50,000 to 500,000
- Secondary guarantee uses a shadow account design
- Base ULSG contract is expected to have low account values in the first ten policy years and zero account value thereafter

Proposed 20-year guaranteed level premium term rider design and assumptions:

- Issue ages: 18-60
- Pricing assumptions for mortality and lapse set equal to the base ULSG plan
- The available rider face amount will be up to nine times the base policy face amount, with an aggregate death benefit limit of 3,000,000
- Premiums equal to the premiums of a stand-alone level premium term insurance product
- The term rider charge deducted from the base product account value will be level for twenty years, followed by annually increasing rider charges

Proposed chronic illness acceleration rider design and assumptions:

- Uses the same underwriting, issue ages and application as the base ULSG plan
- Pricing assumptions for mortality and lapse set equal to the base ULSG plan
- Allows the policyholder to accelerate up to 100% of their base ULSG plan face amount or 1 million (whichever is less), when they are unable to perform two or more activities of daily living (ADLs), without assistance from another person as diagnosed by a medical professional
- Cost of rider is funded through additional premium
- Management is considering reinsuring the proposed chronic illness rider

3. Continued

(a) **(LO 1a, 1b)** (*4 points*) With respect to the proposed 20-year guaranteed level premium term rider:

(i) Critique the proposed design and assumptions.

ANSWER:

(ii) Recommend design changes to minimize risk.

ANSWER:

(b) **(LO 1a, 1b)** (*4 points*) With respect to the proposed chronic illness acceleration rider:

(i) Critique the design and risk control considerations.

ANSWER:

(ii) Recommend design changes to minimize risk.

ANSWER:

3. Continued

Current experience studies show that persistency has been better than expected on the ULSG product which is impacting the profitability as measured using both IRR and profit margin.

(c) **(LOs 1a, 1b, 2b)** (*3 points*) Recommend changes to the ULSG product design and pricing in consideration of the following:

a. Updated lapse experience

ANSWER:

b. The two new riders

ANSWER:

c. Competitive considerations

ANSWER:

4.

Relevant Sources:

- Life Insurance for the Digital Age: An End-to-End View, Product Matters, Nov 2017

(*10 points*) QXZ Life primarily sells products in the affluent market through an exclusive agent and agency manager system.

(a) **(LO 3a)** (*2 points*) Propose design elements for a term product to be sold in the direct to consumer channel.

ANSWER:

(b) **(LO 3a)** (*4 points*) Critique the following statements:

A. The products offered in the direct to consumer channel should accept alternative forms of payment such as credit card.

ANSWER:

B. In designing the end-to-end process for purchasing life insurance, there is no need to consider agent involvement since this is a direct to consumer sale.

ANSWER:

C. The new direct sales channel currently accounts for a small portion of the market so only a small portion of resources should be allocated to the development of this direct to consumer product.

ANSWER:

D. Conversion options and other complex product options should be clearly described during the online sales process.

ANSWER:

4. Continued

QXZ Life believes that a simplified underwriting method should be utilized to be successful in a direct to consumer channel. To support this method, QXZ is building a fluid-less risk score prediction model.

~~(c) **(NOT RELEVANT)** (*4 points*) Recommend four appropriate data elements that this predictive model should use. Justify your answer.~~

~~ANSWER:~~

5.

Relevant Sources:

- ILA101-113-25: Ch. 7 (sections 7.2-7.5 & 7A) of Derivatives Markets, McDonald, 3rd Edition
- ILA101-112-25: Revisiting the Role of Insurance Company ALM w/in a RM Framework

(*10 points*) HLC Life sells a 5-year level premium term product and backs the insurance liabilities with a portfolio of fixed income assets.

(a) **(LO 5b)** (*2 points*) Compare and contrast the following strategies to manage the asset portfolio backing the liabilities:

- Immunization
- Cash flow matching
- Derivatives enabled

ANSWER:

The company's expected liabilities as of 12/31/2021 are as follows:

Calendar Year	Liabilities (EOY)
2022	1,100
2023	400
2024	300
2025	200
2026	200

The following assets are available for purchase:

- 2-year zero coupon bond with a yield-to-maturity of 7%
- 4-year zero coupon bond with a yield-to-maturity of 10%

The current yield curve is:

Maturity	Spot Rate
1 year	2.7%
2 years	3.1%
3 years	3.3%
4 years	3.5%
5 years	3.8%

(b) **(LO 5b)** (*3 points*) Calculate the amount of cash HLC Life should invest in each of the available assets to implement an immunization strategy.

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

5. Continued

One year later on 12/31/2022, there was no change to the expected liabilities and the yield curve had a level shift down.

(c) **(LO 5a, 5b)** (*2 points*) Assess the impact to the proposed immunization strategy.

ANSWER:

(d) **(LO 5a, 5b)** (*3 points*) Critique each of the following statements made by the CEO:

A. *In order to manage interest rate risk, our company needs to duration match the liabilities with a portfolio of fixed income assets at time 0, with no further action until all the liabilities are paid out, with no liquidity considerations.*

ANSWER:

B. *By using fixed income assets to back the liabilities, interest rate risk is the only risk we will need to consider.*

ANSWER:

C. *Our company should have a portfolio risk indicator when implementing an immunization strategy. This will allow us to compare different asset portfolio options.*

ANSWER:

6.

Relevant Sources:

- Life, Health & Annuity Reinsurance, Tiller, John E. and Tiller, Denise, 4th Edition, 2015

(*8 points*) XYZ Life is a life and annuity insurer that has never reinsured any business. Their current business plan includes the following objectives:

- Stop new sales of fixed annuities because of falling interest rates
- Switch from selling universal life with a lifetime secondary guarantee to participating whole life
- Increase available capital for future growth

a) **(LO 5e)** (*3 points*) Describe three types of strategic or customized reinsurance solutions which could help XYZ Life achieve its business plan objectives.

ANSWER:

~~b) **(NOT RELEVANT)** (*2 points*) Assess how XYZ Life may need to update its corporate governance to prepare for issuing participating whole life policies.~~

ANSWER:

6. Continued

c) **(NOT RELEVANT)** (*3 points*) Critique each of the following product design proposals for the new participating whole life product:

A. To help promote the launch of the product, XYZ Life's illustration software will reflect a special one-time dividend paid out of retained earnings from its non-participating term business.

ANSWER:

B. The cost to migrate to a new policy administration system will be borne by newly issued policies by embedding it in acquisition expenses.

ANSWER:

C. Because of low fixed income yields, the investment strategy includes a greater amount of equities than other asset classes; realized gains are paid to the policyholders through the investment component of the dividend scale, once the stock is sold.

ANSWER:

7.

Relevant Sources:

- Life, Health & Annuity Reinsurance, Tiller, John E. and Tiller, Denise, 4th Edition, 2015

(*11 points*) AWL Life would like to improve its capital position through a reinsurance transaction of a certain block of business. The block of business generates gains over the long term and incurs little upfront costs. AWL Life has an existing agency force selling similar products and intends to recapture this block of business at a future date.

AWL Life identified ONA Re as a reinsurance partner and a contract is currently under negotiation. Both parties are open to explore different reinsurance methods, however, both parties also possess specific post-transaction capital requirements.

You are given:

- Investment income and interest are paid at the beginning of the year
- No claims or surrenders during the year
- There are no income taxes

Assumptions for the Block of Business	
Face amount	5,000
Premium tax	2.5%
Direct premium per thousand	0.95
Commissions	80%
Terminal reserve	250
Reserve at time 0	100
Reserve at time 1	850
Proposed Reinsurance Transaction Assumptions	
Yearly Renewable Term retention	10%
Yearly Renewable Term mean reserve per thousand	0.14
Modified Coinsurance interest rate	5%
Modified Coinsurance expense allowance	90%
Modified Coinsurance premium per thousand	0.80
AWL Life	
Initial surplus	1,500
Investment return	17%
Underwriting expenses	300
Maintenance costs	50
ONA Re	
Initial surplus	3,000
Investment return	20%

Underwriting expenses	270
Maintenance costs	10

7. Continued

a) **(LO 5e)** (*2 point*) Propose an appropriate type of reinsurance for AWL Life. Justify your answer.

ANSWER:

b) **(LO 5e)** (*7 points*) For the proposed reinsurance transaction.

i. (*3 points*) Calculate the premium per thousand on a Yearly Renewable Term basis, if AWL Life expects to increase total capital by at least 20%. Show all work, using the financial statements in Excel.

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

ii. (*4 points*) Calculate the ceding percentage on a Modified Coinsurance basis if ONA Re is unwilling to accept a reduction in capital of more than 20%. Show all work, using the financial statements in Excel.

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

~~c) **(NOT RELEVANT)** (*2 points*) Critique the following statement:~~

~~*The block of business contains flexible premium universal life products. After examining the significant risks of the business, ONA Re agreed to provide surplus relief to AWL Life for the next year. Under the surplus relief treaty, all underlying assets backing the liabilities will be transferred from AWL Life to ONA Re, and the appropriate amount of reserve credit will be provided to AWL Life.*~~

~~ANSWER:~~

8.

Relevant Sources:

- ILA101-101-25: Annuity Products and Features
- Market Trends and Product Designs: Considerations when Interest Rates are Rising, Product Matters, Nov 2021
- ILA101-115-25: Simulation of a Guaranteed Minimum Annuity Benefit, Freedman, 2019

(*10 points*) MSQ Insurance Company sells only annuity products. It offers a Variable Annuity with a Guaranteed Living Withdrawal Benefit (VA with a GLWB). The withdrawal benefit base in year t (WBB_t) is a lookback ratchet design equal to the greater of the account value in year t (AV_t) and the prior year withdrawal benefit base (WBB_{t-1}). The initial benefit base is equal to the premium. Withdrawals are only allowed at the end of each policy year. The table below has additional product information for a sample policy.

Initial Premium	100,000
Administration Charge (φ^{adm}) – charged continuously	0.5%
Guarantee Charge (φ^{guar}) – charged continuously	1.2%
Annual Withdrawal Percentage (x_{WL})	5.0%

(a) **(LOs 1a, 1b, 5c)** (*2 points*) Calculate the permitted withdrawal benefit in each year for a policyholder, assuming the benefit is elected in year 1 for each of the following two scenarios' market returns on the variable subaccount.

Year	Scenario 1	Scenario 2
1	0%	6%
2	-3%	9%
3	6%	-5%
4	9%	0%
5	-5%	-3%

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

(b) **(LO 1a, 1b)** (*4 points*) Evaluate how each of the following product changes would impact the volatility of the product cash flows and hedging of the product. Assume the same initial annual withdrawal percentage.

(i) Removal of the ratchet feature.

ANSWER:

(ii) The addition of a remaining withdrawal benefit base ratchet.

ANSWER:

8. Continued

(c) **(LO 3e, 5c)** (*2 points*) Compare how a rising interest rate environment would impact this VA with a GLWB versus a fixed deferred annuity without a GLWB.

ANSWER:

~~(d) **(NOT RELEVANT)** (*2 points*) Evaluate the impact to MSQ's risk exposure of adding a new term life insurance product to MSQ's current product portfolio.~~

~~ANSWER:~~

10.

