CURATED PAST EXAM ITEMS
- Solutions -

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 The inclusion in these curated past exam questions of material that is no longer current does not bring such material into scope for current assessments.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.

ILA 101

CURATED PAST EXAM SOLUTIONS

ALL LEARNING OBJECTIVES

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Fall 2020 LPM Exam

1.

Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.

2. The candidate will understand different types of actuarial assumptions and how experience studies are designed and used for evaluating past experience and for setting assumptions.

Learning Outcomes:

(1a) Describe and compare various life insurance and annuity product designs.

(1b) Evaluate and apply pricing practices for life and annuity products.

(1c) Describe and apply the common profit metrics (IRR, Value of New Business, Embedded Value, ROE) used in pricing insurance products.

(2b) Describe and evaluate mortality, lapse, premium persistency, term conversions and utilization assumptions used for various purposes, and apply methods and techniques for their development.

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

Commentary on Question:

This question compares Term Insurance and UL product characteristics and the selection of appropriate assumptions. A secondary focus is on profitability measurement comparisons & a source of earnings analysis. Candidates did well on parts (a) and (c) and struggled more on parts (b) and (d). See separate comments below.

Solution: (LO 2b)

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

1. Continued

- 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

Critique the mortality pricing assumption.

Commentary on Question:
This question tests candidates' understanding of types of assumptions commonly used in actuarial pricing and product development. Candidates were asked to evaluate mortality assumption for a Term product. Many candidates did well on this question. Full credit was awarded to candidates who made two well explained points below.

- Attained age mortality tables make it difficult to be competitively priced across a range of issue ages
- Currently there is no face bands, mortality is generally better for higher bands than the rest.
- Renewal mortality in the post-level period is influenced by unhealthy lives retaining coverage (anti-selection)
- Post-level term mortality is largely dependent on the magnitude of the shock lapse
- Consider separating smoker/non-smoker or other underwriting criteria

(b) 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

1. Continued

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.

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

~~(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.~~

Commentary on Question:

This question tests candidate's understanding of Source of Earnings analyses. Candidates were asked to apply the methodology to perform a numerical calculation for a given scenario with different drivers of earnings. Most of candidates did relatively well in part (i) and (ii), but poorly on part (iii). Many candidates don't understand what's the difference between the net profit on valuation basis vs. actual result basis.

(i) Interest Added to Reserves
= End of Period Reserves - (Beginning of Period Reserves + Net Premium + Reserve Released for Maintenance Expenses + Reserve Released for Death Benefits + Reserve Released for Surrenders)
= 695,500 – (675,000+370,000-125,000-220,000-18,000) = **13,500**

1. Continued

~~(ii)~~

Source of Earnings Analysis	Actual Results
In Force Profit Margin	
Actual Gross Premium	390,000
GAAP Reserve Premium	(370,000)
Net	20,000
Experience - Investment Gains	
Investment Income	9,500
GAAP Reserve Interest	(13,500)
Net	(4,000)
Experience - Mortality	
Actual Death Benefits	(245,000)
~~GAAP Reserve Released for Death Benefits~~	~~220,000~~
Net	(25,000)
Experience - Lapse	
Actual Surrender Benefits	-
GAAP Reserve Released for Surrender Benefits	18,000
Net	18,000
Experience - Expenses	
Actual Expenses	(128,000)
GAAP Reserve Released for Expenses	125,000
Net	(3,000)
TOTAL	**6,000**

~~**(iii)** On the Valuation basis, it will just be the inforce profit margin (or difference in actual gross premium and GAAP reserve premium that results in a profit margin), which is 20,000~~
~~The net profit from actual results is 6,000 from part (ii)~~
~~Therefore, the expected total variance between actual results and projected valuation results is 6,000 – 20,000 = 14,000~~

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

(i) Mortality

(ii) Lapse

(iii) Interest

1. Continued

Commentary on Question:
This question continues to test candidates' understanding of types of assumptions commonly used in actuarial pricing and product development. Candidates were expected to focus the arguments on difference for each assumption between Term and UL products based on different characteristics of the products. Candidates generally did well on this question.

(i) **Mortality**
Mortality can generally be expected to be similar across term and UL although adjustments would be needed for:

- Mortality is influenced by shock lapses on term which do not impact UL
- Term mortality is based on higher face amounts leading to better mortality
- Term has low long term persistency leading to improved mortality rates
- Implementation of the AUW program can result in 5-10% increase in expected mortality for those that qualify
- For those who do not qualify and need to go through full underwriting, the mortality should be similar

(ii) **Lapse**

- Term will have selective lapsation after level period, which does not apply to UL
- UL lapses need to be supplemented with an assumption for partial withdrawals
- UL lapses tied to market performance, guarantees, the level of crediting rates, as well as overall interest environment etc.

(iii) **Interest**

- Term reserve interest rates will not be directly applicable to UL
- UL interest rate assumptions will need to be more complicated. In addition to a rate of return on assets, UL needs assumption for the rate credited to the account which can either be guaranteed, or based on portfolio of assets backing the fund

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

Commentary on Question:
This question asks candidates to make general comments on the considerations when selecting a profitability metric. Some candidates misunderstood the question to propose different profitability metrics for Term and UL products. Partial credit was given when candidates provided valid explanation and consideration for selected profitability metric.

1. Continued

- The expected pattern of profits over time (for example, the pattern of gains and losses, however measured);
- the significance of the product's underlying risks (for example, the size and pattern of risk capital); and
- any other considerations that the actuary determines are relevant (for example, limitations of the profitability metric for the product being priced; multiple metrics may be adopted if deemed appropriate and relevant)

2.

Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.

2. The candidate will understand different types of actuarial assumptions and how experience studies are designed and used for evaluating past experience and for setting assumptions.

Learning Outcomes:

(1a) Describe and compare various life insurance and annuity product designs.

(1b) Evaluate and apply pricing practices for life and annuity products.

(2b) Describe and evaluate mortality, lapse, premium persistency, term conversions and utilization assumptions used for various purposes, and apply methods and techniques for their development.

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

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) **(LO2b)** 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.

Commentary on Question:

Most candidates were able to identify ABC should not just use company's historical lapse experience. At the end of level term period there are shock lapses due to steep post level term premium increases. However, most candidates missed the fact that competition and preferred underwriting classes drove premium rates down which led to higher lapse rates historically.

Partial credit was awarded if a candidate mentioned lapse assumptions should reflect conversion rates or lapse rate may decrease once conversion is offered.

2. Continued

ABC should not just use historical lapse experience for new business pricing assumptions as term products have changed significantly in the last decades and may not be relevant appropriate for new business.

- Level term period:
  - Fierce competition and introduction of preferred classes drove premium rates down, which led to high replacement activity and lapse rates in earlier decades.
  - New generation level term lapse rates (post early to mid-2000's) tend to be lower than in prior decades.

- End of level term period shock lapse:
  - Rate competitions led more companies to lower premiums in level period and try to recoup with steeper post-level term rates, which resulted in higher shock lapses for new generation products.

- Post-level term period:
  - Higher shock lapses and increased post level term premiums would result in a different residual cohort exhibiting different lapse behaviors.

(b) **(LOs 1a, 1b, 2b)** 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) Explain how a conversion option benefits the policyholder.

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

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

Commentary on Question:
For part (i), most candidates discussed one of the benefits is unhealthy individuals can covert to permanent policy without being re-underwritten. Only a few candidates mentioned the other benefit of conversion for healthy lives.

Candidates did well on part (ii). Credit was awarded if a candidate mentioned permanent product is (generally) more profitable than term.

Most candidates did well on part (iii), but only few candidates discussed the disadvantage from the profitability tracking / experience study perspective.

2. Continued

(i) Policyholders gain access to permanent coverage that does not reflect high concentration of less healthy individuals who typically persists post-level term and contribute to rapidly increasing premiums after the initial term.

Moreover, conversion privilege is an option to policyholders. If policyholders are healthy enough to get re-underwritten, they benefit from qualifying for a new plan and if they are unhealthy, they can exercise the conversion privilege.

(ii) 1. Help sales of term products:
Conversion option makes the product more attractive with future benefit to the policy holder and makes the product more competitive if all your competitors are offering a conversion privilege.

2. Help increase permanent business:
It helps retain healthy lives that might otherwise lapse if they purchase permanent insurance with another company and also rolls them into a potentially more profitable product.

(iii) Advantages:

- Covering conversion costs in the term product is fairer, since it is spread across those who have the right, though not the obligation, to convert to a permanent product.
- Conversion costs then depend on the volume of business with the conversion option. Pricing for conversion costs in permanent products is more difficult because the actuary must accurately estimate not just the term conversion rate, but the volume of permanent business across which the conversion costs are to be spread.

Disadvantages:

- Term is a very price sensitive product. Allocating conversion costs may put the carrier at a disadvantage compared to those who embed conversions costs in permanent products or do not assume any conversion costs.

2. Continued

- Depending on the carrier's administrative capabilities, there is misalignment between the line of business where conversion costs are paid for (term block) and where the costs will occur (permanent block). This may overstate term's profitability and understate permanent product's profitability when reporting earnings. It may also result in a misalignment of excess mortality when performing experience studies since converted policy claims will increase mortality for the for the permanent product.

(c) 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.

~~(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*.~~

2. Continued

Commentary on Question:
Candidates generally struggled with part (i) as many did not appropriately set up the formula for the extra mortality cost $K_{(50,r)}$ nor did many capture conversion as a decrement in calculation $A_{(50,2)}$

For part (ii), most candidates stated that conversion mortality should be revised and the conversion rate should be higher in late durations, but most candidates were not able to identify the 6% conversion rate is too high according to SOA study

(i) where:

$K_{(50,r)} = PV\ of\ extra\ mortality\ cost\ for\ age\ (50+r)$

$q'_{[50]+t} = mortality\ of\ converted\ policy = 1.2 * q_{[50]+t}$

AR = Amount at risk = 500,000

$$K_{(50,r)} = \sum_{t=0}^{\infty} \left\{ {}_tp'_{[50]+r} * \left(q'_{[50]+r+t} - q_{[50]+r+t}\right) * AR * v \right\}$$

$$K_{(50,1)} = \sum_{t=0}^{\infty} \left\{ {}_tp'_{[50]+1} * \left(1.2 * q_{[50]+1+t} - q_{[50]+1+t}\right) * AR * v \right\}$$

$$K_{(50,1)} = \sum_{t=0}^{\infty} \left\{ {}_tp'_{[50]+1} * \left(0.2 * q_{[50]+1+t}\right) * AR * v \right\}$$

$$K_{(50,1)} = \sum_{t=0}^{\infty} \left\{ 0.2 * {}_tp'_{[50]+1} * q_{[50]+1+t} * AR * v \right\}$$

$$K_{(50,1)} = (0.2 * 0.81 * 500{,}000 * 1) = 81{,}000$$

$$K_{(50,2)} = (0.2 * 0.79 * 500{,}000 * 1) = 79{,}000$$

$A_{(50,r)} = PV\ at\ age\ 50\ of\ the\ extra\ mortality\ cost\ due\ to\ conversion\ effected\ at\ the\ end\ of\ policy\ year\ r$

$$A_{(50,1)} = {}_1p_{[50]} * e * K_{(50,1)} * v$$

$${}_1p_{[50]} = 1 - q_{[50]} = 0.9989\ and\ e = 6\%$$

$$A_{(50,1)} = 0.9989 * 6\% * 81{,}000 * 1 = 4{,}855$$

2. Continued

$$A_{(50,2)} = {}_2p_{[50]} * e * K_{(50,2)} * 1$$

$${}_2p_{[50]} = {}_1p_{[50]} * (1 - e) * \left(1 - q_{[50]+1}\right) = 0.9377$$

$$A_{(50,2)} = 0.9377 * 6\% * 79{,}000 * 1 = 4{,}444$$

Conversion cost in the first 2 durations = 4,855 + 4,444 = 9,299

(ii) 1. Conversion rate:

- 6% is high for conversion rate. SOA study showed ~1% for duration 1-9. ABC should lower the conversion rate in duration 1-9.

- Conversion rate should vary by duration. Usually highest in the last year of conversion period due to premiums are generally less expensive than permanent product. ABC should revise the conversion rate assumption to have a spike in duration 10.

2. Post conversion mortality assumption:

- According to SOA study, mortality deterioration multiplier should vary by duration at conversion due to anti-selection at the end of the level term period. ABC should use a higher mortality multiple for late converters. Also based on the study, the mortality rate should slowly reduce following the spike at conversion.

4.

Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.

2. The candidate will understand different types of actuarial assumptions and how experience studies are designed and used for evaluating past experience and for setting assumptions.

Learning Outcomes:

(1a) Describe and compare various life insurance and annuity product designs.

(1b) Evaluate and apply pricing practices for life and annuity products.

(2a) Describe types of actuarial assumptions commonly used for life insurance and annuity actuarial functions.

(2b) Describe and evaluate mortality, lapse, premium persistency, term conversions and utilization assumptions used for various purposes, and apply methods and techniques for their development.

(2c) Explain and apply actuarial credibility methods.

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

Commentary on Question:

Commentary listed underneath question component.

Solution:

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

~~**Commentary on Question**:~~

For maximum points, candidates must give descriptions in addition to listing two examples. Many candidates received partial credit because they described only one challenge. Most candidates addressed data availability/credibility as a challenge but struggled to provide other examples.

Solution:

(1) Data availability: rapid product development combined with the rise of new product designs has resulted in a lack of credible experience data available to insurers
(2) Model complexity: modeling policyholder behavior requires complex models and sophisticated techniques which may not be available in insurers' existing software packages

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

4. Continued

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.

Commentary on Question:
For maximum points, each of the current practices must be evaluated, including providing examples of how the practice could be improved to become consistent with industry practice. Many candidates did not receive maximum credit because they either failed to suggest changes or did not address each bullet point. Of the four categories, candidates had the most success addressing the governance process.

Solution:

- Data analysis, collection, and assumption setting
  - XYZ should also look at external data (e.g., industry).
  - For the repository, should consider expanding beyond admin to include data from underwriting or sales systems.
- Modeling
  - Modeling packages/approaches should be reviewed across functions to ensure there are no inconsistencies
- Validation
  - Should have a model steward. However, should have a formal process for both high level and detailed validation of changes and results.

4. Continued

- Governance process
  - Periodic updates should not be based on resource availability. A formal process should be put in place for updating experience data.
  - Informal recommendation and approval are not consistent – Chief Actuary or other appropriate individual(s) should provide formal signoff on assumption changes.

(c) **(LO 1a, 1b)** 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.

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

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

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.

Commentary on Question:
To receive maximum points, candidates must provide analysis of each statement beyond simply answering true/false. Most candidates received partial credit for providing supporting detail for some statements but often were not able to articulate the relevant differences between variable and indexed annuities.

Solution:
(A) False. Cost is usually higher on a Variable Annuity since Indexed Annuity usually has a floor of zero
(B) Not necessarily true as some companies do not hedge the GMWB on a Fixed Indexed Annuity
(C) True. XYZ does need to follow AG 33, but AG 35 also applies since the method of crediting interest to the annuity is nontraditional
(D) False. With no clearly defined hedging strategy, XYZ must use fair market value of hedging instruments.

4. Continued

(d) **(LOs 1a, 1b, 2a, 2b, 2c)** 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.

Commentary on Question:
Partial credit was given if the candidate only indicated if the source or structure were appropriate with no additional detail. For maximum points, candidates must provide an evaluation. Most candidates failed to provide additional commentary for data sources, such as credibility concerns or the use of external data. Regarding structure, many candidates struggled to indicate the correct approach, particularly for annuitizations.

Solution:

- Surrenders
  - Company data is appropriate, but credibility should be reviewed since there will be differences between the variable and indexed annuity product features
  - Dynamic structure appropriate since surrenders will be sensitive to changes in market conditions
- Withdrawals
  - Company data is appropriate, but credibility should be reviewed since there will be differences between the variable and indexed annuity product features
  - Static structure is appropriate (withdrawals won't vary much)
- GLB Utilization
  - Company data is appropriate but should consider supplementing with industry data
  - Should use dynamic structure
- Annuitizations
  - Company data is appropriate but should review due to differences between the variable and indexed annuity product features
  - Dynamic is inappropriate – should use static structure since it won't vary much.

6.

Learning Objectives:

5. The candidate will understand various techniques for addressing the mitigation of risk within a life insurance and annuity context.

Learning Outcomes:

(5e) Describe basic terms, concepts, and types of life insurance reinsurance arrangements.

Sources:

Tiller, 4th edition, Chapter 4: Basic Methods of Reinsurance

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

Commentary on Question:

The purpose of this question was to test the candidate's knowledge of reinsurance options and their impact on company financials. Most candidates did well on part (a) but struggled with part (b).

Solution:

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

(i) YRT

(ii) Coinsurance

(iii) Modified Coinsurance

(iv) Funds Withheld Coinsurance

Commentary on Question:

Candidates generally performed well on this question. Full credit was given if the candidate answered correctly whether each of the four company objectives were effective or ineffective, for each of the four types of reinsurance.

(i) YRT

1. Effective for reducing capital based on mortality risk.

2. Ineffective for expanding into the annuity business due to focus on mortality risk.

6. Continued

3. Ineffective for achieving expense efficiencies due to small expense allowances.

4. Effective for mitigating mortality risk.

(ii) Coinsurance

1. Effective for reducing capital based on various risks (mortality, lapse, asset/investment, etc.).

2. Effective for expanding into the annuity business since it covers many risks associated with annuity products.

3. Effective for achieving expense efficiencies because of the expense allowance from the reinsurer.

4. Effective for mitigating mortality risk.

(iii) Modified Coinsurance

1. Effective for reducing capital based on various risks (mortality, lapse, asset/investment, etc.).

2. Effective for expanding into the annuity business since it covers many risks associated with annuity products.

3. Effective for achieving expense efficiencies because of the expense allowance from the reinsurer.

4. Effective for mitigating mortality risk.

(iv) Funds Withheld Coinsurance

1. Effective for reducing capital based on various risks (mortality, lapse, asset/investment, etc.).

2. Ineffective for expanding into the annuity business due to funds withheld.

3. Ineffective for achieving expense efficiencies due to additional costs associated with setting up trust or escrow accounts.

4. Effective for mitigating mortality risk.

6. Continued

(b) **(LO 5e)** 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) Construct Life Co's Gain from Operations statement for years 1 and 2 under the reinsurance agreement.

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

Commentary on Question:
For part (i), most candidates who had a broad knowledge of financial values in reinsurance agreements received some credit for this part, but very few candidates achieved full credit for this question. Full credit was given if the candidate not only provided Life Co's gain from operations in year 1 and in year 2, but also showed their work in obtaining those values.

For part (ii), candidates generally performed poorly on this question. The most important step in getting this correct was recognizing that the question was asking for the Balance Sheet values of Reinsurance Inc. Candidates that recognized this received partial credit. Full credit was given if the candidate was able to provide the correct asset, liability, and surplus values in year 1 and year 2, but very few were able to do that.

Note the solution provided here assumes 100% coinsurance. However, since the question did not state the coinsurance percentage, values were adjusted based on the coinsurance percentage assumed by the candidate.

See Excel attachment.

8.

Learning Objectives:

4. The candidate will understand common valuation and capital techniques used in US, Canadian, and international regulatory frameworks.

Learning Outcomes:

(4a) Describe the US statutory actuarial framework, including the principles-based reserves and calculate basic life insurance reserves.

(4b) Describe the US GAAP actuarial framework and calculate term insurance reserves and deferred acquisition cost.

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

Commentary on Question:

This question tested candidates' knowledge of various reserving bases and how they react to changes in assumptions and experience. Many candidates answered the question by listing information about the different reserving bases, but did not always directly address the question that was asked. Some candidates also gave relatively little justification for their answers and therefore only received limited partial credit. The graphs included in the question were also difficult for some candidates to interpret.

Solution:

(a) 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.

Commentary on Question:

Many candidates had difficulty using the provided Excel spreadsheet to answer the question. Some candidates answered the question only based on the provided earnings projection instead of considering the effects of slightly higher mortality rates. Some candidates also discussed which basis had the higher earnings instead of the higher change in earnings.

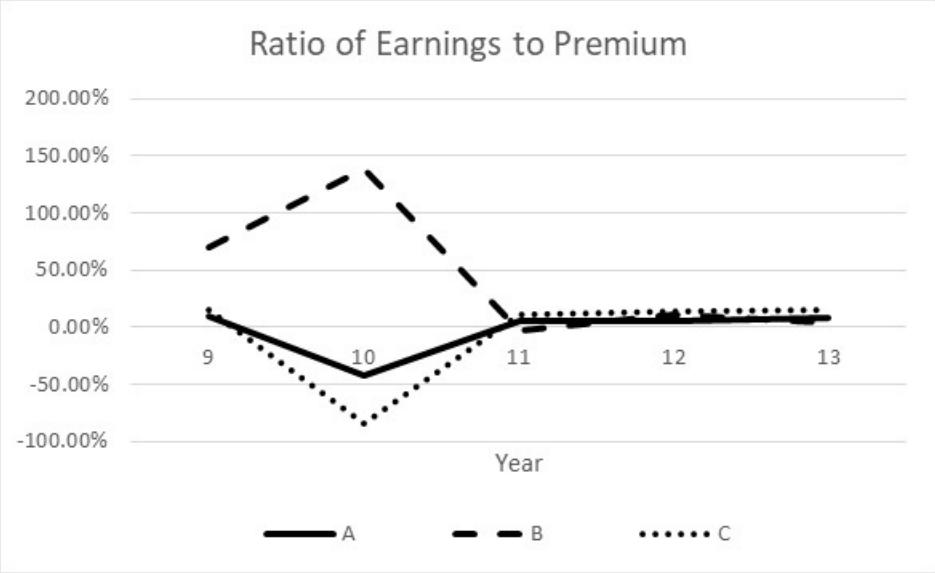
8. Continued

Based on the given values, US Statutory earnings emerge slower in earlier years and faster in the latter half of the level term period. CALM earnings are based on the size and pattern of the PFAD, and assumptions are re-evaluated annually with any changes in assumptions immediately recognized in income.

When the expected mortality changes starting in year 6, US statutory reserves are not recalculated, but CALM reserves are. US Statutory earnings in year 6 will be reduced due to the increased claims, offset by the additional reserve release. CALM earnings in year 6 will also be reduced due to increased claims, offset by additional reserve release, but also reflects the full impact of the assumption change leading to a higher recalculated reserve.

Therefore, CALM has a higher expected change in earnings compared to US Statutory.

(b) 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.

8. Continued

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.

Commentary on Question:
Many candidates correctly identified that line B corresponded to a US Statutory basis. Fewer candidates were able to distinguish between US GAAP and CALM. Some candidates misinterpreted the graph as starting from policy issue instead of duration/year 9 as labeled. Some candidates also misinterpreted the graph as reflecting the dollar amount of earnings instead of the ratio of earnings to premium.

Candidates who correctly matched the graphs to the reserving methods received partial credit, but justification was required for full credit.

(i) US GAAP corresponds to graph C. Under US GAAP for a term product, reserves are not recalculated due to an assumption change. Similarly to CALM, US GAAP will reflect a significant loss at the end of the level premium period, but there is no offset from an assumption change leading to a reserve release.

(ii) US Statutory corresponds to graph B. At the end of the level premium period, US Statutory will experience a significant reserve release leading to the high ratio of earnings to premium in duration 10. US Statutory reserves are also not recalculated based on any assumption changes and are instead based on prescribed methodology.

(iii) CALM corresponds to graph A. CALM earnings behave similarly to US GAAP; however, an assumption change in year 10 due to improved lapse experience results in a higher reserve release which is immediately recognized in income. Therefore, the negative earnings at the end of the level premium period are less severe than US GAAP in this scenario.

(c) ~~**(NOT RELEVANT)** 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.~~

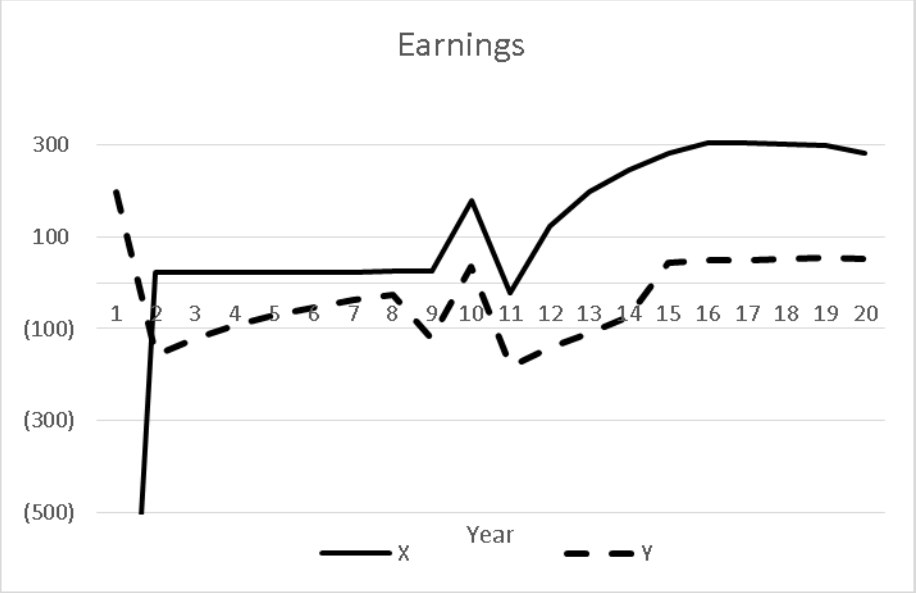
8. Continued

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.

Commentary on Question:

For part (i), many candidates interpreted the graph as reflecting earnings under each basis, instead of reflecting the change in earnings attributable to the repricing. For example, line X on the chart reflected that the repricing sharply reduced earnings in duration 1, it did not necessarily indicate a significant loss in duration 1.

For part (ii), a range of recommendations were acceptable and credit was given for reasonable justifications; one such example is provided below. Some candidates answered part (ii) by recommending a reserving basis instead of recommending a pricing approach for each reserving basis. Such answers received limited credit.

For both parts, many candidates did not give justifications for their answers and therefore received only partial credit.

(i) The CALM reserve reflects the present value of future cash flows plus provisions for adverse deviation. The Market Consistent reserve reflects the present value of liability cash flows plus a risk margin.

Under the re-pricing, we can expect more policies to remain inforce in years 11+ due to lower lapses under the graded premium repricing, and therefore lower mortality due to reduced anti-selection.

8. Continued

Under CALM, with no changes in PFADs, the greater volume of policies remaining inforce will lead to an increased present value of future cash flows and therefore an increased reserve in year 1. Income emerges over the lifetime of the business with the release of PFADs which flow into income. Therefore, CALM corresponds to graph X.

Under Market Consistent, without additional explicit conservatism in assumptions and with the grading of the risk margin, the results of the repricing will show a large increase in earnings at inception, with reduced earnings in the remaining years. Therefore, Market Consistent corresponds to graph Y.

(ii) Under CALM, the graded pricing approach is recommended. Under this approach, earnings are higher in every year except for year 1. In addition, graded rates are more attractive to the policy owner, while the company retains the rights to increase premiums up to the maximum if needed. Experience supports that this approach results in improved earnings.

Under Market Consistent, the traditional approach is recommended. Under this approach, earnings are higher in most years compared to the graded approach. In addition, the company likely has confidence in this approach due to experience, while still maintaining the flexibility to change rates as experience emerges.

9.

Learning Objectives:

5. The candidate will understand various techniques for addressing the mitigation of risk within a life insurance and annuity context.

Learning Outcomes:

(5a) Describe and evaluate approaches for integrating ALM into an enterprise's risk and financial management framework.

(5d) Explain the function and attributes of common assets used to support life insurance and annuity liabilities.

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

Commentary on Question:

Commentary listed underneath question component.

Solution:

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

Commentary on Question:

Candidates generally performed well on this question. Most candidates were able to recognize that cash is the most liquid asset and real estate is the least liquid asset. Candidates lost points when they did not adequately justify the ranking.

9. Continued

Ranking from most liquid to least liquid:

1. Cash
2. Treasury Bonds or Agency MBS
3. Agency MBS or Treasury Bonds
4. Corporate Bonds
5. Real Estate

- Cash is by definition the most liquid asset.
- Treasury Bonds are highly liquid due to the round the clock secondary market combined with high levels of trading.
- Agency MBS are highly liquid due to the guarantees and large issuance.
- Corporate Bonds are actively traded but do not have the guarantees of Treasuries nor Agency MBS.
- Real Estate is an illiquid asset. It takes time to sell and is not actively traded on most markets.

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

~~**Commentary on Question**:~~
~~*Candidates generally performed poorer on this part compared to the rest of the question. Most candidates were able to recognize the following:*~~

- ~~*FAC needs a written liquidity policy that is reviewed regularly*~~
- ~~*FAC's current portfolio could create liquidity risks and recommend re-allocating from less liquid assets (e.g. real estate) to more liquid assets (e.g. treasury bonds)*~~
- ~~*FAC should impose surrender charges for their product*~~

~~*Most candidates did not write enough statements to earn full credit or did not tie back to FAC's specific situation.*~~

~~Credit was given for any reasonable recommendation. The following list is a sample of statements that would receive full credit for this part:~~

- ~~Management needs a written policy which should be approved by senior management and reviewed regularly.~~
- ~~The company needs some quantitative tools for evaluating risks and more useful qualitative tools.~~
- ~~FAC should impose surrender charges. The lack of surrender penalties in product design creates liquidity risks.~~
- ~~Sales of FAC's current portfolio of illiquid corporate bonds could be problematic as a cash flow source.~~
- ~~Similarly, the lack of liquidity in real estate versus Treasuries/MBS should be considered.~~

- ~~IFA distribution networks are prone to greater panic withdrawal risk than tied agents and direct marketing distribution.~~

9. Continued

- ~~The company should manage its access to financial markets and have an ongoing presence in its funding channels.~~
- ~~FAC's plan to use capital to provide for liquidity risk is an ineffective means of managing the risk.~~

(c) **(LO 5a, 5d)** 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.*

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.*

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

Commentary on Question:
Part c) was very well done. Most candidates were able to:
- Indicate that the SAA portfolio should not be changed due to short-term changes in market expectations.
- Suggest that the proposed model needs to be simplified.
- Show an understanding of the impact that adding real estate to the asset allocation has on risk diversification and liquidity.
However, some candidates were unsure of the impact that adding real estate would have on the Sharpe ratio.

Statement A)
The strategic asset allocation (SAA) is based on long-term expectations of risk and target return, and should not impacted by short-term changes in market expectations. The policy portfolio should only be revised due to changes in the investor's long-term market forecasts, not due to short-term projections.

Statement B)
Mortgage-backed security valuation does requires sophisticated modeling. Models with the most useful future projections should be simple and use far fewer than 53 variables. A model using too many variables may fit historical data very well (ie. overfitting), but likely will not provide accurate future projections.

9. Continued

Statement C)

- Real Estate is an important diversifier as it responds differently than stocks or bonds to various market conditions.
- Real estate is an illiquid asset, so adding real estate to FAC's strategic allocation would reduce the overall liquidity of the portfolio.

Sharpe ratio is affected by both the expected return and risk. Since adding real estate improves diversification, the denominator will be smaller, and the Sharpe ratio should increase.

10.

Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.

2. The candidate will understand different types of actuarial assumptions and how experience studies are designed and used for evaluating past experience and for setting assumptions.

Learning Outcomes:

(1a) Describe and compare various life insurance and annuity product designs.

(1b) Evaluate and apply pricing practices for life and annuity products.

(2a) Describe types of actuarial assumptions commonly used for life insurance and annuity actuarial functions.

(2b) Describe and evaluate mortality, lapse, premium persistency, term conversions and utilization assumptions used for various purposes, and apply methods and techniques for their development.

(2c) Explain and apply actuarial credibility methods.

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

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a)

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

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

used in any calculations.

Commentary on Question:
Candidate generally performed well on this question.

In part (ii), various errors in calculating the standard deviation were common.

(i) The goal for the shock premium is to ensure appropriate pricing:

- As underwriting will have worn off, an increase in premium is needed to cover increased mortality risk.
- The jump in premium will cause anti-selection – only policyholders who cannot obtain cheaper coverage elsewhere will persist, worsening mortality deterioration.
- Goal is to increase the premium enough to cover increased mortality risk, but not too much which would drive all good risks away.

10. Continued

Some companies may have additional goals such as replacement or conversion to permanent products. Some companies may choose to use an aggregate rate design which is simpler to administer than a multi-class structure.

(ii) Expected # of lapses = expected lapse rate * policy exposure
= 90% * 8300 = 7470

Variance = Exposure * expected lapse rate * (1 – expected lapse rate)
= 8300 *90% *10% = 747

95th CI of # of lapses = Expected # lapses +/- 1.96 * Std Deviation of # lapses
= 7470 +/- 1.96*(747^0.5)
= (7416, 7542)
95th CI of lapse rate = 7470/8300 +/- 1.96*(747^0.5)/8300
=(89.4%, 90.6%)

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

Commentary on Question:
The candidates who performed well on this question tended to take one of two approaches: (1) apply credibility theory to derive new lapse assumptions or (2) calculating the 95% CI for year 6 and recommending lapse assumptions within the 95% CIs for both years

Other reasonable answers were accepted, as long as candidates justified their answer.

Credibility Approach:

Applying limited fluctuation and using 5% error rate:
Z = min (1, (0.05*(# lapses)^0.5)/1.96)

Year 5 Z = min (1, 0.05*(7835^0.5)/1.96) = 1
Year 6 Z = min (1, 0.05*(394^0.5)/1.96) = 0.506

Year 5 is fully credible, so the actual lapse experience can be used.
Year 6 is not fully credible, so the actual lapse experience must be blended with industry or other data.

10. Continued

Recommend:
Year 5 = 7835/8300 = 94.4%
Year 6 = 0.506*(394/450) + (1-0.506)*80% = 83.8%, using the existing assumption in lieu of industry data

CI Approach:

Calculate the CI for Year 6:

Expected # of lapses = expected lapse rate * policy exposure
= 80% * 450 = 360

Variance = Exposure * expected lapse rate * (1 – expected lapse rate)
= 450 *80% *20% = 72

95th CI of # of lapses = Expected # lapses +/- 1.96 * Std Deviation of # lapses
= 360 +/- 1.96*(72^0.5)
= (343, 377)
95th CI of lapse rate = 360/450 +/- 1.96*(72^0.5)/450
=(76.3%, 83.7%)

Actual lapses for both years 5 and year 6 are above the 95% CI, indicating that the lapse assumption is too low. The lapse assumption should be increased to the higher end of the CI of 90.6% for year 5 and 83.7% for year 6.

(c) **(LO 2a, 2b)** 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.

Commentary on Question:
Most candidates recognized that the Pricing Actuary's recommendation was inappropriate. Candidates who performed well were able to clearly articulate why the recommendation was inappropriate and suggest alternatives.

This recommendation is not appropriate.

- Shock lapses will occur after year 10, not after year 5. The amount of the shock lapse may be different.
- Industry data shows that lapses tend to be lower during the level term period for longer term products, so the level term lapses for the 10 year product will likely be lower than the 5 year product.

10. Continued

- Lapse rates on level term plans issued recently tend to be much lower than older plans from the 90s, so the data from LMN's existing 5-yr term products may not be applicable to a newly designed product.
- Other product features or differences in design may affect lapse rates, such as differences in policy size, distribution channel, ability to convert to permanent product.
- It would be more appropriate to source industry data or consult with a reinsurer to obtain appropriate and relevant data.

~~(d) **(NOT RELEVANT)** 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.~~

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

~~**Commentary on Question:**~~
~~*Most candidates performed moderately well on this question.*~~
~~*For part (i), a common error was listing advantages and disadvantages of predictive analytics and/or traditional approaches instead of explaining the steps and methods of each. For part (ii), candidates could agree or disagree with the recommendation, but had to provide pros/cons of predictive analytics and justify their answer to receive full marks.*~~

10. Continued

(i)

Step	Predicative Analytics	Traditional
Data Collection & Validation	• Uses a number of variables that traditional approaches would not consider. • May require sourcing external data (e.g. credit scores) • No limit on number of variables included • Data needs to be partitioned into training and validation	• Mostly relies on past experience data.
Exploratory Data Analysis	• Analyze the properties of each variable	
Variable Transformation	• Attempt to mitigate data imperfections/	• Preferred approach is generally smoothing.
Model Building	• Select the form of the lapse model (e.g. GLM).	• Generally, no different models are used • A/E is assessed for credibility and a new lapse rate is determined.
Model Validation	• Statistical techniques are used to validate the model. • Use holdback data	• More of a reasonability check.
Final Calibration	• Refit the model as needed	
Implementation and Ongoing Monitoring	• Results of lapse model could be used as scoring engine for another risk model	• Results are also monitored but not used in as many ways

(ii)

Predictive analytics has many advantages:

- Allows the examination of relationships between variables; correlations between lapse factors can be studied statistically
- Provides better insight into the interactions of various factors
- Supported by statistical tests and theory
- Trends can be captured more readily

10. Continued

- Isolated the true effect of each variable, standardizing the effect of other variables
- Allows use of factors not used in traditional methods

However, there are also disadvantages:

- More complicated. Traditional approaches to lapse studies are well established and easier to explain to management.
- Requires specific expertise to implement, which LMN may not have.
- More time consuming (and therefore more expensive)
- Pricing models may not be able to handle more refined assumptions that would result from an predictive analytics approach
- Requires a lot of data, which may be difficult to acquire, especially given LMN's lack of experience with 10-year term.

Predictive analytics can be powerful, but LMN should evaluate the costs (of obtaining data and developing data) vs the expected benefits and ensure the more complex assumptions that would result can be used in the pricing model before proceeding.

Spring 2021 LPM Exam

1. Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.
2. The candidate will understand different types of actuarial assumptions and how experience studies are designed and used for evaluating past experience and for setting assumptions.
3. The candidate will understand common issues and practices related to Product Management.
5. The candidate will understand various techniques for addressing the mitigation of risk within a life insurance and annuity context.

Learning Outcomes:

(1c) Describe and apply the common profit metrics (IRR, Value of New Business, Embedded Value, ROE) used in pricing insurance products.

(1d) Explain and apply nonforfeiture calculation techniques.

(3e) Describe and evaluate the challenges insurers face in a rising interest rate environment.

(5a) Describe and evaluate approaches for integrating ALM into an enterprise's risk and financial management framework.

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

1. Continued

Commentary on Question:
Commentary listed underneath question component.

Solution:

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

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

(ii) Recommend strategies to address these risks.

Commentary on Question:
This question required the candidates to describe two risks and actions that BXP could take to mitigate these risks. The majority of candidates correctly described disintermediation risk and identified actions that could be used to mitigate this risk. Many candidates understood that there was a liquidity risk, and many were able to suggest a change to the asset portfolio to mitigate this risk.

(i) Risks

a. Disintermediation Risk:

- BXP may face disintermediation risk as interest rate rises significantly, where policyholders surrender the policies for better yield elsewhere.

b. Liquidity Risk:

- Since BXP is primarily invested in 30-year fixed income securities, they will need to sell their long-duration assets at a discount, which causes BXP to realize capital losses. Since the market value of assets is lower than anticipated when the policies were first established, additional funds may be required to fund the liabilities.

(ii) Strategies

a. Increasing the surrender charge period will discourage policyholders from surrendering. A surrender charge period of 5-10 years would be appropriate.

1. Continued

b. Adding a market value adjustment (MVA) would decrease the value that the policyholder would receive upon lapse when interest rates rise, which will reduce disintermediation risk.
c. Asset-liability management: To manage the interest rate risk and liquidity risk, BXP should hold assets with earlier and varied maturity dates. This would shorten the asset duration to help match the future liability cash flows.

(b) **(LO 1c, 1d, 2a)** 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.

Commentary on Question:
In order to receive full marks, candidates needed to identify the impact on each component, and provide a thorough explanation.

Most candidates understood the impact on commission, overhead expenses and surrender benefits. However, many candidates incorrectly assumed that the investment income would increase because the BXP would increase crediting rates to remain competitive. Although this is a possibility, this would only occur if BXP explicitly increased crediting rates, and is not the immediate impact if interest rates increased.

(i) Policyholders would lapse to seek a more competitive product, so commissions would decrease, as commissions usually depend on the account value of the policies. Commissions may eventually increase if BXP decides to increase its credited rates to remain competitive.

(ii) Overhead expenses are not impacted by the number of policies in force, so there would be no changes to these expenses.

(iii) Surrender Benefits, especially after the one year surrender charge period, would increase due to a spike in interest rates. Policyholders will lapse their policies in order to obtain better rates elsewhere.

1. Continued

(iv) The immediate impact will be negative since the company will need to sell fixed income assets at a loss in order to pay policyholders that have lapsed. There will be a realized loss on selling the long duration fixed assets after interest rates rise.

2.

Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.

4. The candidate will understand common valuation and capital techniques used in US, Canadian, and international regulatory frameworks.

Learning Outcomes:

(1a) Describe and compare various life insurance and annuity product designs.

(1b) Evaluate and apply pricing practices for life and annuity products.

(4a) Describe the US statutory actuarial framework, including the principles-based reserves and calculate basic life insurance reserves.

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

Commentary on Question:

Commentary listed underneath question component.

Solution:

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

2. Continued

Commentary on Question:
Candidates were generally able to solve for the pre-tax solvency earnings correctly. Most candidates had the correct formula for profit margin. However, many candidates incorrectly calculated after-tax solvency earnings. Two errors were common: using the increase in statutory reserve to calculate taxable income (rather than the increase in tax reserve),or deducting tax from taxable income rather than pre-tax solvency income. Another common error was assuming premiums were paid at the beginning of the year; the question clearly stated that all cashflows occurred mid-year. Partial credit was awarded in these cases.

- Product Cash Flows = Premiums – Benefits – Expenses
- Pre-Tax Solvency Earnings = Product Cash Flows + Investment Income – Increase In Solvency Reserve
- Taxable Earnings = Product Cash Flows + Investment Income – Increase in Tax Reserve
- Taxes = Tax Rate * Taxable Earnings
- After-Tax Solvency Earnings = Pre-Tax Solvency Earnings – Tax
- Premium Margin = PV(After-Tax Solvency Earnings)/PV(Premiums)

ProdCashFlow	700	500	200	(100)	(500)
StatResIncr	1,000	1,000	2,000	(2,500)	(1,500)
Inv Income	20	50	80	140	40
Pre-Tax Solvency Earnings	(280)	(450)	(1,720)	2,540	1,040
TaxResIncr	920	920	1,840	(2,300)	(1,380)
Taxable Income	(200)	(370)	(1,560)	2,340	920
Tax	(42)	(77.7)	(328)	491	193
AT Solvency Earnings	(238)	(372)	(1,392)	2,049	847

- PV(AT Solvency Earnings) = 705
- PV(Premiums) = 9,296
- **Premium Margin = 7.58%**

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

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

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

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

2. Continued

Commentary on Question:
In general, candidates performed poorly on this section.

For part (i), most candidates focused on the differences between AG48 and VM20 reserves. The question was asking them to discuss product design.

Most candidates received partial credit on part (ii). To receive full credit on part (ii), candidates had to specify impacts with and without financing under AG48. Very few candidates performed well on part (iii). Partial credit was awarding for recognizing that the deterministic reserve would increase. To receive full credit, candidates had to discuss the resulting tax inefficiency.

(i)

- Level term premiums will still be followed by some sort of annual renewable term (ART) scale. The importance of having very high guaranteed ultimate rates to achieve the desired segmentation may subside somewhat.
- Product design will evolve around encouraging favourable product cash flows and managing risks, rather than focusing on formulaic reserve requirements.

(ii)

- ~~Profitability will increase when moving to VM20 if the AG48 business was not financed. This is driven by lower reserves under VM20.~~
- ~~Profitability will decrease when moving to VM20 if the AG48 business was financed due to the loss of tax advantages.~~

(iii)

- Pre-tax profit is unchanged but tax inefficiency is introduced, lowering post-tax profitability and increasing the overall reserve requirement.
- If there is no future mortality improvement, the DR prevails in some early and late durations where the NPR was prevailing previously. This produces a small decline in after-tax profit measures due to tax inefficiency, as when the NPR prevails tax efficiency is maximized.

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

~~**Commentary on Question**:~~
~~*Most candidates were able to list the changes, but many struggled to apply those changes to term products. To receive full credit, candidates had to describe the impacts of the Tax Cuts and Jobs Act on both AG48 and VM20 business.*~~

2. Continued

There were four key changes:

1. Tax rate was reduced from 35% to 21%
2. Extension of proxy DAC amortization period from 10 years to 15 year and increase in proxy DAC tax rate from 7.7% to 9.2%
3. Change in the way the tax reserves are calculated via the application of a 92.81% scalar to stat reserves excluding deficiency reserves
4. RBC factors increased by scalar multiple of (1 – 0.21)/(1-0.35). [NAIC may choose to adjust gross factors instead, leaving after-tax factors unchanged].

Tax reform has a small positive impact on VM20 term products, as the increase in profitability due to reduced tax rate outweighs the other impacts.

The tax reform significantly reduces the benefits of financing excess reserves under AG48, significantly reducing the IRR and profit margin.

After tax reform, the profit margins for financed AG48 and VM20 products are much closer together, which may push more companies to adopt VM20 sooner.

3. Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.
2. The candidate will understand different types of actuarial assumptions and how experience studies are designed and used for evaluating past experience and for setting assumptions.

Learning Outcomes:

(1a) Describe and compare various life insurance and annuity product designs.

(1b) Evaluate and apply pricing practices for life and annuity products.

(2a) Describe types of actuarial assumptions commonly used for life insurance and annuity actuarial functions.

Sources:

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

Commentary on Question:

This question tested candidates' knowledge of pricing, product design, and assumption setting as it relates to variable annuity product features. Overall, candidates displayed good understanding of the variable annuity product and performed well on the question as a whole.

Solution:

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

Commentary on Question:

Candidates performed well on part (a). Additional answers were possible, such as discussing the annuitization assumption given in the question. Some candidates lost credit because they discussed recommended changes to product features rather than changes to assumptions as the question asked.

Setting the mortality assumption to be equal to the fixed annuity mortality assumption may not be appropriate. Because the variable annuity contains a guaranteed minimum death benefit (GMDB) feature, the company may experience some anti-selective mortality. This indicates that it may be appropriate to set the mortality assumption higher for the variable annuity product compared to the fixed annuity.

3. Continued

It is likely not appropriate to assume that variable annuity expenses will be lower than fixed annuity expenses. In fact, because of the greater regulation associated with variable products as well as the additional expenses associated with tracking unit value calculations, it is likely appropriate to assume that variable annuity expenses are greater than fixed annuity expenses instead.

Setting surrender charges above the industry average as well as agent commissions below the industry average are both likely to deter sales. Producers will be less motivated to sell the product with lower commissions, and higher surrender charges will decrease the attractiveness of the product. Because of this, it may not be true that these features will improve product profitability once the likely change in sales is factored in to the calculation.

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

~~**Commentary on Question**:~~
~~*Part (b) asked candidates to apply the Governance and Controls section of ASOP 54 (Section 3.6) to the pricing report given in the question. Many candidates discussed other elements of ASOP 54, or other general good practices for assumption setting and governance. However, to receive full credit, candidates needed to apply the specific governance and controls elements of ASOP 54 to the variable annuity product.*~~

~~One governance and controls element discussed in ASOP 54 is that model results should be validated for consistency with independent calculations of such values from outside the model. The Risk Management group independently computing the cost of the death benefit guarantees demonstrates compliance with this principle.~~

~~Another governance and controls principle discussed in ASOP 54 is validation that the model reasonably simulates the expected future financial impact of the product. Given that the model's calculated values for death benefits were demonstrated to be consistent with the product design in one of the stochastic scenarios, compliance with this principle was demonstrated.~~

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

(ii) An increase in annuitization rates

3. Continued

Commentary on Question:
Candidates performed reasonably well on part (c). To receive full credit, candidates needed to both make a recommendation on both parts as well as justify how the recommendation is based on behavioral economics insights.

Some candidates only received partial credit because they only discussed behavioral economics without making a recommendation, or because they made recommendations with no justification.

(i) The annuity application could include a suggested allocation of 50% equity funds and 50% fixed income funds, or another percentage that is higher compared to the allocations the company currently experiences. This is based on the concept of "anchoring", where annuitant behavior is very likely to be influenced by numbers that are suggested by the company.

(ii) Based on the concept of "reliance on defaults", the company could set up a default annuitization age that triggers annuitization if no action is taken, but that allows for an "opt out" or resetting the annuitization to occur at a different age. Reliance on defaults refers to the concept that people are unlikely to override set defaults especially as decision complexity increases.

(d) **(LO 1b, 2a)** 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.

Commentary on Question:
Candidates were largely successful on part (d). One common mistake was using the modeling assumption for the cost of the return-of-premium benefit and the step-up benefit as well as the per-contract expense assumption as deductions to be taken from the account value. Also, some candidates did not correctly perform the "step-up" calculation, or used incorrect timing assumptions in their calculations. Candidates did receive partial credit for those elements of their calculations that were correct.

3. Continued

Year	Return	Account Value	Step up	5% Rollup	Death Benefit
0		10,000	10,000	10,000	
1	-1%	9,900	10,000	10,500	10,500
2	6%	10,494	10,494	11,025	11,025
3	7%	11,229	11,229	11,576	11,576
4	9%	12,239	12,239	12,155	12,239
5	1%	12,362	12,362	12,763	12,763

4.

Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.

Learning Outcomes:

(1c) Describe and apply the common profit metrics (IRR, Value of New Business, Embedded Value, ROE) used in pricing insurance products.

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

4. Continued

Commentary on Question:
Commentary listed underneath question component.

Solution:

(a) **(LO 1c)**

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

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

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

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

Commentary on Question:

This question requires candidates to apply the common profit metrics (IRR, Value of New Business) and evaluate those metrics in a numerical insurance product example. Most candidates did well in the first 3 parts. In part (iv), very few candidates identified that an after-tax incremental cost should be used, and some candidates used the before/after net income instead of value of new business when deciding the break-even point.

The solution below is based on using 40 as current expense assumption. However, using 109.10 in the current income statement to back solve for the new expense is considered equally valid approach, candidates that did this approach also received full credit. Candidates that got an incorrect value for part (i) were still given full credit for the part (ii), (iii), (iv) as long as the methodology in parts (ii), (iii), and (iv) was correct

(i) Expense = Acquisition expense per App × Applications per policy + (Acquisition Expense per premium + Maintenance Expense per per premium) × average Premium per policy = (40 – 10) × 1.5 + (30% +5%) × 26 = 54.1

Pretax Net Income = Premium + investment income - claims - expenses - increases in reserve = 26 + (–1.29) – 0.17 – 54.1 – 48.73 = –78.29

Tax on Income = Pretax Net Income × tax rate = –78.29 × 25% = –19.57

Net Income = Pretax Net Income – Tax on Income = –78.29 – (–19.57) = –58.72

4. Continued

(ii) IRR definition is "a single interest rate that discounts all policy cash flows back to the issue date of the policy, such that the sum of discounted cash flows equals zero". Those cash flows include income, taxes, required capital, and interest on required capital

Using the IRR() formula to solve r, which can also be verified by checking the NPV at the IRR = 0

	1	2	3	4	5
Net Income	–58.72	21.01	24.28	29.94	35.49
Discount Rate	$(1+r)$	$(1+r)^2$	$(1+r)^3$	$(1+r)^4$	$(1+r)^5$

The proposed program's IRR is 28.01%

(iii) Value of new business (VNB) Formula
VNB = Present value of future profits after tax - time value of financial options and guarantees - frictional costs of required capital - cost of non-hedgeable risk

	1	2	3	4	5
Net Income (new)	-58.72	21.01	24.28	29.94	35.49
Discount Rate	$(1+3\%)$	$(1+3\%)^2$	$(1+3\%)^3$	$(1+3\%)^4$	$(1+3\%)^5$

New VNB = NPV @ 3% = 42.23

(iv) The after-tax cost of the program will be 1 million × (1 - tax rate) = 750,000.

	1	2	3	4	5
Net Income (current)	–100.83	21.05	24.34	30.01	35.35
Discount Rate	$(1+3\%)$	$(1+3\%)^2$	$(1+3\%)^3$	$(1+3\%)^4$	$(1+3\%)^5$

Original VNB = NPV @ 3% = 1.57

New VNB = 42.23 (from (iii))
Change in VNB = new VNB – old VNB = 42.23 – 1.57 = 40.66

If amortized over one year, the VNB per policy increase of 40.66 means that \$750,000 ÷ 40.66 = 18,446 policies must be sold to break even on the incremental cost.

4. Continued

If the company can sell more than 18,446 policies, then JXR should proceed with the new underwriting program.

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

~~(i) Traditional approach~~

~~(ii) Simplified re-underwriting~~

~~(iii) Graded~~

~~(iv) Continuing class~~

~~**Commentary on Question**:~~
~~*This question asks the candidates to describe different design structure under the post-level term for level premium term life. Most candidates did well on this question and clearly understood the difference of each strategy. However, some candidates didn't talk about the definition of the structure, instead focused on describing the pros and cons of each structure and lapse/mortality impacts, which was not the intention of the question.*~~

~~Traditional approach: initial term is fixed level premium, followed by a YRT rate schedule thereafter; in most cases, all risks are aggregated post-renewal, i.e. all risks pay the same rate based on their attained age, sex, and smoker status~~

~~Simplified re-underwriting: ahead of the post-level term period, the carrier offers the insured the option to answer a simplified underwriting questionnaire; the result would then classify the insured into a few categories (may be fewer risk classes than the original preferred structure), including a default guaranteed scale for those who decline to respond to the questionnaire~~

~~Graded: moderate the increase in post-level term rates by having rates increase less for the first few years, followed by a jump later (e.g. 5 years post-renewal)~~

~~Continuing class structure - maintain parallel distinction between YRT scales for each risk class at issue rather than aggregate all risks into one YRT scale per the traditional approach~~

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

4. Continued

Commentary on Question:
This question asks candidates to evaluate one specific post level term strategy of level term premium product - simplified re-underwriting and assess its necessary assumptions and the impact on its probability.
Full credit was awarded to candidates who commented on both product design and profitability, as well as provided three valid explanations. Other answers with suitable justification not listed below were also awarded full credit. One common mistake was that candidates were comparing the product design and profitability of a traditional renewable term vs a simplified re-underwriting term instead of a non-renewable term vs a simplified re-underwriting term

- Need to estimate a lapse rate at renewal, where the jump in premium will influence the number of lapses - by maintaining multiple post-renewal risk classes, the insurer may be able to limit the increase in premium and therefore lapse rates because re-underwriting offers some degree of protective value.

- How to estimate anti-selection for each risk class including the guaranteed class: with a simplified re-underwriting structure, the incentive to lapse is somewhat reduced depending on the attractiveness of the offer; only the very best risks may have an incentive to be fully re-underwritten and to the extent this is a small proportion of the cohort, the level of anti-selection may be relatively minimal compared to a typical PLT structure

- Whether to adjust the initial level premium rates to be more competitive ("race to bottom"): the carrier may elect to reduce the initial level term premiums if simplified re-underwriting becomes an option; there is more flexibility over the choice of the break-even year past the initial term period at the cost of lapse risk; Lapse in the level term period would also be affected: most likely reduced when renewal option is added. If initial premium could be reduced, then lapse would be almost certain to reduce as well

- For a US product, ensure that cash values will not be required under standard nonforfeiture law: the addition of renewable premiums may necessitate offering cash values which must be tested for. Only certain PLT structures such as high renewal premiums or limiting issue or attained ages will permit offering no cash values

5. Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.

4. The candidate will understand common valuation and capital techniques used in US, Canadian, and international regulatory frameworks.

5. The candidate will understand various techniques for addressing the mitigation of risk within a life insurance and annuity context.

Learning Outcomes:

(1c) Describe and apply the common profit metrics (IRR, Value of New Business, Embedded Value, ROE) used in pricing insurance products.

(4b) Explain and apply methods in capital management across various jurisdictions.

(5e) Describe basic terms, concepts, and types of life insurance reinsurance arrangements.

Relevant Sources:

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

Commentary on Question:

This question tested candidates understanding of MCEV and capital. Successful candidates were able to demonstrate their understanding of MCEV construction and its purpose in strategic planning and risk assessment.

Solution:

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

Commentary on Question:

Most candidates were able to correctly identify that regulatory capital represents a floor to the amount of capital held by the company. However, many candidates were not able to correctly identify and describe why the capital might be higher than the floor.

5. Continued

The required capital must be at least equal to that determined by following local regulatory capital requirements, but may also include any amounts required to meet other objectives (i.e. internal risk objectives and/or allocations, as well it may incorporate rating agency outlook)

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

~~**Commentary on Question**:~~
~~*Full credit was awarded to candidates who were able to correctly calculate the MCEV of KXW. Partial credit was awarded where candidates were able to correctly articulate the formulas and subcomponents of MCEV. While the ultimate MCEV value needed to reflect both the life and annuity lines of business equivalent credit was awarded to candidates to performed the calculations independently and combined at the end and to candidates who combined the life and annuity values in their first step.*~~

~~*In general, candidates struggled to earn full credit on this question. Many candidates failed to correctly account for the Adjusted Net Worth contribution to MCEV, either by setting MCEV = VIF or by incorrectly calculating the required capital as it contributes to MCEV. Additionally, many candidates failed to provide transparency into the subcomponents of the calculation – making it difficult to award partial credit.*~~

(c) **(LOs 1c, 5e)** 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) Describe the purpose of MCEV sensitivity testing.

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

(iii) 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.

5. Continued

Commentary on Question:

(i) Full credit was given to candidates who were able to describe the purpose of MCEV sensitivity testing specifically. Most candidates were able to articulate the purpose of sensitivity testing, but many struggled to provide the relevance of sensitivity testing within the context of MCEV

(ii) Full credit was awarded to candidates who provided at least two possible reasons for the asymmetry of the sensitivity results referenced in the table. In general candidates performed well on this question, but some candidates failed to provide more than one reason for the asymmetry while other candidates failed to address the specific asymmetries represented in the results they were asked to evaluate.

*(iii) Full credit was awarded to candidates who were able to propose and justify **two** distinct methods of risk transfer for KXW that were directly tied to the sensitivity results presented. While in general candidates did well on this question, many candidates lost points by proposing two reinsurance structures (e.g., coinsurance and modified coinsurance) instead of two distinct methods of risk transfer. On the whole candidates did very well at both identifying and justifying their recommendations.*

(i) The purpose of MCEV sensitivity testing is to provide management and investors to with a means to better understand how changes to assumptions or the broader market environment impact the economic value of the company

(ii) Risk Free Rate - The company is less sensitive to an increase in interest rates of the same magnitude because in general many insurers only partially participate in investment income above guarantees but have to bear the full downside risk.

Mortality Improvement – Mortality improvement has a bigger and opposite impact on total MCEV for the life business than it has for the annuity business because KXW writes more death protection business than longevity business.

(iii) Method 1: Use derivatives to hedge the portfolio against interest rate risk. When the asset-liability match of a business is adversely impacted by a sharp interest rate movement, derivatives can be used to manage the asset risk on the business – transferring risk to investors in the market.

Method 2: Transfer risk to reinsurers. Using reinsurance will allow KXW to directly transfer all or some of their risk exposures to reinsurance partners, depending on the selected structure.

7. Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.

5. The candidate will understand various techniques for addressing the mitigation of risk within a life insurance and annuity context.

Learning Outcomes:

(1a) Describe and compare various life insurance and annuity product designs.

(5b) Describe and apply the basic concepts of cash flow matching, immunization, duration/convexity matching, segmentation.

(5d) Explain the function and attributes of common assets used to support life insurance and annuity liabilities.

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

Commentary on Question:

This question was testing the candidates' understanding of dedication strategies, interest rate hedging instruments, and the fundamentals of swaps.

Solution:

(a) **(LO 5b, 5d)** 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.

7. Continued

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

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

Commentary on Question:
This question required candidates to have a strong understanding of the dedication strategies to be able to critique the statements appropriately. To receive full credit, the candidate needed to provide justification for their critique and relate their response to the product description.

For statement A, most candidates did poorly. Candidates who knew the criteria for classical immunization did well. For statement B most candidates did well. However, many candidates failed to recognize that cash-flow matching will not eliminate all risks or did not describe the risks that remain. For statement C, candidates generally did well.

A. This statement is partially correct. It is correct that the main condition for immunization is duration matching, however that is only the minimal condition. An additional assumption is that the immunizing portfolio has the same present value as the liability being immunized.

   The classical immunization strategy can be used on this product. However, because of the unknown nature of the liability payments in the future it will be required to rebalance the portfolio which is also due to the fact that the duration of both the liability and assets will change in the future.

B. This statement is false as cash-flow matching will not eliminate all risks. Cash flow matching will protect against interest rate risk only, which is the largest risk that a portfolio manager will face. However, the portfolio will still be exposed to other types of risk including default, credit spread and downgrade risk.

   Cash flow matching could only be fully used in the first three years where there is a fixed known liability payment. It cannot be fully implemented when the liability cash flow is unknown so there still remains reinvestment and interest rate risk.

C. This statement is correct. An interest rate swap can be used to alter the cash-flow characteristics of an institutions assets or liabilities. This is accomplished by changing cash flows from fixed to floating or floating to fixed.

7. Continued

The best way to minimize interest rate risk for this product is to enter in to a swap and exchange the floating payments for a fixed payment. By exchanging the variable for a fixed liability payment it will be easier to match the asset cash flow. Swaps can also be used to change the duration of the portfolio.

(b) **(LOs 1a, 5b)** 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

(ii) Interest rates rise

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

Commentary on Question:
For event (i), about half of the candidates did well. For event (ii), candidates did poorly. For events (i) and (ii), this question required the candidate to analyze the impact of the events on the innovative product, and then the impact on the immunization strategy. Some candidates failed to recognize the impact on this particular product and thus only received partial credit.

For event (iii), candidates did well if they identified the reinvestment risk and analyzed the impact to the immunization strategy. About half of the candidates did well.

(i) An increase in annuitant mortality will result in annuity payouts being lower than expected after the guarantee period, since payouts are no longer made once the annuitant dies.

Therefore, the duration of the expected liability payouts as well as the present value of future cash flows will be reduced, and the immunized portfolio may have a duration that is too long.

(ii) An increase in interest rates will result in higher payouts based on the structure of the product.

If the portfolio is invested in fixed interest securities then the resulting asset cash flows will be too low. However, this would be mitigated by using swaps.

7. Continued

(iii) Immunization requires offsetting price risk with reinvestment risk, and increased reinvestment risk means increased immunization risk.

If securities that are assumed to be available for reinvestment become unavailable, the duration matching in the immunization portfolio will no longer be accurate. Therefore, a change in investment strategy will be required.

(c) **(NOT RELEVANT)** 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.

Commentary on Question:
Candidates overall did poorly on this question. Candidates who understood the difference between spot rates and forward rates did well on this question. Being able to understand the difference between forward rates and spot rates impacted both the floating payments and the discounting rates used. Partial credit was given if forward rates were calculated incorrectly, but the candidate showed their work. Full credit was given if units other than 365 were used and resulted in a similar answer.

Calculate forward rates. Forward rates are derived from the spot rates.

$\text{Forward Rate}_t = (1 + \text{Spot Rate}_t)^t / (1 + \text{Spot Rate}_{t-1})^{t-1} - 1$

Year 1: same as 1yr spot rate of 3%
Year 2: $(1.035)^2/(1.03) - 1 = 4.002\%$
Year 3: $(1.032)^3/(1.035)^2 - 1 = 2.603\%$

Calculate the floating payments.
$\text{Floating payment}_t = \text{nominal amount} * \text{Forward Rate}_t * (\text{actual} / 360 \text{ days})$

$\text{Floating payment}_1 = 100\text{M} * 3\% * 365/360 = 3{,}041{,}667$
$\text{Floating payment}_2 = 100\text{M} * 4.002\% * 365/360 = 4{,}058{,}016$

~~Floating payment$_3$ = 100M * 2.603% * 365/360 = 2,638,753~~

7. Continued

~~Calculate PV of floating payments~~
~~$=3{,}041{,}667/(1.03)+4{,}058{,}016/(1.035^2)+2{,}638{,}753/(1.032^3)$~~
~~$= 9{,}142{,}097$~~

~~Calculate the swap rate such that:~~
~~PV of floating payments = PV of fixed rate payments~~

~~PV of fixed rate payments = Sum of (Notional Amount * Swap Rate * days / 360 * discount factor)~~

~~Swap Rate = PV of floating payments / (Sum of (Notional Amount * days / 360 * discount factor))~~
~~$= 9{,}142{,}097 / (100{,}000{,}000 * 365/360 * (1/1.03 + 1/1.035^2 + 1/1.032^3))$~~

~~Swap Rate = 3.204%~~

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

Commentary on Question:
Candidates performed well on this question. To earn full credit, candidates needed to provide justification for their answer. Partial credit was given if candidates provided a valid annuity product change with no justification. Product changes with justification that are not listed below but would mitigate interest rate risk were also given full credit. Candidates who listed hedging or other investment strategies to reduce interest rate risk did not receive credit as these are not product changes.

Possible answers include:

1) Change the product to a period-certain only product (or increase the period certain). Then, changes in mortality can no longer affect the timing and duration of the liability cash flows.
2) Change the payouts to be fixed amounts, instead of being based on the market interest rate. Then, the exact amounts of the liability cash flows will be known and not subject to interest rate risk.
3) A Market Value Adjustment (MVA) feature could be added to the product, so that payouts would reflect changes in current interest rate levels since the beginning of the guarantee period.
4) Add a cap to the market interest rate used to determine the payment. This mitigates interest rate risk as it reduces the risk of volatile interest rates impacting the payment, thus providing a limit to the loss due to rising interest rates.

8. Learning Objectives:

5. The candidate will understand various techniques for addressing the mitigation of risk within a life insurance and annuity context.

Learning Outcomes:

(5a) Describe and evaluate approaches for integrating ALM into an enterprise's risk and financial management framework.

(5b) Describe and apply the basic concepts of cash flow matching, immunization, duration/convexity matching, segmentation

(5d) Explain the function and attributes of common assets used to support life insurance and annuity liabilities.

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

8. Continued

Commentary on Question:
This question asks candidates to address various investment concepts as it relates to the Investment Actuary role. A secondary focus is on testing candidates 'knowledge of asset allocation strategies. Candidates did not do well overall and especially with part (c). See separate comments below.

Solution:

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

(i) The current product portfolio

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

Commentary on Question:
The candidates received points when they listed out the characteristics of the assets. Candidates generally performed well on the first part of the question, although some candidates only indicated whether the asset was suitable for the product without explaining the characteristics of the asset. The second part was done less well. Most candidates answered similarly to the first part, without making the connection to the LTC product. Some candidates were able to recognize that commercial paper is the most liquid asset and real estate is the least liquid asset. Some candidates misunderstood the question to assess the product portfolio, instead of the assets. Partial credit was given when candidates provided valid explanation and consideration for various assets.

8. Continued

(i) Municipal bonds:

- Generally tax exempt but may offer lower returns compared to other investments
- Have been considered second in safety to US treasuries, but there have been more recent concerns about their credit risk
- Offer investment flexibility, since insurance companies typically adjust their holdings of municipal bonds according to profitability, and the relative value they offer compared with taxable bonds

High Yield Bonds:

- May earn higher rates of return than their investment-grade counterparts, but generally carry below investment grade ratings
- Good for companies looking for growth (e.g. M&A activity), working capital or other cash flow purposes; however, referred to as speculative and junk bonds which give a negative connotation and attract higher required capital

Commercial Paper:

- Provide quick liquidity with maturity less than 45 days
- Can be used for short-term funding and can be issued by non-US corporations
- Disadvantages are that it is short term, and risk that the investor faces is that the borrower will not be able to issue new paper at maturity (roll-over risk); also, they are unsecured promissory notes

Real Estate:

- Advantages:
  - To the extent that the law allows mortgage interest, property taxes, and other expenses to be tax deductible, taxable owners of real estate may benefit from favorable tax treatment
  - Mortgage loans permit most real estate borrowers to use more financial leverage than is available in most securities investing
  - Real estate investors have direct control over their property and can increase the market value of the property
- Disadvantages
  - Less flexibility, as most real estate parcels are not easy to divide into smaller pieces; cost of getting information is high as each piece of real estate is unique
  - Expenses – real estate brokers charge high commissions; real estate involves substantial operating and maintenance costs; risk of neighborhood deterioration
  - Income tax deductions can be discontinued and therefore subject to political risk

8. Continued

(ii) LTC products become financially stressed when interest rates are lower than anticipated. This leads to carriers with LTC products to become more cautious on their investment strategy.

LTC products are typically guaranteed renewable (cannot cancel the business but can adjust premium rates for classes of business) and projections of claims and premiums extend for 50 years or more. Long term Investment strategy is critical to LTC.
Since insurance companies typically adjust their holdings of municipal bonds according to profitability, and the relative value they offer compared to taxable bonds, this feature makes municipal bonds appropriate for any product offering, including LTC. Municipal bonds are safe and secure which is important for LTC, given the need for long term security.

High yield bonds have lower investment grade ratings and can be speculative and would not be a safe investment for LTC, although the higher rates of return are attractive.

The disadvantage of commercial paper is that it is largely a short-term funding vehicle, and potentially not as secure over the long term as LTC issues may prefer.

The tax-deductibility and the financial leverage of real estate is attractive to LTC companies as is the diversification features and the low volatility of returns, but the expense of acquiring and maintaining real estate are risks to consider.

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

~~**Commentary on Question**:~~
~~*Candidates were expected to link the scenario to the LTC product in order to receive full points. Most candidates received credit for indicating the catastrophic claims scenario. When discuss disintermediation and customer panic scenario, some candidates answered more relative to general scenario, which is different for LTC. The combination of liquidity test is rarely answered.*~~

~~*Some candidates did not indicate that a decrease in interest rates as LTC carries could become financially stressed.*~~

~~The following are examples of liquidity stress tests, although it is the combination of liquidity stress events that are key.~~

8. Continued

Disintermediation scenario
For interest sensitive products, this scenario examines the amount and timing of increased withdrawals due to an increase in interest rates. However, for LTC, an increase in lapse rates could increase profitability. For LTC products, it might be appropriate to examine a decrease in interest rates, particularly for existing in-force, as LTC carriers could become financially stressed, depending on their interest rate assumptions.

Catastrophic Claims Scenario
This scenario for LTC could be a large increase in nursing home and home care claims such as during a pandemic

Customer Panic Scenario
This scenario could consider the added effect of a material company downgrade due to a sharp deterioration in its financial condition; for LTC, this would primarily impact new business, depending on the extent to which factors such as product availability, underwriting, and price determine if in force business lapses or not.

Impaired Markets Scenario
This scenario addresses the possibility that the company cannot sell assets to raise cash; liquidity may be assumed to be frozen for a period of time (e.g. 3 months), which may impact the LTC company in terms of paying claims or covering acquisition expenses

Impaired Markets/Panic Withdrawal Scenario
This scenario examines "run on the book" level of withdrawal and limited or no sales when capital market liquidity has vanished; for LTC, the withdrawals may not impact the LTC company as much as one with interest sensitive products depending on the degree of lapse support, but the point is to run multiple stress scenarios at once to determine the impact of potentially compounding risk.

Ability for Company to get needed rate increases
Customers and regulators have not been happy with the wave of LTC rate increases, but the company needs them to remain financially solvent.

Other possible scenarios include loss of a key distribution channel and/or a sudden termination of a reinsurance contract, both of which could impact LTC sales or the company's financial health negatively. The loss of sales may limit future liquidity as a smaller stream of future premiums must support the in force business, and if terminated reinsurance contracts are the ones most likely to positively support the ceding company, the loss of such a contract may require additional reserves and required capital for which the reinsurance provided relief.

8. Continued

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

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

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

Commentary on Question:
This question tested candidates' "knowledge of asset allocation strategies". Full points were awarded when candidate demonstrated their understanding of asset liability management. Candidates' performance on the first part was weak. Most candidates came up with a very specific asset mix approach for the company to invest but didn't propose what ALM strategy should be used. For the second part, most candidate understood that ALM ensures asset and liability matched but could not list out all the benefit of ALM and when it is appropriate. Most candidates understood the relationship between liabilities and assets and the impact changes in the asset strategy would have on the portfolio. Some candidates mentioned the mechanics of immunization theory (e.g., duration matching). A few candidates received full credit by explaining why the Asset-Liability Management (ALM) approach is more appropriate than the Asset-Only approach.

(i) An asset liability management approach would be preferred for management since it involves explicitly modeling liabilities and adopting the optimal asset allocation to funding liabilities.

Controlling the risk related to funding future liabilities is a key investment objective for ALM; in contrast to ALM, an asset-only (AO) approach does not explicitly involve modeling liabilities. In an AO approach, any impact of the investor's liabilities on policy portfolio selection is indirect, e.g., through the return requirement.

The following is an example of a recommendation supporting Cash Flow Matching:

- Cash flow matching structures investments in bonds to match (offset) future liabilities
- Cash flow matching minimizes risk with respect to funding liabilities because cash flows are matched
- One potential limitation is that cash flow matching may not be effective if there are no assets which exist to match very long duration liability cash flows

8. **Continued**

The following is an example of a recommendation supporting Immunization:

- Immunization structures investments in bonds to match (offset) the weighted average duration of liabilities
- To improve risk-control characteristics of an immunization approach relative to shifts in the yield curve, convexity may be matched as well
- One potential limitation is that duration is a first order approximation of interest rate risk, whose ability to mitigate interest rate risk becomes less effective as interest rates fluctuate across a wider range

(ii) The following are some advantages of an asset liability approach over an asset-only strategy:

- The asset-only approach affords much less precision in managing risk related to funding of liabilities, which is needed for SXR, and which asset liability management provides

- Asset liability management offers more flexibility for SXR, as the strategy can range from minimizing risk with respect to net worth or surplus (assets less liabilities) to deliberately bearing surplus risk or mismatch risk to earn potentially higher returns

- Asset liability management may produce a higher allocation of fixed-income instruments which SXR Life is already invested in

- If SXR Life has below-average risk tolerance because of their product offering, asset liability management is likely to be more effective in helping stay within their risk tolerance than an asset-only approach.

- The asset-only approach may have a severe financial cost if it results in liabilities not being able to be met.

- The market value of liabilities are interest rate sensitive, which emphasizes the benefit of asset liability management over an asset-only approach.

9. Learning Objectives:

5. The candidate will understand various techniques for addressing the mitigation of risk within a life insurance and annuity context.

Learning Outcomes:

(5d) Explain the function and attributes of common assets used to support life insurance and annuity liabilities.

Relevant Sources:

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

9. Continued

Commentary on Question:
Candidates did not perform well on this question. Part (a) of this question tested the candidates' knowledge of MWR and TWR. Many candidates struggled with the right formula for each metric. Others failed to assess either metric. Part (b) required the candidates to understand and compare features of MBS (Mortgage-Based Securities) and Term Life product. Most candidates listed two advantages but failed to justify their response.

Solution:

(a) **(LO 5d)** 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.

Commentary on Question:

Candidates did not do well on this part. Many used incorrect formulas for either MWR or TWR. Some candidate commonly mistook the timing of the deposit of $400,000. No credit was given for incorrect timing. Some candidates failed to address appropriateness of the approximation

Step1. CFs = Semi-Coupon payment = Par Value *Coupon Rate/2, projecting till maturity date. *Partial credit was awarded for correct formula but incorrect projection period.*

Bond 1: 14,000= 700,000*4%/2, projection from Q2 2021 to Q4 2024
Bond 2: 10,000 = 400,000*4%/2, projection from Q2 2023 to Q4 2024
Deposit: Deposit made at BOY, immediately invested into a Bond 2

Q/Y	t	CF_t	Deposit	MV_t
Jan, 2021	0	-	-	1,400,000
Q2 2021	0.5	14,000	-	889,000
Q4 2021	1	14,000	-	912,450
Q2 2022	1.5	14,000	-	926,450
Q4 2022	2	14,000	-	951,773
Q2 2023	2.5	24,000	400,000	1,400,950
Q4 2023	3	24,000	-	1,455,045
Q2 2024	3.5	14,000	-	1,484,146
Q4 2024	4	14,000	-	1,537,353
Q2 2025	4.5	-	-	1,552,726
Q4 2025	5	-	-	1,568,254

9. Continued

Step 2. MWR – Money Weighted Rate of Return

LIRR Method: Chain-linking annual MWR is the approximation of TWR (as given in the question).