Relevant Sources:

- ILA101-100-25: Life Products and Features
- Overview of Non-guaranteed Elements (NGEs), SOA Research Institute, Nov 2022

(*11 points*) You are the lead pricing actuary at your company.

The existing Universal Life (UL) product utilizes a new money interest crediting method. Management is considering a new UL product that will utilize a portfolio crediting method instead.

(a) **(LO 1a, 1b)** (*4 points*)

a. Compare and contrast the new money crediting method versus the portfolio crediting method.

ANSWER:

b. Analyze the impact of interest rate anti-selection on UL product pricing and profitability.

ANSWER:

10. Continued

You are reviewing and proposing changes to the non-guaranteed elements (NGEs) of the existing UL product.

(b) (*4 points*)

(i) **(LO 3c)** (*1 point*) List four considerations when recommending a revision to NGE scales.

ANSWER:

~~(ii) **(NOT RELEVANT)** (*3 points*) Critique each of the following statements excerpted from your company's NGE framework:~~

~~*A. NGE scales on in-force policies should be reviewed no less frequently than every 3 years.*~~

~~ANSWER:~~

~~*B. Policy class assignments for in-force policies should be redetermined during each NGE review cycle.*~~

~~ANSWER:~~

~~*C. Any changes to the defined profitability metrics for the purpose of evaluating NGEs are discouraged.*~~

~~ANSWER:~~

10. Continued

Your coworker presented the following table summarizing their calculations in determining revised NGE scales for this product. Assume that the impacts to net profits from each NGE update are independent and do not require consideration of other NGEs.

Valuation Year	1	2	3	4	5	NPV at 5%
Net Profits (Original Pricing)	13	16	16	15	13	**63**
Net Profits with Revised Expense Charges	14	16	17	14	13	**64**
Net Profits with Revised COI Charges	20	22	26	28	35	**112**
Net Profits with Revised Crediting Rate	10	15	25	15	8	**63**

~~(c) **(NOT RELEVANT)** (*3 points*) Evaluate compliance with ASOP 2: Non-guaranteed Charges or Benefits for Life Insurance Policies and Annuity Contracts, with respect to your coworker's analysis.~~

~~ANSWER:~~

****END OF EXAMINATION****

Fall 2022 LPM Exam
1.

Relevant Sources:

- ILA101-100-25: Life Products and Features
- Report on Premium Persistency Assumptions Study of Flexible Premium Universal Life Products, May 2012, pp. 9-15
- ILA101-104-25: Ch. 11, pp. 499-512 of Life Insurance Products and Finance, Atkinson and Dallas

(*10 points*)

~~(a) **(NOT RELEVANT)** (*1 point*) Assess the following statements based upon the Canadian Institute of Actuaries' (CIA) Standard of Practice.~~

~~*A An actuary should identify and select each assumption that is needed for the work including those that are prescribed or mandated by law.*~~

~~ANSWER:~~

~~*B The appropriate assumption for a matter, other than a model or data assumption, should be a continuation of the status quo.*~~

~~ANSWER:~~

(b) **(LOs 1a, 1b, 2b)** (*1 point*) Describe two considerations when determining premium persistency assumptions for a flexible premium Universal Life (UL) product.

ANSWER:

(c) **(LOs 1a, 1b, 2b)** (*3 points*) You are given the following three options for premium persistency assumptions for a new UL product with a No Lapse Guarantee rider:

- 100% premium persistency at all durations
- Premium persistency factors vary by duration
- Dynamic premium persistency assumptions that vary with the interest rate

(i) (*2 points*) Discuss advantages and disadvantages of the three structures for premium persistency assumptions above.

ANSWER:

(ii) (*1 point*) Recommend one of the three options. Justify your answer.

ANSWER:

5. Continued

(d) **(LO 1c)** (*4 points*) You are given the following information for a UL product:

Policies sold: 13,000
Discount Interest Rate: 3%
Average first year premium per policy: 4,000

Duration	Beginning of Year Inforce Count	In Millions					Premium Persistency Ratio
		Death Benefit	Surrender Benefit	Expenses	Reserve	Investment Income	
1	13,000	6.5	6.1	0.58	85	0.8	N/A
2	12,545	7.1	7.8	0.54	72	1.2	85%
3	12,106	8.4	11.2	0.23	61	1.0	95%
4	11,622	9.2	8.7	0.22	49	0.8	98%
5	11,100	7.2	9.1	0.21	38	0.7	100%

Simplifying assumptions:

- All policies were sold on the same issue date.
- Benefits and expenses occur at end of year.
- Premium is paid annually at beginning of year.
- There is no reinsurance.

Calculate the following items. Show all work.

(i) (*1 point*) Total premium collected in years 1 through 5.

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

(ii) (*2 points*) Total cash flows in years 1 through 5.

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

(iii) (*1 point*) Present value of pre-tax solvency earnings.

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

6. Continued

(e) **(LO 1c)** (*1 point*)

(i) Describe the differences between solvency earnings and pre-tax stockholder earnings.

ANSWER:

(ii) Explain the benefits of calculating profits based on earnings reserves instead of solvency reserves

ANSWER:

2.

Relevant Sources:

- Life Insurance for the Digital Age: An End-to-End View, Product Matters, Nov 2017

(*8 points*) A smoker propensity model has been developed by a third-party data analytics company.

The model relies upon data from social media, health and wellness programs, spending habits and other publicly available information in combination with the information provided from the insurance application.

The model will classify applicants as nonsmoker, smoker, or unknown.

(a) **(LO 3a)** (*2 points*) Outline potential benefits from using an accelerated underwriting model.

ANSWER:

~~(b) **(NOT RELEVANT)** (*3 points*) Explain key steps your company should take before implementing the smoker propensity model with confidence.~~

~~ANSWER:~~

~~(c) **(NOT RELEVANT)** (*3 points*) Your company would like to implement the use of a smoker propensity model to replace the smoking status question in the application and the urine sample.~~

~~(i) (*1 point*) Explain the primary concerns with eliminating the use of the smoking status question and the urine requirement.~~

~~ANSWER:~~

~~(ii) (*2 points*) Recommend an alternative that would address the primary concerns. Justify your answer.~~

~~ANSWER:~~

3.

Relevant Sources:

- ILA101-107-25: Lapse Supported Insurance Analysis
- ILA101-100-25: Life Products and Features

(*9 points*) Your company has sold an Indexed Universal Life (IUL) product for several years. Lapses have been significantly lower than expected and profitability has not met projections. You are tasked with a review of the lapse-supportedness of this product.

7. **(LO 2b)** (*1 point*) Describe a method for determining if the IUL product is lapse-supported.

ANSWER:

(b) **(LO 2b)** (*1 point*) Explain why lapse-supported products have caused profitability issues for some companies.

ANSWER:

~~(c) **(NOT RELEVANT)** (*4 points*) Critique each of the following statements with respect to ASOP 2 – Non-Guaranteed Elements for Life Insurance and Annuity Products:~~

~~*A. It is acceptable to increase non-guaranteed charges on in-force policies to recoup past losses of the IUL product.*~~

~~ANSWER:~~

~~*B. To ensure that the newly issued policies are profitable, the company may increase planned non-guaranteed charges on them.*~~

~~ANSWER:~~

~~*C. A good method to redesign charges on inforce policies is to evaluate each policy in terms of its past profitability, and create new policy classes with different non-guaranteed rates to rebalance product profitability.*~~

~~ANSWER:~~

~~*D. It is not necessary to document the determination of non-guaranteed elements because that documentation could be used against the company in future litigation.*~~

~~ANSWER:~~

8. Continued

(d) **(LO 1a, 1b)** (*3 points*) You have been asked to analyze why lapse rates have not materialized as expected.

A. (*1 point*) Describe two hypotheses for why life insurance policyholders decide to lapse a product.

ANSWER:

B. (*2 points*) Identify two reasons lapses may be lower than expected on the IUL product. Justify your answer.

ANSWER:

4.

Relevant Sources:

- ILA101-106-25: Experience Assumptions for Individual Life Insurance and Annuities
- ILA101-100-25: Life Products and Features
- ILA101-110-25: Fundamentals of the Principle-Based Approach to Statutory Reserves for Life Insurance, Jul 2019
- Life Insurance Acceleration Riders, SOA Reinsurance News, Jul 2013, pp. 35-38

(*10 points*) ABC Life currently has Universal Life products without secondary guarantees. The company is developing a new lapse-supported Universal Life product that has a secondary guarantee (ULSG).

(a) **(LO 1a, 1b)** (*1 point*) List four examples of guaranteed elements that are relevant to the new ULSG product.

ANSWER:

(b) **(LO 2a)** (*1 point*) The industry data shows there is an equal likelihood that the shock lapse could be 50% or 60%.

Recommend an appropriate shock lapse. Justify your answer.

ANSWER:

~~(c) **(NOT RELEVANT)** (*2 points*) The current Universal Life product used the Blended Method to end the mortality table at age 120.~~

~~(i) Describe three other approaches that have been used to end a mortality table.~~

~~(ii) Describe the impact of each approach on the shape of mortality rates at the oldest ages.~~

~~ANSWER:~~

9. Continued

(d) **(LO 4a)** (*3 points*) ABC life has adopted VM-20.

(i) (*1 point*) Describe the VM-20 reserve calculation.

ANSWER:

(ii) (*2 points*) Explain how each of the following assumption changes will impact the reserve.

A. Emerging company experience for mortality will be higher than expected.

ANSWER:

B. Emerging company experience for lapses will be lower than expected.

ANSWER:

C. Prescribed mortality margins will decrease.

ANSWER:

D. Actual Treasury yield rates up to the valuation date will increase.

ANSWER:

10. Continued

(e) **(LO 1a, 1b)** (*3 points*) The marketing department recommends adding an accelerated benefit chronic illness rider to the ULSG product.

(i) (*1 point*) Describe the chronic illness rider.

ANSWER:

(ii) (*2 points*) Recommend four ways that ABC Life can limit its risk of incurring significant losses on the chronic illness rider. Justify your answer.

ANSWER:

5.

Relevant Sources:

- ILA101-101-25: Annuity Products and Features

(*8 points*)

~~(a) **(NOT RELEVANT)** (*1 point*) List the advantages and disadvantages of using predictive analytics over the traditional approach when setting assumptions.~~

~~ANSWER:~~

~~You are preparing the data for use in building a predictive model.~~

~~(b) **(NOT RELEVANT)** (*1 point*) Describe the steps you would take to collect and organize the data.~~

~~ANSWER:~~

5. Continued

~~**(c) NOT RELEVANT)** (*3 points*) Explain how each of the following should be addressed during the preparation of the data for a study:~~

~~a. Administration systems were updated, fixing an issue where crediting interest rates for a small set of policyholders were not being updated from their original values.~~

~~ANSWER:~~

~~b. Annuity payout offering transitioned from 'Life with 10 years certain' to 'Life only' over the study period.~~

~~ANSWER:~~

~~c. Sales channels expanded to include internet sales.~~

~~ANSWER:~~

~~d. Target market shifted towards individuals with high net worth.~~

~~ANSWER:~~

~~e. Charges were changed five years ago from front-end loading to back-end loads.~~

~~ANSWER:~~

~~f. For the last three years, the focus has been on sales campaigns offering deposit and persistency bonuses.~~

~~ANSWER:~~

5. Continued

(d) (LO 1a, 1b) (*3 points*) Interpret how policyholder behavior, using decision shortcuts, may impact each of the following possible scenarios:

(i) A change to tax policy that allows tax-free withdrawals from policies.