Additional credit was awarded for properly reflecting the deposit of 400,000.

Step 2.1 – Find MWR ® for each (annual) time period.

$MV_t = (MV_{t-1} + Deposit_t)*(1+R)^2 + CF_{t-0.5}(1+R) + CF_t$

Where t increments semi-annually;

R = return for each semi-annual period

r = return for each annual time period = (1+R) ^2 -1

Here are calculation details for certain period as an example:

T=1 (Q4 2021): R_1 = -20.39% => r = (1-20.39%)^2, where

$MV_1 = 912,450 = MV_0 *(1+R_1)^2 + CF_{0.5}*(1+R_1)+CF_1$

$= (951,773+400,000) *(1+R_1)^2 + 14,000 *(1+R_1) + 14,000$, **solve for R_1**

T=3 (Q4 2023): R_3 = 2.01% => r = (1+2.01%)^2, where

$MV_3 = 1,455,045 = MV_2 *(1+R_3)^2 + CF_{2.5}*(1+R_3)+CF_3$

$= (951,773+400,000) *(1+R_3)^2 + 24,000 *(1+R_3) + 24,000$, **solve for R_3**

Q/Y	t	CFs	Deposit	MV_t	R_t (semi-annual)	r_t (annual)
Jan, 2021	0	-	-	1,400,000	-	-
Q2 2021	0.5	14,000	-	889,000		
Q4 2021	**1**	**14,000**	**-**	**912,450**	**-20.39%**	**0.6338**
Q2 2022	1.5	14,000	-	926,450		
Q4 2022	**2**	**14,000**	**-**	**951,773**	**0.61%**	**1.0123**
Q2 2023	2.5	24,000	400,000	1,400,950		
Q4 2023	**3**	**24,000**	**-**	**1,455,045**	**2.01%**	**1.0405**
Q2 2024	3.5	14,000	-	1,484,146		
Q4 2024	**4**	**14,000**	**-**	**1,537,353**	**1.84%**	**1.0371**
Q2 2025	4.5	-	-	1,552,726		
Q4 2025	**5**	**-**	**-**	**1,568,254**	**1.00%**	**1.0201**

Step 2.2 – Chain link annual returns (r_t): MWR = Product of r_t -1

= 0.6338)*1.0123*!.0405*1.0371*1.0201-1 = **-29.37%**

9. Continued

Step 3. True TWR – Time Weighted Rate of Return

Additional credit was awarded for properly reflecting the deposit at time 2.5

Step 3.1 – determine the return at each period $R_t = (MV_t - CF_t)/(MV_{t-0.5} + Deposit_{t-0.5}) - 1$, where t increments semi-annually

t=0.5, $TWR_{0.5}$= (889,000-14,000)/1,400,000-1 = -27.50%

t= 2.5 $TWR_{2.5}$ = (1,400,950-24,000)/(951,773+400,000)-1 = 1.86%

Q/Y	t	CFs	Deposit	MV_t	R_t (semi-annual)
Jan, 2021	0	-	-	1,400,000	-
Q2 2021	0.5	14,000	-	889,000	-37.50%
Q4 2021	1	14,000	-	912,450	1.06%
Q2 2022	1.5	14,000	-	926,450	0.00%
Q4 2022	2	14,000	-	951,773	1.22%
Q2 2023	2.5	24,000	400,000	1,400,950	1.86%
Q4 2023	3	24,000	-	1,455,045	2.15%
Q2 2024	3.5	14,000	-	1,484,146	1.04%
Q4 2024	4	14,000	-	1,537,353	2.64%
Q2 2025	4.5	-	-	1,552,726	1.00%
Q4 2025	5	-	-	1,568,254	1.00%

Step 3.2 – **Chain link R_t to get TWR: TWR = product of $(1+R_t)-1$**

=(1 -37.50%)*(1+1,06%)*(1+0,00%)*(1+1.22%)*(1+1.86%)*(1+2.15%)
(1+1.04%)(1+2.64%)*(1+1.00%)*(1+1.00%)-1 = **-29.60%**

Step 4. Evaluating the 5-year approximation of TWR (MWR) to true TWR:

Some candidates did not complete this step. Partial credit was awarded to candidates who made reasonable conclusions based on incorrect calculated numbers above.

MWR (-29.37%) is not a bad approximation to the true TWR (-29.26%). Annual frequency for MWR is a reasonable frequency and is a positive contributor to being a good approximation. However, the volatile swings in sub-period equity returns contributed to approximation differences.

(b) ~~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.~~

~~**Commentary on Question:**~~

~~*Most Candidates identified two disadvantages but some struggled to provide justifications. Amongst those who did describe disadvantages, many candidates tended to focus on MBS only and didn't properly address features of the Term Life Products. Partial credit was given to candidates who only listed disadvantages. Full credit was awarded to candidates who described any two of the three disadvantages below*~~

9. Continued

The given liability has both positive and negative CFs based on the premium pattern. If investment income is the primary source of liquidity, liquidity risk is minimized when investment income is enough for the liability cash outflow. This is the basis for what's considered relevant.

Disadvantage #1 – Terms & CF pattern mismatch: MBS are typically longer term (15–30 years), which expects somewhat level interest and principal payment in early years. However, liability CFs has 4-5 years cycles.

Disadvantage #2 – Interest rate sensitivity: since income generated from MBS consists of interest, principle and prepayment the amounts often vary and depend greatly on the prepayment assumption. Prepayment assumption poses heavy dependency on interest environment. However, Term Life insurance is not very sensitive to interest rate environment. Therefore, MBS prepayment introduces more volatility

Disadvantage #3 – Complicated modeling: given all underlying assumptions (i.e. prepayment assumption), it is more complex to model MBS products.

10. Learning Objectives:

4. The candidate will understand the designs and risks of the common life and annuity products and features, as well as the methods and metrics used to design and price these products.

5. The candidate will understand various techniques for addressing the mitigation of risk within a life insurance and annuity context.

Learning Outcomes:

(4a) Describe the US statutory actuarial framework, including the principles-based reserves and calculate basic life insurance reserves.

(5a) Describe and evaluate approaches for integrating ALM into an enterprise's risk and financial management framework.

(5b) Describe and apply the basic concepts of cash flow matching, immunization, duration/convexity matching, segmentation.

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

Commentary on Question:

The question asked candidates to describe potential impacts to the investment yield in part a) and then in part b) to identify expected impact to the discount rate for the VM-20 DR calculation. Both part a) and b) required justification of the response. A simple answer of increase or decrease was not sufficient without explanation to support the assertion.

10. *Continued*

The Question provided cashflow information with an increase and a decrease in the lapse as compared to a base assumption. Very few candidates used this information to answer either part of this question. Many candidates provided a generic response to both parts of the questions based on the impacts that would occur for various products with term products, annuities, whole life with cash values being most common.

Solution:

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

Commentary on Question:

Many candidates responded with expected impacts to the investment yield with good explanation. Very few used the cashflow information provided in the question to help justify the expected impacts. Most candidates missed that the sensitivity results tested the year 5 lapse assumption. The resulting impact to the cashflows in years 6 through 12 result from the change in assumption the 5 year lapse assumption. Instead many candidates provided generalized comments about the impacts of increases in lapses without specifically mentioning the specific example in the question. Both approaches were given full credit.

Some candidates proposed an overall change in the investment rates in the market as a reason for the increase in lapses and others suggested high lapses would drive mortality anti-selection that would hurt future mortality experience. With these projected items the candidates explained potential impacts. This was unnecessary as there was sufficient information to fully answer the question without requiring these additional assumptions.

Candidates that answered the question by referring to the change in cashflows followed by explanations of the expected impacts to the investment yield scored well on this part of the question. Some candidates referred to the expected impact to profits rather than the investment yield as requested in the question.

As illustrated by TXL's sensitivity to the 5 year lapse assumption, an increase in lapses generates a reduction in the cashflows for duration 6 though 10 and duration 12. There is a slight improvement in the cashflow in duration 11. This change in cashflows will drive an expected reduction in the investment yield from overall lower total assets due to faster runoff of reserves. The investment yield will be lower if the investment cashflows are not sufficient to cover the liability cash outflow and there is a need to borrow. The increased need for shorter duration assets and increased liquidity will also be expected to reduce the investment yield.

10. Continued

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

Commentary on Question:
Very few candidates referred to the specific situation for decreased lapse in year 5 as provided in the question and referred in general to the impact of decreased lapses for various types of products. The wording in the question asked about the impact if lapses decrease. An answer using the specific change in the year 5 lapse rate or lapses in general would receive full credit.

Some candidates provided an estimate of the expected impact without including a justification.

A number of candidates incorrectly felt there would be no change in the discount rate for the VM-20 DR calculation. Some candidates proposed there would be a decrease in the discount rate while the majority of the candidates stated they expected an increase in the discount rate.

Full credit for the question required a good description that could be aided by the information provided in the question along with properly explained justification. and explained, others thought there would be a decrease and

The discount rate for the VM-20 DR calculation would be expected to increase if lapses decrease.

The VM-20 DR discount rate is based on the investment yield provided by the assets that are modeled based on existing assets and reinvestments under VM-20 assumptions to fully satisfy the company's obligations over the lifetime of the modeled policies under the DR scenario.

The decrease in lapses for TXL's product changes the expected number of policies that will be inforce. More policies will be inforce for longer periods and the assets would be different than expected leading to different asset investment timing and different amounts. The reinvestment strategy would need to be reviewed to reflect the different amounts of assets and the different timing. The yield curve would affect the price and would contribute to the increased discount rate.

Fall 2021 LPM Exam

1. Learning Objectives:

2. The candidate will understand different types of actuarial assumptions and how experience studies are designed and used for evaluating past experience and for setting assumptions.
3. The candidate will understand common issues and practices related to Product Management.

Learning Outcomes:

(2a) Describe types of actuarial assumptions commonly used for life insurance and annuity actuarial functions.
(2d) Describe and apply the framework, process, and significant considerations for creating modern mortality tables used by life insurance companies.
(2e) Describe the process and apply techniques for experience studies.
(3a) Describe and assess insurance and annuity distribution approaches and underwriting approaches.

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

Commentary on Question:

This question was testing the candidate's knowledge of mortality table development, including the development process, impacts of different distribution channels, dealing with limited data for older ages, and ending the mortality table.

Full credit was awarded to candidates who fully described responses instead of listing and provided justification on recommendations.

Candidates generally did well on this question with most candidates performing particularly well on parts b, c, and d.

Solution:

(a) **(LO 2d)**

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

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

1. Continued

Commentary on Question:
Candidates generally did not do well on part i. Many candidates described the steps of establishing experience assumptions instead of the steps of table development. Candidates received partial credit for listing steps of the table development flow chart without describing. Partial credit was awarded for providing 2 to 4 steps correctly.

Candidates generally did well on part ii. To receive full credit, candidates had to provide one or more consideration for three separate steps of the table development flow chart. Partial credit was awarded for providing considerations for fewer than three steps. For candidates who answered part (i) incorrectly, credit was awarded in part (ii) if the considerations listed were reasonable for the steps provided. Examples of acceptable considerations are listed below. Other reasonable considerations were accepted for partial or full credit.

(i)

1. Develop Data
   - Review predecessor studies
   - Define the goals of the table
   - Review available data

2. Identify table dimensions/data analysis
   - Analyze the study's variable to determine which subset best predicts the event under study
   - Conduct outlier analysis

3. Populate table
   - Smooth out inputted rates by graduation
   - Differentiate between count based and amount-based rates
   - Consider improving insufficiently credible data with grouping

4. Review and adjust rates
   - Conduct creative and enforcement reviews
   - Enforce relationships between rates
   - Project future rates by using existing data and assumptions about the future

5. Assess financial impact and finalize table
   - Consider reporting parameters
   - Weigh using Internal vs Industry tables
   - Finalize tables (trend and loading factors)
   - Documentation of the project
   - Determine how project oversight would be administered

1. Continued

(ii)
Step 1: Key considerations include dealing with limited availability, inconsistent definitions, formatting issues, and lag issues

Step 2: Key considerations include identifying target variables, considering type of analytics, considering model requirements, and developing factors

Step 3: Key considerations include determining type of graduation method and dealing with insufficient credible data or lack of data

Step 4: Key considerations include determining relationships between adjacent rates and between an array of rates

Step 5: Key considerations include impact on reserves, stat surplus, GAAP equity, cash flows, premiums, and dividends

(b) 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.

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

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

Commentary on Question:
For part (i), most candidates generally understood the differences between the three distribution channels but did not fully understand their impacts on mortality. Partial credit was awarded to candidates who provided an incorrect level of mortality with reasonable justification (i.e. direct written business would have lower mortality, on average, since its target market is younger insureds.).

For part (ii), most candidates were able to provide at least one way to address mortality variation. Full credit was provided to candidates who provided two or more suggestions for addressing mortality variation. Partial credit was given for providing only one method. Examples of reasonable answers are listed below. Other reasonable responses were awarded partial or full credit.

1. Continued

For part (iii), many candidates recognized that credibility in older ages would be an issue of mortality table development. Few candidates provided a second issue besides credibility. Full credit was given for candidates who provided two or more potential issues. Examples of reasonable answers are listed below. Other reasonable responses were awarded partial or full credit.

(i)

- Direct selling policies may have higher mortality than career agency or independent advisor written policies because of anti-selection due to more incentive to shop around or "churn" the business.
- Direct selling policies may have higher mortality compared to career or independent advisor as the policies tend to be guaranteed issue and/or smaller size policies.
- Socio-economic factors, e.g., affluent markets which may use an independent advisor may have an impact on mortality.
- Career agencies are expected to have relatively low mortality due to career agents being more closely aligned with the insurance company leading to less anti-selection.

(ii)

- Adding either a PAD or factor adjustment for the different distribution channels will help address risk.
- Reinsurers can add valuable insight and help address issues with extra mortality risk
- Underwriting of new issues can be adjusted to address risk (stricter underwriting leads to better mortality).
- Adjust commission schedule to incentive agents to retain policies longer, resulting in less anti-selective lapsation which worsens mortality.

(iii)

- Data is generally limited in older attained ages leading to credibility issues.
- Older insureds are at risk of outliving the mortality table and reaching maturity.
- Future mortality improvement trends will vary from past improvement due to medical advancements, different living styles, etc. and should be considered.
- A method of ending the mortality table must be selected.

1. Continued

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

(i) Ages 90-95

(ii) Ages 96-105

Commentary on Question:
Candidates generally did well on part (c).

Full credit was awarded to candidates who understood that the company would have more limited experience in ages 96-100 versus 90-95 and provided reasonable recommendations for finalizing mortality rates. Full credit was awarded to candidates who provided justification of their recommended approach. Examples of reasonable recommendations are provided below.

(i)

- For ages 90-95, credibility weight the company's own experience against the Society of Actuaries (SOA) table using a credibility method such as Limited Fluctuation Credibility Theory (LFCT) or Bühlmann credibility.
- Assuming the company has credible experience, use graduation to smooth the experience data using Whittaker-Henderson/Whitaker-Henderson Lowrie method or B-splines method.

(ii)

- For ages 96-105, the company does not have credible mortality experience. Use the SOA mortality table directly.
- There is limited company data available above age 96. Use table extension to extend the SOA mortality table past attained age 105.

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

~~**Commentary on Question**:~~
~~*Most candidates did well on part (d) and were able to describe three or four methods of ending a mortality table. To receive full credit, candidates had to accurately describe all four methods. Partial credit was awarded if a candidate listed fewer than 4 methods or simply listed the methods without describing.*~~

~~1. Forced Method~~
~~Select an ultimate age and set the mortality rate at that age equal to 1 without any changes to other mortality rates. This creates a discontinuity at the ultimate age.~~

1. Continued

2. Blended Method

Select an ultimate age and blend the rates from some earlier age to dovetail smoothly into 1 at the ultimate age.

3. Pattern Method

Let the pattern of mortality continue until the rate approaches or hits 1 and set that as the ultimate age.

4. Less-than-1 Method

Select an ultimate age but end the table at whatever rate is produced at that age so that the ultimate rate is less than 1.

2. Learning Objectives:

2. The candidate will understand different types of actuarial assumptions and how experience studies are designed and used for evaluating past experience and for setting assumptions.

3. The candidate will understand common issues and practices related to Product Management.

Learning Outcomes:

(2b) Describe and evaluate mortality, lapse, premium persistency, term conversions and utilization assumptions used for various purposes, and apply methods and techniques for their development.

(3a) Describe and assess insurance and annuity distribution approaches and underwriting approaches.

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

Commentary on Question:

Candidates generally did well in part a) and part b) but not in part c). Some candidates loss credit by not explicitly critiquing the statements. In part c), some candidates failed to identify the key difference between raising COIs and reducing the crediting rate by showing sufficient understanding under New York Regulation 210.

2. Continued

Solution:

(a) 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.*

~~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.*~~

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.*

Commentary on Question:

Most candidates performed better on parts A and B. For part C, the majority missed economic/financial underwriting. Some candidates failed to critique each statement. Additional credit was given to candidates who managed to correctly critique all parts. No credit was given if candidates did not explicitly conclude "false/incorrect" for part B and C.

A. This is not entirely true/partially correct/partially true. Accelerated underwriting will introduce a simplified sales process. However, accelerated underwriting may misclassify risks compared to full medical underwriting at various steps such as predicting smokers, or the risk scoring model which could lead to "mortality slippage" which could result in a somewhat more expensive product. Additionally, there is usually a step in the triage process for accelerated underwriting which will result in some applicants getting redirected to traditional medical underwriting.

~~B. This is not true/incorrect. It is beneficial for policyholders as they would get higher cash value than life settlement. However, it is not beneficial for issuers/companies. While persistency is likely to be higher, it may be concentrated in business more exposed to mispricing (e.g. older issue age cells) where an aggregate % of industry table might understate old age mortality, or simply because for life settlements, higher persistency directly drives older mortality because of anti-selection (life settlement companies may carefully select policies to make offers on depending on the health of the insured). In addition, minimum premium would be paid to maintain the policy in-force.~~

2. Continued

C. This is not true/incorrect. If the financial/economic underwriting is inadequate, even if the medical risk is satisfactory, the company could be exposed to risk if the financial goal being sought does not align with what would otherwise be expected based on other information available at the time of underwriting. If the policy is ultimately expected to become stranger-owned life insurance (STOLI), it could lead to a higher prevalence of minimum funding combined with higher than expected persistency; if the product is lapse supported this could become a problem for the insurer.

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

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

(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.

Commentary on Question:
Candidates generally did well in part i) but some candidates suggested sensitivity tests on interest rate or mortality assumption instead of the mix of funding pattern. No credit was given in this case.

(i) It is not appropriate to use the weighted average premium persistency factors for pricing. The use of weighted average factors can produce significantly different results than if the different funding patterns are modeled distinctly. By blending the single premium to 75 with level to 100, the projection may produce funding that carries the overall liability to some attained age in between and not adequately capture the true tail liability for level solve to 100 funded policies.

(ii) An appropriate sensitivity test would be to test different weights to derive the weighted average - e.g. 100% level to 100 or 100% single pay. This could reveal how material of a cross subsidy might exist between different funding patterns that isn't adequately captured by a best estimate blended approach. The model must be adequately designed to respond to these sensitivity tests

2. Continued

(c)

(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.~~

(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.

Commentary on Question:
Some candidates failed to identify the key difference between raising COIs and reducing the crediting rate in part i). Most candidates were able to recommend dynamic lapse assumptions in part ii) but some struggled to successfully identify a second dynamic assumption. Some candidates suggested stochastic modelling or scenario testing instead of specific assumptions. No credit was given in this case.

~~(i) In section 48.4 a(3), the key difference between raising COIs and reducing the crediting rate is that an actuarial memorandum is required for a change in a non-guaranteed element of an existing policy other than a change in credited interest rate based entirely on changes in the insurer's expected investment income. Policyholders need to be notified of the changes and COIs should not be changed to recoup past losses nor increased to earn a higher profit on the policy than the profit level set at issuance.~~

(ii) Two of the following examples of dynamic assumptions earned full credit:

- Dynamic lapse assumption: as interest rates are expected to rise and fall, the lapse rate of policies might move up or down depending on the company's general account performance in relation to what current and guaranteed rates other companies might offer
- Partial withdraw/surrender: premium withdraw behavior is also lined to external interest rate environment. Policyholder behavior would vary in relation to a raising/dropping interest rate environment.
- Premium adjustment/funding: In a declining interest rate environment, depending on how well informed the insurer or agent keeps their policyholders (e.g. inforce illustrations), policyholders may increase their premiums to achieve the original financial objective illustrated at issue.
- Dump-in activities: portfolio crediting may encourage dump ins, and accelerate the erosion of the portfolio rate in a declining/stagnant interest rate environment - take into consideration increased weighing of "new money"

2. Continued

- No lapse guaranteed cliff: depending on interest rates at the time the NLG expires at year 10, there might be a spike in lapses or an increase in funding to the extent the guarantee was keeping policies in force or depending on how favorable the inforce illustration looks at the time in relation to other options the policyholder has
- Policy loan utilization: a dynamic policy loan utilization assumption would capture the impact of interest rate more accurately by incorporating interest rate movement into the policy loan assumption .

4. Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.
2. The candidate will understand different types of actuarial assumptions and how experience studies are designed and used for evaluating past experience and for setting assumptions.

Learning Outcomes:

(1a) Describe and compare various life insurance and annuity product designs.

(1b) Evaluate and apply pricing practices for life and annuity products.

(2b) Describe and evaluate mortality, lapse, premium persistency, term conversions and utilization assumptions used for various purposes, and apply methods and techniques for their development.

Relevant Sources:

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

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) ~~**(NOT RELEVANT)** 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.~~

~~**Commentary on Question**:~~

~~*Most candidates were unable to identify the intangible marginal cost. Instead, many candidates identified tangible marginal costs such as fixed or overhead expenses and received no credit.*~~

~~The intangible marginal cost affecting the profitability of the firm is displacement cost. Displacement is when sales from existing products decrease due to new products entering into the market and taking sales that would have otherwise originated with the existing product. The cost is the loss of profit on the existing product due to this product losing sales to a new product.~~

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

4. Continued

Commentary on Question:
Candidates only needed to describe one of the two methods, below. Candidates generally performed well on this question. Points were most often lost when candidates did not fully describe the method. Some candidates described the process for updating an existing product form instead of a new product form, and only received partial credit.

Method 1

- The marketing department carefully examines each price profile
- For each product price, an attainable production level is selected resulting in a set of price/production pairs
- The set of price/production pairs are plotted on a price-production graph, which then leads expected total profitability for each product price
- The price with the greatest expected profitability is selected and the project is evaluated on that basis.
  - If the expected profitability is satisfactory, then the project continues on that price structure
  - If not, consideration is given to expanding the decision set and investigating other more profitable projects

Method 2

- Similar to method 1, but avoids explicit price/production estimates
- Management determines the minimum total profitability such that the project will be carried through to completion
- The profitability serves as a minimum standard used to develop price/production pairs

(c) 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.*

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.*

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.*

4. Continued

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.*

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

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.*

Commentary on Question:
This question required the candidate to analyze the comments from the email. To get full credit on each question, the candidate needed to confirm if the comments were True or False and provide rationale and implications of the comments. Partial credit was given for identifying True or False, or providing rationale or implications.

For part A, most candidates did not do well on this part. Candidates who were familiar with ASOP 24 definition of lapse support and the implication for using non-guaranteed values in illustrations did well.

For part B, candidates generally did well. Some candidates did not recognize that the lower lapse rate will decrease the profitability

For part C, candidates generally did well and recognized that we cannot use comments from the marketing team to set lapse assumptions.

For part D, most candidates recognized that return of premium would increase persistency, but some failed to recognize that we should likely not offer the rider as persistency is already high. Some students also only commented on one sentence and ignored the other.

For part E and F, students generally did well.

A. The statement is not accurate. Actuarial Standard of Practice 24 defines lapse support as one that is not self supporting given defined persistency assumptions in the first 5 years, and assuming 100% persistency thereafter. If the product is still profitable under those conditions, it is not considered lapse supported. In this case the product would be considered lapse supported and non-guaranteed values could NOT be used in the illustration.

4. Continued

B. True – the lower the price of the product the greater the perceived value is likely to be, and thus the lower the probable lapse rate. However, the lower lapse rate will decrease the profitability of the product. The fundamental problem with lapse support is that the higher the assumed lapse rate, the lower the premium, the better the perceived bargain, and the lower the resultant lapse rate.

C. False – comments from the marketing team should not be used to set lapse assumptions. A full experience study using credible data should be used to set lapse assumptions. Agent persistency will impact lapse rates in the first few policy years, but the effect will wear off over time and the lapse rate at later durations is determined by the market.

D. The first sentence is false. Since the company expects high persistency, the return of premium rider should not be considered. The return of premium rider is better for a company that suffers from poor persistency in the early years.

The second statement is true. Return of premium riders are popular with agents, as they make a product look much cheaper, and sometimes even "free" on a "net cost" basis. Since payments under the rider go only to those who persist to the end of the specified period, it has the maximum possible lapse support, and profitability will be highly sensitive to the lapse rate.

E. False - the lapse assumption should be the same/similar in pricing and reserving.

F. False – regardless of if the product is lapse supported or not, the path of the reserves matters for profit emergence and reserve adequacy. If the reserve accumulates too slowly, you may be reporting a profit right up until the day it is discovered the reserve is inadequate. Products with significant lapse support are particularly difficult to gauge. Management needs to be sure that not only is the product lapsing at the rate designed, but that the reserve assumptions match the product design assumptions.

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

~~**Commentary on Question**:~~
~~*Candidates who provided considerations, with explanations and/or examples, to make prior to implementing the assumption change from the Setting Assumptions ASOP Exposure Draft received full credit. Partial credit was given if the candidate provided other reasonable considerations not covered in the Setting Assumptions ASOP Exposure Draft. A majority of candidates also listed considerations for after implementing the assumption change, for which they did not receive credit.*~~

4. Continued

- The marketing department said the agents selling the product have high persistency, but this should be verified with actual experience (ie. conduct an experience study) and any credible data available (ie. industry data). We should analyze the sales and persistency by each individual agent as well.
- We should consider any other existing or future known conditions (ie. economic, legislative, regulatory, demographic, technological, and social environments) that may change our opinion of what the expected lapse rate should be. We should also consider changes in the condition of internal circumstances (ie. change in claim processing or change in mix of business).
- We should consider other possible methodologies for setting this assumption.
- Consideration should be given to the impact of this assumption change on other assumptions used in pricing (ie mortality). The assumptions should be reasonable in aggregate
- We should use sensitivity analysis to evaluate the impact of reasonable alternative lapse assumptions on price and profitability.
- We should consider whether it is appropriate to adjust the assumptions by including a margin for adverse deviation.

6.

Learning Objectives:

3. The candidate will understand common issues and practices related to Product Management.

Learning Outcomes:

(3d) Describe standards for illustrations in both the United States and Canada.

Relevant Sources:

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

Commentary on Question:

This question tested the candidates' knowledge of Dividend scales and the considerations for setting the scale. In general, candidates did not score well on this question. Many listed items to think about but did not explain or analyze or evaluate as the question asked.

Solution:

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

~~**Commentary on Question**:~~

~~*Most candidates could identify the components of the three factor formula but failed to provide any analysis of the given information (for example, the impact of removing pegging).*~~

~~The Three factor formula includes investment factor (A - E), mortality factor (E - A), and expense factor (E-A). The need to reflect credible experience and smoothing techniques is important to avoid changes due to random fluctuations and a minor temporary decline due to pegging being removed.~~

~~**6. Continued**~~

~~1. Investment Factor considerations: The lower portfolio yield should be recognized in the scale due to supportability. The scale should be lowered to reflect the lower yield. Also consider RCG/Ls and determine the release into surplus.~~
~~2. Mortality Factor: For mortality, it is common to use averaging. Particularly with the temporary nature of the pandemic, use a three to five year rolling average for the experience. Five year = (90+95+100+105+125)/5 = 104% A/E OR consider removing the 125% for the COVID year if we do not expect the experience to continue. For policyholder equity, consider reviewing the A/E by attained age and risk class and applying different factors by age.~~
~~3. Expense Factor: The decision to move acquisition expenses to OH may over allocate expenses to old blocks in favor of new blocks, causing pricing issues and equity issues for the existing policies. Expenses may need to be increased due to higher lapses caused by the economic downturn so per policy expense would increase and in addition, removal of pegging may cause higher lapses since the dividend is allowed to decrease, so per policy expenses increase but also any unamortized acquisition expenses.~~

~~(b)~~

~~(i) **(NOT RELEVANT)** Evaluate the update program.~~

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

Commentary on Question:
Many focused on the equity of the inforce scale versus the new business scale which was not the intent of the question. Candidates also failed to identify how the program provisions relate to invested assets or earnings. Some candidates suggested alternative provisions rather than evaluating the given program. In part (ii), most candidates failed to identify that the currently payable scale could be used for illustrations.

(i)

- Investment income credited must include all sources of investment earnings. The Actuary must bridge the gap between statutory accounting and how inv income is tracked for dividend purposes.
- The Moody's benchmark, would not be appropriate for determining policyholder dividends on the par whole life.
- Changing to market yield strategy would necessitate all sources of investment earnings including unrealized gains and losses. Consider creating a similar process to IMR for unrealized gains and amortize over a similar period. Make sure there is similar treatment for unrealized as realized losses.
- Only actively invested assets should back the dividend scale.

6. Continued

- Some non-loaned policies may elect to not update as they prefer the current program provisions to the updated provisions. Need to account for that in the impact to the divisible surplus and retained earnings.
- The variable loan rate without direct recognition would help drive up the portfolio rate when interest rates are increasing, but illustration when the variable rate is low could be misleading.
- Recommend either including direct recognition or limit the illustrated loan rate.

(ii) The illustration should not exceed the currently payable scale, but can be lower if justified. Illustrations on new business should be limited to the currently payable scale and pegging would not apply. Although, inforce policies can illustrate pegging if that's the company practice.

8. Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.
5. The candidate will understand various techniques for addressing the mitigation of risk within a life insurance and annuity context.

Learning Outcomes:

(1a) Describe and compare various life insurance and annuity product designs.
(1b) Evaluate and apply pricing practices for life and annuity products.
(5b) Describe and apply the basic concepts of cash flow matching, immunization, duration/convexity matching, segmentation.

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

Commentary on Question:

Commentary listed underneath question component.

Solution:

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

Commentary on Question:

The question asked candidates to evaluate the crediting strategy on the pricing consideration of a new deferred annuity product. Candidates needed to clearly explain why new rate will be uncompetitive in the rapid rising interest rate environment if using asset portfolio yield as a basis to receive full credit. Most of candidates did well in explaining the excess lapse risk and liquidity risk, but very few commented on the profitability.

8. Continued

- During a rising interest rate environment, the net yield of the asset portfolio underlying a block of existing deferred Annuities will lag the net new money rate being used to price new issue. Therefore, the crediting rate will lag the rates being offered by competitors on new issues. The crediting rate will be uncompetitive.
- If the crediting rate is uncompetitive, excess lapses will occur. If the excess lapses are high, in an extreme case, ABC Life may be forced to liquidate assets and probably incur realized losses on the sale of assets in order to meet the surrender demands.
- Excess lapses will result in the profit margin not being met. That will cause lower-than-expected profitability.

~~(b) **(NOT RELEVANT)** 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.~~

~~Evaluate the investment manager's proposal.~~

~~**Commentary on Question**:~~
~~*The question tested candidate's understanding of the role of LIBOR in an insurance company investment management. Candidates needed to demonstrate an understanding of the shortcomings of the investment manager's proposal as well as the issues with using LIBOR as a reference rate to receive full credit. Candidates generally did well on this question, but many failed to comment on the credit risk that embedded in LIBOR.*~~

- ~~It is not appropriate to use LIBOR as the benchmark rate in this transaction.~~
- ~~LIBOR reflects the banking sector's credit risk, since ABC Life is predominately invested in corporate bonds, which already entails a level of credit risk, borrowing another large chunk of money (one half of the existing assets) using this reference rate will further expose ABC Life to even more credit risk~~
- ~~Banks can strategically provide misleading quotes to benefit themselves, so LIBOR has lost its reliability~~
- ~~LIBOR will soon be replaced by SOFR hence it is not ideal for funding future business~~

(c) **(LO 5b)** 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.

8. Continued

Commentary on Question:
This question asked candidate to describe how derivatives instruments can work to hedge against the cost of borrowing. Full credit was awarded to candidates who provided with either one of the two answers below, however, candidates had to clearly demonstrate an understanding of how the interest rate risk is mitigated in a rising interest rate environment through each instrument to receive full credit.
Most candidates did well in this question.

ABC Life can use a Forward Rate Agreement (FRA) to hedge against the increase in the cost of borrowing

In a FRA, payment is based on the reference rate; i.e. borrower is paid if the reference rate is above the FRA, and the borrower pays if the reference rate is below the FRA rate.

OR

ABC Life can use an interest rate swaps to hedge against the increase in the cost of borrowing

Interest rate swaps are agreements in which the parties exchange fixed-rate interest payments for floating-rate interest payments. ABC Life can benefit from this instrument in a rising interest rate environment because the value of the incoming SOFR-based payments is now higher, even though the cost of the fixed-rate payments to the counterparty remains the same.

(d) **(LO 5b)** 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) 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.

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

8. Continued

Commentary on Question:
This question tested candidate's understanding about how to construct a synthetic portfolio using zero-coupon bonds. Most candidates did well in part (i) about calculating implied forward rate, but didn't do well in part (ii), not many candidates were able to synthetically create same effect of required cashflows using zero-coupon bonds.

(i) Implied forward rate of 270-day loan commencing on day 90
Starting day t=90 Maturity length s=270
Zero Coupon Bond Price
P(0, t) = P(0,90) =0.99009
P(0, t+s) = P(0, 90+270) = P(0, 360) = 0.95328
Implied forward rate: r_0 (t, t+s) = P(0,t)/P(0, t+s) -1
r_0 (90, 90+270) = P(0,90)/P(0, 360) -1 =0.99009/0.95328-1 = 3.86%

Implied forward rate of 90-day loan commencing on day 90
Starting day t=90 Maturity length s=90
Zero Coupon Bond Price
P(0, t) = P(0,90) =0.99009
P(0, t+s) = P(0, 90+90) = P(0, 180) = 0.97943
Implied forward rate: r_0 (t, t+s) = P(0,t)/P(0, t+s) -1
r_0 (90, 90+90) = P(0,90)/P(0, 180) -1 =0.99009/0.97943-1 = 1.088%

Difference = r_0 (90, 90+270) - r_0 (90, 90+90) = 3.86% -1.088%=2.77%

(ii) Implied forward rate of 90-day loan commencing on day 180
Starting day t=180 Maturity length s=90
Zero Coupon Bond Price
P(0, t) = P(0,180) =0.97943
P(0, t+s) = P(0, 180+90) = P(0, 270) = 0.96525
Implied forward rate: r_0 (t, t+s) = P(0,t)/P(0, t+s) -1
r_0 (180, 180+90) = P(0,180)/P(0, 270) -1 =0.97943/0.96525-1 = 1.469%

For a 10 million 90-day loan commencing on day 180, the cashflows are as follows:

- on day 180, we receive \$10M loan
- on day 270, we pay back \$10M loan with interest \$10M*(1+1.469%)=\$10.1469M

We need to have cashflows net out to zero on day 0, 180 and 270 using the strategy.

8. Continued

To accomplish this, on day 0,

- we buy a $10M zero coupon bond with maturity at day 180.

Price of bond = face amount * P (0, 180) = $10M * 0.97943 =$9.7943M

- we short sell a $10.469M zero coupon with maturity at day 270

Price of bond = face amount * P (0, 270) = $10.1469M * 0.96525 =$9.7943M

	Day 0	Day 180	Day 270
Loan amount worth 10M on day 180		10.000	-10.1469
Buy 0.9794 *$10M zero coupon bonds maturing on day 180	9.7943	-10.000	
Short-sell 1.01469*(-10M)*0.9653 zero couple bonds maturing on day 270	-9.7943		10.1469
Total	0.0000	0.000	0.000

9. Learning Objectives:

5. The candidate will understand various techniques for addressing the mitigation of risk within a life insurance and annuity context.

Learning Outcomes:

(5d) Explain the function and attributes of common assets used to support life insurance and annuity liabilities.

(5e) Describe basic terms, concepts, and types of life insurance reinsurance arrangements.

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

9. Continued

Commentary on Question:
This question required candidates to explain tools for managing common interest rate and related asset risks associated with accumulation-driven life insurance products.

Solution:

(a) ~~**(NOT RELEVANT)**~~

(i) ~~Define the swap rate.~~

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

(iii) ~~Calculate the swap rate.~~

~~**Commentary on Question:**~~
~~*Candidates were generally able to define the swap rate, however many candidates had difficulty applying their knowledge to the calculations. Common errors included incorrectly computing the period forward rates and forward discount factors from the given forward rates.*~~

~~(i) The swap rate is the singular rate on which the fixed payments in a swap are based.~~

~~(ii) Period Forward Rate = Forward Rate * number of days in quarter / 360~~

~~FDF = Forward Discount Factor~~
~~Q1 FDF = 1 / (1 + Q1 Period Forward Rate)~~
~~Q2 FDF = Q1 FDF / (1 + Q2 Period Forward Rate)~~
~~Q3 FDF = Q2 FDF / (1 + Q3 Period Forward Rate)~~
~~Q4 FDF = Q3 FDF / (1 + Q4 Period Forward Rate)~~

~~Floating Rate Payment = Notional Amount * Period Forward Rate~~

~~PV Floating Rate Payment = Floating Rate Payment * FDF~~

	~~Number Days in Q~~	~~Forward Rate~~	~~Period Forward Rate~~	~~FDF~~	~~Floating Rate Pmt at End of Quarter~~	~~PV Floating Rate Pmt~~
~~Q1 2021~~	~~90~~	~~2.00%~~	~~0.50%~~	~~0.995025~~	~~500,000~~	~~497,512~~
~~Q2 2021~~	~~90~~	~~5.00%~~	~~1.25%~~	~~0.982741~~	~~1,250,000~~	~~1,228,426~~
~~Q3 2021~~	~~90~~	~~8.00%~~	~~2.00%~~	~~0.963471~~	~~2,000,000~~	~~1,926,942~~
~~Q4 2021~~	~~90~~	~~11.00%~~	~~2.75%~~	~~0.937685~~	~~2,750,000~~	~~2,578,633~~
						~~**6,231,514**~~

~~(iii) Swap Rate = $\frac{\Sigma \text{ PV Floating Rate Payments}}{\Sigma \text{ Notional Amount} * (\text{days in quarter} / 360) * \text{FDF}}$~~

9. Continued

	Notional Amount * (90 / 360) * FDF
Q1 2021	24,875,622
Q2 2021	24,568,515
Q3 2021	24,086,780
Q4 2021	23,442,122
	96,973,039

Swap Rate = 6,231,514 / 96,973,039

Swap Rate = **6.43%**

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

Commentary on Question:

Most candidates correctly identified and explained why an increase in interest rates increases the value of a pay fixed interest rate swaption and many also received credit for interest volatility. Few candidates identified and explained the impact of strike rate and time to expiration.

A pay fixed interest swaption gives the buyer a right to establish a position in an interest rate swap where they would pay at a fixed rate and receive floating rate payments.

Yield curve – An increase to the level of slope of the yield curve will increase the value of a pay-fixed swaption, given the floating rate payments would become more valuable.

Interest volatility – There is a positive relationship between swaption values and the assumed interest rate volatility. An increase to the volatility of interest rates increases the likelihood of favorable movements of the underlying, thus increasing the value of the pay-fixed swaption.

Strike rate – The value of a swaption is essentially the difference between the prevailing swap rate and the strike rate. Thus, a decrease to the strike rate, all else equal, will increase the value of a pay-fixed swaption.

Time to expiration – Effects are ambiguous, depending on other factors such as the current yield curve, volatility, and the strike rate. Increasing the swaptions time to expiration can either increase or decrease its value.

9. Continued

(c) **(LO 5b)** 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.

Commentary on Question:
Many candidates recommended credit default swaps to address default risk arising from lower rated Bullet bonds and currency swaps to address foreign exchange risk from euro-denominated Bullet bonds. Only partial credit was awarded if the strategies were not fully explained or assessed in terms of XYZ's needs. Almost all candidates failed to assess the impact of the above derivative strategies on XYZ's cash flows.

Credit default swaps (CDS) are recommended to mitigate the default risk arising from lower rated Bullet bonds. Purchasing CDS' can hedge XYZ's portfolio against these lower rated securities, transferring credit risk off XYZ's balance sheet. XYZ may have to pay an upfront premium, which may be positive or negative, and then during the premium leg XYZ would need to pay a regular coupon to the protection seller.

Currency swaps are recommended to provide protection against the foreign exchange risk stemming from XYZ's euro-denominated Bullet bonds. XYZ would want to receive dollars, and pay Euros, to hedge the risk of the US subsidiary's exposure to fluctuating Euro to USD exchange rates. XYZ's cash flow needs will depend on the relationship between the reference rates for euro and dollar-denominated debt. After entering the swap, if the dollar declines relative to the euro, then XYZ will pay to the counterparty.

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

Commentary on Question:
Most candidates received partial credit by recommending a modified coinsurance arrangement and providing rationale supporting the appropriateness of this structure. To receive full credit, commentary on mitigating persistency risk and capital implications was required. Credit was also given for funds withheld coinsurance if properly justified.

Since XYZ seeks reinsurance to optimize its capital position but does not wish to sell or transfer any assets, they should use a modified coinsurance ("modco") reinsurance agreement that will allow them to continue controlling and investing their own assets to benefit from strong asset performance.

9. Continued

Yearly renewable term (YRT) reinsurance isn't appropriate since it only transfers mortality risk which isn't a primary concern for XYZ given their stringent underwriting performance. Modco reinsurance will transfer a quota share of all risks, including persistency risk, thereby reducing XYZ's exposure to surrender benefits.

Entering into a modco reinsurance agreement will also provide capital and surplus relief to XYZ, thereby allowing XYZ to release some of its capital for other business opportunities.

Spring 2022 LPM Exam

1. Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.

2. The candidate will understand different types of actuarial assumptions and how experience studies are designed and used for evaluating past experience and for setting assumptions.

Learning Outcomes:

(1c) Describe and apply the common profit metrics (IRR, Value of New Business, Embedded Value, ROE) used in pricing insurance products.

(2a) Describe types of actuarial assumptions commonly used for life insurance and annuity actuarial functions.

(2d) Describe and apply the framework, process, and significant considerations for creating modern mortality tables used by life insurance companies.

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

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) **(LO 1c)**

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

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

Commentary on Question:

Most candidates were able to identify the drivers and indicators required for full credit. However, many candidates were unable to list the components of a life insurer's earnings analysis. Instead, many candidates listed the drivers and indicators.

(i) The three components of a life insurer's earnings analysis are as follows:
1) Underwriting result

2) Investment result component
3) Fee income component

1. Continued

(ii) The drivers and indicators for each component are as follows

1) Underwriting result
    a. Mortality / morbidity / longevity experience
    b. Lapses / surrender experience
    c. Actual to expected expenses
2) Investment result component
    a. Asset allocation
    b. Investment performance / yields
    c. Crediting rates and investment spreads
3) Fee income component
    a. Investment management fees
    b. Assets under management

(b) **(LO 2d)**

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

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

Commentary on Question:
Candidates generally did well on part (i) of this question. Many candidates gave a full year of exposure for the policyholders who died, which is incorrect. The adjustment to ensure that policyholder 6 had a full year of exposure was required to get full credit for this question.

Candidates generally struggled with part (ii) of this question. Many candidates said the daily rate method was superior to the annual rate method because 2020 was a leap year, but this is not relevant. To get full credit candidates needed to explain why the annual rate exposure method is inappropriate and understated that the mortality rate was high, and explain that the mortality rate is expected to decrease in the future as the pandemic comes to an end.

1. Continued

(i)

Policyholder	Entry Date	Exit Date	Days	Portion of Year (Days/365.25)
1	May 15, 2020	Dec 31, 2020	230	0.6297 = 230/365.25
2	Jan 1, 2020	Aug 15, 2020	227	0.6215 = 227/365.25
3	Apr 15, 2020	Dec 31, 2020	260	0.7118 = 260/365.25
4	Jan 1, 2020	Dec 1, 2020	335	0.9172 = 335/365.25
5	Mar 15, 2020	Jul 15, 2020	122	0.3340 = 122/365.25
6	Jan 1, 2020	Dec 31, 2020	365.25	1.000 Manually change the # of days to ensure full year of exposure
7	Feb 15, 2020	Dec 31, 2020	320	0.8761 = 320/365.25
8	Aug 15, 2020	Oct 15, 2020	61	0.1670 = 61/365.25
Total			1920.25	**5.2567**

(ii) The daily rate exposure method is more accurate than the annual rate exposure since there was a high mortality rate and very few exposures. The annual rate method will overstate the total exposure for policyholders who died, and therefore understate the mortality rate. We also expect mortality to decrease in future years as we exit the pandemic. If the study contained more lives or more years, then an annual rate exposure would be appropriate.

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

Commentary on Question:
This question tested whether candidates understood the various methodologies required for producing a suitable experience study.

Many candidates were able to receive maximum credit by correctly identifying appropriate methodology improvements. However, not many candidates mentioned that studies could be compared to existing tables to identify trends in experience.

1. Continued

Methodology improvements that may enhance the quality of experience are as follows:

- Perform an Actual to Expected analysis by comparing experience to the existing assumption tables
- Use industry or reinsurance data to enhance the quality, especially when the company's own experience is not credible
- Perform the study based on amount rather than on count to understand the true economic impacts of the assumption
- Extend the study period to ensure that the assumption being set uses more than the experience from the height of the pandemic.
- Significantly increase the number of policyholders in the study to have a more credible study

2. Learning Objectives:

2. The candidate will understand different types of actuarial assumptions and how experience studies are designed and used for evaluating past experience and for setting assumptions.

Learning Outcomes:

(2b) Describe and evaluate mortality, lapse, premium persistency, term conversions and utilization assumptions used for various purposes, and apply methods and techniques for their development.

Relevant Sources:

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

Commentary on Question:

This question tested the candidates' knowledge of topics related to level term products, including conversion and post-level term experience, premiums, and post-level term optimization. Candidates who did well provided recommendations with justification where asked. Candidates generally did well on parts b and d but struggled with part c.

Solution:

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

~~**Commentary on Question**:~~

~~*Candidates were given full credit for recommending a premium scale with appropriate justification. Any premium scale could have been recommended with appropriate justification for full credit. Candidates who provided less thorough justifications such as "Premium scale A has the highest IRR" or "Premium scale C minimizes the differences between IRR and ROI" received partial credit. No credit was given for recommending a premium scale without justification. Examples of full credit responses are given below.*~~

2. Continued

Product B has the highest ROI, which uses GAAP assumptions. This is a more accurate representation of actual earnings

Or

I recommend premium scale B which has the second highest lifetime IRR to ensure we have enough cash flow at later duration to cover high death benefits after the shock lapse. It also has the highest GAAP ROI at issue.

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

Commentary on Question:
This question tested the candidate's knowledge of slope-inducing variables that create differences between annual ROI and lifetime IRR. Candidates were given full credit for identifying why annual ROI and lifetime IRR cannot, in reality, be equal and for identifying 3 or more slope-inducing variables. Partial credit was given for identifying fewer slope-inducing variables or for stating that unreasonable assumptions must be met without listing any examples.

Some of the assumptions and methodologies that are necessary to produce expected level annual ROIs equal to lifetime IRR are either actuarially unsound or outside of statutory and GAAP accounting conventions. The assumptions and methodologies that are necessary to produce level annual ROIs equal to lifetime IRR, also known as slope-inducing variables, include:

- DAC interest rate equal to IRR rate
- No required capital based on assets, reserves, or insurance inforce net of reserves
- No DAC tax
- Statutory reserves equal to GAAP reserves
- GAAP reserve mortality equal to pricing mortality
- GAAP reserve interest rate equal to pricing earned interest rate
- Lapse rate for GAAP reserves and DAC amortization equal to pricing lapse rate

(c) **(LO 2b)**

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

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

2. Continued

Commentary on Question:
Candidates generally struggled with part (i) but did well on part (ii).

For part (i), candidates were expected to calculate premium for a converted policy and a non-converted policy separately and calculate the difference as the term conversion premium. Many candidates calculated one premium using the differenced in the converted and non-converted mortality rates as the mortality rate. Many candidates struggled with calculating survival probability incorporating the expected lapse rate. Credit was given to candidates for reasonable attempts at calculating ABAR and death benefit per $1,000 even if they didn't match the model solution precisely.

For part (ii), candidates who provided 2 or more concerns, one of which must have been related to mortality/anti-selection, were given full credit. Partial credit was given for providing only one concern or for not mentioning mortality/anti-selection of conversions. Examples are provided below but other reasonable responses were accepted for full or partial credit.

(i)

Non-Converted Premium:

Duration (t)	Lapse	Mortality	q_x(total)	p_x	Abar	DB per $1,000	EOY PVFB
0					1		
1	2.5%	0.038	0.062	0.938	0.695	26.4	25.7
2	2.5%	0.044	0.068	0.932	0.639	28.1	26.5
3	2.5%	0.051	0.075	0.925	0.612	31.2	28.6
4	2.5%	0.059	0.083	0.917	0.581	34.3	30.5
5	2.5%	0.068	0.091	0.909	0.543	37.0	31.9
6	2.5%	0.078	0.101	0.899	0.498	38.8	32.5
7	2.5%	0.090	0.113	0.887	0.441	39.7	32.3
8	2.5%	0.104	0.126	0.874	0.370	38.5	30.4
9	2.5%	0.120	0.142	0.858	0.279	33.5	25.7
10	2.5%	0.138	0.160	0.840	0.160	22.0	16.4

Where:

Lapse rate = provided
Mortality rate = provided
q_x = =1-(1-mortality rate)*(1-lapse rate)
p_x = 1- q_x (credit was also given for calculating ${}_tp_x$)
Abar = any reasonable attempt at calculating Abar was given full credit. A precise formula was not needed.
DB per $1,000 = 1,000 * mortality rate * Abar

2. Continued

EOY PVFB = DB per $1,000 / (1.03)^t

Non-Converted Premium = SUM(EOY PVFB) = 280.3

Converted Premium:

Duration (t)	Lapse	Mortality	q_x(total)	p_x	Abar	DB per $1,000	EOY PVFB
0					1		
1	2.5%	0.042	0.066	0.934	0.690	28.8	28.0
2	2.5%	0.048	0.072	0.928	0.668	32.3	30.5
3	2.5%	0.056	0.080	0.920	0.642	36.0	33.0
4	2.5%	0.065	0.088	0.912	0.611	39.6	35.2
5	2.5%	0.075	0.098	0.902	0.573	42.9	37.0
6	2.5%	0.086	0.109	0.891	0.527	45.2	37.9
7	2.5%	0.099	0.122	0.878	0.469	46.4	37.8
8	2.5%	0.114	0.137	0.863	0.396	45.3	35.7
9	2.5%	0.132	0.154	0.846	0.300	39.6	30.4
10	2.5%	0.152	0.173	0.827	0.173	26.3	19.5

Where:

Lapse rate = provided
Mortality rate = provided * 1.1
q_x = =1-(1-mortality rate)*(1-lapse rate)
p_x = 1- q_x (credit was also given for calculating ${}_tp_x$)
Abar = any reasonable attempt at calculating Abar was given full credit. A precise formula was not needed.
DB per $1,000 = 1,000 * mortality rate * Abar
EOY PVFB = DB per $1,000 / (1.03)^t

Converted Premium = SUM(EOY PVFB) = 324.9

Term Conversion Premium = Converted Premium – Non-Converted Premium = 324.9 – 280.3 = 44.6

(ii)

1. Anti-selective behavior: The conversion decision is generally one of self-selection: based only on information known to the policyholder, of which none is known to the insurer. This will increase mortality costs.

2. Company must consider who should bear the cost of conversions: the originating term product or the converted WL product.

2. Continued

(d) **(NOT RELEVANT)**

(i) Explain what concerns could exist about post-level term profitability.

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

Commentary on Question:

Candidates generally did well on part (d). On part (i), full credit was given to candidates who thoroughly discussed the shock lapse phenomenon on level term products and resulting poor mortality. Partial credit was given for only mentioning lapses or mortality but not both. On part (ii), candidates who did well provided one of three possible solutions, defined the solution, and justified their recommendation. The three acceptable answers are given below but only one was needed for full credit. Many candidates described all three options but did not provide an explicit recommendation. These candidates were given partial credit.

(i) The increase in premium at the end of the level-term period leads to a shock lapse event where all but the worst risks are almost guaranteed to lapse and seek new, more affordable coverage. The remaining lives are expected to be in poor health, as they have the greatest incentive to keep their policies in force. Poor mortality on the remaining block reduces profitability of the product.

(ii) I recommend simplified re-underwriting. In this scenario, the company offers the insured the option to answer a simplified issue underwriting questionnaire as the PLT approaches. Those who decline to reply default to the traditional guaranteed YRT rate. Under this scenario, the policyowner obtains the benefit of a possible PLT rate discount, while the insurer can be somewhat confident that the discount is warranted. This may encourage healthier policyholders to persist, improving mortality on the PLT block.

Or

I recommend the graded approach. This involves using a graded approach when setting premium rates, where PLT rates increase at much smaller increments until a future anniversary. Following the end of this graded period, rates jump to the original YRT schedule. If the premium increases gradually instead of spiking at the end of the level term period, more policies will stay inforce longer, increasing the amount of premium paid to the company over time.

~~**2. Continued**~~

~~Or~~

~~I recommend the class continuation approach where the PLT rate is modified based on the insured's select risk class at issue, with rates converging to an ultimate rate in later durations. The continuing-class approach seems to be the fairest approach in that is relies upon the select underwriting to determine the magnitude of the PLT jump. However, the structure, also lends itself to the highest selective lapsation risk among the approaches. Lower rates for healthier individuals, at issue, will improve persistency of healthier policyholders and improve mortality on the PLT block.~~

3. Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.

2. The candidate will understand different types of actuarial assumptions and how experience studies are designed and used for evaluating past experience and for setting assumptions.

Learning Outcomes:

(1a) Describe and compare various life insurance and annuity product designs.

(1b) Evaluate and apply pricing practices for life and annuity products.

(2b) Describe and evaluate mortality, lapse, premium persistency, term conversions and utilization assumptions used for various purposes, and apply methods and techniques for their development.

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

Commentary on Question:

This question tested candidates' understanding of two different life insurance riders in the context of a ULSG product. Candidates were expected to understand how product design and assumption development for these riders may differ from base products that the riders could be attached to or patterned after. Candidates were also expected to be able to evaluate these riders in a competitive context.

For both parts (a) and (b), candidates generally performed well when asked to critique the proposed design and assumptions, with many candidates displaying strong understanding of these riders. Some candidates did not perform as well when asked to recommend design changes to minimize risk. Candidates that suggested assumption updates instead of design changes for these parts did not receive credit.

Solution:

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

(i) Critique the proposed design and assumptions.

(ii) Recommend design changes to minimize risk.

Commentary on Question:

See commentary above. Many candidates successfully received credit for recognizing that term rider assumptions may be significantly different than ULSG assumptions, and that the shadow account design may not be completely compatible with a term insurance rider.

3. Continued

(i) Setting the lapse assumption for the term rider equal to that of the ULSG product is not appropriate. In particular, we would expect a shock-lapse at the end of 20 years which would not be present in the ULSG assumptions. This shock lapse would also be associated with increased anti-selective mortality. Pricing may also need to differ from that of a standalone term product because of different mortality characteristics associated with permanent insurance when compared to term.

The product design is also flawed in that the charge for the rider is designed to be deducted from the base product account value. However, many ULSG products are designed to have zero account value, so there may not be any account value available to cover the monthly deductions.

(ii) One way to minimize risk on the rider is to reduce the maximum face amounts and issue ages allowed on the rider. By doing this, expected claims on the rider are expected to be reduced. The product should also be modified to charge for the rider with an explicit premium to avoid issues with no account value being available.

Additionally, terminating the rider at the end of 20 years, instead of including an annually increasing post-level-term period, would minimize anti-selective risk associated with shock lapses on term insurance.

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

(i) Critique the design and risk control considerations.

(ii) Recommend design changes to minimize risk.

Commentary on Question:
See commentary above. Candidates performed very well on this section and displayed strong knowledge of chronic illness acceleration riders and associated risks.

(i) Underwriting approaches used for the base policy may not be appropriate for the chronic illness rider, as morbidity risks associated with chronic illness claims are not always assessed in standard life underwriting.

Offering the rider up to age 85 is also risky, as is offering the rider to substandard insureds. In each of these cases, the volume of chronic illness accelerations could be higher than expected in pricing.

The product should also have strong risk controls around qualifying for a rider acceleration to avoid fraudulent claims.

3. Continued

(ii) Limiting the maximum issue age to something lower, such as 65, and not offering the rider to substandard insureds will reduce risk.

The company should also consider limiting the maximum and/or annual acceleration amounts, as accelerating 100% of the base product's face amount could substantially increase risk.

Finally, the company could consider using the lien or actuarial discount method rather than a separate rider charge. By doing this, the company avoids much of the risk associated with anti-selective claims on chronic illness riders.

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

(i) Updated lapse experience

(ii) The two new riders

(iii) Competitive considerations

Commentary on Question:
Candidates did not perform as well on this section. Many candidates provided general commentary on these items without providing recommendations. These types of responses generally received partial credit.

Candidates were also expected to understand that improved persistency hurts profitability on a lapse-supported product. Answers that suggested that improved persistency improved profitability and competitiveness did not receive credit.

(i) Because lapse experience has been lower than expected, we recommend that the company reduce the lapse assumption used in pricing.

The company should also consider making changes to the shadow account design to provide less favorable guarantees, which may help to bring persistency more in line with what was originally expected.

(ii) The term insurance rider may result in additional anti-selective mortality occurring in the post-level-term period if more policies than expected maintain their coverage. This additional mortality needs to be reflected in the mortality assumed for the base product.

3. Continued

The availability of the chronic illness rider may further improve persistency as it provides additional motivation for policyholders to maintain their policies. In this case, the company would need to further reduce lapse rate assumptions which will also have a negative impact on profitability.

(iii) In light of the considerations above, premiums will likely need to be increased. This will hurt competitiveness and potentially reduce sales or lead to anti-selective mortality results.

Introducing a Return of Premium rider would help to counteract these considerations and help return the product to a desirable competitive position. The ROP rider would both provide an additional marketing advantage and also may increase lapses at the end of the term period, reducing the profitability impact from lower lapses on a lapse-supported product.

4. Learning Objectives:

3. The candidate will understand common issues and practices related to Product Management.

Learning Outcomes:

(3a) Describe and assess insurance and annuity distribution approaches and underwriting approaches.

Relevant Sources:

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

Commentary on Question:

Commentary listed underneath question component.

Solution:

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

Commentary on Question:

The question is looking for what is important for a direct to consumer product to have, to be successful. Very few papers mentioned making sure the language in the policy be simplified and non-confusing.

Overall this part of the question was not done well. Very few papers commented on the need for simplified, non-confusing language in the policy. Some candidates did mention no complicated riders, no conversion options and/or simplified underwriting.

In the direct to consumer market it is important to have simplified, non-confusing language in the policy. Keep the product simple. No conversion options; no complicated riders; no cash values or non-forfeiture values. Simplified underwriting process. Credit was given for other product features that supported a simple design.

4. Continued

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

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

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.

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.

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

Commentary on Question:
This question is also trying to determine how products in the direct to consumer market need to be different from the traditional sales process products.

Overall this question was not answered well. It seemed candidates were not thinking about the fact this market is fairly new for life insurance sales and that there are going to be growing pains.

A. Most papers did support credit card payments and provided a reason why. Some papers also discussed challenges this option may present.
B. Most papers did recognize agents will still be needed.
C. Most papers recognized the growth potential, and that resources should be allocated to the development of the direct to consumer product, but most didn't discuss the challenges and changes required.
D. A number of papers did not mention that it would be best to keep the products and options simple for online sales, especially in the early stages of using this market.

A. Credit card payment may facilitate identity verification. The increased flexibility in premium payment methods could improve the customer experience. However this could result in higher transaction costs or new compliance requirements or administration changes. Policyholder behavior may change.

B. Modern consumers may prefer to do their own research without the use of an agent, but the advice of agents will still be needed by some customers especially for complex risks. This means the insurer will have to manage multiple distribution channels efficiently.

4. Continued

Some segments of the target market may be more or less comfortable buying online without interacting with an agent. Older individuals who may be more likely to need or afford insurance may prefer dealing with an agent,

C. Current online sales are a small portion of the market. But there is tremendous growth potential in this market. It's important to invest in this market. Investment in overhauling IT systems to account for multi-channel distribution systems and mobile friendly apps may result in a competitive advantage for the company. Strong customer service will also be important.

D. Consumers are generally happy with their insurance, but also lament the complexity and fine print associated with product descriptions. It is easy for customers to experience information overload. So, ideally complex products and options should not be provided in the direct market. It is better to keep products and options simple and use plain language to explain them. If a more complicated option is provided, the company should be sure to use plain language.

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

~~**Commentary on Question**:~~
~~*This question was answered fairly well. Partial credit was given for listing the data element even if it wasn't justified. There are other data sources from the 4 listed below such as Public Data, Social Data, and Population-level Open Data and credit was given for any 4 sources and justifications.*~~

~~Medical Information Bureau (MIB) …. this data source validates prior medical history which helps access current and future mortality depending on the applicant's health.~~

~~Prescription (Rx) history ,,,, this source can give clues about potential medical conditions that they are being treated for either for purposes of screening for conditions or verifying responses on an application.~~

~~Motor Vehicle Records (MVR) can help identify risky behavior by providing a history of moving violations such as speeding or running red lights, which may be predictors of propensity to engage in other hazardous activities.~~

~~Credit Score can be used as a predictor to predict mortality risk, especially for low risk individuals.~~

5. Learning Objectives:

5. The candidate will understand various techniques for addressing the mitigation of risk within a life insurance and annuity context.

Learning Outcomes:

(5a) Describe and evaluate approaches for integrating ALM into an enterprise's risk and financial management framework

(5b) Describe and apply the basic concepts of cash flow matching, immunization, duration/convexity matching, segmentation.

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

Commentary on Question:

Commentary listed underneath question component.

Solution:

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

- Immunization
- Cash flow matching
- Derivatives enabled

Commentary on Question:

Candidates did fairly well explaining the basic ideas behind the three strategies. More credit was given if candidates identified that immunization/ cash flow matching used purchased assets while a derivative enabled strategy used derivatives to protect against interest rate exposure.

5. Continued

- It is important to realize that all three strategies are designed to protect against interest rate risk.
- Immunization attempts to build a portfolio that provides a predetermined return that is unaffected by interest rate fluctuations.
- Cash flow matching builds a portfolio that meets future liabilities by using the coupon and the yield to maturity payments of a bond. Since the bond is held to maturity, the payments are predetermined and will not change with interest rate fluctuations.
- Both immunization and cash flow matching are considered passive dedication strategies since they use fixed income assets to meet liability cash flows.
- A derivative enabled strategy (i.e. future, swaps, options) is used to protect against interest rate risk. Unlike immunization and cashflow matching, this strategy does not own the assets that back the liabilities.

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

Commentary on Question:
Candidates did well calculating the present value and duration of the liabilities but struggled with setting them equal to those of the assets. While some candidates used Goal Seek in Excel to determine the cash investment required, most solved two equations and with two unknown variables to determine a solution. Both methods were given full credit.

- Calculate present value and duration of liabilities

Year	Cash Flow	Spot Rate	Present Value of Liabilities	Present Value of Liabilities*Year
1	1,100	2.70%	1071.08	1071.08
2	400	3.10%	376.31	752.61
3	300	3.30%	272.16	816.47
4	200	3.50%	174.29	697.15
5	200	3.80%	165.98	829.88
		Total	2059.81	4167.20

5. Continued

Present Value of Liabilities = Σ(Cashflow/(1+Spot Rate)^Year)
= 2059.81
Macaulay duration = Σ(Present Value of Liabilities*Year)/
Σ(Present Value of Liabilities)
= 4167.20/2059.81
= 2.023

- Calculate the duration of the asset

Asset	Maturity	Yield	Present Value of Bond	Present Value of Bond* Maturity	Duration
2-yr zero coupon bond with a yield of 7%	2	7%	.873	1.746	2
4-yr zero coupon bond with a yield of 10%	4	10%	.683	2.732	4

Present Value of Bond = 1/(1+ Yield)^Maturity
Duration of Bond = Present Value of Bond*Maturity/Present Value of Bond

- Solve by setting the Present Value and Duration of Liabilities equal to the Present Value and Duration of the Assets

Solve for Present Value of 2-yr bond purchased and Present Value of 4-yr bond purchased using the following equations:

Equation #1: Present Value of Liabilities = Present Value of 2-yr bond purchased + Present Value of 4-yr bond purchased

Equation #2: Duration of Liabilities = (Present Value of 2-yr bond purchased *Duration of 2-yr bond)/(Present Value of Liabilities) + (Present Value of 4-yr bond purchased *Duration of 4-yr bond)/(Present Value of Liabilities)

Sample Solution
A = Present value of 2-yr bond purchased
B = Present value of 4-yr bond purchased

Equation #1: 2059.81 = A+B
Equation #2: 2.023= A*2/2059.81 + B*4/2059.81

5. Continued

A=2036.02
B=23.79

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)** Assess the impact to the proposed immunization strategy.

Commentary on Question:
Candidates struggled to explain how a level interest rate shift would impact the immunization strategy. Very few were able to conclude that the timing of the yield curve shift would impact the present value of asset and liabilities.

- The present value and duration of both the asset and liability will change due to the interest rate shift.
- Since the yield shift occurred shortly after immunization started and the yield shift was level, the expected difference in present values and durations should be small.
- The duration of the liability will increase since the expected first year cashflow increased more than latter year cashflows.
- Rebalancing the immunized portfolio may be necessary when interest rates change. Too frequent rebalancing may result in increased transaction costs while infrequent rebalancing may cause durations to deviate from target.

(d) **(LO 5a, 5b)** 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.*

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

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

Commentary on Question:
Candidates did well on this part of the question. Critiques shared by most candidates lined up with expectations but additional credit could have been awarded with more robust justification.

5. Continued

A. False. If there are changes in the yield curve, rebalancing may be required to meet financial objectives. Liquidity concerns should be a key issue when selecting assets during rebalancing.

B. False. Risks such default risk, cap risk and contingent claim risk are other risks that should be considered. If rebalancing is required, reinvestment risk and price risk must also be addressed.

C. True. Having a risk measure for the portfolio would help track its performance and would be a good idea. Some examples of portfolio risk measures include variance, semi-variance, shortfall risk and Value at Risk (VAR).

6. Learning Objectives:

5. The candidate will understand various techniques for addressing the mitigation of risk within a life insurance and annuity context.

Learning Outcomes:

(5e) Describe basic terms, concepts, and types of life insurance reinsurance arrangements.

Relevant Sources:

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

Commentary on Question:

This question tests the candidate's knowledge of reinsurance and participating business. The backdrop is a simple business plan with the objective of entering the par business, and all the considerations required such as governance related to nonguaranteed elements (such as dividends), and dividend best practices. The candidate will understand the various forms of traditional reinsurance, will be able to assess how and when they are effectively used.

Solution:

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

Commentary on Question:

Most candidates performed well on this part.

6. *Continued*

Full credit was given to candidates who described 3 strategic solutions and explained how each solution applied to one or more of XYS business objectives. Partial credit was given if a correct reinsurance solution was provided but did not describe how the solution applied to one of XYZs business objectives.

Monetization of inforce business can be used. As XYZ plans to stop new sales of fixed annuities and it might want to obtain the capital or profits of the inforce fixed annuities. Reinsurance can be used to monetization profits with reinsurer paying ceding commission in exchange for rights to future cashflows under the contract.

Reinsurance solutions for developing a new product which enables strategy and growth can be used to help XYZ switch from selling universal life with lifetime secondary guarantee to participating whole life. XYZ could gain experience in developing and launching participating whole life products. or might gain information about the market, reinsurers can provide capital as a funding for the new product, as well as the underwriting expertise to help developing the product.

Reinsurance solutions of surplus relief and risk transfer can reduce the required capital can help to increase available capital for future growth. Reinsurance can be used to transfer risks to reinsurers and reduce the required capital so that the capital that is freed up can be invested in other more profitable areas and in other projects for future growth.

Alternative solution:

100% Coinsurance of the fixed annuities: Under such agreement, the risk embedded in the fixed annuities is shared proportionally with reinsurer, which minimize the related risks. Also, XYZ could gain reserve credit and available capital released for further growth.

Assumption reinsurance. This reinsurance agreement is like the sale of whole block of business to the reinsurer. Given the low interest rate environment, the sales of the ULSG business could help XYZ gain capital for its business development.

Modified coinsurance for Participating Whole Life product. With the Mod-co, the Par whole life product's risk is split proportionally with the reinsurer. This agreement allows XYZ gain reserve credit and release of capital for its business plan.

6. *Continued*

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

Commentary on Question:
Most candidates received only partial credit on this part.

The objective of this question is to test the candidate's ability to identify key considerations for establishing a dividend policy. Full credit was given for 4 reasonable considerations identified by the candidate. The candidate did not need to explain what sort of approach the company should take for each consideration since there can be multiple valid approaches for some.

Solution (any 4 reasonable considerations such as):

XYZ's corporate governance may need to be updated to establish the level of aggregate dividends to be distributed as approved by the board. This includes how the dividend scale will be managed.

Establish methodology for managing pattern of scale over time such as relying on pegging or substitution ("dividend stabilization")

Establish how different groups/classes will be determined based on experience or how investments are tracked/managed Dividend strategy

Determine how investment income will be allocated / credited, such as the treatment of unrealized gains/losses for certain asset classes or if returns are measured using portfolio earned rates vs new money (investment year) rates

Ensure that expenses are fairly allocated between classes based on factors such as inflation and higher maintenance costs later in a policy's lifespan

The participating account surplus should be managed to avoid excessive terminal dividends to avoid creating tontines

Ensure there is clear guidance on how surplus flows between participating and non-participating accounts/funds (e.g. if surplus needs to be borrowed and repaid)

6. *Continued*

(c) **(NOT RELEVANT)** 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.

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

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.

Commentary on Question:
Most candidates did well on this part.

Full credit was given for each part stating whether the statement is appropriate or not and justifying the answer.

A. This is an inappropriate initiative: Exceptional one-time dividends should not be illustrated to new business

B. This may be appropriate: In general, expense allocations should not favor new business at the cost of older in force policies; consideration would need to be made in terms of how expense savings are measured, and if the decision to invest in the system was driven by new business (e.g. would not have been done if the in force was being run off).

Alternately
This is inappropriate: Assuming the new admin system will support inforce business as well new business, the cost should not be considered an acquisition expense.

C. This is not appropriate: Capital gains (realized or unrealized) is an intergenerational equity issue. If the equity is material, the earnings should be paid to the block of business producing the cash flow before most of the policies terminate. So, if there is no guarantee the assets will be sold over that timeframe, the company might impute some form of bond-type return to common stock or real estate and monitor against the actual underlying assets.

7. Learning Objectives:

5. The candidate will understand various techniques for addressing the mitigation of risk within a life insurance and annuity context.

Learning Outcomes:

(5e) Describe basic terms, concepts, and types of life insurance reinsurance arrangements.

Relevant Sources:

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

Commentary on Question:

Commentary listed underneath question component.

Solution:

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

Indemnity reinsurance is an appropriate option for AWL Life.

- If the subject business generates gains over the long term and incurs little upfront costs, under indemnity reinsurance, gains can be amortized over future years while losses can be recognized immediately, this type of reinsurance can lock in some level of future profits and may therefore be more favorable for AWL Life.
- Since AWL Life has an existing agency force selling similar products, indemnity reinsurance is preferred; it allows AWL Life to continue utilizing existing agency forces to sell similar products.

7. Continued

- Indemnity reinsurance is a quicker process and allows recapture with relative ease; if AWL Life is looking to recapture the block of business at a future date, indemnity reinsurance is preferred.

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

(i) 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.

(ii) 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.

Commentary on Question:
The question asked candidates to construct financial statements to evaluate and analyze two basic reinsurance methods – YRT and Mod-co. Candidates generally did not perform well on this question. Many candidates could not demonstrate how YRT or Mod-co work. Some of the common mistakes included the following:

- *Not using Terminal reserve in the NAR calculation under YRT transaction*
- *Not calculating reinsurance allowance for premium under Mod-co transaction*
- *Not applying ceding% on Mod-co premium*
- *Treat Mod-co ceded reserve as a liability for ONR Re*

Candidates that got incorrect value for early steps were still given full credit for later steps as long as the methodology in later steps was correct. Candidates also received full credit for the correct calculation whether they assumed the face amount was denominated in units or thousands of units.

Full Income Statement and Balance Sheet are shown in the Excel. Only major steps are listed below. All numbers are in thousands

(i) AWL Life

<u>Without Reinsurance</u>
Gross Premium = face amount × direct premium per thousand
=5,000 × 0.95= 4,750
Investment Income from Surplus = initial Surplus × investment return
= 1,500 × 17% = 255
Total Revenue = Premium + Investment Income = 4,750 + 255= 5,005
Reserve Increase = time 1 reserve – time 0 reserve = 850 – 100 =750

7. Continued

Commission = Gross premium × commission%=4,750 × 80%= 3,800
Premium tax = Gross Premium × Premium tax% = 4,750 × 2.5%=119
Expense = Commission + Underwriting expenses + maintenance + premium tax
= 3,800 + 300 + 50 + 119 = 4,269

Net Income = Revenue – Reserve Increase – Expense
= 5,005 – 750 – 4,269 = (14)
Total capital = Initial Surplus + Net Income = 1,500 – 14 = 1,486

With YRT Reinsurance
NAR for YRT =(Face amount-Terminal Reserve) × (1-Retention%)
=($5,000-$250) × (1-10%)=$4,275
Ceded Premium = YRT NAR × YRT Premium per thousand
Ceded reserve = YRT NAR × Yearly Renewable Term mean reserve per thousand
= 4,275 × 0.14= 599
Reinsurance allowance = Ceded Premium × Premium tax
= ceded premium × 2.5%

To allow AWL life to meet its post-transaction capital requirement: minimum of 20% increase in capital, the total capital has to increase from $1,486 to $1,784 (1,486 × 120% = 1,784)

Use goal seeker to solve for YRT premium per thousand to be 7.2%

(ii) ONA Re
Without Reinsurance
Investment Income from Surplus = Initial Surplus × investment return
= 3,000 × 20% = 600
Total Revenue = Investment Income = 600
Net Income = 600
Total capital = Initial Surplus + Net Income = 3,000 + 600 = 3,600

With Mod-co Reinsurance
ModCo premium = Face amount × Mod-Co Premium × Mod-Co Ceding%
=5,000 × 0.8 × Mod-Co Ceding%

Reinsurance allowance for Premium tax= Modco Premium × Premium tax
= ModCo premium × 2.5%
Reinsurance allowance for expense allowance= Modco Premium × expense allowance% = Modco premium × 90%

ModCo Adjustment = Reserve Increase × Mod-Co Ceding%

7. Continued

ModCo adjustment is a "benefit" item, not a "revenue" item or an "expense" item for ONA Re; there is no interest on prior period reserve in the ModCo adjustment because this is a new transaction, interest is paid at the beginning of the year, and prior period reserve is 0 for ONA Re

Unlike YRT or Coinsurance, the ceded reserve is not a liability item for ONA Re's, AWL Life maintains the entire reserve balance, instead, the reserve increase is funded by the ModCo adjustment

To allow ONA Re life to meet its post-transaction capital requirement: maximum of 20% decrease in capital, the total capital has to decrease from $3,600 to $2,880 (3,600 × 80% = 2,880)

Use goal seeker to solve for Mod-Co Ceding% to be 97.8%

~~(c) **(NOT RELEVANT)** 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.*~~

~~**Commentary on Question**:~~
~~*This question tests candidates' understanding of the Life & Health Reinsurance Agreement Model Regulation and identify all risks that are significant for flexible premium universal life products. Most candidates understood that in order to receive reserve credit, all significant risks have to be transferred, but they failed to identify that the treaty cannot be on temporary basis just for next year.*~~

- ~~Under the Life & Health Reinsurance Agreement Model Regulation, the treaty does not appear to transfer adequate amount of risk, and is short-term in nature, hence reserve credit may be denied.~~
- ~~It is appropriate for ONA Re to examine all significant risks of the subject block of business, however, flexible premium universal life products possess more than asset risk, mortality and lapse are also significant risks that need to be considered.~~
- ~~Transferring the assets backing the liabilities only partially legitimates the treaty, in order for AWL Life to receive the desired amount of reserve credit, mortality and lapse risks must also be transferred.~~
- ~~Surplus relief treaties that are short-term in nature may be viewed as illegitimate under Life & Health Reinsurance Agreement Model Regulation.~~

8. Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.
3. The candidate will understand common issues and practices related to Product Management.
5. The candidate will understand various techniques for addressing the mitigation of risk within a life insurance and annuity context.