ANSWER:

(ii) Advertising of fund performance highlights return volatility instead of historical returns.

ANSWER:

(iii) Default annuitization options change from opt-in to opt-out at option dates.

ANSWER:

9.

Relevant Sources:

- ILA101-100-25: Life Products and Features

(*10 points*)

Your company sells Universal Life (UL) product with the following features:

- Current credited rate of 3%, guaranteed for 5 years
- Minimum guaranteed rate of 1%
- No surrender charges and no partial withdrawal fees

The current target asset mix for the investment portfolio is:

- 50% corporate bonds
- 25% real estate
- 25% equities

~~(a) **(NOT RELEVANT)** (*2 points*) List the principles that underlie the establishment of best practices for the management of liquidity risk within an insurance company.~~

~~ANSWER:~~

9. **Continued**

~~(b) **(NOT RELEVANT)** (*4 points*) Critique the following elements of the company's liquidity management policy:~~

~~(i) Corporate bond cash flows will be the primary source of liquidity for surrender benefits.~~

~~ANSWER:~~

~~(ii) Premiums received will be used to provide additional liquidity should surrender benefits exceed expected.~~

~~ANSWER:~~

~~(iii) The company will maintain a Liquidity Coverage Ratio of 100% over a 1-month time horizon under two stress scenarios:~~

~~A. Surrender benefits 20% higher than expected~~

~~ANSWER:~~

~~B. Death benefits 10% higher than expected~~

~~ANSWER:~~

(c) **(LO 1a, 1b)** (*4 points*) Propose changes to the UL product design to address liquidity risks. Justify your answer.

ANSWER:

10.

Relevant Sources:

- ILA101-113-25: Ch. 7 (sections 7.2-7.5 & 7A) of Derivatives Markets, McDonald, 3rd Edition
- Handbook of Fixed Income Securities, Fabozzi, F.J., 9th Edition, 2021, Ch. 10: Corporate Bonds

(*10 points*)

(a) **(LO 5b)** (*2 points*) Define the following dedication strategies:

(i) Immunization

ANSWER:

(ii) Cash Flow Matching

ANSWER:

(b) **(LO 5d)** (*6 points*) You have the following performance report for an asset portfolio:

Asset Class	**Book Value**	**Market Value**	**Duration**	**Dollar Duration**
Short term bonds	125,000	100,000	1.50	1,500
Medium term bonds	175,000	200,000	5.25	10,500
Long term bonds	95,000	100,000	9.75	9,750
Liability dollar duration				8,000
Duration variance (%)				-6.6%

The objective is to manage the asset portfolio to within +/- 10% of the liability dollar duration.

10. Continued

Assess the effectiveness of each of the following proposed changes to the asset portfolio based on the objective:

(i) Replacing medium term bonds with 50/50 split of short and long term bonds on a book value basis.

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

(ii) Replacing 25% of the short-term bonds with long term bonds on a book value basis.

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

(iii) Rebalancing to an equal split among short, medium, and long-term bonds on a book value basis.

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

(c) **(LO 5d)** (*2 points*) Explain how leverage can be used to increase an asset portfolio's rate of return.

ANSWER:

11.

Relevant Sources:

- Handbook of Fixed Income Securities, Fabozzi, F.J., 9th Edition, 2021, Ch. 21: An Overview of Mortgages and the Mortgage Market

(*5 points*) TPL Life is an institutional investor considering the following allocation of their assets backing their Universal Life (UL) products for the next five years to generate stable cash flows:

- A 30-year mortgage-backed security (MBS) issued by Fannie Mae that has been heavily refinanced in the past.

or

- A 30-year Corporate Bond paying a coupon rate of 8%.

~~(a) **(NOT RELEVANT)** (*1 point*) Calculate the Conditional Prepayment Rate (CPR) if the Single Monthly Mortality (SMM) rate is 0.008.~~

~~ANSWER:~~

(d) **(LO 5d)** (*4 points*) Critique the following statements:

A. If prevailing mortgage rates are 50bps lower, investing in the 30-year corporate bond is a better choice.

ANSWER:

B. If TPL Life wishes to minimize exposure to reinvestment risk, investing in the 30-year MBS is a better choice.

ANSWER:

C. The MBS is more likely to produce more volatile investment performance since it has been heavily refinanced in the past and it carries a higher risk for default.

ANSWER:

****END OF EXAMINATION****

Spring 2023 LPM Exam

1.

Relevant Sources:

- LPM-107-07: Experience Assumptions for Individual Life Insurance and Annuities

- Table Development, Feb 2018 (excluding Appendices C, D, F, G & H)

(*8 points*) You have been asked to develop a new mortality table.

(a) **(LO 2d)** (*4 points*) You are given the following information for a group of policies with attained age 35 at the beginning of the study period:

Situation	Number of policies
Active at beginning and end of study period	1250
Active at beginning of study period, death occurs after 6 months	10
Active at beginning of study period, withdrawal occurs after 9 months	150
Entered study 3 months after beginning of study period, active at end of study period	200
Entered study 3 months after beginning of study period, death occurs 3 months later	5
Entered study 3 months after beginning of study period, withdrawal occurs 3 months later	75

(i) (*3 points*) Calculate an experience-based mortality rate for attained age 35 policies given this information.

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

(ii) (*1 point*) Calculate a 95% confidence interval for the mortality rate obtained in part (i).

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

Your company is exploring the use of predictive analytics in the development of the new mortality table.

(b) **(LO 2a)** (*1 point*) Compare the advantages of using a predictive analytics approach to those of the traditional approach for setting mortality rates.

ANSWER:

(c) ~~**(Not Relevant)** (*1 point*) Describe legal and ethical concerns related to the use of predictive modeling in life insurance.~~

~~ANSWER:~~

1. Continued

(d) **(Not Relevant)** *(2 points)* Assess the implications of the "Generalized Linear Model" and the "Random Forest Approach" in terms of each of the following aspects:

(i) Explanatory ability

ANSWER:

(ii) Predictive power

ANSWER:

(iii) Ease of table implementation

ANSWER:

2.

Relevant Sources:

- Variable Annuity Guaranteed Living Benefits Utilization, SOA LIMRA Research, 2018, Executive Summary only (pp. 19-32)

- LPM-166-20: Annuity Product and Features

(*9 points*) JS Life is a mutual life insurer that is launching its first individual Variable Annuity (VA) product. JS Life wants to add a Guaranteed Lifetime Withdrawal Benefit (GLWB) that allows the policyholder to take 5% withdrawals for life.

(a) **(LO 1a,1c)** (*1 point*) List four relevant profitability metrics that could be used to price the new individual VA product.

ANSWER:

JS Life's Chief Actuary wants to confirm that the new individual VA complies with applicable ASOPs. Specifically, she wants to understand if the following ASOPs apply to the new product:

- ASOP No. 2 – Nonguaranteed Elements for Life Insurance and Annuity products.
- ASOP No. 54 – Pricing of Life Insurance and Annuity Products.

~~(b) **(Not Relevant)** (*1 point*) Describe the applicability of ASOPs 2 and 54 apply to the VA.~~

~~ANSWER:~~

2. Continued

JS Life is developing assumptions for the new VA product with a GLWB.

(c) **(LO 2a,2b)** (*3 points*) Critique each of the following statements:

A. *Few VA contracts with lifetime payout riders are funded with qualified money.*

ANSWER:

B. *Source of funding, i.e., qualified or nonqualified, is more important than distribution channel when determining assumptions related to how customers take withdrawals.*

ANSWER:

C. *Policyholders under age 60 are more likely to take withdrawals in amounts less than the maximum allowed.*

ANSWER:

D. *Policyholders with smaller contract values are less likely to take withdrawals that significantly exceed the benefit maximum.*

ANSWER:

A proposal has been made to allow a dollar-for-dollar reduction in the GLWB benefit base for partial withdrawals in excess of the 5% allowable withdrawal amount.

(d) **(LO2b)** (*2 points*) Assess the appropriateness of this proposal.

ANSWER:

2. Continued

(e) **(LO 1a)** (*2 points*) Compare and contrast VA and fixed deferred annuities based on the following aspects:

(i) Rate of return on investment

ANSWER:

(ii) Control of assets

ANSWER:

(iii) How insurers generate product revenue

ANSWER:

3.

Relevant Sources:

- Pension Risk Transfer in Canada and the U.S., SOA Research Institute, Feb 2022

(*9 points*) You are a group annuity pricing actuary for ABC Life, a large life insurance and annuity company with a large operations department and whose risk appetite favors non-financial over financial risk. Your company wants to bid on a new pension risk transfer (PRT) deal.

(a) **(LO 1a, 1b)** (*2 points*) Explain how to mitigate two main risks underlying assumptions that need to be made for group annuities.

ANSWER:

You are considering the following cases:

Case 1: A nationwide telecommunications company is looking for a buy-out deal for their defined benefit pension plan that covers over 5,000 current employees and 25,000 retirees.

Case 2: A small, local natural gas company is looking for a buy-in deal of their defined benefit pension plan that was closed 10 years ago, and all participants have retired.

Case 3: A large, regional manufacturing company is looking for a buy-out deal for their defined benefit pension plan that covers only retired participants. Plan benefits are linked to CPI (Consumer Price Index).

(b) **(LO 1a, 1b)** (*5 points*)

(i) (*3 points*) Describe the risk characteristics of each of the three cases.

ANSWER:

(ii) (*2 points*) Recommend which case your company should bid on.

ANSWER:

3. Continued

(c) **(LO 1a, 1b)** (*2 points*)

(i) Explain why a different longevity assumption might be required for each case.

ANSWER:

(ii) Identify how ABC Life can reduce the financial impact of incorrectly estimating the assumptions related to longevity.

ANSWER:

4.

Relevant Sources:

- Structured Settlement Annuities, SOA Research Institute, Mar 2022
- ILA101-101-25: Annuity Products and Features
- ILA101-105-25: Life Insurance and Annuity Non-forfeiture Practices

(*9 points*) Your company is a leader in the annuity market, with many years of credible annuity data. The company is now expanding to the structured settlement market.

(a) **(LO 1a, 1b, 1d)** (*4 points*) Critique each of the following statements:

A. *Mortality experience from the existing annuity block can be used to price the new structured settlement product, since it is just a different type of annuity.*

ANSWER:

B. *Underwriting process for substandard risks associated with the structured settlement can follow the same underwriting methodology used in the company's life insurance business.*

ANSWER:

C. *It is important for the company to cash flow match expected asset and liability cash flows on the structured settlement block to reduce the investment risk.*

ANSWER:

D. *In designing the benefit of structured settlement, the company must consider nonforfeiture benefits.*

ANSWER:

4. Continued

(b) **(LO 1a, 1b)** (*2 points*) With respect to the reserves on substandard lives of the structured settlement product:

(i) Describe the treatment of total expected cashflows.

ANSWER:

(ii) Describe the statutory reserving method to be used.

ANSWER:

(iii) Describe the valuation interest rate to be used.

ANSWER:

(c) **(LO 1a, 1b)** (*3 points*) You are analyzing the risks for the structured settlement product.

(i) Describe the impact on the product's risk profile if the benefit is to increase 2% annually.

ANSWER:

(ii) Describe how the company can manage the risk of falling interest rates when preparing an initial pricing quote.

ANSWER:

(iii) Recommend two solutions to mitigate the risk of falling interest rate between the time the case was quoted and closed.

ANSWER:

5.

Relevant Sources:

- ILA101-102-25: Understanding Profitability in Life Insurance

(*6 points*)

(a) **(Not Relevant)** (*4 points*) You are developing a framework that measures the economic value created by your company's life insurance contracts.

(i) (*1 point*) Explain how insurers differ from investment funds in value creation.

ANSWER:

(ii) (*3 points*) You are provided with the following cash flows of a level term policy, payable over three years as shown in the table below:

Time	**At inception**	**EOY 1**	**EOY 2**	**EOY 3**
Premiums	40	40	40	--
Claims	--	20	30	55
Expenses	7.5	2.5	2.5	2.5
Risk capital	15	10	8	--

Furthermore, assume the following simplifications:

- All future cash flows are paid at the end of each year
- Only frictional risk capital costs are considered
- Risk capital costs amount to 3% of risk capital at the start of each year
- A risk-free discount rate of 4% per annum can be used for all maturities

Calculate the economic value of this contract at inception using zero coupon bonds to construct a replicating portfolio for this contract's cash flows.

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

5. Continued

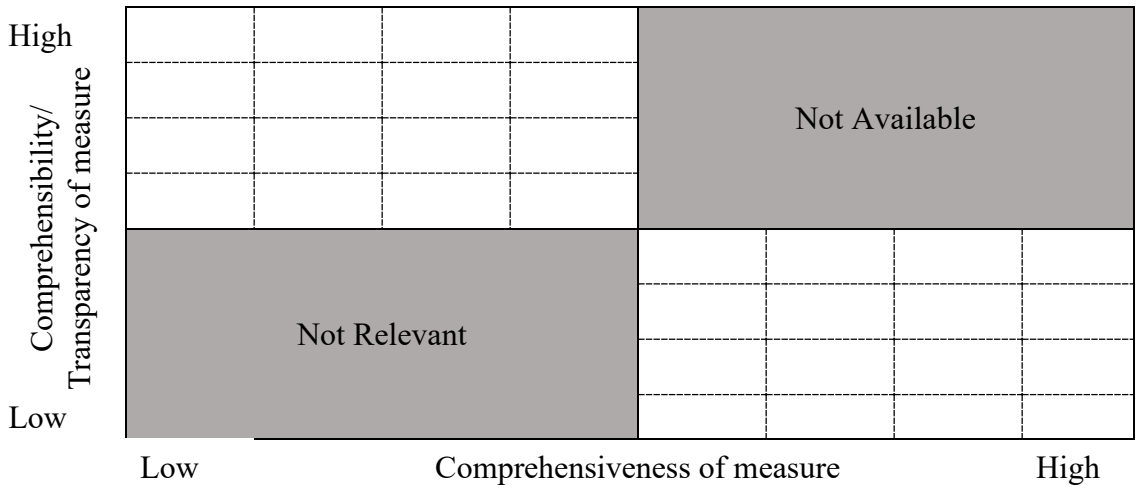
(b) **(LO 1c)** (*2 points*) Place the following profit measures in the table below. Justify your answer.

(i) Embedded Value (EV)

(ii) ROE

(iii) Operating Profit (OP)

(iv) Market Consistent Embedded Value (MCEV)



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

6.

Relevant Sources:

- Life, Health & Annuity Reinsurance, Tiller, John E. and Tiller, Denise, 4th Edition, 2015 - Ch. 4: Basic Methods of Reinsurance

- Life, Health & Annuity Reinsurance, Tiller, John E. and Tiller, Denise, 4th Edition, 2015 - Ch. 5: Advanced Methods and Structures of Reinsurance

(*9 points*) TPL Life is seeking to transfer a portion of investment risk on a block of Universal Life business via reinsurance. They will partner with XYZ Re, a newly established reinsurer, for this transaction.

Although the statutory reserves will be ceded to XYZ Re, TPL Life wishes to retain control over the investment strategy of the assets backing the reserves, as well as limit their counterparty credit exposure. In addition, TPL Life intends to recapture the underlying business eventually.

(a) **(LO 5e)** (*2 points*) Propose an appropriate reinsurance method for TPL Life. Justify your answer.

ANSWER:

(b) **(LO 5e)** (*4 points*) The following information is provided for the transaction:

General Assumptions (for all years)	
Coinsurance percentage	80%
Invested assets earned rate	8%
Allowance percentage	20%
Year 1 Projections	
Direct premium	100
Gross death benefits	0
Risk charge	0
Experience refund	0
Year 2 Projections	
Direct premium	80
Gross death benefits	10
Increase in reserve	30
Risk charge	3

Experience refund	6

6. Continued

(i) (*2 points*) Calculate the total amount due to XYZ Re at the end of Year 2 under coinsurance

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

(ii) (*1 point*) Calculate the total amount due to XYZ Re at the end of Year 2 under funds withheld coinsurance

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

(iii) (*1 point*) Calculate the funds withheld balance at the end of Year 2 under funds withheld coinsurance

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

Show all work.

(c) **(LO 5e)** (*3 points*) Critique each of the following statements with respect to reinsurance in general, and not related to the TPL company information above:

A. *While yearly renewable term reinsurance can be a cost-effective solution to transfer mortality risk, it provides little surplus benefit to the ceding company.*

ANSWER:

B. *Modified coinsurance is not an appropriate solution for ceding companies focused on developing policyholder dividend scales or interest credits.*

ANSWER:

C. *Pure coinsurance provides the benefit of minimizing capital gains and losses on assets at initiation of the reinsurance.*

ANSWER:

Fall 2023 LPM Exam

1.

(*10 points*)

Relevant Sources:

- Structured Settlement Annuities, SOA Research Institute, Mar 2022
- Credibility Methods Applied to Life, Health, and Pensions, SOA, Feb 2019 (pp. 1-25 only)
    - Credibility Methods Companion Excel Files

(a) **(LO 1a, 1b)** (*2 points*) Describe considerations in the development of a mortality assumption for structured settlements with respect to the following:

(i) Underwriting compared to an insured population

(ii) Experience studies

(iii) Mortality improvement

ANSWER:

(b) **(LO 2c)** (*6 points*) The following is a company's experience study for their in-force structured settlements:

Attained Age	Death Count	Count Exposed
0-19	5	5,000
20-49	250	75,000
50-79	1,000	80,000
80-99	400	3,000
100+	15	50
Total	**1,670**	**163,050**

You are given the following additional information:

Confidence Interval	Normal Distribution Z-value
85%	1.440
90%	1.645
95%	1.960

Expected value of the process variance = 42,000

Variance of the hypothetical means = 13

(i) List one strength and one weakness of each of the Limited Fluctuation and the Greatest Accuracy methods for calculating credibility.

ANSWER:

1. Continued

(ii) Calculate the credibility for each line within the highlighted box in the provided Excel spreadsheet using the Limited Fluctuation method with a 95% probability of a 5% margin of error. Show all work.

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

(iii) Calculate the credibility for each line within the highlighted box in the provided Excel spreadsheet using the Greatest Accuracy method, also known as the Bühlmann Credibility Formula. Show all work.

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

(iv) Recommend a credibility method for pricing structured settlements. Justify your response.

ANSWER:

~~(c) **(Not Relevant)** (*2 points*) Evaluate how a predictive analytics approach could be beneficial for pricing structured settlements.~~

~~ANSWER:~~

2.

Relevant Sources:

- Registered Index-Linked Annuities, SOA Research Institute, Aug 2022
- ILA101-101-25: Annuity Products and Features– Chapter 3 Indexed Annuities

(*10 points*) You are given the following for AMO Life Insurance Company's Registered Index-Linked Annuity (RILA) product:

RILA Rate sheet:

Crediting Option	Term	Index	Crediting Structure	Cap	Floor	Buffer
RILA-A	1 Year	S&P 500	Cap with Buffer	15%		10%
RILA-B	1 Year	S&P 500	Cap with Floor	18%	10%	
RILA-C	3 Year	S&P 500	Cap with Buffer	40%		10%

(a) **(LO 1a, 1b)** (*2 points*) You are given:

S&P 500 Annual Index Returns	
Year	**Return**
1	-15%
2	35%
3	-5%

At the end of each term, the same crediting option is chosen for the following term and the same rates are available.

(i) Determine which RILA crediting option will have the highest cumulative return at the end of 3 years. Show all work.

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

(ii) Determine which RILA crediting option will have the lowest cumulative return at the end of 3 years. Show all work.

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

2. Continued

(b) **(LO 1a, 1b)** (*4 points*) You are given the following pricing data for a Fixed Indexed Annuity (FIA):

- FIA crediting option has no cap but has a participation rate
- S&P 500 index level at time of pricing: 4,000
- Option costs (as a percentage of notional amount):

Strike Price	Put Cost	Call Cost
3,400	2.7%	19.3%
3,600	3.4%	16.4%
3,800	4.6%	12.5%
4,000	5.9%	9.0%
4,200	7.7%	6.4%
4,400	9.7%	4.0%
4,600	12.1%	2.0%

Calculate the participation rate of the FIA crediting options that will result in the static hedging cost being equal to the RILA-A crediting option. Show all work.

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

(c) **(LO 1a, 1b)** (*4 points*) For each of the two ways for calculating the interim value of a RILA contract:

(i) Assess whether the interim value would increase, decrease, or remain unchanged due to an increase in equity index volatility.

ANSWER:

(ii) Explain which way each of the following would prefer:

- Shareholders
- Advisors

Justify your response.

ANSWER:

3.