Learning Outcomes:

(1a) Describe and compare various life insurance and annuity product designs.

(1b) Evaluate and apply pricing practices for life and annuity products.

(3e) Describe and evaluate the challenges insurers face in a rising interest rate environment.

(5c) Describe how common insurance guarantees generate embedded options and calculate the value of these options.

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

Commentary on Question:

Candidates who did well on this question had a solid understanding of the various benefit designs and basic mathematical workings of the product and had a solid intuition with respect to the risk exposure of particular product features.

Solution:

(a) **(LOs 1a, 1b, 5c)** 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%

Commentary on Question:
On the whole candidates did fairly well on this part of the question. However, candidates struggled to receive full credit on this part because they failed to correctly reflect the impact of regular withdrawals (the question mentioned to assume the benefit was elected in year 1). Partial credit was also given for the correct construction of the benefit base value and guaranteed withdrawal amount.

8. Continued

Solution: see spreadsheet from rubric

(b) **(LO 1a, 1b)** 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.

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

Commentary on Question:
Candidates performed poorly on part b). While most candidates were able to correctly identify the different benefit structures and describe the implications for cash flow volatility, many struggled to completely capture the hedging considerations across each benefit. Partial credit was awarded where candidates were able to identify the impact but failed to fully evaluate the impact, as well as credit for responses that only considered product cash flow volatility or only considered hedging.

(i) Removal of the ratchet reduces the GLWB upside potential and would extend the period before the AV is exhausted. Additionally, without the ratchet there would no longer be any volatility around the withdrawal benefits -- providing a known deterministic cash flow. Removal of the ratchet increases the delta because the guarantee is not adjusted when fund prices rise.

(ii) The Remaining WBB Ratchet has a higher likelihood of increasing the GLWB amount since the market only has to out perform fees instead of fees and the GLWB. Due to the increase in the GLWB amount, all else equal, this design would exhaust the AV more quickly. The higher ratchet increases the vega since the ratchet will gain in more value as volatility is increased. Increased delta or vega increases the cost of the hedges which reduces profitability.

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

Commentary on Question:
Candidates performed consistently well on this part of the question, however they tended to have weaker responses when considering the impacts of the rising rate environment on the VA – tending to account for the underlying investment accounts or the guarantee option value but did not consistently account for both.

8. Continued

The main risk in a rising interest rate environment for fixed annuities is disintermediation risk. This is the risk that assets are sold at a loss in order to fund the cash flow needs created by excess lapses. As interest rates rise, new money rates will also rise and customers are likely to leave older policies for those higher rates. Surrender charges and MVAs provide some dampening effects to this. In contrast, for the VA with GLWBs the guarantees would be worth less as interest rates rise and therefore would be cheaper to provide/hedge for. Contracts are also less likely to be in-the-money as interest rates rise.

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

~~**Commentary on Question**:~~
~~*On the whole candidates did very well at identifying the natural hedge between the existing longevity exposure from the annuity business and the mortality exposure from the proposed term business. However, most candidates failed to recognize that the mortality and longevity risks are not always perfectly offsetting and therefore additional analysis is required.*~~

~~Annuities (especially GLWB features) expose the company to longevity risk. Decrease in mortality rates will result in losses. These losses can be offset by reduced life insurance death claims. There is a relative diversification benefit between the longevity of an annuity product and mortality of a life insurance product. However, the actuary should not presume this is a perfect offset. It is important to analyze the direct risk interaction between different types of business. This can be done by varying the volume of the life insurance versus annuity business. Nevertheless, the addition of term life would, in general, improve the risk exposure of MSQ.~~

10. Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.

3. The candidate will understand common issues and practices related to Product Management.

Learning Outcomes:

(1a) Describe and compare various life insurance and annuity product designs.

(1b) Evaluate and apply pricing practices for life and annuity products

(3c) Recommend and justify changes to non-guaranteed elements

Relevant Sources:

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

Commentary on Question:

Overall, the candidates did well for this question. For parts (b) and (c), maximum credits were obtained by the candidates who clearly specified whether they agree or disagree with the statements, and then supported by providing rationale.

Solution:

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

(i) Compare and contrast the new money crediting method versus the portfolio crediting method.

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

Commentary on Question:

Most of the candidates answered this section appropriately.

(i)

- The portfolio crediting method credits the same interest rate to all fund values for all policies of a given plan or plans, which is often based on a portfolio of assets that the company is managing to back these policies.
- In contrast, the new money interest crediting method will credit varying interest rates to different pieces of a fund's value according to when premiums were received.

- New money crediting products can appear more competitive in times of rising interest rates, because the credited rate on new premiums can rise by an equal amount, and the credited rate is quicker to respond to changes in interest rates.

10. Continued

- On the other hand, the credited rate on portfolio crediting products will lag interest rate changes, which is a competitive advantage in a decreasing interest scenario.
- From an operational standpoint, the portfolio crediting method is also simpler to explain and administer.

(ii)

- In the event that external interest rates become significantly higher than the rate credited to the cash value on a UL policy, the policyholder may choose to withdraw some or all of the cash value and invest it at higher rates elsewhere (i.e., disintermeditation risk).
- This issue is further compounded by the reduced market value of the assets held by the company that have to be sold to fund the resulting lapse or partial withdrawal (i.e., capital loss), which can result in a significant hit to profitability.
- UL products are particularly sensitive to interest rate risk because of the credited interest rate and greater availability of partial withdrawals. Therefore, the pricing actuary should develop and analyze a range of investment and interest crediting strategies under different interest scenarios (e.g., via stochastic scenario analysis), in order to quantify the appropriate charge for the interest rate risk. Furthermore, the base and dynamic lapse assumptions should be reviewed and periodically updated to reflect emerging experience, since policyholder behavior can significantly impact profitability as well.
- From a product design perspective, the actuary should also consider the implications of any guarantees offered on this product, such as guaranteed COIs, expenses, and/or minimum crediting rate.

(b)

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

~~(ii) **(NOT RELEVANT)** 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.*~~

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

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

10. Continued

Commentary on Question:
For (i), while most of the candidates stated the anticipated experience factors, they stumbled on highlighting other considerations. Some candidates listed the requirements instead of considerations.

For (ii), it was expected that the candidate would first comment whether the statement is correct or not, and then provide rationale. Most of the candidate failed to recognize that there is nothing wrong with the periodic review happening at least once every three years.

(i) Listing any four points would get the full credit

- Time elapsed since NGE scales were last reviewed
- The anticipated experience factors that are used for revising NGE scales
- Deviations in emerging experience from what was assumed in the prior determination of NGE scales
- How any recommended revision could affect reserves, capital, reinsurance, taxation and regulation
- The appropriateness of the profitability metrics and objectives
- The change in the prospective profitability due to the change in anticipated experience factors and any other relevant additional factors
- The complexity of the analysis needed
- Whether other analyses, such as sensitivity analysis, are needed
- Costs, practical implementation difficulties, and materiality of making revisions to the NGE scale
- Potential impacts on the policyholder or insurer of revising or not revising NGE scales to reflect changes in anticipated experience factors

~~(ii)~~

~~A. No edits needed - per ASOP No. 2, the NGE determination policy should consider periodic review of NGEs on in-force policies, such as the maximum time period between successive insurer reviews of NGEs. It should not exceed five years.~~

~~B. Edits are needed - per ASOP No. 2, the actuary should recommend that in-force policies remain assigned to their policy classes, unless there is new information that is material to the anticipated experience factors and supports reassigning the policies to different policy classes.~~

10. Continued

C. Edits are needed - per ASOP No. 2, when considering whether to recommend a revision to NGE scales, the actuary should also consider the appropriateness of the profitability metrics and objectives at that point in time.

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

Commentary on Question:
This question was answered well by most of the candidates. However, some candidates failed to comment on the pattern of profits to determine compliance.

A. Expense charges – Complies with ASOP2. The pattern of profits remains in line with those of original pricing, and the NPV is not materially greater than baseline NPV, so the proposed NGE scale **does not violate the guidance** set forth in ASOP No. 2.

B. COI charges – Does not comply with ASOP2. The pattern of profits deviates materially from those of original pricing (i.e., significantly greater throughout), and the NPV is also materially greater than baseline NPV, so the proposed NGE scale **violates the guidance** set forth in ASOP No. 2.

C. Crediting rate – Does not comply with ASOP2. The NPV is not materially greater than baseline NPV, but the pattern of profits deviates materially from those of original pricing (i.e., there is a projected spike in 3 years), so the proposed NGE scale still **violates the guidance** set forth in ASOP No. 2.

Fall 2022 LPM Exam

1. Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.

2. The candidate will understand different types of actuarial assumptions and how experience studies are designed and used for evaluating past experience and for setting assumptions.

Learning Outcomes:

(1a) Describe and compare various life insurance and annuity product designs.

(1b) Evaluate and apply pricing practices for life and annuity products.

(1c) Describe and apply the common profit metrics (IRR, Value of New Business, Embedded Value, ROE) used in pricing insurance products.

(2b) Describe and evaluate mortality, lapse, premium persistency, term conversions and utilization assumptions used for various purposes, and apply methods and techniques for their development.

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

Commentary on Question:

Commentary listed underneath question component.

1. Continued

Solution:

(a) **(NOT RELEVANT)** 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.

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

Commentary on Question:
Candidates generally did well on this question.

In part A, most candidates understood that assumptions that were prescribed or mandated by law must be treated differently than other assumptions.

In part B, some candidates did not clarify that there are legitimate reasons the assumption should deviate from the status quo.

A. The statement is partially correct. An actuary should identify and select each assumption that is needed for the work. However, for assumptions that are mandated by law or prescribed, the actuary needs to obey the applicable laws or regulatory guidance.

B. The statement is partially correct. The appropriate assumption for a matter, other than a model or data assumption, should be a continuation of the status quo. However, if there is no status quo, or if the actuary has a reasonable expectation that the assumption will change, then the status quo may no longer be followed.

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

Commentary on Question:
This question tested the candidates' knowledge of the impact that some components have on the premium persistency assumption.

Many candidates were able identify and explain two considerations.

Some candidates provided responses that recommended methodologies to conduct the experience study, such as using stochastic study methodologies. These responses were not given credit as this question is meant to test the candidate's knowledge on product feature impacts.

1. Continued

1) The policyholder has flexibility on their premium payments. This means that they can choose to make payments more frequently than required. They also may choose to pay more, and in some cases, less than the original amount.

2) Some flexible premium Universal Life products contain minimum premiums, which may persist for one or more years. Due to these minimum premiums, the cash flows in these early years become more predictable for the actuary to predict.

(c) **(LOs 1a, 1b, 2b)** 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) Discuss advantages and disadvantages of the three structures for premium persistency assumptions above.

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

Commentary on Question:
(i) In this question candidates are asked to demonstrate knowledge of assumption setting for Universal Life (UL) products. Full credit is awarded for explaining an advantage and disadvantage for each option. Candidates generally answered this question well and received full credit. Some candidates did not describe both an advantage and disadvantage for each of the three assumptions and received partial credit.

(ii) Candidates are asked to decide with premium persistency assumption to use to price the product and support their decision. Full credit is awarded for selecting one of the three assumptions and providing a reason to support the decision. Note that any of the three premium persistency assumptions could be chosen – the model solution below is an example. Candidates generally performed well on this question.

(i)
<u>100% premium persistency at all durations</u>

An advantage of this method is its simplicity. It is an easy assumption to model and explain. A disadvantage is that it will likely be inaccurate and does not account for things that can vary policyholder behavior. It is very unlikely that 100% premium persistency will hold so this assumption will be wrong the majority of the time.

1. Continued

Premium persistency factors vary by duration

This assumption is likely to be more accurate than the first option of assuming 100% premium persistency across all durations. Premium persistency does tend to vary with duration, so building this assumption could limit asset liability mismatch. A disadvantage of this method is that only one variable is used. Many other variables, which can impact the accuracy of the assumption (policyholder age) is not used to set the assumption.

Dynamic premium persistency assumptions that vary with the interest rate

An advantage of this methodology is that many variables have an impact on determining premium persistency, such as premiums or interest rates. The company will develop assumptions that have a higher likelihood of being accurate. Disadvantage is the complexity of modeling and setting the assumption, especially on a new rider with little to no actual experience data.

(ii)
I recommend using a dynamic premium persistency assumption. Because of the flexibility and complexity of the UL product, assumption setting can be very difficult and should be performed using stochastic scenarios. Setting the premium persistency assumption to vary dynamically based on the market environment and other variables will give us the best chance at setting the assumption appropriately. Dynamic assumptions should be used in cases when the assumption is expected to vary greatly and can have a large impact on the product profitability, and premium persistency falls in that category for Universal Life.

(d) **(LO 1c)** Calculate the following items. Show all work.

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

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

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

Commentary on Question:
This question tested candidates' knowledge of premium persistency for Flexible Premium Universal Life products as well as profit measurement and analysis.

Most candidates showed an understanding of product cash flows and how to calculate pre-tax earnings for each policy year.

1. Continued

Many candidates did not accurately reflect the premium persistency assumption. They did not understand that premium persistency provided in the question was only for that duration, and a cumulative premium persistency must be used. Cumulative premium persistency is calculated by multiplying that duration's premium persistency by the prior year's cumulative premium persistency.

(i) For t=1, Average Premium (t) = 4,000

For t=2 to t=5
Average Premium (t) = Average Premium (t-1) * Premium Persistency (t)

For t=1 to t=5
Total Premium(t) = Average Premium (t) * BOY Inforce (t)

Duration	Premium Persistency Ratio	Average Premium	Total Premium ($mm)
1	N/A	4,000	52.0
2	85%	3,400	42.7
3	95%	3,230	39.1
4	98%	3,165	36.8
5	100%	3,165	35.1
			205.7

(ii) Product Cash Flow(t) = Premium(t) - Benefit(t) - Expense(t)
Benefit(t) = Death Benefit(t) + Surrender Benefit(t) + Dividend(t)

Duration	Product Cash Flows ($mm)
1	38.8
2	27.2
3	19.3
4	18.7
5	18.6
	122.6

(iii) Pre Tax Solvency Earnings(t) = Product Cash Flow(t) + Investment Income(t) – Increase In Solvency Resereve (t)

In t=1, the reserve increases from 0 to 85. In all subsequent years, the reserve decreases.

1. Continued

Take Present Value at 3%

Duration	Pre Tax Solvency Earnings ($mm)	Present Value
1	(45.4)	(44.1)
2	41.4	39.0
3	31.3	28.6
4	31.5	28.0
5	30.3	26.2
		77.7

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

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

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

Commentary on Question:
This question tested the candidates' knowledge of the difference between the various types or earnings.

Most candidates were able to articulate the differences.

Some candidates incorrectly indicated that one type of earnings calculation to be more accurate. Although the methodologies are used differently, it is inaccurate to say that one is more accurate than another.

(i) Solvency earnings are done on a statutory reserve basis while stockholder earnings are based on a GAAP reserve basis. The GAAP basis uses the benefit reserves, as well as subtracting Deferred Acquisition Cost (DAC). Statutory reserves are typically more conservative.

(ii) One of the benefits of calculating profits based on earnings reserves is that it smooths the first-year acquisition costs through DAC amortization. This results in a smoother earnings pattern and generally no loss in the first year.

2. Learning Objectives:

3. The candidate will understand common issues and practices related to Product Management.

Learning Outcomes:

(3a) Describe methodologies, approaches, considerations and tools related to the Underwriting function.

Relevant Sources:

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

Commentary on Question:

This question tested the candidates' knowledge of topics related to accelerated underwriting and predictive modeling. Candidates generally did well on parts a and c but struggled with part b.

Solution:

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

Commentary on Question:

Candidates generally did well on part a. Most candidates were able to recall at least two benefits from using an accelerated underwriting model. Candidates who received full credit listed six or more benefits. Partial credit was awarded for fewer responses. Other reasonable responses not included below were considered for full or partial credit.

- Accelerated underwriting (AUW) does not require blood and urine testing and is therefore less invasive for the customer. This leads to a better customer experience.
- The use of digital imaging, pre-filled fields, and shorter application form make for greater application completion rate.
- AUW can help speed up the underwriting process to complete more applications - i.e., faster turnaround times.
- It can reduce cost and lead to expense savings.
- AUW leverages new data sources that can provide better understanding of the risks.

2. Continued

- It can help reach the shift in demographics toward millennial & gen X buyers.
- It can reduce the friction of waiting times in the life insurance buying process and lead to an improved customer experience.
- It improves the quality and speed of assessing the customer's mortality risk.
- It has the potential to reduce human error in the underwriting process and standardize underwriting results.

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

~~**Commentary on Question**:~~
~~*Candidates generally did poorly on part b. Candidates who did well described several steps the company should consider before implementing the model. Most candidates mentioned that the model should be validated against fully underwritten experience but failed to provide other steps or concerns. Many candidates listed the steps of building a predictive model or described what the company should do after implementing the model. These responses received partial credit. Examples of acceptable solutions are provided below.*~~

- ~~Consider whether portions of the application can be pre-filled with data from internal and external sources~~
- ~~Calculate the financial impact of misclassification error by conducting a cost benefit analysis~~
- ~~Consider whether the model should predict the risk class or predict the expected mortality (which can then be converted to a risk class)~~
- ~~Validate the predicted risk class against a training dataset of previously underwritten policies to confirm that the model works~~
- ~~Consider regulatory and compliance concerns when using data; Legal and Compliance should review list of variables~~

~~(c) **(NOT RELEVANT)** 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) Explain the primary concerns with eliminating the use of the smoking status question and the urine requirement.~~

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

2. Continued

Commentary on Question:
(i) Candidates who did well on c.i provided two or more concerns of eliminating the smoking status question and the urine requirement. Most candidates mentioned model accuracy as a primary concern, but few listed a second concern.

(ii) Candidates were given full credit for recommending one alternative approach with appropriate justification. Partial credit was awarded for recommendations with some justification. Examples of full credit responses are given below.

(i)

- The model is not 100% accurate and introduces risk of misclassification, particularly the risk of classifying smokers as non-smokers.
- More work would be needed to set a rating for those that are not identified as smoker or non-smoker by the model such as a triage step for complex cases.
- Reliability and/or availability of some publicly available data such as social media data may be low.
- There may be potential for applicants and producers to game the system and exploit the reduced underwriting requirements, resulting in anti-selection.
- The company may lose out on other useful information that a urine test could provide beyond smoking status.

(ii)

- The company should continue including the smoker question on the application until it is determined that the model is accurate. The smoker question will serve as a check against the model output and does not feel invasive to the customer like a urine test would. If the model result does not match the customer's response to the smoker question, the customer can be sent through traditional underwriting.
- The company should feed the output of the predictive model into a triage step. Predicted low-risk applicants can then proceed ahead through the fast-track process while the predicted high-risk applicants are asked to proceed via the traditional underwriting process which should reduce misclassification risk.
- The company should complement the predictive model with an external rules engine (from proprietary on industry research studies) to apply a mortality load for increasing risk factors. This would use experience-based rules to further refine the risk class assigned to an applicant.

2. Continued

- ~~The company should send a random sample of policies through traditional underwriting and compare against model results to validate model is working. Once the company is satisfied that the model is working correctly, they can cut off or limit the use of traditional underwriting for this product.~~

3. Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.

2. The candidate will understand different types of actuarial assumptions and how experience studies are designed and used for evaluating past experience and for setting assumptions.

Learning Outcomes:

(1a) Describe and compare various life insurance and annuity product designs.

(1b) Evaluate and apply pricing practices for life and annuity products

(2b) Describe and evaluate mortality, lapse, premium persistency, term conversions and utilization assumptions used for various purposes, and apply methods and techniques for their development.

Relevant Sources:

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

Commentary on Question:

Overall, candidates typically performed well on this question by being able to express their understanding of lapse supported products, nonguaranteed elements, and implications of pricing assumptions and lapse experience.

Solution:

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

Commentary on Question:

Most candidates were able to describe the profitability run to test if the IUL product is lapse-supported. The alternative answer of assuming zero lapses in all years received full credit too.

One possible method of determining whether a product is lapse supported is the NAIC Illustration Model Regulation lapse-support test. This test involves determining whether the product is self-supporting given defined persistency assumptions during the first 5 years, and 100% persistency thereafter.

3. Continued

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

Commentary on Question:
Candidates who described the 'moving target' nature of the implications of original pricing assumptions on premium rates and lapse experience received full credit. Partial credit was given to candidates who explained how lapse supported products with lower lapses can lead to high benefits in the future, with the potential of insufficient reserves, reducing profitability for the company.

Assuming higher lapses in pricing can result in lower premium rates being justified, which improves the marketability of the product. However, lower premium rates result in the product being more desirable to maintain, so lapse rates end up being lower than expected.

(c) ~~**(NOT RELEVANT)** 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.*~~

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

~~*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.*~~

~~*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.*~~

~~**Commentary on Question**:~~
~~*Candidates did not perform as well on this question, as they needed to critique each statement with a well justified response to receive full credit. Identifying whether each statement was acceptable or not only received partial credit.*~~

~~A. This practice is not acceptable. According to ASOP 2, NGE scales should be determined based on reasonable expectation of future experience and may not be determined with the objective of recouping past losses or distributing past gains.~~

3. Continued

~~B. This practice is acceptable. For newly-issued policies, NGE scales can be determined based on anticipated experience factors, and NGE scales should be structured to cover costs under the product design.~~

~~C. It is not an acceptable practice to modify policy classes for this reason. Instead, the actuary should recommend that inforce policies remain assigned to their policy classes unless there is new information about anticipated experience factors, not based on past performance or profitability.~~

~~D. This is not acceptable. ASOP 2 states that the actuary should document the determination policy that led to the determination of the NGE scales, including items such as anticipated experience factors, marketing objectives, profitability, policy provisions and applicable law, and so on. In addition, the actuary should recommend that an NGE framework be developed or updated if the NGE framework is inadequate or nonexistent.~~

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

D. Describe two hypotheses for why life insurance policyholders decide to lapse a product.

E. Identify two reasons lapses may be lower than expected on the IUL product. Justify your answer.

Commentary on Question:
Candidates generally did well on this question, for both parts (i) and (ii).

(i) Most candidates were able to describe the hypotheses well. Candidates were given full credit for describing other reasonable scenarios that would lead to lapse rates not materializing as expected.

(ii) Most candidates struggled to identify reasons that related specifically to the IUL product. The majority of candidates were able to provide two general comments about lapsation, which earned partial credit. Candidates who provided other reasonable responses justifying lower lapses on the IUL product received full credit.

(i) 1. Interest rate hypothesis: lapse rates are negatively related to internal rates of return and positively related to external rates of return. If external interest rates are higher than their currently earned rate, policyholders are likely to lapse to earn a higher rate elsewhere.

3. Continued

2. Emergency funds hypothesis: policyholders surrender their policies due to financial distress, as they need the additional cash. For example, unemployment or an economic downturn could lead to this.

(ii) 1. Interest rates - if external interest rates are less than the index floor guaranteed on the policy, policyholders are likely to persist.

2. Relative choices - policyholder will determine whether a policy is a good deal by comparing against outside products. If the IUL product was lapse-supported and was priced with high lapses, it likely has a competitive premium. Policyholder wouldn't be able to lapse and get a better priced product elsewhere.

4. Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.

2. The candidate will understand different types of actuarial assumptions and how experience studies are designed and used for evaluating past experience and for setting assumptions.

4. The candidate will understand common valuation and capital techniques used in US, Canadian, and international regulatory frameworks.

Learning Outcomes:

(1a) Describe and compare various life insurance and annuity product designs.

(1b) Evaluate and apply pricing practices for life and annuity products.

(2b) Describe and evaluate mortality, lapse, premium persistency, term conversions and utilization assumptions used for various purposes, and apply methods and techniques for their development.

(4a) Describe the US statutory actuarial framework, including the principles-based reserves and calculate basic life insurance reserves.

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

Commentary on Question:

Commentary listed underneath question component.

4. Continued

Solution:

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

Commentary on Question:
This question tested the candidate's understanding of ULSG features. Most candidates were able to list some guaranteed elements to receive partial marks. The candidates are required to list 4 elements correctly to receive full marks. Few candidates listed the feature of Seg Fund/Variable Annuity and did not receive marks.

Examples of guaranteed elements include

- maximum premium charges,
- maximum expense charges,
- minimum credited interest rates,
- maximum cost of insurance charges,
- maximum gross premiums,
- minimum index parameters,
- maximum mortality and expense (M&E) risk charges, and
- maximum policy loan interest rates

(b) **(LO 2a)** 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.

Commentary on Question:
This question is generally answered well by the candidates. Candidates were able to receive full credit by providing the following:

1. *ULSG is a lapse supported product and mentions that a lower lapse assumption is more conservative for lapse supported products.*
2. *Recommend that the 50% shock lapse should be used given the more conservative choice would be chosen if two choices are deemed equally likely.*

Candidates recommended the correct shock lapse without appropriate explanation received partial marks.

Universal Life with secondary guarantee is a lapse supported product.

The 50% shock lapse assumption is more conservative than the 60% assumption.

The 50% shock lapse should be used since "if two choices are deemed equally likely, the more conservative choice would generally be chosen"

4. Continued

(c) **(NOT RELEVANT)** 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.

Commentary on Question:
Candidates generally did well on this question. Most candidates were able to describe the impact of the 3 approaches. Candidates are also required to disclose the name of the approaches to receive full marks.

The Forced Method: Select an ultimate age and set the mortality rate at that age equal to 1.000 without any changes to other mortality rates. This creates a discontinuity at the ultimate age compared to the penultimate and prior ages.

There is a natural limiting wall to the life span and that the rate of mortality jumps to a rate very close to 1.000 at the ultimate age, irrespective of the shape of the curve before the ultimate age.

The Pattern Method: Let the pattern of mortality continue until the rate approaches or hits 1.000 and set that as the ultimate age.

Mortality rates at the oldest ages continue to increase with age, but probably at a lower rate than for the younger ages, until the rate of mortality approaches 1.000. Proponents of this theory would probably accept the fact that the mortality rate is never actually 1.000, but would argue that it eventually becomes close enough to 1.000 for practical purposes in designing a mortality table.

The Less-Than-One Method: Select an ultimate age but end the table at whatever rate is produced at that age so that the ultimate rate is less than 1.000.

Rates at the oldest ages are asymptotic to an ultimate rate that is well below 1.000. For instance, if 0.500 is set as the ultimate rate, the rates probably slowly decelerate until they hit but do not exceed 0.500.

4. Continued

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

(i) Describe the VM-20 reserve calculation.

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

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

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

C. Prescribed mortality margins will decrease.

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

Commentary on Question:
Candidates generally performed well on this question.

(i) Most candidates were able to identify and describe the VM-20 reserve. The candidates are also required to describe NPR, DR and SR to receive full marks.
(ii) Candidates are required to provide explanation on the reserve movement to receive full marks. Candidates provided accurate reserve movement without appropriate explanation received partial marks.

(i)
The VM-20 reserve is equal to the NPR, plus the excess, if any, of the maximum of the DR and SR over the NPR adjusted for due and deferred premium.

Net Premium Reserves
The NPR is a seriatim formulaic calculation using specified CSO mortality tables, prescribed lapses and prescribed valuation interest rates. The NPR for a policy after issue may reflect valuation mortality tables and prescribed lapses different from those in effect when the policy was issued. The valuation interest rate does not change after policy issue.

Deterministic Reserves
The DR is an aggregate gross premium reserve developed as the present value of pretax liability cash flows at discount rates, using a prescribed scenario. Another way to think of the DR is the amount of general account assets at the valuation date that will fully satisfy the company's obligations for a group of policies over the lifetime of the policies under the specified DR scenario.

4. Continued

Stochastic Reserve
The SR is an aggregate reserve calculation using an asset liability model developed as a starting asset amount plus the greatest present value of accumulated deficiencies over a range of stochastic scenarios, with the SR set at the 70th conditional tail expectation (CTE). The liability cash flows reflected in the SR calculation are projected under the same assumptions used in the DR calculation and subject to change from the items listed above. Prudent estimate assumptions within the SR vary from scenario to scenario where appropriate, reflecting scenario-dependent risks.

(ii)

A. Higher mortality experience results in higher mortality assumption which increases the reserve.
B. Lower lapses result in lower lapse assumption which increases the reserve (ULSG is lapse supported).
C. Lower mortality margin results in lower mortality assumption which reduces the reserve.
D. Higher treasury rates result in higher discount rate which reduces the reserve (if not already floored at NPR).

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

(i) Describe the chronic illness rider.

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

Commentary on Question:

(i) Most candidates were able to describe the chronic illness rider appropriately. Few candidates mixed the chronic illness requirement with critical illness requirement and received no marks.

(ii) Most candidates were able to list a few recommendations limiting the risks. Candidates received full marks if they listed 4 ways accurately.

(i)

A chronic illness rider is one that allows policyholders to accelerate a portion of their face amount when they are unable to perform two or more activities of daily living (ADLs) without assistance from another person. Activities of daily living are bathing, continence, dressing, eating, toileting and transferring.

4. Continued

(ii)

- Use of a supplemental underwriting application for any acceleration riders. The supplemental underwriting typically consists of questions related to the applicant's medical history with respect to the triggers that are used for the acceleration benefit. Those coverage questions are intended to determine if it appears that the individual is over-insured for these benefits (overinsurance may imply that the applicant is intending to anti-select against the writing company).
- Limiting the issue ages at which the chronic illness rider can be added and/or incorporation of cognitive testing at particular issue ages.
- Holding the accelerated amount as a lien against the death benefit and charging interest against that lien OR payment of a discounted amount relative to the face amount that is being accelerated.
- Limiting both the annual and the maximum acceleration amount to some specific dollar amount.
- Requiring that an approved licensed health care practitioner certifies that the policyholder is unable to perform the ADLs that are the triggering events for the benefit payment. The writing company often reserves the right to pay for an independent examination of the insured by a licensed health care practitioner to confirm the validity of the claim.
- Defining the loss of ADLs as expected to be permanent can be an important risk control. In the absence of such a definition, an otherwise healthy individual could claim under the rider when there is a situation that involves a temporary loss of ADLs.
- The rider form may have certain exclusions such as some mental or nervous disorders, alcoholism, drug addiction, act of war (declared or undeclared), suicide or intentional self-inflicted injury.
- The rider is typically only available on policies that are issued up to some maximum rating (such as Standard or Table D).
- The contestability rights for the writing company with respect to the rider typically follow those of the base policy.
- Limiting the maximum benefit to be less than 100 percent of the death benefit on the life insurance policy.

5. Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.

Learning Outcomes:

(1a) Describe and compare various life insurance and annuity product designs.

(1b) Evaluate and apply pricing practices for life and annuity products.

Relevant Sources:

- ILA101-101-25: Annuity Products and Features

Commentary on Question:

This question tested candidates' knowledge of predictive analytics techniques used in setting assumptions, issues related to data gathering and data quality in a predictive analytics study, and understanding of how decision-making shortcuts impact policyholder behavior.

Solution:

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

~~**Commentary on Question**:~~

~~*Candidates who discussed predictive analytics in the context of assumption setting generally performed well. These candidates displayed good knowledge of advantages and disadvantages of predictive analytic approaches.*~~

5. Continued

Some candidates gave answers that related to underwriting processes rather than assumption setting. Although some of these responses received partial credit, in general these answers received lower scores as they did not answer the question in the context given.

- Using predictive analytics provides better insight into the interaction of various factors and allows for better use of the available data.
- Using predictive analytics could lead to a different expectation of profitability both overall and at a cell level which may assist in optimizing competitiveness.
- Regulators are requesting increased sophistication in assumption setting which can include use of predictive analytic techniques.
- However, without significant expertise, predictive analytic models can be misinterpreted and may be built with unintended flaws.

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

Commentary on Question:
Candidates were generally able to correctly identify several steps that are used to collect and organize data. Some candidates described general considerations related to data quality. Such responses received credit only if they also described steps that would be taken in the data collection process to address those considerations.

- The first step is variable generation, including the mapping of input data and creating synthetic variables where necessary.
- Then, exploratory data analysis should be performed to understand the distribution of variables and any correlations between predictive and target variables.
- Variables should be transformed where necessary to group excessive categorical values, replace missing values, and cap extreme values or outliers.
- Finally, the data should be divided into a training, validation, and test set to carry out an iterative process that produces the strongest model.

5. Continued

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

(i) 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.

(ii) Annuity payout offering transitioned from 'Life with 10 years certain' to 'Life only' over the study period.

(iii) Sales channels expanded to include internet sales.

(iv) Target market shifted towards individuals with high net worth.

(v) Charges were changed five years ago from front-end loading to back-end loads.

(vi) For the last three years, the focus has been on sales campaigns offering deposit and persistency bonuses.

Commentary on Question:
For each part, candidates received full credit if they described a method to address the given issue and gave justification for their answer. Answers which only described a method without justification received partial credit, as did answers that described possible impacts of the issue without explaining a method to address it.

(i) Since the crediting rates in the study are incorrect, we will either need to adjust the study for this issue. If this is not possible, these policies could be excluded from the study as the number of policies is small.
(ii) A dummy variable should be created to track which policies were sold with which annuity type, since annuitizations become less valuable with the "life only" payout type.
(iii) Using a variable to distinguish between distribution channels in this case will enable differentiation between internet sales and non-internet sales, as these channels may have different sales incentives and products available.
(iv) A variable should be added to the study to identify policies with large deposits or balances as these are likely to be high net worth individuals. This will help identify any differing behavior that these individuals may exhibit.
(v) A dummy variable should be set up in this case to distinguish policies before the change from policies after the change, since moving from front-end loading to back-end loading may impact early lapses.

5. Continued

~~(vi) Lapses would likely decrease for policies sold with persistency bonuses, so a dummy variable should be set up to identify policies sold with these types of incentives.~~

(d) **(LO 1a, 1b)** 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.

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

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

Commentary on Question:
Most candidates were able to correctly identify decision making shortcuts that applied to these scenarios. To receive full credit, candidates needed to both describe the decision-making shortcut that was applicable and apply that shortcut to the given scenario. Also, several responses were possible for some of these scenarios, and candidates who gave reasonable and justified answers using other shortcuts received credit.

(i) Many people are more likely to take advantage of opportunities that appear to be free, referred to as the "love of free" shortcut. In this scenario, if withdrawals can now be made tax free, policyholders will now be more likely to take withdrawals from their policies even if the economics of their policy are otherwise unchanged.

(ii) Advertising in this way changes the framing of the investment decisions for the policyholder, meaning that although the available options have not changed, the way the options are portrayed is likely to lead to a different decision. In this case, seeing volatility rather than return may steer the policyholder toward safer investments and lower both their risk and return.

(iii) This change takes advantage of policyholders' reliance on defaults, where a proportion of policyholders are likely to remain with whatever default option the insurer has selected, often believing that the insurer likely knows best. As a result, more policies will tend to annuitize which may benefit the insurance company if annuitizations are more profitable for the company.

9. Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.

Learning Outcomes:

(1a) Describe and compare various life insurance and annuity product designs.

(1b) Evaluate and apply pricing practices for life and annuity products.

Relevant Sources:

- ILA101-100-25: Life Products and Features

Commentary on Question:

This question tested a candidate's knowledge related to liquidity risk management as well as designs and risks of common life and annuity products and features. Candidate is expected to understand objectives of liquidity risk management and how product design impacts liquidity risk.

Solution:

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

~~**Commentary on Question**:~~

~~*Candidates generally performed well on part (a). Many candidates were able to list a few principles of liquidity risk management, with a few providing the complete list. Candidates received full credit if they were able to list 6 out of 8 principles.*~~

9. Continued

- Liquidity risk is an asset/liability concern. Effective liquidity risk management starts with a careful assessment of the liquidity characteristics of the company's assets and liabilities.
- Management should set its tolerance for liquidity risk by using qualitative and quantitative tools.
- The cost of securing adequate liquidity should be reflected in the product. The company's strategic asset allocation and contingent liquidity planning should directly reflect the expected and contingent liquidity needs of its liabilities and potential sudden extreme shifts.
- A company should manage its access to the financial markets and have an ongoing presence in its chosen funding channels.
- Management should require that a written liquidity risk policy be maintained. Policy should be reviewed regularly.
- A company should maintain a written liquidity stress management plan that is approved by senior management.
- Requiring capital to provide for liquidity risk is an ineffective means of managing this risk. Liquidity risk needs to be managed at all times - before, during, and after any stress event.