(*8 points*)

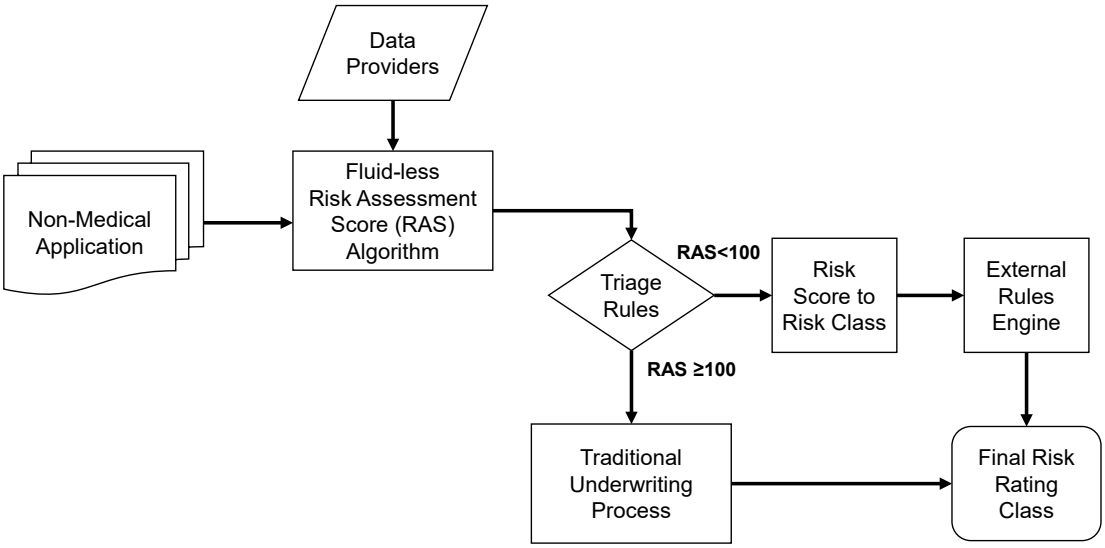
Relevant Sources:

- Life Insurance for the Digital Age: An End-to-End View, Product Matters, Nov 2017

(a) **(LO 3a)** (*1 point*) Describe considerations for use of data that is subject to FCRA (Fair Credit Reporting Act).

ANSWER:

DEF Life sells whole life. You are given the following information with respect to the end-to-end accelerated underwriting process for purchasing DEF Life's whole life insurance product.



- Data providers offer information for prescription history, motor vehicle records, electronic medical records, public data for background check and criminal history, income and employment history, and credit score on applicants.
- The nonmedical application includes a question on tobacco use status.
- The nonmedical application includes questions regarding family history and risky avocations. The responses to these questions feed into the external rules engine.
- The traditional underwriting process uses underwriters to assess final risk classification.
- The traditional underwriting process uses paramedical examination and collecting fluids including blood, urine, and saliva tests.
- If the RAS equals or exceeds 300, then the case automatically is declined for coverage.

3. Continued

You are given the following information with respect to four applicants for the whole life insurance product:

Applicant	Risk Assessment Scores (RAS)	Days To Underwrite	Adverse Underwriting Decision Disclosure For Applicant
A	75	1	-
B	110	55	Hypertension
C	50	1	Participate in risky avocations
D	305	1	RAS Algorithm

For all applicants:

- answered no tobacco use on application
- no criminal history and clean driving record for the last 5 years.

The risk classes include:

- best nonsmoker (NS)
- second best NS
- standard NS
- standard smoker

The best nonsmoker risk class was assigned to applicant A.

You are reviewing the company's underwriting results.

(b) **(LO 3a)** (*5 points*) For each of the applicants B, C and D:

(i) (*2 points*) Determine the applicant's risk class. Justify your answers.

ANSWER:

(ii) (*2 points*) Critique the appropriateness of the underwriting decision disclosures.

ANSWER:

(iii) (*1 point*) Describe how predictive analytics can improve the mortality assumptions for this block of whole life business using end-to-end accelerated underwriting process.

ANSWER:

3. Continued

(c) **(LO 3a)** (*2 points*) Recommend additional analyses and data elements from external providers that can be used to reduce mortality anti-selection in DEF Life's accelerated underwriting program.

ANSWER:

4.

Relevant Sources:

- ILA101-103-25: Ch. 9 of Life Insurance Products and Finance, Atkinson and Dallas

- ILA101-104-25: Ch. 11, pp. 499-512 of Life Insurance Products and Finance, Atkinson and Dallas

- Life, Health & Annuity Reinsurance, Tiller, John E. and Tiller, Denise, 4th Edition, 2015 – Ch. 4: Basic Methods of Reinsurance

- Life, Health & Annuity Reinsurance, Tiller, John E. and Tiller, Denise, 4th Edition, 2015 – Ch. 5: Advanced Methods and Structures of Reinsurance

(*8 points*) XYZ Insurance is developing a new term life product. You are given the following pricing assumptions and projections:

End of year	**2022**	**2023**	**2024**	**2025**	**2026**
Statutory Reserve	0	350	700	650	0
GAAP Benefit Reserve	0	250	500	700	0
Tax Reserve	0	325	650	603	0
Earnings Reserve	0	100	375	600	0

	2023	**2024**	**2025**	**2026**
Premium Income	400	390	380	350
Investment Income	15	68	86	85
Investment Income on Required Capital	10	25	20	35
Benefits	100	125	200	995
Expenses	175	0.5	0.5	0.5
DAC Amortization	-150	25	25	100
PermDiff*	0	0	0	0
Tax Rate	21%	21%	21%	21%

* Permanent difference between solvency earnings and taxable earnings

(a) **(LO 1c)** (*1.5 points*) Calculate the pre-tax stockholder earnings for each year 2023 through 2026. Show all work.

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

(b) **(LO 1c)** (*1.5 points*) Calculate the taxes payable on solvency earnings for each year 2023 through 2026, assuming no DAC tax. Show all work.

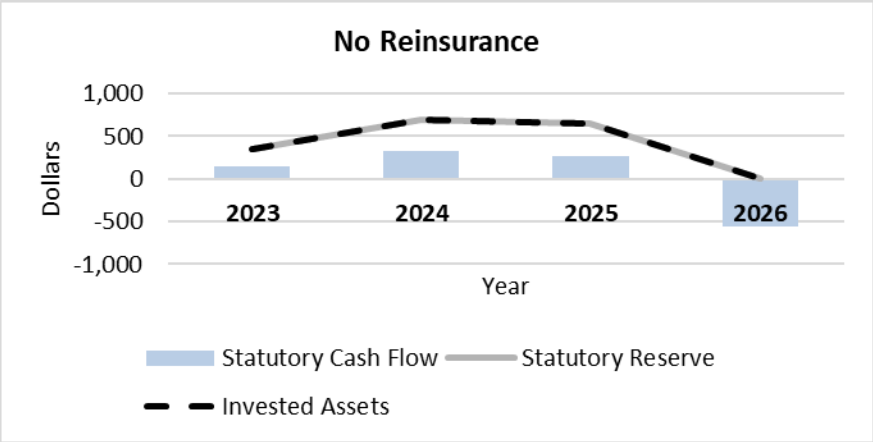
The response for this part is to be provided in the Excel spreadsheet.

(c) **(LO 1c)** (*1 point*) Calculate the Deferred Tax Liability for years 2024 and 2025. Show all work.

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

4. Continued

You are given the following graph detailing the current statutory cash flow and reserve pattern of XYZ's term product without reinsurance.

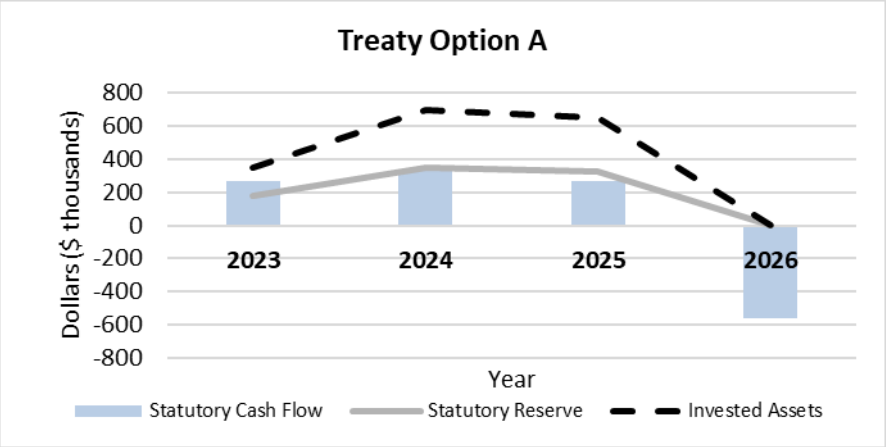


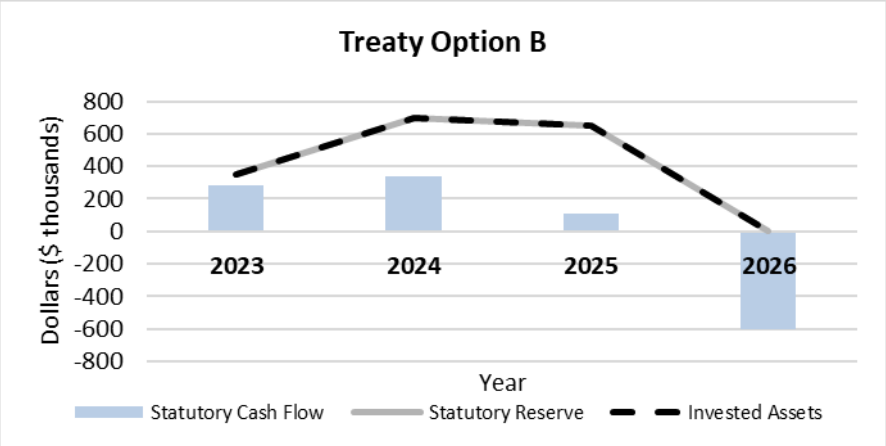
XYZ Insurance is considering three reinsurance treaty options with the following terms:

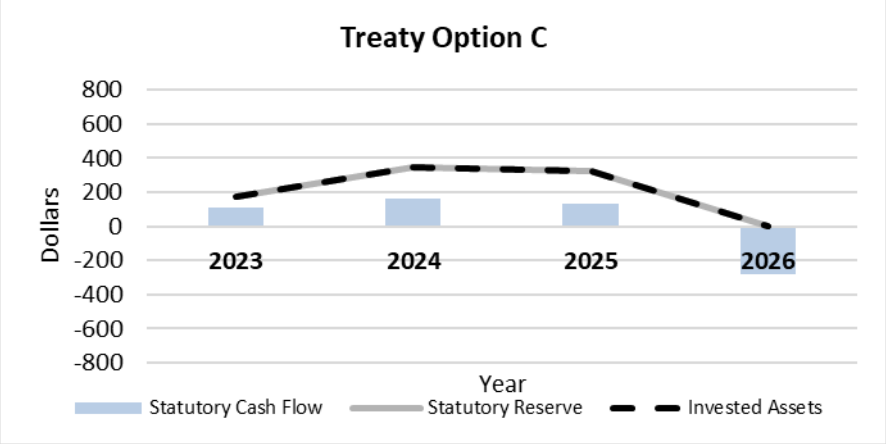
- Initial expense allowance equal to 125
- 50% quota share
- Mod Co interest rate equal to the asset earned rate, where applicable

4. Continued

You are given three graphs illustrating XYZ's statutory cash flow and reserve pattern under the three reinsurance treaty options.







4. Continued

(d) **(LO 5e)** (*3 points*) Identify which of the following reinsurance methods corresponds to each treaty option above. Justify your response.