(b) **(NOT RELEVANT)** 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.

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

(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

B. Death benefits 10% higher than expected

Commentary on Question:
Candidates didn't do well on part b). Many candidates were unable to provide critiques with the right rationale. Very few candidates were able to receive full credit by giving critique with good rationale and providing appropriate recommendation.

9. **Continued**

(i) ~~Corporate bond may be purchased with different durations to develop maturity and coupons to have a predefined cash flow pattern. The cash flow pattern may not align with UL surrender benefits.~~
~~Corporate bonds, if sold prior to their maturity date, may lead to market losses. When constructing asset portfolio, consideration should be given to asset types that can be quickly and easily converted to cash without losing significant value in the process. Examples of such assets include US Treasuries or cash.~~

(ii) ~~With respect to establishing the liquidity sources, premiums are considered as an important source of liquidity before asset cashflows. Premiums should be used to offset expected liquidity needs, but not excess surrender benefit.~~

(iii) ~~The two excess claim scenarios listed are not overly server and very short term.~~
~~The liquidity coverage ratio of 100% is low, which doesn't provide buffer for losses on sale of assets or other uncertainty.~~
~~Stress test should test a company's expected liquidity adequacy in extreme market and business conditions. Examples include but are not limited to:~~
- ~~Catastrophic claim scenario, for example, 'run on the bank'~~
- ~~Impaired market scenario, where it's impossible or very difficult to sell assets to raise cash~~
- ~~Disintermediation scenario, where the company may face significantly increased withdrawal activity due to a sudden material rise in interest rate~~
- ~~Customer panic scenario, where the company experience a sharp increase in lapse due to a material company downgrade.~~

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

Commentary on Question:
Candidates generally did well on part c). Most candidates were able to list a few product designs that could mitigate liquidity risks. Some candidates received full credit by providing initial thoughts, plus 4 product design ideas with logical justification. Common mistakes include proposing to decrease crediting rate and remove minimum guarantee.

9. Continued

Depending upon a number of factors, including surrender options granted, the size of new money rates increases, the variety and appeal of alternative investment choices, and the company's product preservation efforts, the magnitude of the resulting disintermediation could vary dramatically. There are many mitigating elements (tax penalties, surrender charges, deferral of payment clauses, etc) that can help mitigate the liquidity risk.

UL has a risk of interest rate anti-selection. If external interest rates are higher, the policyowner may withdraw and invest it elsewhere. It's suggested to consider improving credit rates or minimum guarantees to encourage clients to keep their policies

The company could consider tying credited rate to external index with shorter guarantee period, which may be more reactive as interest rates rise and lower

A feature of UL not found in most traditional products is that of partial withdrawal. Introducing an administrative fee may discourage frequent partial withdrawals.

To mitigate liquidity risks from early surrenders, the company should consider adding surrender charges in early years or at least beyond crediting guarantee periods to discourage early surrenders.

The company could consider a persistency bonus after 10 or 15 years to encourage persistency

A higher interest rate can be credited after the policy reaches a certain or fund amount. This type of reward could be more effective to improve persistency and is less tontine-like.

10. Learning Objectives:

5. The candidate will understand various techniques for addressing the mitigation of risk within a life insurance and annuity context.

Learning Outcomes:

(5b) Describe and apply the basic concepts of cash flow matching, immunization, duration/convexity matching, segmentation

(5d) Explain the function and attributes of common assets used to support life insurance and annuity liabilities

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

Commentary on Question:

The question was wanting candidates to indicate an understanding of asset portfolios and matching strategies.

Solution:

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

(i) Immunization

(ii) Cash Flow Matching

Commentary on Question:

Many candidates did discuss managing the duration of assets and liabilities or the management of the cash flows of the assets and liabilities. Many also discussed constructing a portfolio that would earn a predetermined return regardless of interest rate changes. A smaller number of candidates discussed the Classical Single Period Immunization that produces an assured return for a specified time horizon. Partial credit was given for each of the above. Full credit required discussion of all variations and what they involve.

10. Continued

For ii) Most candidates did discuss selecting securities to match the timing and amount of the liabilities. Very few candidates discussed that it provides a future funding of a liability stream from the coupon and matured principal payments of the portfolio. Even fewer discussed that it's an alternative to multiple liability immunization. Partial credit was given. Full credit required discussion of all three points. Click here to enter text

i) Immunization
Aims to construct a portfolio that will earn a predetermined return regardless of interest rate changes
Popular for "locking in" a guaranteed rate of return over a particular time horizon
Requires management of duration to offset price risk and reinvestment risk
Three variations:
Classical Single-Period Immunization
Produces assured return for specific time horizon
Multiple Liability Immunization
Produces enough funds to pay all liabilities when due
Immunization for General Cash Flows
Given schedule of liabilities met by investment funds that are not fully available at the time portfolio is constructed
ii) Cash flow matching
Provides future funding of a liability stream from the coupon and matured principal payments of the portfolio
Alternative to multiple liability immunization
Select securities to match timing and amount of liabilities

(b) **(LO 5d)** 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.

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

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

10. Continued

Commentary on Question:
This question was not answered well overall. Even calculating the new Book Value and Market Value based on the split, were often not calculated correctly. Many candidates did calculate the new Book Value based on the split but did not update the Market Values based on the split.

Most Candidates did calculate Dollar Duration correctly. However, a number of candidates just added the dollar durations for the portfolio dollar duration, where full credit for this part required candidates to weight average the dollar duration by book value in order to calculate the variance.

Many candidates did not provide an assessment of the effectiveness of the changes, as asked by the question, thereby not receiving credit for that portion of the question. Candidates that commented on whether their calculated value for portfolio duration was inside or outside the range received credit for that statement.

(i) Replace medium with 50/50 split of short/long

Asset Class	Book Value	Market Value	Duration	Dollar Duration
Short term bonds	212,500	170,000	1.50	2,550
Medium term bonds	-	-	5.25	-
Long term bonds	182,500	192,105	9.75	18,730
Total Bonds	395,000	362,105		10,026
Liability dollar duration				8,000
Duration variance(%)				25.3%

(ii) Replace 25% short term bonds with long term bonds

Asset Class	Book Value	Market Value	Duration	Dollar Duration
Short term bonds	93,750	75,000	1.50	1,125
Medium term bonds	175,000	200,000	5.25	10,500
Long term bonds	126,250	132,895	9.75	12,957
Total Bonds	395,000	407,895		9,060
Liability dollar duration				8,000
Duration variance(%)				13.3%

(iii) Shifting to 33/33/33 split

Asset Class	Book Value	Market Value	Duration	Dollar Duration
Short term bonds	131,667	105,333	1.50	1,580
Medium term bonds	131,667	150,476	5.25	7,900
Long term bonds	131,667	138,596	9.75	13,513
Total Bonds	395,000	394,406		7,664
Liability dollar duration				8,000
Duration variance(%)				-4.2%

i) BV(ST) = 125,000+.5(175,000) ie Starting BV for ST + .5 Starting BV Med.

MV(ST) = 100,000x212,500/125,000 ie Starting MV for ST x Calculated BV for ST/starting BV for ST

Dollar Duration(ST) = 170,000x1.5x.01 ie Calculated MV(ST)xDuration(ST ...given) x.01

Total portfolio duration = sumproduct Calculated BVxCalculated Dollar Duration/Total calculated BV = 10,026

Duration Variance = (Calculated total portfolio dollar duration – given liability dollar duration)/given liability dollar duration = 25.3 %

This is outside the 10 % variance (7200-8800) therefore not effective. Do not implement.

ii) Same approach as above.

Variance = 13.3 %

Outside the range therefore not effective. Do not implement.

Also gave marks for … 13.3 % is fairly close so could be effective and could implement. Consider shifting less than 50% of short bonds.

Iii) Same approach as above.

Variance = -4.2 %

Total Dollar Duration is within the range. It is effective and should be implemented.

10. Continued

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

Commentary on Question:
The question was wanting candidates to indicate an understanding of what leverage is and how it works as well as any risks/rewards. Credit was given for discussion of this. Most candidates did indicate an understanding of leverage, but a number did not go further, in terms of discussing what can increase or decrease the impact of leverage. Further credit was given for discussing what can increase or decrease the impact of leverage. Full credit was given for the above as well as discussion of the repo market.

To be successful the manager must earn a rate of return that is in excess of the cost of the borrowed funds.
If unsuccessful (ie if the rate of return is lower than the cost of the borrowed funds) leverage will decrease profit.
The larger the amount of borrowed funds, the greater the variation in potential outcomes.
The greater the variability in the annual return of the invested funds. The greater the variation in the possible outcomes.
r (total) = r (funds) + B/E (r (funds) – r (Borrowed))
where r is return; B is borrowed funds; E is equity.
Repurchase agreements, or repos, are a favourite financial instrument in leverage deals.
Repos involve the sale of securities coupled with an agreement to repurchase the same securities at a later date.
The repo market presents a low-cost way for managers to borrow funds and it allows investors to earn a return above the risk-free rate on treasuries.

11. Learning Objectives:

5. The candidate will understand various techniques for addressing the mitigation of risk within a life insurance and annuity context.

Learning Outcomes:

(5d) Explain the function and attributes of common assets used to support life insurance and annuity liabilities.

Relevant Sources:

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

Commentary on Question:

The purpose of this question was to test candidate's understanding of the risk profile and impact of interest rate changes on interest-bearing securities based on a specific company's financial needs and priorities.

Solution:

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

~~**Commentary on Question**:~~

~~*Candidates generally did well on this question. Most candidates were correctly able to identify the CPR as the annualized SMM rate. Candidates received partial credit if they annualized incorrectly (e.g., multiplied by 12).*~~

~~The Conditional Prepayment Rate (CPR) is the annualized Single Monthly Mortality (SMM) rate.~~

~~$CPR = 1 - (1 - SMM)^{12}$~~
~~$CPR = 1 - (1 - 0.008)^{12}$~~
~~$CPR = 0.0919$ or 9.19%~~

11. Continued

(b) **(LO 5d)** Critique the following statements:

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

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

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.

Commentary on Question:
Candidate results were mixed on this question. To receive full credit, candidates needed to demonstrate an understanding of the impact of interest rate changes and the relative reinvestment, prepayment, volatility, and default risks for the two securities.

For statement A, the candidate needed to understand how interest rate changes impact investment performance.

For statement B, both correct and incorrect were acceptable answers with the appropriate justification.

For statement C, most candidates knew MBS has lower default risk. However, most candidate struggled to note MBS has lower volatility since it has been heavily refinanced in the past.

Statement A:

Correct. If mortgage rates are 50 bps lower, then there will be refinancing activity, which means MBS will have lower returns and higher volatility. The priority for TPL Life is stable cash flows over the next five year, which corporate bonds are better suited to provide.

Statement B:

Correct. MBS has minimal reinvestment risk; the key risk is prepayment risk. Corporate bond return depends heavily on interest-on-interest, so there is high reinvestment risk. Corporate bond reinvestment risk also increases with duration and we are considering a 30-year bond here.

11. Continued

Statement C:

Incorrect. Heavily refinanced MBS tends to be less responsive to future refinancing opportunities, which leads to less volatile performance. MBS was issued by Fannie Mae, which is implicitly backed by the US government, so there is little-to-no default risk.

Spring 2023 LPM Exam

1. Learning Objectives:

2. The candidate will understand different types of actuarial assumptions and how experience studies are designed and used for evaluating past experience and for setting assumptions.

Learning Outcomes:

(2a) Describe and evaluate the types of assumptions commonly used in actuarial pricing and product development.

(2d) Describe and apply the framework, process, and significant considerations for creating modern mortality tables used by life insurance companies

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

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

Commentary on Question:
Commentary listed underneath question component.

1. Continued

Solution:

(a) **(LO 2d)** 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) Calculate an experience-based mortality rate for attained age 35 policies given this information.

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

Commentary on Question:
This question tested the candidate's ability to calculate a mortality rate and confidence interval, using a variety of exposure periods.

Most candidates did very well on both parts of this question. Candidates who made an error in calculating the exposures or the number of deaths were given partial credit for attempting to calculate a mortality rate. Candidates who did not calculate the expected mortality rate in part (i) correctly were given full credit in part (ii) if the methodology used to calculate the confidence interval was correct.

The most common error that candidates made was assuming that there were 3.75 deaths for policies that entered study 3 months after beginning of study period where the death occurs 3 months later. The full 5 deaths should be counted.

1. Continued

(i) To begin, calculate the exposures as shown in the table below:
Total Exposures = Number of Policies * Exposure Period

Note that the exposure period of the deaths is as follows:

- 1 for the policies that were active at the beginning of the study period and did not withdraw
- Reduce the exposure period only if the policyholder withdrew before the end of the study period or entered the study after the beginning of the study period.
- Note that deaths within the exposure period do not impact the exposure period.

Situation	Number of policies (A)	Exposure Period (B)	Total Exposures = (A) x (B)
Active at beginning and end of study period	1250	1	1250
Active at beginning of study period, death occurs after 6 months	10	1	10
Active at beginning of study period, withdrawal occurs after 9 months	150	0.75	112.5
Entered study 3 months after beginning of study period, active at end of study period	200	0.75	150
Entered study 3 months after beginning of study period, death occurs 3 months later	5	0.75	3.75
Entered study 3 months after beginning of study period, withdrawal occurs 3 months later	75	0.25	18
Total (Sum of the rows above)			1,545

Number of Deaths = 10 + 5 = 15

Experience Based Mortality Rate = Number of Deaths / Total Exposures
Experience Based Mortality Rate = 15 / 1,545
Experience Based Mortality Rate = 0.00970874

(ii) Expected Claims = Mortality Rate * Exposure = 0.00970874 * 1545 = 15
Variance = Exposure * Mortality Rate * (1 - Mortality Rate)
= 1545 * 0.00970874 * (1 - 0.00970874) = 14.8543

1. Continued

Confidence Internal
= Mortality Rate +/- [1.96 * sqrt(Variance)] / Exposure
= 0.00970874 +/- [1.96 * sqrt(14.8543)] / 1545
= 0.00970874 +/- 0.004889
= (0.004819, 0.014598)

(b) **(LO2a)** Compare the advantages of using a predictive analytics approach to those of the traditional approach for setting mortality rates.

Commentary on Question:
This question tested the candidates' knowledge on the advantages of both the predictive analytics approach and the traditional approach.

The majority of candidates successfully listed the advantages of the predictive analytics approach, but many did not list the advantages of the traditional approach as a comparison. For full credit, candidates must identify the advantages of both approaches.

Advantages of predictive analytics:
- Provides better insight into the interaction of various factors
- Allows for better use of available data
- Isolates the true impact of each factor by standardizing the effect of all other factors in the model
- Allows for the use of statistical tests to back up decisions made in the modeling process
- Easier to apply industry data to a company without significant data by adjusting the standard model based on the factors developed from the larger dataset

Advantages of traditional approach:
- Widely used in the life insurance business; processes used to support are well-established
- Relatively easy to produce new results
- Management is used to seeing the results and can determine how to apply the findings to undertake management action

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

~~**Commentary on Question**:~~
~~*Most candidates were able to describe at least two concerns. Three valid concerns were required to earn full credit. Many candidates did not identify the need to consult with the Legal and Compliance functions.*~~

1. Continued

- Collecting data about individuals is a sensitive subject governed by the Fair Credit Reporting Act (FCRA). Collection of data is legal given that certain consumer protections are maintained around access and transparency.
- Ethical questions arise about whether utilizing certain types of consumer data is overly invasive.
- The company's Legal and Compliance functions should be the first to review a list of potential variables used in a model, to determine if there are any legal or public relations risks or is counter to any of the company's values.
- Legal and ethical concerns depend upon which business decisions the model is allowed to influence. Predictive models could play the lead role in assigning underwriting classes.

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

(i) Explanatory ability

(ii) Predictive power

(iii) Ease of table implementation

Commentary on Question:
This question tested the candidate's knowledge of both the Generalized Linear Model and the Random Forest Approach, and their ability to compare the two methods.

Candidates generally did well on this question. Most candidates showed an understanding of each aspect's impact on the modelling approaches. However, some candidates confused Explanatory Ability with Predictive Power, and some candidates neglected to give a verdict on which method was better for part ii, which was required for full credit.

(i) The Random Forest Approach is difficult to interpret or explain and are often referred to as black boxes. Generalized Linear Models (GLMs), on the other hand, are much more transparent and easier to explain because the effect of individual predictor variables on rates is apparent.

(ii) GLMs have shown above-average predictive power for some insurance experience-based applications. Random Forests have even stronger potential predictive power.

1. Continued

~~(iii) GLMs are straightforward to implement as they are formula-based. Random Forest models are more difficult to implement, requires computation time and power, and may not give consistent results as it relies on randomly generated binomial trees.~~

2. Learning Objectives:

1. The candidate will understand the designs and risks of the common life and annuity products and features, as well as the methods and metrics used to design and price these products.
2. The candidate will understand different types of actuarial assumptions and how experience studies are designed and used for evaluating past experience and for setting assumptions.

Learning Outcomes:

(1a) Describe and compare various life insurance and annuity product designs

(1c) Describe and apply the common profit metrics (IRR, Value of New Business, Embedded Value, ROE) used in pricing insurance products

(2a) Describe types of actuarial assumptions commonly used for life insurance and annuity actuarial functions

(2b) Describe and evaluate mortality, lapse, premium persistency, term conversions and utilization assumptions used for various purposes, and apply methods and techniques for their development

Sources:

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

LPM-166-20: Annuity Product and Features

Commentary on Question:

This question tested the candidate's knowledge of pricing, policyholder behavior, and product designs of individual annuity products. Candidates generally did well on this question, particularly on parts a and e.

Solution:

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

2. Continued

Commentary on Question:
Most candidates did well on part a. To receive full credit, candidates were required to list four of the six profitability metrics below. Partial credit was given for listing fewer than four metrics.

1. Internal Rate of Return (IRR) or Return on Investment (ROI)
2. Return on Equity (ROE)
3. Profit Margin
4. Return on Assets (ROA)
5. Value of New Business (VNB)
6. Surplus Strain

~~(b) **(Not Relevant)** 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.~~

~~Describe the applicability of ASOPs 2 and 54 apply to the VA.~~

~~**Commentary on Question**:~~
~~*Most candidates understood that both ASOPs apply to the pricing of the VA, but some candidates struggled to relate the ASOP requirements back to the specifications of the product. To receive full credit, candidates needed to specify why the ASOP is applicable to the VA.*~~

~~ASOP 2 provides guidance on the determination of non-guaranteed elements (NGEs) and is applicable to the VA product. The actuary needs to ensure that the NGE elements such as the crediting rate and rider charges comply with the guidance in the ASOP.~~

~~ASOP 54 applies to actuaries performing actuarial services with respect to pricing life and annuity products, when the product is initially developed, or when charges or benefits are changed for future sales. ASOP 54 applies since JS Life is pricing a variable annuity product.~~

2. Continued

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

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

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

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

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

Commentary on Question:
Most candidates assessed A, C, and D correctly. Candidates struggled on B with most stating that source of funding and distribution channel are equally important. For full credit, candidates were required to assess whether the statement was true or false and provide justification.

A. This statement is not true. Most VA contracts with lifetime payout riders are funded with qualified money.

B. This statement is true. Source of funding (i.e., qualified or nonqualified) and age are the two most important influences on when owners start withdrawals.

C. This statement is not true. Owners under age 60 are more likely to take withdrawals in excess of the maximum amount allowed.

D. This statement is not true. Owners with smaller contract values are more likely to take withdrawals that significantly exceed the benefit maximum.

(d) **(LO2b)** 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.

Assess the appropriateness of this proposal.

2. Continued

Commentary on Question:
Candidates who did well on part d assessed that the proposal was not appropriate, provided justification for why it was not appropriate, and provided an alternative solution. Many candidates recognized that a dollar-for-dollar reduction had been used in the past without success but did not explain why the proposal was not appropriate.

This proposal is not appropriate. The dollar-for-dollar provision could allow policyholders to exploit their contracts in situations where the account value is lower than the benefit base. This would allow policyholders to withdraw most of their account value but keep the guaranteed living benefit at minimal cost. A more appropriate proposal would be to reduce the benefit base on a pro-rata/proportional basis.

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

(i) Rate of return on investment

(ii) Control of assets

(iii) How insurers generate product revenue

Commentary on Question:
Candidates generally did well on part e.

(i) Fixed deferred annuities have a guaranteed crediting rate. Variable annuities do not.

(ii) The funds for a variable annuity are invested in the separate account while the funds for a fixed deferred annuity are invested in the general account.

(iii) For fixed deferred annuities, the insurer earns revenue from taking a spread between the rate earned on assets and the crediting rate provided to contract owner. For variable annuities, the insurer earns revenue from taking charges such as mortality and expense risk charges from the separate account.

3. Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.

Learning Outcomes:

(1a) Describe and compare various life insurance and annuity product designs
(1b) Evaluate and apply pricing practices for life and annuity products

Sources:

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

Commentary on Question:

Overall, candidates were able to demonstrate a general understanding of risk considerations associated with pension risk transfer (PRT) business. However, candidates generally did not perform well when asked to evaluate the individual cases. Depending on the case, candidates were able to identify the risk associated with the design and structure of individual cases. Some candidates confused pricing considerations vs. risk considerations per the reading material.

Solution:

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

Commentary on Question:

Most candidates were able receive full credit by identifying two main risks and explaining how to mitigate them. Partial credit was given for identifying the risks without providing any mitigation. Full credit was awarded for identifying two of the below risks and providing an acceptable mitigation per identified risk for which the bullets provide examples.

Investment Risk

- Careful credit underwriting
- Using higher credit quality fixed income assets and limit amount of non-fixed income assets

Interest Rate Risk

- Closely matching the duration of insurer's asset portfolio with the duration of group annuity cash flows
- Strong asset-liability management (ALM)

3. Continued

Longevity Risk

- Limit number of deferred annuitants
- Use a more conservative longevity assumption
- Manage life and annuity business to create a natural risk hedge
- Reinsurance

Annuitant Behavior Risk

- Conservatism in choosing the assumed retirement date

Operational Risk

- Verifying that annuitants are still alive

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

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

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

Commentary on Question:

(i) Candidates did not perform as well on this question; they needed to define buy-in vs. buy-out, and identify risk characteristics for each of the cases to receive full credit. Partial credit was given for commentary related to risks associated with each case.

(ii) Most candidates struggled to provide complete justifications to receive full credit. Partial credit was given for recommending a case and some justification.

(i) Case 1

This is a buy-out deal where the life insurer makes monthly pension payments directly to the pension plan members. The pension plans covers over 5,000 current employees and 25,000 retirees and is a material PRT deal. ABC will take on operational risk and annuitant behavior risk (from the active employees).

Case 2

This is a buy-in deal where the life insurer makes a monthly bulk payment to the pension fund, which will continue to pay pension members directly. Consequently, ABC avoids much of the operational risk. As all participants have retired, there is no annuitant behavior risk.

3. Continued

Case 3
This is a buy-out deal where the life insurer makes monthly pension payments directly to the pension plan members. ABC will take on operational risk. There is no annuitant behavior risk as the plan has only retired participants. However, benefits are linked to CPI, which introduces inflation risk to ABC.

(ii) Model solutions dependent on case recommendation:

Examples of justification for recommending Case 1:

- ABC favors non-financial over financial risk.
- This is a buy-out deal. ABC has large operations department. Therefore, they can take on operational risk on administering monthly pension payments directly.
- Annuitant behavior risk is inherent in this case due to the active employees. ABC can leverage experience from the retired cohorts to develop appropriate assumptions for the active employees.
- This case does not take on inflation risk as the pension benefits are not linked to CPI (unlike case 3)

Examples of justification for recommending Case 2:

- ABC favors non-financial over financial risk.
- This is a small plan with lower financial exposure/risk (both upside and downside).
- This is a buy-in deal. ABC will have low operational risk, as the gas company will retain administration associated with making pension payments to the retirees.
- This case has no active employees (only retirees), thus no annuitant behavior risk as no active employees, just retirees.
- This case does not take on inflation risk as the pension benefits are not linked to CPI (unlike case 3)

Examples of justification for recommending Case 3:

- ABC favors non-financial over financial risk.
- This is a buy-out deal. ABC has large operations department. Therefore, they can take on operational risk on administering monthly pension payments directly.
- This case has no active employees (only retirees), thus no annuitant behavior risk as no active employees, just retirees.
- This case does take on inflation risk as the pension benefits are linked to CPI, which will need to be mitigated.

3. Continued

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

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

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

Commentary on Question:

(i) Candidates did not perform well on this question, as they needed to provide commentary related to occupational types and geographic differences on these cases for full credit. Partial credit was given for commenting on either occupation or geographic differences. Candidates received no credit for speculative justifications (e.g., mix of gender, age, etc.)

(ii) Candidates did not perform well on this question, as they need to provide all mitigation methods associated with longevity for full credit. Partial credit was given for subset of the mitigation methods.

(i) Longevity assumption may vary by zip code or region, meaning the assumption needs to be consistent with where the plan members live. The employees of a company operating locally within a small geographic area may exhibit different longevity than those from a wider region or an entire country. The job type also matters as occupational hazards are different between white-collar jobs (e.g. telecommunications) vs. blue-collar jobs (e.g. gas company, manufacturing).

(ii) ABC can reduce the financial impact of incorrectly estimating longevity assumptions through the following mitigation methods:

- Limit number of deferred annuitants
- Choose more conservative longevity assumptions
- Manage life and annuity business to create a natural hedge
- Transfer longevity risk via reinsurance

4. Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.

Learning Outcomes:

(1a) Describe and compare various life insurance and annuity product designs

(1b) Evaluate and apply pricing practices for life and annuity products

(1k) Explain and apply nonforfeiture calculation techniques

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

Commentary on Question:

Overall, this question was testing the candidate's understanding of structured settlement annuity pricing and its unique qualities, especially in comparison to typical life/retirement annuities.

Solution:

(a) **(LO 1a, 1b, 1d)** 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.

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.

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.

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

4. Continued

Commentary on Question:
Candidates did well on this question. Candidates needed to not only verify the validity of the statement, but also provide commentary. Most notably, for part A, the majority of candidates did not comment on mortality improvement or provide an alternative source of experience and thus received partial credit. For part C, most candidates did not comment on how insurers would back the long-tailed liabilities. Candidates did consistently well on parts B and D.

A. This statement is not correct. Mortality from the existing annuity business is not appropriate as structured settlement mortality differs significantly from the typical insured population. SOA industry studies would be more appropriate than company data because it would reflect the unique aspects of structured settlements. Additionally, the mortality improvement assumption also differs from annuities. Notably, structured settlements commonly use a one-dimensional mortality improvement scale. The possibility of certain impairments being cured dramatically changes mortality rates for substandard lives, which also makes mortality improvement difficult to determine.

B. This statement is not fully accurate. Although life underwriters will have experience with substandard underwriting, there are differences between underwriting life insurance policies and structured settlements that should be considered in the underwriting process. The mortality risk can be significant, as structured settlement annuitants are typically very young and don't have the same anti-selection as life insurance. Even with strong underwriting, the annuitant may not follow a mortality curve of the typical population at a rated age.

C. This statement is partially correct. Many insurers would cash flow match for a limited number of years, then duration match in total. If insurers attempt to cash flow match over the entire investment horizon, they will be left with reinvestment risk. Insurers may use derivative securities to help extend their asset duration. Some companies have used equities to back long-tail liabilities.

D. This statement is not correct. There is no need to consider nonforfeiture benefits, as they would not generally exists for these types of annuities. A structured settlement is a type of income annuity with a single premium (SPIA), which typically do not have nonforfeiture values.

4. Continued

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

(i) Describe the treatment of total expected cashflows.

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

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

Commentary on Question:
This question tests the candidate's knowledge of the statutory reserving requirements for structured settlements. Most candidates did poorly on this question. Due to the overlap in the potential answers to the subquestions, candidates received credit if they answered one subquestion in another subquestion. For example, if the candidate provided the answer for question i) in question iii), they still received full credit.

(i) The company can aggregate expected cashflows for each year's block, and all amounts that do not exceed the prior year by 10% can be considered a single series of benefits for the purposes of assigning an interest rate. Amounts in excess of 10% from the prior year must be valued as lump sum payments.

(ii) Reserve is the present value of the income payments based on an appropriate mortality table and valuation rate of interest in accordance with Standard Valuation Law. For substandard life reserves, the "constant extra death" method is used where a number of extra deaths per thousand is added at each duration so life expectancy matches that given at underwriting. The intention is to grade reserves to a standard basis by the end of the valuation table. This approach produces mortality rates that are too high in early durations and significantly higher margins in later durations.

(iii) The discount rate should not exceed that prescribed by VM-22. The discount rate is based on the issue year method, similar to payout annuities. Durational interest rates are also used for structured settlements.

4. Continued

(c) **(LO 1a, 1b)** 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.

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

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

Commentary on Question:
Candidates generally did well on this question. For part i), candidates needed to comment on both mortality risk and interest rate risk to earn full credit. For part ii) candidates needed to provide an example of a way to manage the risk related to pricing the quote (as opposed to managing the assets). For part iii) candidates earned full credit for any two reasonable strategies that were appropriately explained. Some examples are listed below.

(i) Inflationary factors do not add new risk, but magnify the existing risk. Mortality risk is mitigated to a degree by discounting, as longer duration payments have a lower present value. However, benefit escalators, such as this 2% annual increase, can partially or fully offset the discounting function. Additionally, if benefit payments extend beyond the investment horizon, benefit escalators can compound the reinvestment risk.

(ii) It is common pricing practice to honor pricing rates for a period of time after quoting. When interest rates decrease, prices are expected to rise. However, the honored price will be too low under a lower interest rate, causing profits to decrease. An additional margin on the interest rate can be applied to offset this impact.

(iii) 1) Shorten the time period of rate guarantee (ie, how long the client has to accept the offer)

2) Hedge the risk using various investments (e.g. Swaps, options, derivatives)

3) Impose limits on dollar amounts of their published rates

5. Learning Objectives:

2. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.

Learning Outcomes:

(1c) Describe and apply the common profit metrics (IRR, Value of New Business, Embedded Value, ROE) used in pricing insurance products

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

Commentary on Question:
Generally, students did not do very well on this question. Especially in part ai and in the justification part of part b. They did not identify the correct source reading and key concept that the questions were asking. Most students did well on the calculation questions.

Solution:

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

~~(i) Explain how insurers differ from investment funds in value creation.~~

~~(ii) 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~~

5. Continued

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

Commentary on Question:
For part i, most students didn't do well. Many students discussed how insurance products are different from investment products in general but did not discuss it from a value creation perspective. For students who discussed the differences around value creation, they either discussed why insurance was favorable or unfavorable as compared with investment funds. Very few students covered both the favorable aspects and the unfavorable aspects.

For part ii, many students got confused by the timing of when Risk Capital cost should be based off. Students typically did well on the cashflow calculation. They included proper components, discounted cashflows using appropriate interest rates.
On the other hand, many students struggled with the replicating portfolio portion of the question. They either misinterpreted the calculated balances and had an incorrect replicating portfolio, or they did not construct a replicating portfolio at all. Students also didn't do well on the economic value part. Many students did not calculate EV in their answer.

(i)
Favorable

- Insurers have a competitive advantage in raising funds by selling policies for more than their economic cost, including frictional capital cost
- Insurers can create value by borrowing in the relatively less efficient insurance market, rather than in capital markets or by achieving an investment result that beats the benchmark implicit in the base cost of capital on a risk-adjusted basis.

Unfavorable

- As comparing with investment, insurance is less favorable in value creation. It is more opaque and operate less beneficial tax and regulatory
- Insurance face multiple sources of frictional capital costs (e.g. double taxation on investment returns). This also makes it harder for insurance to create value.

(ii)
See solution in excel

5. Continued

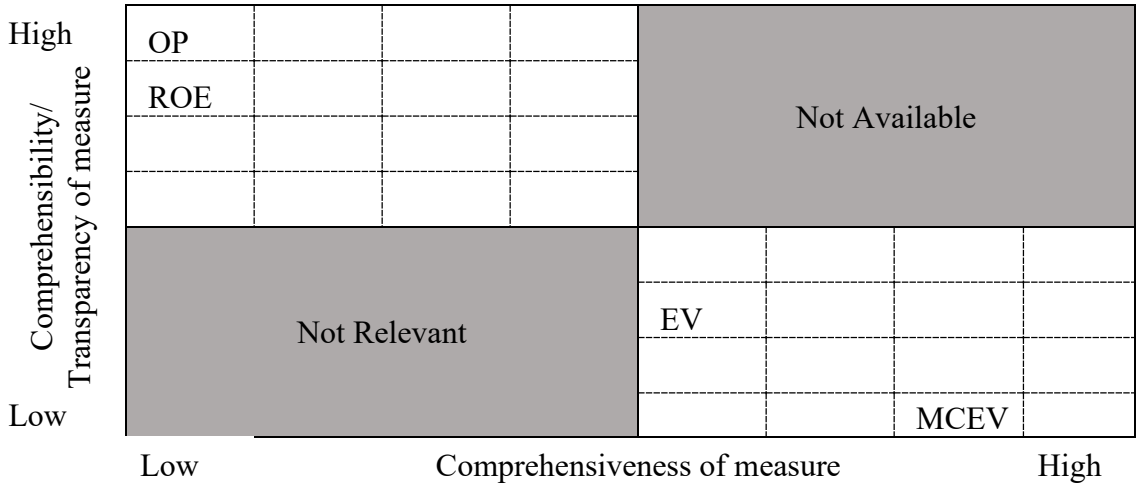
(b) **(LO 1c)** Place the following profit measures in the table below. Justify your answer.

(i) Embedded Value (EV)

(ii) ROE

(iii) Operating Profit (OP)

(iv) Market Consistent Embedded Value (MCEV)



Commentary on Question:
Graph:
Most students were able to identify the correct quadrants for OP, ROE, EV and MCEV. Many students labeled EV and MCEV with correct relative position that EV is more transparent than MCEV and MCEV is the most comprehensive measure. Students struggled more with the relative position between OP and ROE and did not get the relative position right. Few students labeled them in wrong quadrants or did not understand how the quadrants work.

Justification:
Some students did well in justifying the positions. Some students discussed the definitions of each measure but did not connect it with the comprehensiveness and transparency scale which cannot serve as justifications for their positioning in the graph. Also, a few students did not compare measures. So, the relative position between measures was not justified.

5. **Continued**

- OP & ROE are easier to understand but doesn't provide as much information for management. So, both measures are not comprehensive.
- ROE is a little less easy to understand than OP, which is why it is lower in terms of transparency
- EV & MCEV are both comprehensive and provide more details for management to more properly manage the business
- EV is more transparent than MCEV, and slight easier to understand
- MCEV is the most comprehensive, it allows management more info to make business decisions

6. Learning Objectives:

5. The candidate will understand various techniques for addressing the mitigation of risk within a life insurance and annuity context.

Learning Outcomes:

(5e) Describe basic terms, concepts, and types of life insurance reinsurance arrangements

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

Commentary on Question:

Candidates were expected to evaluate and analyze traditional and advanced reinsurance transactions and prepare related financial statement entries. Candidates were also expected to describe risk transfer considerations and evaluate their impact on reinsurance agreement provisions.

Solution:

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

Commentary on Question:

In order to receive any credit for this section, candidates had to first identify Funds Withheld Coinsurance as the appropriate type of transaction. Additional points were awarded for providing information on why this is the best solution to meet management goals.

Funds Withheld Coinsurance (FWC) is the best reinsurance method for TPL Life as FWC does not require asset transfer to the reinsurer.

- This allows TPL Life to keep the assets on their books and manage the investment strategy.
- Counterparty credit exposure is very minimal with FWC because the assets stay with the ceding company. Given that XYZ Re is a new reinsurer, counterparty risk could be higher.

6. Continued

- Recapture is easier under FWC because the assets are not transferred, avoiding any capital gains/losses from moving assets.

(b) **(LO 5e)** 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

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

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

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

Commentary on Question:
Most candidates received more points on part (i) than on parts (ii) or (iii). Very few candidates received full points on this section.

6. Continued

(i) Coinsurance

TPL Life
Reinsurance Report
Coinsurance - Year 2

Ceded premiums = Direct premiums * Coinsurance %	64.00
Allowances = Ceded premiums * Allowance %	12.80
Benefits = Gross Death Benefits * Coinsurance %	8.00
Experience refund	6.00

Total due to XYZ Re = Ceded Premiums – Allowances – Benefits – Experience refund = 37.2

(ii) and (iii) Funds withheld coinsurance

TPL Life
Reinsurance Report
Funds withheld coinsurance - Year 1

Funds withheld beginning balance	0
Ceded premiums = Direct premiums * Coinsurance %	80
Allowances = Ceded premiums * Allowance %	16
Benefits	0
Experience refund	0
Risk charge	0
Total due to XYZ Re = Ceded Premiums – Allowances – Benefit – Experience	64
Funds withheld ending balance	64

TPL Life
Reinsurance Report
Funds withheld coinsurance - Year 2

Funds withheld beginning balance	64.00	
Ceded premiums = Direct premiums * Coinsurance %	64.00	
	5.12	

FWH investment income = Funds withheld beginning balance * Invested asset earned rate

Allowances = Ceded premiums x allowance %	12.80
Benefits = Gross Death Benefits * Coinsurance %	8.00
Experience refund	6.00
Risk charge	3.00

Total due to XYZ Re at the end of year 2 =
+ Ceded Premiums
+ FWH Investment Income
- Allowances
- Benefits
- Experience Refund =
$64 + 5.12 – 12.80 – 8 – 6 = 42.32

Funds withheld ending balance =

+ BOY FWH Balance
+ Total due XYZ Re
– Risk Charge =
$64 + 42.32 - 3 = 103.32

(c) **(LO 5e)** 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.*

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

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

Commentary on Question:
Points were awarded for correctly identifying the statement as True, Partly True, or False. Further points were awarded for explaining why the statement was true or false.