(i) Coinsurance

ANSWER:

(ii) Funds Withheld Coinsurance

ANSWER:

(iii) Modified Coinsurance

ANSWER:

(e) **(LO 5e)** (*1 point*) Recommend one of the above three reinsurance methods for XYZ Insurance. Justify your response.

ANSWER:

5.

Sources:

- Life, Health & Annuity Reinsurance, Tiller, John E. and Tiller, Denise, 4th Edition, 2015 - Ch. 4: Basic Methods of Reinsurance, Ch. 5: Advanced Methods and Structures of Reinsurance

(*7 points*)

(a) **(LO 5e)** (*3 points*) GHI Life is entering into a coinsurance treaty with FSD Re and negotiating premiums for banded policies as follows:

Band	Face Amount	Expense allowance (% of premium)	Ceded Face Amount	Gross premium per 1,000
1	1 million or less	10%	100,000,000	15
2	Over 1 million	12%	250,000,000	10

You are given the following options to determine reinsurance premium and allowance:

- **Option 1**: reinsurance premium is based on the gross premium rate charged the policyholder, using 11% of premium as the expense allowances for all policies.
- **Option 2**: reinsurance premium is based on the gross premium rate charged to the policyholder, with different expense allowances for each band.
- **Option 3**: reinsurance premium and expense allowances are based on the policy with the highest face amount.

(i) Describe one advantage to GHI Life for using each of the options.

ANSWER:

(ii) Identify which option will yield the highest ceded premium net of allowances. Show all work.

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

5. Continued

(b) **(LO 5e)** (*4 points*) GHI Life is evaluating a reinsurance treaty at 80% quota share with BBB Re on its new business at issue. You are given the following information about the reinsured business, before reinsurance:

Policy Year	Gross premium	Investment income (5%)	Total Claims	End of year Reserves
2				2,000
3	6,000	100	600	6,000

- Investment income(t) = reserve(t-1) * earned rate
- BBB Re proposed a modified coinsurance structure, with the modco rate set to its investment earned rate at 4%.
- BBB Re will pay an experience refund equal to half of its pre-tax statutory income to GHI Life

Assume:

- Reinsurance treaty was effective at policy issue
- No expenses

(i) Calculate the pre-tax statutory income for BBB Re in policy year 3, before the experience refund. Show all work.

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

(ii) Calculate the pre-tax statutory income for GHI Life in policy year 3, including the experience refund. Show all work.

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

(iii) Recommend whether coinsurance or modified coinsurance is more beneficial to GHI Life, assuming BBB Re has also offered a coinsurance quote with the same 80% quota share. Justify your response.

ANSWER:

6.

Relevant Sources:

- ILA101-102-25: Understanding Profitability in Life Insurance
- ILA101-107-25: Lapse Supported Insurance Analysis
- ILA101-100-25: Life Products and Features
- ILA101-101-25: Annuity Products and Feature

(8 points) UXS is a publicly traded company that operates in multiple regulatory regimes, with half of its business written in the U.S.

(a) **(LO 1c)** (2 points)

(i) Define embedded value.

ANSWER:

(ii) List one reason why embedded value is not based on economic principles.

ANSWER:

(b) **(LO 2b)** (*2 points*) UXS has a block of term to 100 business that was sold 15 years ago. Lapses have been lower than assumed at pricing, and profitability has been below expectations.

Critique the following statements:

A. *Given the poor performance of the business, UXS proposes exiting the business using indemnity reinsurance with 100% quota share.*

ANSWER:

B. *UXS should invest in programs that increase customer satisfaction, which will improve policy persistency and profitability. Higher than expected lapses will prevent UXS from recouping expenses, which ultimately hurts the profitability of the block.*

ANSWER:

6. Continued

(c) **(LO 1a, 1b, 1c)** (*4 points*) For its U.S. business, the product team has proposed three potential products.

	A	**B**	**C**
Profit Metrics	**Term**	**Whole Life**	**Annuity**
IRR on distributable earnings	13%	9%	14%
Profit Margin	8%	9%	8%
PV (of distributable earnings) @ 8%	10,000,000	4,000,000	28,000,000

UXS senior management has the following objectives:

- The required return on capital is 14%.
- Using the CAPM, the hurdle rate is 8%.
- Decisions should be made based on long term value impact.

(i) (*3 points*) Evaluate each of the three profit metrics in terms of their appropriateness for comparing the profitability across all three products.

ANSWER:

(ii) (*1 point*) Recommend a product that best aligns with UXS senior management's objectives. Justify your answer.

ANSWER:

7.

Relevant Sources:

- ILA101-100-25: Life Products and Features
- ILA101-101-25: Annuity Products and Features
- Report on Premium Persistency Assumptions Study of Flexible Premium Universal Life Products, May 2012, pp. 9-15
- Market Trends and Product Designs: Considerations when Interest Rates are Rising, Product Matters, Nov 2021

(*9 points*) ABC Life sells term life insurance products and would like to expand its business by introducing a new universal life (UL) product.

(a) **(LO 1a, 1b, 2b)** (*5 points*) Explain how each of the following sections of a term pricing report will change for UL:

(i) Mortality

ANSWER:

(ii) Lapses and policyholder behavior

ANSWER:

(iii) Expenses

ANSWER:

(iv) Options and Guarantees

ANSWER:

(v) Compensation

ANSWER:

(b) **(LO 1a, 1b, 3e)** (*2 points*) Explain two ways rising interest rates could influence the pricing of the UL product.

ANSWER:

(c) **(LO 1a, 1b)** (*2 points*) In order to address policyholders' concerns about high inflation, ABC is interested in expanding its business into the annuities market.

Recommend an annuity product for ABC Life. Justify your answer.

ANSWER:

Spring 2024 LPM Exam

1.

Relevant Sources:

- Structured Settlement Annuities, SOA Research Institute, Sklar, 2022
- Pension Risk Transfer in Canada and the U.S., SOA Research Institute, Feb 2022
- Market Trends and Product Designs: Considerations when Interest Rates are Rising, Product Matters, Nov 2021

(*10 points*) ABC Life Insurance is a small insurance company that specializes in individual fixed annuities (FA), whole life (WL), and universal life (UL) products. ABC Life is evaluating expanding into the pension risk transfer (PRT) market or structured settlement market. The market is now entering a rising interest rate environment after a period of sustained low interest rates.

(a) **(LO 1a, 1b, 2a)** (*5 points*) Compare and contrast the following pricing considerations for retirement annuities and structured settlements.

A. Asset Return/Interest Rates

ANSWER:

B. Longevity/Mortality

ANSWER:

C. Annuitant Behavior

ANSWER:

D. Expenses

ANSWER:

E. Liquidity

ANSWER:

1. Continued

(b) **(LO 3e)** (*3 points*) Compare the impact of a sustained low interest rate environment against a rising interest rate environment for each of the following:

1. ABC Life's inforce FA block

ANSWER:

2. ABC Life's inforce life insurance block

ANSWER:

3. Pricing of future PRT deals and structured settlements

ANSWER:

(c) **(LO 1a, 1b, 3e)** (*2 points*) Recommend one of the following business strategies for ABC Life. Justify your response.

Strategy A: Enter the PRT market
Strategy B: Enter the structured settlement market
Strategy C: Focus on growing the WL business
Strategy D: Focus on growing the FA business

ANSWER:

2.

Relevant Sources:

- Life, Health & Annuity Reinsurance, Tiller, John E. and Tiller, Denise, 4th Edition, 2015 - Ch. 4-5

(*11 points*)

(a) **(LO 5e)** (*5 points*) Recommend a method of reinsurance for each of the following. Justify your answers.

(i) Company A is looking to free up surplus for the issuance of a new line of universal life (UL) products. Company A would like to run off its old whole life (WL) block and is looking to reduce the size of its balance sheet immediately.

ANSWER:

(ii) Company B is looking to mitigate its lapse risk on the fixed annuity business by transferring 30% of its lapse risk exposure using reinsurance without reducing its total invested assets or reserves. Company B also prefers to have frequent cash flow settlements.

ANSWER:

(iii) Company C would like to reduce 90% of its mortality risk on its UL business while retaining all other risk. Company C is looking for a fast and efficient solution.

ANSWER:

(iv) Company D discovered if the surrender rate on their whole life block were to exceed 35% in any given year, the company may not have sufficient cash on hand to pay out the surrender benefits. The block has profitable experience with surrender rates around 3%, and Company D does not seek to give up much profit generated from the mortality and investment experience.

ANSWER:

2. Continued

(v) Company E's investment yield ranks among the highest in the industry due to its aggressive investment strategy and utilization of alternative assets, but its mortality and lapse experience has been undesirable on its WL, term, and UL business. Company E would like to transfer 40% of its underwriting risk using reinsurance without altering its investment portfolio.

ANSWER:

UWU Life is looking to reinsure a block of business with the following information as of reinsurance effective date:

Reserve inforce	2,200,000,000
Total invested asset	2,400,000,000

You are given the following reinsurance quotes:

	Quota share	**Structure**	**Initial allowance**
Quote 1	80%	Modified Coinsurance	9% of reinsurance premium
Quote 2	75%	Coinsurance	10% of reinsurance premium
Quote 3	75%	Funds Withheld Coinsurance	10% of reinsurance premium

(b) **(LO 5e)** (*4 points*) Calculate the following for each of the three quotes above:

(i) Initial reinsurance premium

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

(ii) Initial amount due from UWU Life to the reinsurer

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

(iii) UWU Life's net reserve as of the reinsurance effective date

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

2. Continued

(iv) UWU Life's invested assets as of the reinsurance effective date

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

Show all work.

(c) **(LO 5e)** (*2 points*) XYZ is considering reinsurance to improve capital efficiency on their long term care block. XYZ is evaluating the use of the following reinsurance structure which combines modified coinsurance and coinsurance:

	Modified Coinsurance Component	**Coinsurance Component**
Initial Quota Share	90%	10%
Initial Allowance	10%	10%

Critique the following characteristics of the proposed reinsurance structure with respect to the NAIC's model regulations on acceptable risk transfer:

(i) *Based on recent asset performance, XYZ will use a constant modified coinsurance interest rate of 5%.*

ANSWER:

(ii) *XYZ will use assumption reinsurance to maximize the value of the transaction but seeks the option to recapture the business in 5 to 10 years if experience improves.*

ANSWER:

(iii) *XYZ is looking to receive an experience refund at the end of every month, settled on a cash basis.*

ANSWER:

(iv) *XYZ will adjust the quota shares of modified coinsurance and coinsurance to minimize the size of periodic cash settlements.*

ANSWER:

•

Relevant Sources:

- Experience Study Calculations, SOA, Oct 2016 (revised Mar 2024), sections 2-4, 11, 12, 15, 17 & 18 (excluding 18.2, 18.8 & 18.9)

- Life Insurance for the Digital Age: An End-to-End View , Product Matters, Nov 2017

(*7 points*)

(a) **(LO 2b, 2e)** (*2 points*) DEF Life sells income payout annuities and term life insurance. DEF Life would like to leverage the mortality experience from their immediate annuity business to price structured settlements.

Evaluate this approach.

ANSWER:

(b) **(LO 2b, 2e, 3a)** (*5 points*) Explain how each of the following components of an accelerated underwriting (AUW) program helps to achieve mortality at a level closer to a fully underwritten process versus nonmedical underwriting:

- Smoker propensity model
- Risk score model
- Prescription (Rx) data
- Medical records
- Triage rules

ANSWER:

5.

Relevant Sources:

- Pension Risk Transfer in Canada and the U.S., SOA Research Institute, Feb 2022

(*9 points*) ONA Life specializes in long term care insurance, individual annuities, and the conversion of defined benefit pension plans to group annuities.

The partners at DNS, a small legal firm, wish to continue offering a pension benefit but would like to know more about converting it to a group annuity. They have asked ONA Life to develop a proposal to understand the process.

(a) **(LO 1a, 1b)** (*2 points*) List four reasons that the group annuity proposal could be advantageous to DNS.

ANSWER:

(b) **(LO 1a, 1b, 2a)** (*3 points*) Critique each of the following statements from the proposal to DNS:

(i) *ONA Life plans to use individual annuity experience to price the group annuity.*

ANSWER:

(ii) *The best way to mitigate longevity risk is to fully reinsure the business.*

ANSWER:

(iii) *Since this is an established block of business for ONA Life, a deterministic model with a single set of assumptions would be sufficient.*

ANSWER:

5. Continued

(c) **(Not Relevant)** (*4 points*) DNS is interested in providing long term care insurance for their employees, but is concerned about recent premium increases.

(i) Describe four challenges that the long term care insurance industry has faced that has led to premium rate increases.

ANSWER:

(ii) Propose a strategy to address one of the challenges.

ANSWER:

6.

Relevant Sources:

- Term Conversions: Pricing and Reserving, Product Matters, Mar 2017
- ILA101-106-25: Experience Assumptions for Individual Life Insurance and Annuities
- Predictive Models on Conversion Studies for the Level Term Premium Plans, SOA, Mar 2017

(*7 points*)

(a) **(LO 2a, 2b)** (*4 points*) Critique the following statements on term conversions:

A. *The converted policy is perfectly priced if, at conversion, the slope of the expected mortality is less than the gross premium for a permanent policy.*

ANSWER:

B. *For a convertible term policy, the costs associated with the conversion are unrelated to the issue age.*

ANSWER:

C. *When conversion privileges are shortened, the premium for the convertible term product is expected to increase.*

ANSWER:

D. *There is no need to charge for a conversion option as part of the term premium, because the premium for the permanent products will already reflect the additional mortality experience due to conversions.*

ANSWER:

(b) **(LO 2b)** (*3 points*)

(i) Describe two approaches for developing the mortality assumption for converted policies.

ANSWER:

(ii) List an advantage and a disadvantage of each of the above approaches.

ANSWER:

7.

Relevant Sources:

- ILA101-102-25: Understanding Profitability in Life Insurance
- ILA101-107-25: Lapse Supported Insurance Analysis
- ILA101-106-25: Experience Assumptions for Individual Life Insurance and Annuities Life, Health & Annuity Reinsurance, Tiller, John E. and Tiller, Denise, 4th Edition, 2015 - Ch. 4: Basic Methods of Reinsurance

(*7 points*) You are given the following information about your company's inforce block of individual life insurance:

	Whole Life	**Term Life**	**Universal Life**
Present value of future profits	3,000	1,500	2,000
Time value of financial options and guarantees (TVOG)	100	200	120
Required capital	900	500	700
Free surplus	200	500	300
Mortality risk costs	250	2,000	150
Long-dated equity option costs	50	500	50
Additional taxes and investment costs incurred by shareholders	40	20	30

Lapse experience has been adverse for all products.

(a) **(LO 1c)** (*2 points*) Evaluate the advantages and disadvantages of an Embedded Value (EV) approach to measuring profitability versus accounting-based metrics.

ANSWER:

(b) **(LO 1c)** (*2 points*) Calculate the Market Consistent Embedded Value (MCEV) of each product. Show all work.

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

(c) **(LO 2a, 2b, 5e)** (*3 points*) Critique each of the following proposals to improve profitability of the inforce products:

(i) Increase persistency on the universal life block by sending annual reminders about all the benefits of holding a policy

ANSWER:

(ii) Up-sell term life policyholders by providing annual reminders that they may convert to a permanent policy which will have higher premiums

ANSWER:

7. Continued

(iii) Recapture whole life policies following a series of YRT reinsurance rate increases which have made the reinsurance more expensive than the benefit provided.

ANSWER:

Fall 2024 LPM Exam

1.

Relevant Sources:

- ILA101-109-25: PLACEHOLDER – New illustration paper

(*8 points*) You are an actuary at JET Life, a Canadian life insurance company. You have prepared the following illustration for an inforce whole life policy:

Policy Information:

Product	ExcelLife 2021
Prepared for	Jane Doe
Policy Number	12345EX
Issue Age	40
Class	Female, Standard Non-Smoker
Issue Date	1/1/2022
Inforce Illustration Date	1/1/2024
Death Benefit	100,000
Initial Monthly Premium	500
Dividend Option	Paid-Up Additions
Policy Loan Used	Yes

Policy Values (in thousands):

Policy Year	Age	Premium	CSV	Death Benefit	Annual Dividend
1	40	6	0.00	100	0.10
2	41	6	0.00	100	0.15
3	42	6	0.23	100	0.20
…					
25	64	6	22.95	100	1.50
26	65	0	25.33	100	1.70
27	66	0	28.01	100	2.00

Illustration Scenarios (in thousands):

		Primary Scenario		Second Scenario	
Policy Year	Age	Cash Surrender Value	Annual Dividend	Cash Surrender Value	Annual Dividend
1	40	0.10	0.10	0.20	0.20
2	41	0.25	0.15	0.51	0.30
3	42	0.46	0.20	0.92	0.40
…					
25	64	22.95	1.50	45.89	3.00
26	65	25.33	1.70	50.67	3.40

27	66	28.01	2.00	56.19	4.00

1. Continued

(a) **(LO 3d)** (*3 points*) Identify two missing or incomplete elements of each of the following sections of the illustration in accordance with CLHIA Guideline G-6:

(i) Policy Information

ANSWER:

(ii) Policy Values

ANSWER:

(iii) Illustration Scenarios

ANSWER:

(b) **(LO 3d)** (*2 points*) Critique the following excerpts from JET Life's illustration in accordance with CLHIA Guideline G-6:

A. The illustrated scenarios above represent reasonable projections of possible scenarios. The actual value of your policy may vary but will likely be higher than the primary scenario.

ANSWER:

B. Illustrated dividends are based on the current dividend scale as of the date of this illustration and cannot be guaranteed.

ANSWER:

C. Dividend accumulations will be credited an interest rate to be determined by the insurer annually.

ANSWER:

1. Continued

D. The scenarios shown in this illustration are consistent with those developed at the time of the pricing of your policy.

ANSWER:

(c) **(LO 3d)** (*3 points*) Contrast how the following elements of an illustration differ between Canada and the US.

(i) The role of the actuary preparing an illustration

ANSWER:

(ii) Illustration of non-guaranteed elements

ANSWER:

(iii) Mortality assumptions

ANSWER:

2.

Relevant Sources:

- Registered Index-Linked Annuities, SOA Research Institute, Aug 2022
- ILA101-101-25: Annuity Products and Features, Chapter 1, 2020

(*9 points*) SLAC Life offers a Registered Index-Linked Annuity (RILA) product with a 1-year term crediting structure, featuring a 10% buffer rate and a 15% cap rate on the S&P 500 index. SLAC sets these rates once a month.

SLAC has previously outsourced the hedging of the RILA product to an external firm due to small production and is setting up a hedging program internally to support anticipated growth.

(a) **(LO 1a, 1b)** (*3 points*)

(i) Describe two potential challenges SLAC will face in implementing effective hedging strategies.

ANSWER:

(ii) Describe the hedge position(s) SLAC may or would need to take to fully immunize market risk under each of the following:

- The crediting structure being currently offered
- A 10% floor instead of the buffer

ANSWER:

(b) **(LO 1a, 1b)** (*3 points*) Critique the following statements from the SLAC pricing report:

A. *SLAC is required to perform an interim value calculation on RILA contracts only to determine the death benefit and annuitization amount at any time.*

ANSWER:

2. Continued

B. *The market value approach to the interim value calculation is preferable because it provides a method that is easier for advisors, contract holders, and regulators to understand. However, because of its simplicity it maximizes the volatility in financial statements of the company.*

ANSWER:

C. *The interim value lock feature can either automatically lock a prespecified target interim value set when the contract is issued or give an option to the contract holder to manually lock the interim value as of the last market close.*

ANSWER:

D. *There is no risk to SLAC to offer a value lock feature since all the information is known regarding the timing or target of the interim value to lock.*

ANSWER:

(c) **(LO 1b)** (*3 points*) You are given the following information for four policies:

Policy	**Product Type**	**Investment Option**
1	Fixed Indexed Annuity	70% participation strategy only, annual point-to-point
2	Variable Annuity	100% index fund
3	Fixed Indexed Annuity	4% cap, annual point-to-point
4	Registered Index-Linked Annuity	15% cap and 10% buffer, annual point-to-point

2. Continued

All investment options are tied directly to the S&P 500 Index
Assume no charges

Year	S&P 500 Index
0	1,000
1	1,160
2	1,200
3	1,085
4	1,130
5	900

Calculate the account value progression through the end of year 5 for each of the four policies, assuming an initial deposit of 1,000. Show all work.

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

3.

Relevant Sources:

- Predictive Models on Conversion Studies for the Level Term Premium Plans, SOA, Mar 2017

- Credibility Methods Applied to Life, Health, and Pensions, SOA, Feb 2019 (pp. 1-25 only)
    - Credibility Methods Companion Excel Files

(*6 points*) EFG Life Insurance Company would like to use predictive analytics to improve its underwriting risk selection and its experience studies.

You are reviewing a consultant's report on the potential value of predictive analytics.

(a) **(LO 2b, 2e)** (*2 points*) Critique each of the following statements from the consultant's report:

A. *Predictive analytics will allow EFG to introduce new factors in underwriting without having to rely on traditional A/E results.*

ANSWER:

B. *Predictive analytics will help EFG deal with the lack of experience data at older ages.*

ANSWER:

C. *The refined assumptions from predictive analytics may be applied easily in both the pricing models and the valuation models.*

ANSWER:

(b) **(LO 2b, 2e)** (*2 points*) EFG is developing a predictive model to improve its underwriting process. They have begun the model building process by collecting and organizing the data.

Describe the four activities in the data preparation process.

ANSWER:

(c) **(Not Relevant)** (*2 points*) EFG is concerned about anti-selection from applicants and their advisors when predictive modeling is used for underwriting.

Describe two actions EFG can take to guard against anti-selection.

ANSWER:

4.

Relevant Sources:

- ILA101-102-25: Understanding Profitability in Life Insurance

(*8 points*) ORD Life is looking to improve profitability on their inforce business.