For part A, partial credit was awarded for mentioning coinsurance provides higher surplus relief.

6. Continued

A. This statement is partly true. Year Renewable Term (YRT) is a more cost-effective solution to transfer mortality risk, it can also be used to transfer the C2 (mortality/morbidity) component of the ceding company's risk based capital requirements, which can be relatively significant.

B. This statement is not true. Modified Coinsurance allows the ceding company more control over their asset investments, which is important in developing policyholder dividend scales or interest credits and in matching assets

C. This statement is not true. Other forms of coinsurance (e.g., funds withheld coinsurance, modified coinsurance) enable the benefit of minimizing capital gains and losses on assets at initiation of the reinsurance, since they eliminate the movement of assets from ceding company to reinsurer that is required with pure Coinsurance. Movement of assets will require liquidation and thus may have large capital gain/loss implications for the ceding company.

Fall 2023 LPM Exam

1. Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.

2. The candidate will understand different types of actuarial assumptions and how experience studies are designed and used for evaluating past experience and for setting assumptions.

Learning Outcomes:

(1a) Describe and compare various life insurance and annuity product designs

(1b) Evaluate and apply pricing practices for life and annuity products

(2c) Explain and apply actuarial credibility methods

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

Commentary on Question:

Commentary listed underneath question component.

1. Continued

Solution:

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

Commentary on Question:
This question tested the candidates' knowledge of the items that need to be accounted for when developing a mortality assumption for structured settlements.

This question was fairly well done. Many candidates were able to identify and explain the key considerations for each of the three parts to this question.

Some candidates did not receive full credit because they focused on the process for issuing a structured settlement policy, instead of focusing on the differences in the characteristics of the policyholders.

(i) The insured mortality experience is likely to be significantly different from the overall insured population. Structured Settlements normally arise from an injury to the insured which increases the mortality risk of the insured in the early years of the policy. An increased age rating may be added to match the increased mortality risk.

(ii) Credibility is likely to be an issue for experience studies as the number of structured settlements issued by each company is limited. Additionally, credibility is reduced even further when applying separate ratings to various injuries or medical conditions. Insurers may need to depend on industry studies and pool experience of different causes of structured settlements if their experience lacks credibility.

(iii) Due to the limited amount of data on specific impairments and the future recoveries from these impairments, it is hard to project the mortality trends into the future. So, developing a mortality improvement assumption is very challenging and insurance carriers will often use a single dimension improvement factor.

1. Continued

(b) **(LO 2c)** 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.

(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.

(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.

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

Commentary on Question:
This question tested the candidates' ability to calculate the credibility and demonstrate knowledge of the two methods for calculating credibility.

1. Continued

On part i), many candidates received full credit, as they were able to identify both one strength and one weakness for each method of calculating credibility. The model solution below shows one possible response, but other valid strengths and weaknesses identified in the source reading are acceptable and were also awarded full credit.

Many candidates only received partial credit on parts ii) and iii). Exposures were often incorrectly used instead of death counts in part ii), and death counts were incorrectly used instead of policy exposures in part iii). Additionally, some candidates omitted the square root in the calculation or did not cap credibility at 100% for part ii).

On part iv), candidates received full credit if they selected either of the two methods of calculating credibility, along with a reasonable justification which is specific to structured settlements. The model solution below is one of many acceptable responses.

(i)
Limited Fluctuation

- Strength: the methodology is relatively simple and easy to apply.
- Weakness: the inputs are arbitrary and are less theoretically grounded than the Greatest Accuracy method.

Greatest Accuracy

- Strength: this methodology is backed by a statistical method with the clear objective of minimizing the mean squared error.
- Weakness: this method may produce a poor approximation when the random variable has a heavy tail.

(ii)
1. List formulas

LFCT Credibility = MIN(1, SQRT(N_{AC}/N_{FC}))
Where
N_{AC} = the actual observations = death claims
N_{FC} = the observations required to achieve full credibility = (Z-value/Margin of Error)^2

2. Recognize to use Z-value of 1.960 when calculating number of claims required for full credibility = nq = N_{FC} = 1,537

1. Continued

3. Apply the LFCT Credibility formula at each attained age and to the Total.

4. Cap credibility at 100%

Attained Age	Death Count	LFCT Credibility
0-19	5	6%
20-49	250	40%
50-79	1,000	81%
80-99	400	51%
100+	15	10%
Total	**1,670**	**100% (capped at 100%)**

(iii)
Buhlmann Credibility Formula = N / (N + K)
Where N = Number of Exposures
K = v / a = (Expected Value of the Process Variance) / (Variance of the Hypothetical Mean)
v = 42,000
k = 13
K = v / a = 42,000 / 13 = 3,231

Attained Age	Count Exposed (N)	Buhlmann Credibility
0-19	5,000	61%
20-49	75,000	96%
50-79	80,000	96%
80-99	3,000	48%
100+	50	2%
Total	**163,050**	**98%**

(iv)
I would recommend the Limited Fluctuation method.

With the Limited Fluctuation method, the only data that is needed is from the group of risks being assessed. In contrast, the Greatest Accuracy method requires a portfolio of data from comparable risk groups to estimate the parameters and portfolio rate. This is important because structured settlement data is often limited and the industry data may not align with the insured population for the company in question. Without a good estimation of portfolio rate, the Greatest Accurate method may not produce accurate results.

1. Continued

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

Commentary on Question:
To receive full credit, this question required the candidate to understand the benefits of using predictive analytics and relate these benefits specifically to pricing structured settlements.

Most candidates successfully listed the features and benefits of using predictive analytics. However, many candidates did not receive full credit because they did not align the benefits of using predictive analytics specifically to pricing structured settlements.

Predictive Analytics is beneficial when working with less data, which is the case with structured settlements.

The traditional pricing approach works well when there is a large amount of homogenous data. The structured settlement population has limited data available, and the insured population usually has unique injuries or medical impairments, which means that the data will not be homogenous.
Predictive Analytics allows for the use of more variables that are not normally used in traditional modelling methods. This is useful since there are more factors to be considered due the variability in the insureds that would purchase a structured settlement. This helps to isolate the true effect of each factor.
Predictive Analytics gives more information about the correlation between factors and the target variable. The correlation between factors and the mortality rate of those insured in structured settlements may otherwise not be well known.

2. Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.

Learning Outcomes:

(1a) Describe and compare various life insurance and annuity product designs

(1b) Evaluate and apply pricing practices for life and annuity products

Sources:

Registered Index-Linked Annuities, SOA Research Institute, Aug 2022

ILA101-101-25: Annuity Products and Features– Chapter 3 Indexed Annuities

Commentary on Question:

Part (a) of this question tested candidates' application of their knowledge on the following Registered Index-Linked Annuity (RILA) product features:

1. *Caps*
2. *Buffers*
3. *Floors*
4. *Term Lengths*

Part (b) tested candidates' application of their knowledge of hedge costs, both for RILAs and Fixed Indexed Annuities (FIAs).

Solution:

(a) **(LO 1a, 1b)** 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.

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

2. Continued

Commentary on Question:
For both RILA-A and RILA-C some candidates did not seem to understand that a buffer only eliminates the first x% of a loss. For example, for RILA-A the year 3 loss of 5% becomes a 0% gain, not a 5% gain.

For RILA-B some candidates misunderstood the convention that "floor of 10%" means here that the loss for the term will not exceed 10% and not that the gain is floored at 10%. Candidates who applied the logic correctly received most of the credit for their answers on this part of the question.

For RILA-C some candidates failed to understand the significance of the three-year term, that the cap and buffer are applied only at the end of the term and not on an annual basis.

We need to calculate the cumulative returns for each contract:

RILA-A has one-year terms, so returns are adjusted for the buffer and cap at the end of each year.
For year 1 the -15% return on the S&P 500 index results in a -15+10=-5% return for RILA-A due to its buffer.
For year 2 the +35% return on the S&P 500 index results in a 15% return for RILA-A due to its cap.
For year 3 the -5% return on the S&P 500 index results in 0% return for RILA-A due to its buffer.

Accumulating: (1-0.05)*(1+0.15)*(1+0) – 1 = 9.25%

RILA-B has one-year terms, so returns are adjusted for the floor and cap at the end of each year.
For year 1 the -15% return is floored at -10%.
For year 2 the +35% return is capped at +18%.
For year 3 the -5% return is unaffected by either the floor or cap.

Accumulating: (1-0.10)*(1+0.18)*(1-0.05) – 1 = 0.89%.

RILA-C has three-year terms, so returns are only adjusted at the end of each three years.
Calculate the raw three year return of the S&P 500 first:
(1-0.15)*(1+0.35)*(1-0.05) – 1 = 9.01%
Neither the cap nor the buffer is triggered by the three-year S&P 500 return, and thus RILA-C has a 9.01% cumulative return.

2. Continued

RILA-A has the highest return and RILA-B has the lowest return

(b) **(LO 1a, 1b)** 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.

Commentary on Question:
Many students struggled to apply the formula for the hedging costs for RILA with a cap and buffer (At-The-Money (ATM) Call minus Out-of-The-Money (OTM) Call minus OTM Put). Many of these students failed to identify strike prices for the three option purchases.

Many students also tried to connect this question to part (a). Hedge costs for a static hedge generally are incurred at the time zero of the term, while the returns described in part (a) occur over a three-year period.

Many students also missed that the FIA in part (b) does not have a cap. It only has a participation rate. While participations rates and caps are not necessarily mutually exclusive, the stem to the question was explicit that there was no cap on the FIA.

Candidates were given some credit when they correctly calculated the costs of the RILA hedge alone. They also earned some credit when they calculated a participation rate for the FIA based on the appropriate cost of the ATM call option and an inaccurate RILA hedge cost.

2. Continued

RILA-A has a 15% cap and a 10% buffer. This means the company is on the hook for returns up to 15% but not beyond 15%, and that the company can pass losses beyond 10% but not before 10% to the contract holder. Therefore, the company can effectively hedge the RILA-A returns with the following combination of options:

1. Base: Buy a call option with a strike at the initial index level of 4,000
2. Cap: Sell a call option with a strike at the cap, 1.15 * 4,000 = 4,600
3. Buffer: Sell a put option with a strike at the buffer, 0.90 * 4,000 = 3,600

Referring to the table, the net cost is then 9.0% for the base minus 2.0% for the cap minus 3.4% for the buffer, 9.0% - 2.0% - 3.4% = 3.6%

For the FIA we thus set the hedge cost to 3.6%. Since this FIA is using a participation rate crediting mechanism, the hedge cost equals the cost of the ATM call option times the participation rate. In other words, 3.6% equals 9.0% times the participation rate. Therefore, the participation rate is 3.6 / 9.0 = 40%.

(c) **(LO 1a, 1b)** 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.

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

- Shareholders
- Advisors

Justify your response.

Commentary on Question:
This part of the question was deemed defective, the source material used to write this question changed between the time the question was created and the time the syllabus was published to candidates.

Not applicable

3. Learning Objectives:

3. The candidate will understand common issues and practices related to Product Management.

Learning Outcomes:

(3a) Describe and assess insurance and annuity distribution approaches and underwriting approaches

Sources:

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

Commentary on Question:

The question tested the candidate's knowledge of accelerated underwriting concepts. Candidates generally did well in part b and poorly on parts a and c.

Solution:

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

Commentary on Question:

Candidates did poorly on this question. Maximum credit was received by demonstrating knowledge of FCRA data.

FCRA data is readily available and is updated regularly. Not all FCRA data is relevant to LI U/W. In other words, significantly more data may be collected than is needed to determine risk. If there is a dispute about FCRA data accuracy, the consumer has to obtain additional information and dispute findings.

3. Continued

FCRA data is extensive and accessing such data may result in access to non-usable credit attributes. As additional rating factors are introduced via insurance scores or with specific data elements, unfair discrimination, including disparate impact, may be introduced or amplified.

It is already used by Life and P&C lines of business. There is existing regulation and oversight by the FTC and CFPB.

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

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

(ii) Critique the appropriateness of the underwriting decision disclosures.

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

Commentary on Question:
Most candidates did well on part (i) and (ii) but struggled with part (iii). This question required candidates to answer parts (i) and (ii) for each applicant. For part (i), most candidates were able to determine the correct risk class providing correct reasoning. For part (ii), most candidates assess were able to assess whether the disclosures were appropriate or inappropriate. For part (iii), most candidates failed to address how predictive analytics can improve the mortality assumption.

(i) All applicants answered no tobacco use on application.

Applicant B: RAS score is 110 >= 100. According to the triage process, this applicant moved to full underwriting where a paramed exam was conducted and high blood pressure was determined. They should be assigned to standard NS.

Applicant C: RAS score is 50 < 100 which is even better than applicant A who was assigned best NS. However, external rules engine for family history and avocations came back with an adverse decision based on participating in risky avocations. They should be assigned to second best NS.

Applicant D: RAS score is 300 > 100. Due to the triage process, this applicant should be declined. No risk class is assigned.

3. Continued

(ii) Applicant B: Traditional data source was used to determine the risk class and the disclosure reason of hypertension was appropriate.

Applicant C: External rules engine was used to determine the risk class of second best NS which overruled the RAS-based risk class. The disclosure reason of participating in high risk avocations was appropriate.

Applicant D: Applicant is not given information as to why the case was declined and what in the underwriting would have caused the decline. Since data provider elements from MIB, Rx, MVR, EMRs, and public and financial info and credit score was used, the applicant has the right to be told the information use to deny insurance and review the accuracy of the information. The disclosure was inappropriate.

(iii) Predictive analytics allows DEF to leverage the increased availability of individual policy data collected from accelerated underwriting to develop a more robust mortality study. It can provide better insight into the interactions of various factors and allows for better use of available data to refine the mortality assumption. It also allows DEF to introduce new factors based on the collected data and evaluate their impacts without having to rely on traditional A/E results.

(c) **(LO 3a)** 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.

Commentary on Question:
Candidates did poorly on this question. Candidates needed to both provide additional analysis or data elements from specific external data sources and explain how they can be used to reduce mortality anti-selection. Any reasonable analysis/data and external data source received credit (examples below).

Additional Analyses:

- Develop a smoker propensity prediction model to identify smokers. Population-level open data such as county/state tobacco taxes and regulations can be useful for smoker propensity prediction.
- Digital imaging via facial image analysis can be used to access the individual's age group, BMI, and smoking status.
- Verify identity, hobbies, smoker status, and use of alcohol or drugs through social data public ally available such as Facebook.

3. Continued

Additional data:

- Health and wellness information from vital statistics, heart rate, and physical activity data collected from wearables can be used.
- Food preferences and psychological and emotional health data from wellness websites and programs can be used.

4. Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.

5. The candidate will understand various techniques for addressing the mitigation of risk within a life insurance and annuity context.

Learning Outcomes:

(1c) Describe and apply the common profit metrics (IRR, Value of New Business, Embedded Value, ROE) used in pricing insurance products

(5e) Describe basic terms, concepts, and types of life insurance reinsurance arrangements

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

Commentary on Question:

The first few parts of this question provided an opportunity for candidates to demonstrate their mastery of several pricing and earnings concepts, through a series of calculations on a term life insurance product. The latter parts of the question evaluated the candidate's understanding of basic reinsurance structures by analyzing statutory cash flows, statutory reserves, and invested assets vis-à-vis the term life product without reinsurance.

Solution:

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

4. Continued

Commentary on Question:
Most candidates performed well on this question, as they were able to successfully recall and apply the pre-tax stockholder earnings formula. Partial credit was assigned if candidates had minor errors in the formula, such as using a reserve other than the Benefit Reserve, but the calculation was otherwise correct.

Pre-tax stockholder earnings = ProdCashFlow – BenResIncr – DACAmort + InvIncome + InvIncRC
ProdCashFlow = Prem – Ben – Exp
BenResInc(t) = BenRes(t) – BenRes(t – 1)

Year 2023: (400 – 100 – 175) – (250 – 0) – -150 + 15 + 10 = 50.00
Year 2024: (390 – 125 – 0.5) – (500 – 250) – 25 + 68 + 25 = 82.50
Year 2025: (380 – 200 – 0.5) – (700 – 500) – 25 + 86 + 20 = 60.50
Year 2026: (350 – 995 – 0.5) – (0 – 700) – 100 + 85 + 35 = 74.50

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

Commentary on Question:
Candidates generally did well on this question and were able to apply tax formulas to determine the taxes payable. Partial credits were assigned for formula errors, such as including InvIncRC or using a reserve other than TaxRes. No points were deducted for not explicitly including PermDiff in the calculation since it is given in the question as 0 in all years.

TaxableEarn = ProdCashFlow + InvIncome – TaxResIncr + PermDiff†
OR
TaxableEarn = Prem + InvIncome – Ben – Exp – TaxResIncr + PermDiff†
TaxResIncr = TaxRes(t) – TaxRes(t – 1)
TaxOnEarn = TaxableEarn × EarnTaxRate

† *PermDiff was given in the question as 0 in all years.*

Year 2023: [125 + 15 – (325 – 0) + 0] × 21% = -38.85
Year 2024: [264.5 + 68 – (650 – 325) + 0] × 21% = 1.58
Year 2025: [179.5 + 86 – (603 – 650) + 0] × 21% = 65.63
Year 2026: [-645.5 +85 – (0 – 603) + 0] × 21% = 8.93

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

Commentary on Question:
Candidates generally had difficulty with this question.

4. Continued

A common mistake was using the incorrect reserve basis in the calculation, which is a key part of the question.
Several candidates did not apply the tax rate at all, and did not receive any credit.

DefTaxLiab = (TaxRes – EarnRes) × EarnTaxRate

Year 2024: [650 – 375] × 21% = 57.75
Year 2025: [603 – 600] × 21% = 0.63

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

(i) Coinsurance

(ii) Funds Withheld Coinsurance

(iii) Modified Coinsurance

Commentary on Question:
Candidates generally did well on this question and were able to correctly match the graphs to the basic reinsurance methods. Most candidates explicitly described effects on assets, reserves and cashflows. To receive full credit, the correct treaty along with appropriate justification in comparison to the scenario with no reinsurance was required.

Coinsurance – Design C
In a coinsurance arrangement, the reinsurer establishes its proportionate share of the policy reserves. Since there is a 50% quota share agreement, the reinsurer bears 50% of the reserve and takes 50% of the assets. Compared to no reinsurance, design C shows a 50% reduction in reserve and assets and is therefore coinsurance.

Funds Withheld Coinsurance – Design A
Similar to ModCo, under funds withheld coinsurance the assets are retained by XYZ. Under design A, invested assets match the no reinsurance design. Additionally, the ceding company has a reserve credit similar to coinsurance. Under design A, the reserves are 50% of the no reinsurance design. Therefore, design A is funds withheld coinsurance.

4. Continued

Modified Coinsurance – Design B
Unlike coinsurance, under ModCo the statutory reserve on the ceded portion of the policy is an obligation of, and held by the ceding company rather than the reinsurer. The ceding company also retains the assets. Under design B, the statutory reserves and invested assets match the no reinsurance scenario and is therefore ModCo reinsurance. Additionally, cash flows are impacted vs no reinsurance due to the initial expense allowance and ModCo adjustment.

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

Commentary on Question:
Most candidates did well by recommending one of the reinsurance frameworks with justification. However, only some candidates tied the recommended reinsurance framework back to the given scenario. To receive full credit, candidates must recommend one of the three reinsurance frameworks given, justify their recommendation, and tie the recommendation back to either company XYZ or to Term Insurance.

Option 1: Coinsurance
- This is the most commonly used reinsurance for term products since term products have little or no cash value build up, and, therefore minimal investment risk. From the graphs in part d, coinsurance shows the greatest reduction in reserves.
- Product features such as dividends, policy loans, and non-forfeiture status (ETI/RPU) can present reinsurance problems under a coinsurance arrangement. Since Term does not have these features, coinsurance provides a simple risk transfer solution for XYZ.

Option 2: Modified Coinsurance
- ModCo allows XYZ to retain the assets for investment purpose (giving them more control over investment decisions) while still obtaining the surplus relief aspects of coinsurance. Under the ModCo design, invested assets remain in full and year 1 cash flows are higher than the no reinsurance scenario which may relieve some of the initial shock of developing a new term insurance product.
- ModCo eliminates some of the problems with coinsurance. Since XYZ maintains the policy reserves, there is no question about reserve credits.
- ModCo allows the ceding company to maintain a higher level of assets and, therefore, can attain a higher comparative asset ranking than coinsurance.

4. Continued

Option 3: Funds Withheld Coinsurance

- This allows XYZ to retain the assets for investment purposes (giving them more control over investment decisions) while still getting the quota share reserve relief like coinsurance. XYZ will need to set up a liability for funds withheld since they are retaining the assets while getting reserve relief. Under this design, invested assets remain in full but the reserve is reduced by half. Since term insurance does not have product features such as dividends, policy loans, funds withheld coinsurance provides an appropriate derisking solution for XYZ.

5. Learning Objectives:

5. The candidate will understand various techniques for addressing the mitigation of risk within a life insurance and annuity context.

Learning Outcomes:

(5e) Describe basic terms, concepts, and types of life insurance reinsurance arrangements

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

Commentary on Question:

This question tested candidates' knowledge and understanding about three common methods used to determine reinsurance premium and allowance for banded policies. Candidates were also expected to understand how to interpret income statement results and make recommendations and decisions utilizing the statements.

Solution:

(a) **(LO 5e)** 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.

5. Continued

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

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

Commentary on Question:
Candidates generally did well on part (i). Candidates received partial credit if concluding that the advantage of option 3 is simply the highest expense allowance. Candidates did very well on part (ii).

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

Option 1: It is the simplest to understand or to use.
Option 2: It leads to an equitable, fair, balanced, or accurate cost to the ceding company on all bands.
Option 3: The reinsurance premium for the reinsured portion will never exceed the lowest premium received by the insurance company. One set of allowances is used for all sizes, resulting in a common net reinsurance premium rate (reinsurance premium rate less allowance) for all policy sizes. This can simplify the administration. The use of a common net reinsurance rate based on the highest band's premium results in an additional margin on reinsurance for the ceding company on policies written on the lower bands.

(ii)

Option	1	2	3
Reinsurance Premium (A)	actual gross premium = 4,000,000	actual gross premium =4,000,000	10% * Total Face = 3,500,000
Allowance (B)	Reinsurance premium * 11% = 440,000	Reinsurance premium * allowance % = 450,000	Reinsurance premium * 12% = 420,000
Ceded Premium – Allowance = (A)-(B)	3,560,000	3,550,000	3,080,000

Option 1 would yield the highest ceded premium net of allowance.

5. Continued

(b) **(LO 5e)** 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.

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

(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.

Commentary on Question:
Candidates generally did well on part (i). Most candidates were able to calculate the ceded premium and benefit. Many candidates were unable to correctly calculate the mod co adjustment. A common mistake on part (ii) was to assume the ceding company also transferred the asset. Candidates generally did well on part (iii). Very few candidates were able to clearly mention GHI Life can receive experience fund.

(i) BBB income statement

Pre-tax Income for BBB Re = Ceded premium – Ceded claim – Mod co adjustment - Increase in reserves + Investment income

5. Continued

	BBB Re	
Revenue:		
Ceded Premium:	$ 4,800	(=80% * 6,000)
Investment InIncome:	0	(mod co-reinsurance doesn't transfer asset)
Total Revenue	$ 4,800	
Benefits		
Ceded Claim:	$ 480	(=80% * 600)
Reserve Increase	0	
Mod-co Adjustment	$ 3,136	(=80%*(6,000-2,000-2,000*4%)
Total Benefits	$ 3,616	
Pre-tax Income	$ 1,184	

(ii) GHI income statement

Pre-tax income for GHI Life = Net premium – Net claim + Mod co adjustment – Increase in reserves + Investment income + Experience Refund

	GHI Life	
Revenue:		
Net Premium:	$ 1,200	(=20% * 6,000)
Investment InIncome:	100	(given as mod co doesn't transfer assets)
Mod-co Adjustment	$ 3,136	(from b(i))
Experience Refund	$ 592	(50% * 1,184)
Total Revenue	$ 5,028	
Benefits		
Ceded Claim:	$ 120	(=20% * 600)
Reserve Increase	$ 4,000	
Total Benefits	$ 4,120	
Pre-tax Income	$ 908	

5. Continued

(iii) Modified coinsurance is recommended as it's more beneficial to GHI Life. GHI Life will receive an experience refund equal of 50% of BBB Re's pre-tax statuary income. Modified coinsurance allows GHI life to retain the assets and generate higher investment income while still obtaining the surplus relief aspects of coinsurance.

6. Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.

2. The candidate will understand different types of actuarial assumptions and how experience studies are designed and used for evaluating past experience and for setting assumptions.

Learning Outcomes:

(1a) Describe and compare various life insurance and annuity product designs

(1b) Evaluate and apply pricing practices for life and annuity products

(1c) Describe and apply the common profit metrics (IRR, Value of New Business, Embedded Value, ROE) used in pricing insurance products

(2b) Describe and evaluate mortality, lapse, premium persistency, term conversions and utilization assumptions used for various purposes, and apply methods and techniques for their development

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 Features

Commentary on Question:
Commentary listed underneath question component.

Solution:

(a) **(LO 1c)**

(i) Define embedded value.

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

Commentary on Question:
The question asked candidate to provide the definition of embedded value and its limitation. Candidates only needed to offer one reason why embedded value is not based on economic principle to receive full credit. Many candidates failed to

include adjusted net worth in the embedded value definition. Deductions were made for candidates who provided the definition of Market Consistent Embedded Value (MCEV) instead of Embedded Value.

(i) Define embedded value

The embedded value is the sum of the in-force value and the market value of the statutory shareholder capital. It calculates the value of existing business, termed in-force value, as the discounted future statutory profits (PVFP) that are expected to emerge on this business.

(ii) Below are the reasons why embedded value is not based on economic principles.

(1) Using the embedded value method, value is based on the composition of the backing assets rather than on the risk characteristics of the cash flows being valued. This is because the projected statutory profits are calculated incorporating expected investment returns. The embedded value method creates a bias towards high-yield investments that is not justified from an economic perspective. The value of the liabilities should be independent of the composition of the backing assets.

(2) The embedded value method levies frictional capital costs solely on the basis of regulatory restrictions. It does not explicitly allow for frictional risk capital costs. Thus, in the extreme, if two lines of business were written in different territories, the one line being virtually risk-free but requiring high regulatory reserves, the other being risky but only requiring low levels of regulatory reserves. Then the embedded value method would penalize the former line regardless of the level of risk inherent in the other line.

6. Continued

(3) Under the embedded value method, the level of the regulatory capital charge is highest for business backed by the lowest yielding assets. This would typically mean that the least risky business would be allocated the highest frictional capital costs.

(4) As the embedded value method is based on expected cash flows, it does not easily accommodate options and guarantees. The economic method properly allows for these by valuing them based on a corresponding replicating portfolio. Valuing these options based on expected cash flows is likely to understate their value.

(b) **(LO 2b)**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. ***(Not relevant)*** *Given the poor performance of the business, UXS proposes exiting the business using indemnity reinsurance with 100% quota share.*

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.*

Commentary on Question:
This question tested candidate's understanding of key difference between indemnity and assumption reinsurance as well as characteristics of a lapse supported product. For both statements, the candidate should clearly indicate that the statement is incorrect and provide their rationale to receive full credit. Deductions were applied where candidates provided conflicting and ambiguous information in the response. Most Candidates did well in this question. Some candidates failed to recognize that term to 100 business is a lapse-supported product.

A. This statement is not correct.

To exit the business, Assumption reinsurance should be used instead of indemnity reinsurance. UXS should use assumption reinsurance as a vehicle to exit T100 business if it no longer wants the risk or administrative expense. Assumption reinsurance has been used to divest entire lines of business or to sell problematic blocks of business.

6. Continued

B. This statement is not correct.

- T100 is a lapse-supported product. Improving policy persistency will not necessarily boost the profitability.
- For a Term Life insurance product that was sold 15 years ago, it is likely that Company already had the time to recoup majority of the expenses. Thus, higher than expected lapse will not have material impact on the profitability of the business.

(c) **(LO 1a, 1b, 1c)** 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) Evaluate each of the three profit metrics in terms of their appropriateness for comparing the profitability across all three products.

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

Commentary on Question:
The question asked candidates to evaluate common profit metrics and their appropriateness in measuring profitability for different insurance products. Candidates generally did not perform well on this question. Some candidates only described what each profit metric is in general without providing specific comparison between different insurance products. Most candidates failed to identify that only IRR is an appropriate profit metric for comparing life and annuity business. For the Present value of distributable earnings (PVDE), most

candidates did not comment on the appropriateness of the discount rate obtained through CAPM.

6. Continued

(i) **IRR**

For comparing Life and Annuity business. the internal rate of return ("IRR") is an appropriate profit metric, it is the breakeven rate which solves for the interest rate at which the present value of profits and (usually first year) losses equals zero.

All other things being equal, IRR using distributable profits is lower than when it is calculated using book profits, else equal. It is the more appropriate indicator of the general level of return on total capital, since the amounts of surplus being held as target or required surplus is "sterile" capital and cannot be utilized by the company to produce additional new business.

Profit margin

Profit margin is commonly used for life product. It is not an appropriate profit metric for comparing Life and Annuity business mainly because Profit Margin does not reflect the timing of profits or losses, cost of capital and the relative riskiness of the business are not considered.

PVof Distributable Earnings

It is not appropriate to use the PV of Distributable Earnings discounted at the hurdle rate of 8% developed using the CAPM model, mainly due to two reasons:

- CAPM focuses on the systematic risk a company takes while systematic risk is not the most important driver of the cost of taking insurance risk. Frictional capital costs are more important although CAPM does not explicitly capture them, which will inevitably lead to wrong conclusions regarding the cost of taking risk for insurers.

- Insurance companies take most of their systematic risk on the investment side. Whatever systematic risk is embedded in insurance liabilities can be hedged by offsetting positions on the asset side.

(ii) Based on IRR, only Block "C" is greater than the required return on capital of 14%, so annuity product best aligns with UXS senior management's objectives.

7. Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.

2. The candidate will understand different types of actuarial assumptions and how experience studies are designed and used for evaluating past experience and for setting assumptions.

3. The candidate will understand common issues and practices related to Product Management.

Learning Outcomes:

(1a) Describe and compare various life insurance and annuity product designs

(1b) Evaluate and apply pricing practices for life and annuity products

(2b) Describe and evaluate mortality, lapse, premium persistency, term conversions and utilization assumptions used for various purposes, and apply methods and techniques for their development

(3e) Describe and evaluate the challenges insurers face in a rising interest rate environment

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

Commentary on Question:

Candidates are expected to apply ASOP 54 to the pricing report noting and identifying missing components and incompleteness of different sections. Candidates are also expected to be able to evaluate the common features and assumptions used in the pricing and product development of Universal Life products.
Candidates should be able to identify how rising interest rates create opportunities and risks relating to product design.
Candidates should be able to recommend an annuity and to justify the reasons for recommending that annuity.

Solution:

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

7. Continued

Commentary on Question:
Overall, part a was answered well. However, some candidates would say, for each of i, ii, iii, iv, and v that "it will be different for UL vs. Term" …. but they didn't state how it would be different. No marks were given if nothing was said regarding how they would be different. Similarly, for part v), Compensation, some candidates discussed the policyholder being compensated through their chosen death benefit and the company being compensated through the various charges on a UL policy, but did not address the specific question; no marks were given in this case..

(i) Mortality
Average face amounts are likely to drop because Term insurance is usually cheaper than UL which may result in higher mortality for UL.
The effect of antiselection in the mortality of Term at post level term renewal may produce steeper mortality at later durations for Term vs. UL

(ii) Lapses and policyholder behavior
The flexible nature of premium funding for UL may require a more sophisticated/dynamic lapse assumption than for Term
Premium persistency needs to be considered in addition to lapses. Shock lapses at the end of the Term renewal period and at the end of the UL surrender charge period need to be considered

(iii) Expenses
Maintenance expenses are likely to be higher for UL due to account value options such as cash surrenders, policy loans and partial withdrawals.
The presence of non-guaranteed (e.g. no-lapse guarantees) elements for UL create additional governance requirements that may increase expenses.

(iv) Options and Guarantees
For UL, need to document minimum credited rate, maximum expense charges and maximum COI's as applicable.
Need to plan for management of non-guaranteed elements

(v) Compensation
Term commission rates are likely to be higher to offset lower premiums.
Because UL has flexible premiums, the company will probably need to establish the concept of a target premium on which a commission rate is payable

7. Continued

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

Commentary on Question:
Most candidates discussed disintermediation risks and described how and why that would occur. Fewer candidates discussed new money and portfolio crediting strategies. Very few candidates discussed the reinvestment risk or the non-guaranteed elements management plan. Partial credit was given for incomplete answers.

The insurer may consider a new money rate crediting strategy which will allow for higher initial crediting rates. However, if interest rates fall, so does the credited rate more quickly than under a portfolio crediting strategy. Offering lower rates than market rates could result in policyholders lapsing their policies resulting in the company having to sell assets at a loss (disintermediation risk).

The company will likely encounter reinvestment risk and the actuary must be careful to test the impact of reinvestment rates that differ from current rates, while accurately reflecting minimum rate guarantees and the anticipated non-guaranteed elements management plan.

(c) **(LO 1a, 1b)** 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.

Commentary on Question:
All Candidates recommended an annuity product and most justified why they selected that particular annuity. Very few candidates discussed the fact the pricing team had never priced annuity products before, and the challenges this may present. Partial credit was given for incomplete answers.

Recommendations of Variable Annuity, Fixed income annuity, Equity indexed annuity or Registered index-linked annuity with an explanation as to why that annuity is recommended.

For example, recommend Variable annuity if the goal is to offset inflation. The historical rational for VA was to protect retirement income from inflation. While the relationship may not hold in the short run, it should hold in the long run. The company needs to take into account that VA's would be a very different addition for ABC Life, since the insurer primarily sells Life Insurance products.

Spring 2024 LPM Exam

1. Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.

2. The candidate will understand different types of actuarial assumptions and how experience studies are designed and used for evaluating past experience and for setting assumptions.

3. The candidate will understand common issues and practices related to Product Management.

Learning Outcomes:

(1a) Describe and compare various life insurance and annuity product designs
(1b) Evaluate and apply pricing practices for life and annuity products

(2a) Describe types of actuarial assumptions commonly used for life insurance and annuity actuarial functions

(3e) Describe and evaluate the challenges insurers face in a rising interest rate environment

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

Commentary on Question:

The question was to test the candidate's knowledge of pension risk transfer (PRT) and structured settlement (SS)products. For part (a), Most candidates demonstrated their knowledge about the SS, some candidates lost some points as they mixed the concept between PRT and FA. For part (b), most candidates didn't receive the full marks as they only described the impacts from policyholder behavior under the different interest environments, very few candidates mentioned the pricing strategy and product design under the low/high interest scenarios. For part (c), most candidates made the recommendation with reasonable justifications.

1. Continued

Solution:

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

F. Asset Return/Interest Rates

G. Longevity/Mortality

H. Annuitant Behavior

I. Expenses

J. Liquidity

Commentary on Question:
Most candidates were able to provide reasonable considerations for these items, except for Expenses – The candidates were expected to understand the types of different expense items, the difference of how they are determined from pricing between these two, i.e. SS is priced individually, while PRT it is a group contract. Some candidates also lost points on the annuitant behavior as they treated the pensioner as a general holder of fixed annuity (and even variable annuity from some candidates) instead of retirement-specific products.

- Assets Return/Interest Rates:

  Both types of annuities are long-duration products, so insurers often use illiquid assets in their portfolios.
  The inability to match all the projected long duration cash flows with equally long duration assets creates reinvestment risk for both products.

- Longevity/Mortality

  The insured populations for retirement annuities and SS is vastly different which creates different types of longevity risk.
  For PRT, insurers often use several data points in their underwriting such as ZIP code, job type, and other experience data.
  SS insureds tend to be much younger than retirements annuities at issue, and underwriting is a challenge for SS due to physical and medical impairments of many annuitants which impacts the shape of the mortality curve.

1. Continued

- Annuitant Behavior

  Deferred annuitants are able to choose their retirement date and form of pension. If these options are subsidized (as opposed to being actuarial equivalent) then pricing needs to reflect an assumed retirement date and pension form for each deferred annuitant.
  Since SS are used to fund a tort settlement and are not individually purchased by the annuitant, there isn't the type of longevity-related anti-selection or behavior risk that exists with other life annuities.

- Expenses

  For SS, expenses such as maintenance, overhead, commission, and other acquisition expenses must be factored into the pricing of the product. Most expenses can be covered by adding a fixed percentage to the premium.
  For PRT, similar expense categories apply but at a larger scale. While SS are generally individually priced, PRT's are group annuity contracts that can be thought of as a mini-M&A transaction. The pricing for each quote is highly customizable and expenses are of larger scale and are less fixed than SS.

- Liquidity:

  For PRT, deferred annuitants sometimes have the option to commute their pension, so pricing needs to reflect the proportion of annuitants expected to choose a pension versus lump sum commuted value. The asset portfolio should have enough liquid assets to cover these amounts.
  For SS, the benefit payments (annuity certain, single life annuity, temp life annuity, lump sum) are fixed and determinable at issue so there is no uncertainty of when benefits will be due, only for how long.

(b) **(LO 3e)** 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

2. ABC Life's inforce life insurance block

3. Pricing of future PRT deals and structured settlements

1. Continued

Commentary on Question:
Many candidates were unable to cover all the aspects as presented in this model solution, but points were given to answers that had reasonable justification. Many candidates mainly focused on the impacts due to the policyholder behavior under the low/high interest environment, and failed to touch on other aspects. Very few candidates mentioned what the company could do to actively manage the inforce blocks to react to these interest scenarios.

- Fixed Annuity:
  In the sustained low interest rate environment, fixed annuity writers have increased the use of reinsurance to provide surplus relief or to allow for access to a broader range of investment options.
  FA sales growth has occurred during periods of credit spread widening, flow reinsurance mechanics and new capital injection from PE backed companies.