(a) **(LO 1c)** (*2 points*) Critique each of the following statements:

A. *ROE is an accounting-based metric that provides a product level view of earnings performance. It is less volatile than book value per share. There is a strong correlation between ROE and price-to-book ratio.*

ANSWER:

B. *Operating margin is an accounting-based metric and captures the general trends in earnings. It reflects the timing of profits and losses and the relative riskiness of the business. Statutory operating margins vary by country due to product mix and regulatory regimes.*

ANSWER:

C. *Market Consistent Embedded Value (MCEV) values liabilities using book value and assets on a market-consistent value basis. The MCEV consists of two components: value of in-force business (VIF) and required capital.*

ANSWER:

~~(b) **(Not Relevant)** (*3 points*) Describe two methods to improve consumer value or long-term profitability within each of the following areas of inforce management:~~

~~(i) Steering liability portfolios~~

~~ANSWER:~~

4. Continued

(ii) Increasing persistency

ANSWER:

(iii) Improving claims management

ANSWER:

(c) **(Not Relevant)** (*3 points*) ORD Life's term products have a level premium period followed by increasing premiums in the post-level term (PLT) period.

A. Describe three approaches to improve profitability during the PLT period.

ANSWER:

B. Discuss the advantages and disadvantages of each approach.

ANSWER:

5.

Relevant Sources:
Life, Health & Annuity Reinsurance, Tiller, John E. and Tiller, Denise, 4th Edition, 2015
Chapter 4: Basic Methods of Reinsurance

(*11 points*) ABC Life, a US insurance company, issues a whole life policy:

Face amount	750,000
Annual premium rate per 1,000	15
Annual policy fee	25

Assume:

- Premium tax rate is 2% for all years
- There are no surrenders, lapses, or deaths
- The accounting is on a US statutory basis

You are given:

ABC Statutory Gain from Operations (no reinsurance)	**Year 1**	**Year 2**
Premiums	11,275	11,275
Investment Income on Surplus	80	40
Investment Income on Reserves	0	36
Total Revenue	**11,355**	**11,351**
Claims	0	0
Surrenders	0	0
Reserve Increase	450	4,050
Total Benefits	**450**	**4,050**
Commissions	10,148	1,128
Acquisition	1,000	0
Maintenance	30	30
Premium Tax	226	226
Total Expenses	**11,403**	**1,383**
Gain from Operations	**-498**	**5,918**

ABC is evaluating two reinsurance proposals from XYZ Re:

- Proposal 1: 80% Coinsurance
- Proposal 2: YRT with an initial ceded face amount of 600,000

5. Continued

You are given:

- XYZ Re acquisition expenses are 40 per ceded policy
- XYZ Re maintenance expenses are 20 per ceded policy annually
- ABC and XYZ Re each have an initial surplus of 1,000 and an investment rate of return of 8% in all years
- The reserves per unit are the same for the ceding company and the reinsurer
- NAAR is defined as face amount – mean reserves

	Year 1	**Year 2**
Mean Reserves per 1,000	0.60	6.00
YRT Mean Reserves per 1,000	0.70	0.90
YRT Reinsurance Premium Rate per 1,000	0.65	0.80

(a) **(LO 5e)** (*2 points*) Explain the advantages and disadvantages of each reinsurance proposal for ABC.

ANSWER:

(b) **(LO 5e)** (*1 point*) Explain why the change in XYZ Re's Gain from Operations in year 1 may not mirror the change in ABC's Gain from Operations in year 1 under either proposal. No calculations are required.

ANSWER:

(c) **(LO 5e)** (*4 points*)

(i) Determine the minimum first year expense allowance as a percent of ceded premium that would be needed in Proposal 1 for ABC to avoid a negative Gain from Operations in year 1. Show all work.

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

(ii) Determine whether XYZ Re could afford to pay this first year expense allowance without exhausting all of its surplus in year 1. Show all work.

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

5. Continued

(d) **(LO 5e)** (*4 points*) ABC would like to avoid additional surplus strain in the first two policy years. To help meet this objective, ABC plans to ask XYZ Re to offer a ZFT scale (zero first year YRT premium) instead of the proposed premium scale, which requires an increase in the YRT rates in subsequent years to offset the cost.

Determine the maximum increase that ABC could accept in the second year YRT premium, as a percent of ceded face per 1,000. Show all work.

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

Questions 6 and 7 pertain to the Case Study.
Each question should be answered independently.

6.

Relevant Sources:

- ILA101-106-25: Experience Assumptions for Individual Life Insurance and Annuities ILA101-107-25: Lapse Supported Insurance Analysis
- Overview of Non-guaranteed Elements (NGEs), SOA Research Institute, Nov 2022
- ILA101-100-25: Life Products and Features
- ILA101-103-25: Ch. 9 of Life Insurance Products and Finance, Atkinson and Dallas

(*10 points*) You have been asked to reprice TTPD's 20-pay whole life product with competitive premiums and a return of premium rider to be marketed in the qualified market using an assumption of 60% male and 40% female.

(a) **(LO 1a, 1b, 2a)** (*4 points*) Critique each of the following statements:

A. *There is no reason to worry about the product being lapse supported because it's a limited-pay whole life product.*

ANSWER:

B. *To determine relevant characteristics of the product, only the chief operating officer and chief actuary were interviewed on how the product will be administered. They were asked about limitations in administrative or valuation systems that could impact the product design or pose operational risks. There was no reason to interview the chief marketing officer.*

ANSWER:

C. *For a non-participating whole life product, cash values are fixed at issue, making current interest rates irrelevant to the consumer.*

ANSWER:

(b) **(LO 2a, 2b)** (*3 points*) Calculate the duration 20 mortality rate for issue age 45 using the mortality rates provided in the case study (see the Excel spreadsheet.) Show all work.

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

(c) **(LO 3c)** (*3 points*) The chief actuary has proposed using indeterminate premiums in the product design to reduce the product's risk.

(i) Explain how the proposal will reduce risk.

ANSWER:

6. Continued

(ii) Describe three elements of ASOP 2, "Nonguaranteed Elements for Life Insurance and Annuity Products", that TTPD should consider in developing an indeterminate premium whole life product.

ANSWER:

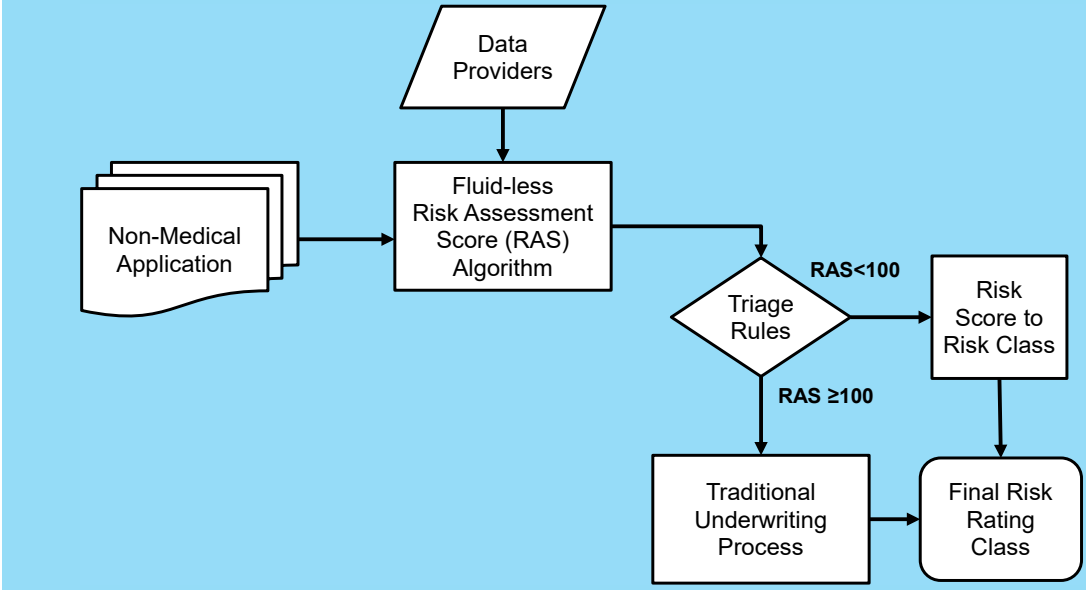
Questions 6 and 7 pertain to the Case Study.
Information in the shaded region comes directly from the Case Study.
Each question should be answered independently.

7.

Relevant Sources:

- Life Insurance for the Digital Age: An End-to-End View , Product Matters, Nov 2017

(*8 points*) You are given the following information with respect to the new end-to-end accelerated underwriting process:



Triage Model information:

- RAS scores less than 75 are best preferred.
- RAS scores at least 75 and less than 100 are second best preferred.
- RAS results greater than or equal to 100 are triaged to the traditional underwriting process for assessment of standard or substandard extra risk classes (standard non-tobacco, standard tobacco, substandard non-tobacco, decline).
- The traditional underwriting process uses underwriters to assess the final risk classification.
- The traditional underwriting process uses a paramedical examination and fluids collected include blood, urine, and saliva tests.

You are given the following additional information:

- The Risk Assessment Score (RAS) algorithm uses a model to predict the expected mortality of the applicant based on the nonmedical application and, where available, input from various data providers as follows:

Nonmedical Application Questions	**RAS Predictive Model's Reliance on Data Providers**
Tobacco in the last twenty-four months	Uses population-level open data to validate tobacco use responses and predicts smoker propensity.
Hospitalized in the last 45 days	None; model will automatically decline
Hospitalized between 2020-22 due to Covid-19	Predicts comorbidities and associated mortality based on population-level open data from 7 major urban centers
Alcohol and drug use	Uses social media to verify

(a) **(LO 3a)** (*2 points*)

(i) List three non-traditional data sources used in the life insurance underwriting process.

ANSWER:

(ii) Describe considerations for use of these non-traditional data sources according to the NAIC Life Accelerated Underwriting in Life Insurance Educational Report.

ANSWER:

(b) **(LO 3a)** (*4 points*) With respect to the new end-to-end accelerated underwriting process:

(i) Explain how risk classes are determined by the triage process vs. the historical traditional underwriting process.

ANSWER:

7. Continued

(ii) Explain how regulatory considerations may impact the use of data inputs and predictive models/algorithms.

ANSWER:

(iii) Critique the triage process of using only RAS scores to sort applicants into preferred risks or to be routed to the traditional underwriting process. Justify your response.

ANSWER:

(iv) Critique the triage process of routing only applicants assessed as standard and below risk classes to the traditional underwriting process. Justify your response.

ANSWER:

(c) **(LO 3a)** (*2 points*) Sales under the new program have been 20% less than expected. This is mainly due to fewer preferred risk class placements than expected. Early A/E studies reveal preferred classes overall are 110% of A/E mortality whereas the standard and substandard classes are exhibiting 99% A/E. A higher percentage of accidental deaths, anti-selective cancer claims and cardiovascular deaths has occurred than was experienced with the fully underwritten process.

Recommend changes to the accelerated underwriting process to improve preferred risk class placements and improve the mortality A/Es. Justify your answer.

ANSWER:

****END OF EXAMINATION****