- Whole Life and UL:
  The sustained low interest rate environment in recent years followed by increases since late-2020 has been less impactful on WL than UL. WL products are generally more stable in changing interest rate environments, likely due to the simple design of the product.
  In contrast, products that are more interest rate sensitive, including UL products, tend to have lower sales as these products are more expensive for policyholders to keep in force when interest rates are low.
  In the current interest rate environment, insurers must participate in active management on non-guaranteed elements, including raising COI charges on UL products, to ensure profitability. Management also need to maintain a reasonable level of profitability and minimize market value loss on the sale of fixed income by adjusting crediting rate.

- PRT and SS:
  PRT and SS are both long duration products. The inability to match all the projected long duration cash flows with equally long duration assets creates "reinvestment risk" for both products.
  As interest rates start to slowly rise, carriers in the long-duration insurance market may be prudent to react given past interest rate trends to be competitive in the annuity market. Leveraging lessons learned during prior periods of rising interest rates can better position carriers for long-term competitiveness and profitability, particularly for PRT cases.

1. Continued

(c) **(LO 1a, 1b, 3e)** 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

Commentary on Question:
Most candidates made a recommendation with appropriate justifications. Partial credits were given to candidates who provided reasonable analysis but did not get to enough details. No points were given if the candidate made a recommendation without explaining the reasons, or the reasons given were not correct.

Option 1 - Enter the PRT market:

I recommend that the company enter the PRT market.
The PRT market is a massive opportunity for expansion for ABC with PRT transactions often worth premiums of hundreds of millions or even billions of dollars. Additionally, ABC may be average to leverage some of its experience on fixed annuities to developed customized mortality assumptions for each PRT transaction.
In contrast, the SS market is a niche market. Additionally, the complexities of setting unique mortality assumptions, factoring in level of impairment, may be a challenge for ABC since the mortality curve of structured settlements can differ than traditional annuities or retirement annuities.

Option 2 - Enter the SS market:

I recommend that the company enter the SS market.
Of the two new markets proposed, SS is more appropriate for ABC due to the size of the company. PRTs are generally large deals which can be thought of as mini-M&As. ABC may not have the infrastructure to handle such a financially large block of business.
In contrast, SS is a niche market with annuities used to fund tort settlements. ABC's experience with fixed annuities would be a benefit while entering the SS market.

1. Continued

Option 3 - Focus on growth of WL business:

I recommend that the company grow its WL business.
In a period of sustained low interest rates followed by a moderate increase in recent years, ABC should focus on product designs that perform well in rising interest rate environments, such as Whole Life. Historically, WL products have performed well in dramatically changing interest rate environments due to their simple design.
The company should focus on WL over UL because it is less interest sensitive. In the UL line, the company may need to adjust COIs to stay profitable.

Option 4 - Focus on growth of FA business:

I recommend that the company grow its FA business.
As a small company, ABC may not have the appropriate infrastructure to expand its product offerings; however, in the current period of heightened mortality, the company may be able to see profits on their annuity business.
While expanding its FA business, ABC should increase the use of reinsurance to aid profitability, provide reserve relief, and to use offshore reinsurance transactions utilized to better recognize asset-liability-management and allow for access to a broader range of investment options.

2. Learning Objectives:

4. The candidate will understand various techniques for addressing the mitigation of risk within a life insurance and annuity context.

Learning Outcomes:

(5e) Describe basic terms, concepts, and types of life insurance reinsurance arrangements

Sources:

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

Commentary on Question:

The question tested the candidate's understanding of a variety of types of reinsurance transactions, how to prepare financial statement entries, and the NAIC's model regulations on acceptable risk transfer. Overall, candidates did reasonably well on this question. Candidates performed the best on part a.

Solution:

(a) **(LO 5e)** 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.

(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.

2. Continued

(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.

(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.

(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.

Commentary on Question:
Candidates performed well on this question. Candidates who selected the appropriate method of reinsurance and described why the method was the best choice received full credit. Credit was also given for other methods of reinsurance that were appropriately justified. Many candidates did not recognize that part (iv) was a non-proportional reinsurance structure.

(i) Recommend coinsurance. Coinsurance will reduce the balance sheet and free up surplus. It is also efficient and quick to administer. Assumption reinsurance is not appropriate in this scenario because Company A wishes to reduce the size of the balance sheet immediately.

(ii) Recommend modified coinsurance. Modified coinsurance allows Company B to mitigate its lapse risk without reducing its total invested assets or reserves, as opposed to coinsurance. Company B also prefers to have frequent cash flow settlements, which would happen with modified coinsurance, but not with funds withheld modified coinsurance.

(iii) Recommend YRT. This will allow the ceding company to reduce their exposure to mortality risk. YRT is also a fast and efficient solution and is low cost.

(iv) Recommend stop loss reinsurance. Company D seeks to reduce excess risk, which is best handled by stop loss reinsurance. This type of reinsurance will also be low cost, which will allow Company D to retain profit generated from mortality and investment experience.

2. Continued

(v) Recommend modified coinsurance. Modified coinsurance will not alter the asset positions of the ceding company and thus not affect the portfolio. Although a funds withheld could also aim to achieve this, the alternative assets may cause additional regulatory scrutiny under this structure. Thus, modified coinsurance is the best choice.

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

(i) Initial reinsurance premium

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

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

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

Commentary on Question:
Candidates needed to be able to demonstrate their understanding of how reinsurance of in-force business is calculated. Full credit was awarded for a correct response to each part, including work shown. Candidates received partial credit for each result they correctly calculated for a particular quote.

(i) The initial premium is based on a pro-rata share of the reserve backing the policies to be reinsured.

Initial Premium = quota share * reserve inforce

Quote #	**Initial Premium**
Quote 1	=80% * 2,200,000,000 = 1,760,000,000
Quote 2	=75% * 2,200,000,000 = 1,650,000,000
Quote 3	=75% * 2,200,000,000 = 1,650,000,000

(ii) For Quote 1, the initial amount is equal to the ceded premium less allowance less the modco reserve adjustment. Thus,

initial amount due = initial premium - initial allowance – modco reserve adjustment

initial amount due = 1,760,000,000 – 1,760,000,000 * 9% – 1,760,000,000
= -158,400,000

2. Continued

For Quote 2, the initial amount is equal to the ceded premium less allowance. Thus,
initial amount due = initial premium - initial allowance

= 1,650,000,000 – 1,650,000,000 * 10%
= 1,485,000,000

For Quote 3, the initial amount due is 0 because it is a funds withheld basis where the new position is reflected via payable / receivable. Thus,

initial amount due = 0

(iii) On a Coinsurance or Funds Withheld Coinsurance basis, the net reserve is simply the pro-rata share of the gross reserve (i.e., 25% of 2,200,000,000), while on a Modified Coinsurance basis, all assets are retained by the ceding company and therefore the net reserve is equal to the gross reserve. Thus,

Quote #	**Net reserve at reinsurance effective date**
Quote 1	= 2,200,000,000
Quote 2	= 2,200,000,000 * 25% = 550,000,000
Quote 3	= 2,200,000,000 * 25% = 550,000,000

(iv) In general, the invested assets are equal to the surplus and reserve, plus the initial gain (allowance) from the reinsurer. However, on a Funds Withheld Coinsurance basis, a paper liability (accounts payable) results in the invested assets remaining the same since no funds physically change hands.

First, the surplus = total invested asset – reserve inforce = 200,000,000

Quote #	**Net reserve at reinsurance effective date**
Quote 1	Invested assets = surplus + reserve from (iii) + allowance = 200,000,000 + 2,200,000,000 + 1,760,000,000 * 9% = 2,558,400,000
Quote 2	Invested assets = surplus + reserve from (iii) + allowance = 200,000,000 + 550,000,000 + 1,650,000,000 * 10% = 915,000,000
Quote 3	invested assets = original total invested assets = 2,400,000,000

2. Continued

(c) **(LO 5e)** 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%.*

(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.*

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

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

Commentary on Question:
To receive full credit, candidates needed to not only say if they agreed or disagreed with the statement, but needed to explain why the statement was correct or incorrect. For statements that could violate model regulations, alternative options were required for full credit. Credit was also given for other reasonable responses.

(i) The constant modified coinsurance interest rate is inappropriate. XYZ should use a rate that references actual asset performance, otherwise risk transfer will not be met.

(ii) Assumption reinsurance transfers policy obligations directly to the assuming insurer, and therefore would not permit recapture. Indemnity reinsurance should be used if recapture is a requirement.

(iii) There is nothing wrong with the structure in settlement frequency as it is more frequent than quarterly. The experience refund is also acceptable since it appears that the risk to the reinsurer is not eliminated (e.g., by requiring the ceding company to subsidize losses)

2. Continued

(iv) This structure is also known as partially modified coinsurance. An increase in quota share when reserves increase may not be appropriate as some states may not allow it, thereby losing any reserve/surplus credit. It would be preferable to choose a reinsurance method with clearer risk transfer that requires the reinsurer to pay for its share of cash losses, such as traditional modified coinsurance.

4. Learning Objectives:

2. The candidate will understand different types of actuarial assumptions and how experience studies are designed and used for evaluating past experience and for setting assumptions.

3. The candidate will understand common issues and practices related to Product Management.

Learning Outcomes:

(2e) Describe the process and apply techniques for experience studies

(2b) Describe and evaluate mortality, lapse, premium persistency, term conversions and utilization assumptions used for various purposes, and apply methods and techniques for their development

(3a) Describe and assess insurance and annuity distribution approaches and underwriting approaches

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

Commentary on Question:

This question tested the candidates' knowledge of how experience studies are used for evaluating past experience and for setting assumptions. It also tests the candidates' knowledge about how an accelerated underwriting (AUW) program helps to achieve mortality at a level closer to a fully underwritten process compared to nonmedical underwriting. Most candidates did well on part a). Candidates did not perform as well on part b).

Solution:

(a) **(LO 2b, 2e)** 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.

Commentary on Question:

For part a), candidates were expected to comment on the source of business differences between immediate annuities and structured settlements – age and significant impairment of structured settlement lives would be required for full credit.

Most candidates did well on this part. This included stating the approach was not appropriate and providing justification including younger age of structured settlement demographics or injury/impairment creating higher mortality risk relative to demographics purchasing an immediate annuity. The candidates were expected to mention specifically higher mortality from structured settlements instead of simply different mortality compared to immediate annuities.

4. Continued

Immediate annuities often attract buyers who are healthier than average and at risk of outliving their savings:

As with life insurance products, larger amounts are often associated with lower mortality. In the case of immediate annuities, the best amount to study is the monthly income amount.

Immediate annuity studies are needed to help quantify historical mortality improvement. This can be difficult because so many variables need to stay constant to develop accurate comparisons. For example, how immediate annuities are sold or bought and what competing options are available can vary over time and consequently affect the expected mortality of new buyers.

Structured settlements often arise from injury lawsuits. Their terms are sometimes decreed by a court of law but are more often the result of negotiated settlements.

Typically, the structure of the payments is not a single monthly amount payable for life. Instead, there may be one or more lump sums and some payments that increase over time, with a goal of providing for the injured person or, in some cases, the surviving dependents of the plaintiff.

Mortality levels for structured settlements would normally be higher than those for immediate annuities. The most severely injured payees would be expected to live shorter lives and may thus qualify for substandard underwriting, which would provide greater annuity benefits

When studying mortality by the amount of a structured settlement, reserves are not a perfect choice for the amount but are often a better choice than a monthly income amount that varies. The premium paid to purchase the structured settlement might be a better choice of amount, but most companies don't store the premium in their administration system.

(b) **(LO 2b, 2e, 3a)** 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

4. Continued

Commentary on Question:
For part b), candidates were expected to explain how each component helps to achieve mortality at a level closer to a fully underwritten process.

Candidates had mixed performance on this question, but most had a fundamental understanding of these AUW components. Points were most frequently missed by not adequately explaining how these AUW components can help get mortality closer to that of fully underwritten business. This includes not only stating that smoker propensity model identifies smoking status, but also an accurate model should lower the cost of misclassifying smokers as non-smokers as smoking status is highly correlated with mortality. In terms of triaging rules, to receive full credits, candidates were expected to expand on the desire to reduce mortality slippage to get AUW mortality closer to FUW.

Smoker propensity models – these lower the cost of misclassifying smokers, whose mortality is frequently 3 times as high as nonsmokers. Without such a model, non-medical underwriting is prone to greater misclassification with the loss of ability to detect cotinine in urine or blood.

Risk score model – risk scores are frequently used to classify risk in much the same way an underwriter would. A better risk scoring model will result in more distinct relative A/E ratios, while a poor model will fail to adequately distinguish relative risk.

Prescription / Rx data – Rx data is frequently an input into a risk scoring model that helps identify potential impairments requiring drugs to treat that could explain or predict higher mortality associated with that impairment.

Medical records / Dx data – Dx data, similarly to Rx data, may be used by a rules engine or as an input into a risk scoring model to predict relative mortality in relation to health insurance claims and other data embedded in medical records.

Triage rules – these rules help determine the optimal amount of screening for a given applicant. It can fast track good risks, but arguably more importantly, has criteria determining which applicants must be referred to an underwriter for a more traditional underwriting experience. For applicants whose predicted mortality is more uncertain or more likely to be higher than can be tolerated, this helps reduce mortality slippage in an AUW program.

5. Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.

2. The candidate will understand different types of actuarial assumptions and how experience studies are designed and used for evaluating past experience and for setting assumptions.

Learning Outcomes:

(1a) Describe and compare various life insurance and annuity product designs

(1b) Evaluate and apply pricing practices for life and annuity products

(2a) Describe types of actuarial assumptions commonly used for life insurance and annuity actuarial functions

Sources:

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

Commentary on Question:

Candidates were generally able to list much of the appropriate content and showed knowledge of the concepts making the question reasonably well done overall. Few were able to demonstrate a complete depth of understanding which was needed to get full marks.

Solution:

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

Commentary on Question:

Many were able to list 2 or 3 solid reasons. Often candidates repeated the same item twice but in different words or gave a reason quite similar to one they had already given which was not sufficient for full marks.

5. Continued

-It would transfer investment and longevity risk from DNS to ONA which are significant components in the cost of a benefit plan. ONA has more experience managing these type of risks.
-If a buy-out transaction was used this would also transfer a lot of administrative and operational work to ONA allowing DNS to focus on their specialty of legal work.
-Life insurers are well-regulated and the plan members generally have increased confidence in their benefit payments being made when pensions are transferred to insurers. So a plus for the DNS plan members.
-Insurers have access to their interest and industry experience data which may allow ONA to offer a more competitive quote.

(b) **(LO 1a, 1b, 2a)** 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.*

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

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

Commentary on Question:
Candidates typically showed understanding of the concepts and could respond to the statements. A proper critique or opinion was required for full markets. Listing some relevant content but leaving the response too open ended only earned partial credit. For part (iii) some candidates simply stated stochastic models as the better approach but without giving some context or justification.

(i) This is not an appropriate plan. Individual and Group annuity experience are often different due to the nature of who uses each product. Individual annuities are selected by individual customers where group contracts are generally based on the customers type of employment. This can cause differences in data. ONA would be better to look at internal group data and supplement it with relevant industry data for group products.

(ii) This is not the case. For a well established life insurer typically the best way is to naturally hedge longevity risk with products containing mortality risk like permanent life insurance or term insurance. It does not appear ONA has mortality risk products based on their specialties listed, but this is the first suggestion. Reinsurance can still be a tool but not the best way to mitigate longevity risk.

5. Continued

(iii) A deterministic model with a single set of assumptions is not sufficient. Experience can vary and it is unlikely that one model will have every assumption precisely accurate. Sensitivity testing a variety of assumptions in a deterministic model can work to assess the range and magnitude of possible risks. Depending on the size of risk and length of contract a stochastic model for interest rates or mortality may also be appropriate. But either way a deterministic model with one set of assumptions will not suffice to assess the potential risks.

~~(c) **(Not Relevant)** 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.~~

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

~~**Commentary on Question**:~~
~~*Many candidates could list 3 or 4 key challenges but often missed some points in not truly describing them and why they caused premium rate increases. Part (ii) was not well done. Many candidates listed a solution but did not connect it to what challenge it was trying to address or give sufficient detail to support why their proposed strategy would be beneficial.*~~

~~(i)~~
~~1. Lapse rates were much lower than expected. Because there was no benefit from surrendering policyholders developed a 'use it or lose it' mentality and held onto the policies longer than expected or even incentivized them to go on claim resulting in higher likelihood of claims payout.~~
~~2. Mortality improvement was higher than expected and mortality lower than expected. People living longer led to longer time when on claim, and less terminations due to death, and thus higher amount of benefits being paid~~
~~3. Interest rates turned out to be much lower than originally forecasted when the products were initially priced. The investment return was a large component of the product as the product is a longer duration product. The expectation was investment returns would support the pricing but low interest rates led to low investment returns.~~
~~4. Inflation and long-term care costs were higher than expected. The cost of LTC increased substantially between when the products were initially priced and when the majority of people started making claims. There was no mitigation for inflation in the premiums.~~

5. **Continued**

~~(ii)~~

~~To address that lapse rates were much lower than expected and that policyholders developed a 'use it or lose it mentality' the company could add a return of premium or non-forfeiture benefit. The price of the benefit would need to be included in the overall price meaning customers would still have higher premiums, but a return of premium or other non-forfeiture benefit can encourage the policyholder to consider lapsing the policy if they haven't made a claim by a certain time period and thus reduce the risk of policies staying on longer than expected. Encouraging some lapsation shortens the overall duration of the product.~~

6. Learning Objectives:

2. The candidate will understand different types of actuarial assumptions and how experience studies are designed and used for evaluating past experience and for setting assumptions.

Learning Outcomes:

(2a) Describe types of actuarial assumptions commonly used for life insurance and annuity actuarial functions

(2b) Describe and evaluate mortality, lapse, premium persistency, term conversions and utilization assumptions used for various purposes, and apply methods and techniques for their development

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

Commentary on Question:

This question tested candidates' knowledge on various aspects of term conversions. Candidates were also required to understand the impact on mortality assumptions for converted policies. Overall, candidates performed better on the first part of the question compared to the second part.

Solution:

(a) **(LO 2a, 2b)** 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.

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

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

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.

6. Continued

Commentary on Question:
Candidates generally did well on this part. For Statement A, full marks were given for stating either 'True' or 'False' given reasonable justification. A common error for Statement D, was describing the different ways the conversion cost charge could be distributed. Some candidates did not indicate if they agreed or disagreed with the statement so full credit wasn't given when this happened.

Statement A – This statement is partially true.
Although this situation is ideal in theory, based on the nature of mortality selection on converted policies, the rate scales would likely need to be separate from other permanent products and create administrative complexity that may be difficult to manage.

Statement B – This statement is false.
Generally speaking, the older the issue age, the higher the excess mortality. Therefore, policies issued to older people who convert at a later stage of the level term period tend to have higher claims costs.

Statement C – This statement is false.
When conversion privileges are shortened, it would be reasonable to expect policyholders to accelerate their conversion decisions while they still have the option. The earlier the conversion, the younger the policyholder, the lower the claim costs, the lower the premium.

Statement D – This statement is false.
It is more appropriate to separate converted policies' mortality experience from the permanent products due to the following reasons:

- Converted permanent products generally have higher mortality experience than permanent policies bought outright.
- Experience could vary significantly by the motivation of the policyholders who exercise the conversion option. For example, for a 10-year term life product, the first 9 years of experience would likely see very low conversion rates and impact on the permanent policies' experience will be minimal while year 10 could see a jump in conversion rates and cause the mortality of permanent products suddenly spike, if blending the two for experience study.

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

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

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

6. Continued

Commentary on Question:
Many candidates did not do well on this part of the question as they were unable to identify the approaches for developing mortality assumptions for converted policies. Some candidates described options as to where to add the additional premium for the conversion option rather than describe methods to develop the mortality assumption for converted policies. Many candidates also erroneously referenced Dukes-McDonald or Becker-Kitsos. Although there are three distinct approaches, full marks were given to candidates for identifying and explaining any two approaches.

First Approach - Estimate the mortality rate on converted policies by making an assumption of the degree of anti-selection using the principle of "conservation of deaths".

Advantage – It more accurately reflected the characteristics and risks associated with the converted policies.

Disadvantage – An assumption about the degree of anti-selection is required. Anti-selection refers to those insured whose health has deteriorated are more likely to convert in order to maintain their insurance coverage since they cannot qualify for newly underwritten term insurance and the current term insurance may expire or have rapidly rising premiums.

Second Approach – Blend the experience of the permanent product and the converted policies and conduct a combined experience study for the two.

Advantage – More data will increase creditability; lead to assumption more tailored for the company's experience.

Disadvantage – Since converted permanent products generally have higher mortality experience than permanent policies bought outright, blending the experience of the two might make overall mortality for a given product appear artificially high. The premium for permanent products would reflect the excess death experience due to conversions.

Third Approach – Conduct a separate mortality study for converted policies, if there is adequate data.

Advantage – More accurately reflected the characteristics and risks associated with the converted policies.

Disadvantage – If there is inadequate data, will need to determine the credibility.

7. Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.

2. The candidate will understand different types of actuarial assumptions and how experience studies are designed and used for evaluating past experience and for setting assumptions.

5. The candidate will understand various techniques for addressing the mitigation of risk within a life insurance and annuity context.

Learning Outcomes:

(1c) Describe and apply the common profit metrics (IRR, Value of New Business, Embedded Value, ROE) used in pricing insurance products
(2a) Describe types of actuarial assumptions commonly used for life insurance and annuity actuarial functions
(2b) Describe and evaluate mortality, lapse, premium persistency, term conversions and utilization assumptions used for various purposes, and apply methods and techniques for their development.

(5e) Describe basic terms, concepts, and types of life insurance reinsurance arrangements

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

Commentary on Question:
The candidates did an average job answering this question. In section (a) and (c), most answers relied on overall actuarial knowledge, which was duly rewarded. However, considering the intent of these exams, the better answers drew upon the readings from the syllabus. Section (b) was a bit surprising due to the difficulty a fair number of candidates had in identifying the MCEV formula, a key concept.

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

7. Continued

Commentary on Question:
Partial credit was given if the answer was actuarially sound but did not appear in the solution. Optimal answers discussed both advantages and disadvantages. At times the key aspects of MCEV vs accounting based metrics were switched.

Advantages:

- MCEV recognizes the relative riskiness of different business lines better than accounting based metrics.
- MCEV better addresses the long-term nature of the life insurance business.
- MCEV values assets and liabilities on a market-consistent basis to capture their value at the time of valuation.
- MCEV provides a common methodology for comparison that is missing due to the differences in rules and practices between statutory, local GAAP, and IFRS accounting.

Disadvantages:

- Accounting based metrics provide more transparent profit indicators.
- Accounting-based metrics are straightforward and easy to access.
- MCEV has lost some steam after the financial crisis as investors concentrate less on long term cash flows and become more concerned with current cash generating power.

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

Commentary on Question:
Straightforward calculation question that required the candidate to properly use Market Consistent Economic Value (MCEV) and Value In Force (VIF) equations. Partial credit given if the correct equation was listed and the numerical answer was not correct. A common error was that candidates confused required capital and frictional costs of required capital in the equations.

	VIF=Present Value of Future Profits-Time value of financial options and guarantees-Cost of residual non-hedgeable financial and insurance risks-Frictional costs of required capital	MCEV=VIF + Required Capital + Free surplus
Whole Life	=3000-100-250-50-40=2560	=2560+900+200=3660
Term Life	=1500-2000-200-500-20=-1220	=-1220+500+500=-220
Universal Life	=2000-120-150-50-30=1650	=1650+700+300=2650

7. Continued

(c) **(LO 2a, 2b, 5e)**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

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

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

Commentary on Question:
Partial credit was once again given for actuarial sound analysis with the better answers using insight directly form the syllabus.

(i) While improving customer service may improve customer persistency, it is important to realize that if this is a lapse supported product, it would harm profitability. Answers that mentioned the generally superior profitability of a Universal/Whole Life product compared to Term Life products, also received some credit.

(ii) Anti-selection should be a key concern when upselling policyholders to a permanent policy due to high risk policyholders oversubscribing to this conversion. Additional underwriting or data analytics may diminish this risk. Reputational risk may also be an issue if a policyholder denied the option to convert was to find out about the missed opportunity.

(iii) Before recapturing a reinsurance block of business, it is important to understand the implications of any recapture fees. It is also important that the ceding company understands the causes of the higher mortality found in the reinsurance agreement. The reinsurer may have additional insight into the block of business the ceding company does not have.

Fall 2024 LPM Exam

1. Learning Objectives:

3. The candidate will understand common issues and practices related to Product Management.

Learning Outcomes:

(3d) Describe standards for illustrations in both the United States and Canada

Sources:

ILA101-109-25: PLACEHOLDER – New illustration paper

Commentary on Question:

The question was to test the candidate's knowledge of illustrations. Overall, many candidates didn't answer this question well. Many candidates misinterpreted what information was being asked for and provided irrelevant responses. Part (c) was generally the most poorly done, while (a) and (b) received partial credit. Answers were largely consistent across candidates with most credit being received for the same sections.

Solution:

(a) **(LO 3d)** 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

(ii) Policy Values

(iii) Illustration Scenarios

Commentary on Question:

Many candidates recognized the second scenario should be less favorable or assumptions should have been provided. Many critiques provided on Information and Values were irrelevant. Most candidates lost points as they didn't state the generic product description, the abbreviation of CSV should not be used in the illustration, or note that the start date of the illustration was incorrect.

1. Continued

(i).

- The product name should avoid company-specific or product-specific terminology that does not clearly indicate the nature of the product. A consumer-friendly description should accompany the terminology. The product appears to be paid up at age 65 but is not stated in the description.
- Since the illustration states that the policy has a loan balance, the current policy loan value should be disclosed.

(ii).

- The illustration does not specify which values are guaranteed vs non-guaranteed which is required in an illustration.
- CSV should be written out as cash surrender value. All terminology should be evaluated carefully to determine whether it is understandable by a reasonable consumer. If the terminology could be misinterpreted or is not likely to be understood by a reasonable consumer, it should be avoided.
- An in-force illustration should reflect the current status of the policy. This illustration shows scenario values since inception of the policy instead of actual current cash value and dividend accumulations.

(iii).

- An illustration should include at least two scenarios. One of these scenarios, the primary scenario, should be drawn from an identified range of scenarios that the insurer judges as reasonable. The second scenario should be less favorable than that primary scenario.
- The illustration does not outline the key assumptions used within the scenarios as required.

(b) **(LO 3d)** 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.

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

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

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

1. Continued

Commentary on Question:
Majority of candidates didn't separate section b from section a, and commented specifically in relation to the case illustrated above. They missed many of the points as they weren't commenting on the statements themselves in isolation. Most candidates didn't receive full marks as they didn't touch on the minimum guaranteed rate in (C) and scenarios should be review at least annually in (D).

(A).

- Illustrations are not meant to be predictive. The assessment that actual values of non-guaranteed elements may be higher than illustrated is not appropriate in an illustration.

(B).

- The statement accurately states that dividends are a non-guaranteed element.

(C).

- The illustration should indicate whether there is a minimum guaranteed rate and, if there is, what that minimum is or if a formula exists for determining the rate.

(D)

- The process of identifying a range of scenarios should be done at least annually. If the new identified range differs from the previous one, the new basis should be implemented within a reasonable period of time, i.e., 90 days. The scenarios should not be the same as those developed at pricing.

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

(i) The role of the actuary preparing an illustration

(ii) Illustration of non-guaranteed elements

(iii)Mortality assumptions

Commentary on Question:
This section of the question was very poorly answered, with no candidates receiving full marks. This section was frequently left blank. A few candidates received partial points most commonly for identifying US favorability rules or not allowing mortality improvement.

1. Continued

(i).

- In the US, an illustration actuary must be appointed in writing, and the actuary must meet the qualifications described in the Qualification Standards for Actuaries Issuing Statements of Actuarial Opinion in the US.
- Canada does not require appointment of an illustration actuary.

(ii).

- In the US, the illustrated scale must be no more favorable than the currently payable scale or the disciplined current scale at any duration.
- In Canada, at least two scenarios of non-guaranteed amounts should be displayed. One of these scenarios, the primary scenario, should be drawn from an identified range of scenarios that the insurer judges as reasonable. The second scenario should be less favorable than that primary scenario. Other scenarios are optional.

(iii).

- In the US, assumptions should be based on actual experience when available or other reasonable and appropriate experience from similar business. ASOP 24 specifies that no improvement in assumptions may be assumed beyond the effective date of the illustration.
- In Canada, the assumptions may be set as the insurer judges reasonable and should be disclosed in the illustration.

2. Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.

Learning Outcomes:

(1a) Describe and compare various life insurance and annuity product designs

(1b) Evaluate and apply pricing practices for life and annuity products

Sources:

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

Commentary on Question:

Commentary listed underneath question component.

Solution:

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

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

(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

Commentary on Question:

Candidates performed well in this section. For part (i), some candidates were not able to provide challenges specific to SLAC for implementing a hedging strategy. Partial marks were given for correct challenges identified without explanation. Candidates identifying that SLAC's small size makes it challenging to achieve economies of scale for hedge trades also received credit. For part (ii), most candidates were able to correctly identify the call and put option combinations needed to hedge SLAC's position for each RILA structure.

(i)

1. One challenge to SLAC for implementing an effective hedging strategy is operational complexity. Implementing and managing a hedging strategy requires sophisticated systems and expertise, which may pose challenges for smaller insurance companies or those with limited resources like SLAC.
2. Another challenge for SLAC would be counterparty risk. There is heavy reliance on counterparties for executing option trades. This exposes SLAC to counterparty risk, particularly in volatile market environments or during periods of financial instability.

2. Continued

(ii) To achieve the current 15% cap and 10% buffer structure, SLAC would need to:

- Buy at-the-money call option
- Sell 15% (cap) out-of-the-money call option
- Sell 10% (buffer) out-of-the-money put option

To achieve a structure of 15% cap and 10% floor, SLAC would need to:

- Buy at-the-money call option
- Sell 15% (cap) out-of-the-money call option
- Sell at-the-money put option
- Buy 10% (floor) out-of-the-money put option

(b) **(LO 1a, 1b)**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.*

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.*

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.*

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.*

Commentary on Question:
Most candidates were able to identify the valid and invalid statements for this question. Candidates earned full credit by critiquing each statement, explaining its correctness or identifying inaccuracies and providing corrections or clarifications where necessary.

2. Continued

A) This statement is incorrect.

SLAC is required to include an interim value calculation to determine the death benefit, withdrawal amount, annuitization amount, or surrender value at any time other than the start date and end date of an index term. They also require an interim value calculation due to the risk of potential mismatches between the account value and the option portfolio within an index term.

B) This statement is incorrect.

The market value approach to the interim value calculation is preferred by regulators and minimizes insurance company balance sheet volatility compared to the pro-rata approach. The pro-rata approach is less complicated and easier to explain to advisors and contract holders.

C) This statement is partially correct.

The interim value lock feature can either be automatic or manual.

The automatic lock is based on a target interim value, which can be reset after issue if a lock has not already taken effect. If the closing interim value hits the target, the lock is automatically invoked and cannot be changed.

The contract holder can elect a manual lock during the index term on any day other than the anniversary to lock in the day's interim value as of the market close. A manual lock cannot happen at previous day's market close.

D) This statement is incorrect.

SLAC is exposed to hedging risk. Once a lock is invoked, the hedging needs to be readjusted to reflect the new floor. The use of options requires expertise in hedging, investments, asset liability management, and contract design. Other risks, such as administration risk and operational risk, would still remain.

(c) **(LO 1b)**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.

Commentary on Question:
Candidates generally did well on this part. Candidates who correctly applied participation rates, caps, buffers, and floors and demonstrated the difference between annuity product mechanics received full credit. Candidates that only calculated the rates but not the account values received partial credit.

2. Continued

For policy 1, some candidates failed to apply the 70% participation rate correctly, while other candidates incorrectly applied a cap or floor.

Candidates did well calculating the account value progression for Policy 2.

For policy 3, some candidates failed to correctly apply the cap, while other candidates incorrectly applied the participation rate from policy 1.

For policy 4, some candidates failed to apply the cap and buffer correctly, while other candidates incorrectly applied the participation rate from policy 1.

The solution is in Excel.

3. Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.

Learning Outcomes:

(2b) Describe and evaluate mortality, lapse, premium persistency, term conversions and utilization assumptions used for various purposes, and apply methods and techniques for their development

(2e) Describe the process and apply techniques for experience studies

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

Commentary on Question:

Commentary listed underneath question component.

Solution:

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

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

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

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

Commentary on Question:

The question assessed candidates' understanding of how predictive analytics could impact underwriting and modelling. Most candidates scored fairly well, as they were able to demonstrate an understanding of the implications of using predictive analytics.

For statement A, candidates received full credit if they were able to elaborate on why the statement weas true, and that traditional A/E analysis was no longer necessary.

For statement B, to receive full credit, candidates needed to elaborate on how predictive modeling is applied when lacking data at older ages. Strong responses included examples such as extrapolating data for older ages or the need for utilizing industry data.

3. Continued

For statement C, candidates received partial credit if they indicated that there may be challenges in applying the refined assumptions in both the pricing and valuation models. Full credit was granted to candidates who indicated that there are may be unique challenges to apply predictive analytics to valuation models.

Statement A: This statement is correct. Predictive analytics will allow EFG to use new factors in addition to traditional ones to have a better understanding of the drivers of experience and the relationship among various factors. EFG no longer needs to rely on the A/E results, as they may not be credible with new factors.

Statement B: This statement is correct. Predictive analytics is better than traditional modelling in developing assumptions where experience is missing, especially at older ages. However, it may still require judgment or the use of industry data due to the lack of data available at older ages.

Statement C: The more refined assumptions may be challenging to apply in both the pricing models and the valuation models. It's likely more challenging for valuation models, as pricing models can be more dynamic and can often accommodate adjustments and refined assumptions more easily.

(b) **(LO 2b, 2e)** 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.

Commentary on Question:
Full credit was given for a full explanation for each of the four activities. Partial credit was given for an incomplete explanation or for only listing the activity. Candidates did reasonably well on this question. Most candidates did correctly discuss Variable Transformation and Partitioning the Model Set. Somewhat fewer candidates discussed Exploratory Data Analysis and fewer still discussed Variable Generation.

1. Variable Generation
This is the process of creating variables from the raw data. Each data field is assigned a name and format. Data fields can be combined to generate additional fields, such as using height and weight to calculate the body mass index (BMI).

2. Exploratory Data Analysis
This process involves building an understanding of the properties of each variable, such as min, max and mean. This process allows one to understand the data and may determine if there are any data issues. After the initial analysis, a

univariate analysis can be conducted to determine the relationship with the target variable.

3. Continued

3. Variable Transformation
This process helps to find and address defects in the data. Data issues can be mitigated by:

i) Grouping excessive categorical values;
ii) Replacing missing values;
iii) Capping extreme values or outliers;
iv) Capturing trends

4. Partitioning the Model Set
The data is divided into 3 equal parts: Train, Validation, and Test sets. The Train and Validation sets are used to build the model, and the Test set should be used to assess the appropriateness of the model. Afterwards, a fairly complex and iterative process is used to determine the most appropriate model for the particular dataset.

~~(c) **(Not Relevant)** 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.~~

~~**Commentary on Question**:~~
~~*To receive full credit, candidates were required to identify and describe two actions EFG can take to guard against anti-selection and describe how they prevent anti-selection when using predictive modeling for underwriting. No credit was given for actions that did not prevent anti-selection from using predictive modeling.*~~

~~*Many candidates correctly identified that being able to randomly select a percentage of applicants to go through full underwriting was an appropriate action. However, very few candidates also listed the use of third-party marketing data as an action to guard against anti-selection.*~~

~~EFG can randomly select a percentage of applicants, who would have otherwise forgone additional requirements, to go through traditional underwriting. This will allow EFG to disguise the profile of applicants who are eligible for streamlined underwriting and offer a baseline for monitoring results.~~

~~EFG can also use third-party marketing data as input into the predictive model. This data cannot be easily manipulated by applicants as it is reported directly by third-party agencies and is based upon trends captured over time rather than sudden changes in behaviour.~~

4. Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.

Learning Outcomes:

(1c) Describe and apply the common profit metrics (IRR, Value of New Business, Embedded Value, ROE) used in pricing insurance products

Sources:

ILA101-102-25: Understanding Profitability in Life Insurance

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) **(LO 1c)** 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.

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.

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.

Commentary on Question:

In critiquing the statements most candidates got part credit – usually missing the accuracy of one or more parts of the statements.

4. Continued

A Statement is partly true. ROE provides a portfolio level (and not product level view) of earnings performance. It tends to be more volatile, not less, than book value per share. Its correlation with the price-to-book ratio is true.

B. Statement is partially true. Operating margin does capture the earnings trend but does not reflect the timing or riskiness. It does vary by different countries regulatory regimes.
C. Statement is incorrect. Liabilities are valued on a Market Consistent Basis and not by book value. MCEV consists of three components including free surplus.

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

~~(iii) Steering liability portfolios~~

~~(iv) Increasing persistency~~

~~(v) Improving claims management~~

~~**Commentary on Question**:~~
~~*On part (i) a number of candidates focused on assets rather than liabilities. Parts (ii) and (iii) were generally better done with most candidates getting half or more of the available grading points.*~~

~~(i) -Redesign products to have lower guaranteed benefits.~~
~~-Add profitable business through cross and up-selling~~
~~-Consider selling or reinsuring unprofitable blocks~~

~~(ii) -Increase involvement with the consumer through current and new communication channels.~~
~~-Consider premium holidays to retain valued clients~~

~~(iii) -Invest in improving operational efficiencies to speed up claim times.~~
~~-Communicate with clients to explain what their policies cover and what they don't.~~
~~-Improve fraud detection through training and software if necessary~~

~~(c) **(Not Relevant)** 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.~~

~~B. Discuss the advantages and disadvantages of each approach.~~

4. Continued

Commentary on Question:
This part was generally very well answered with many candidates receiving all or most of the grading points. Many combined A and B, which was fine

A. -Simplified Re-Underwriting Approach – Client is sent a simplified underwriting questionnaire to determine risk class. If not answered client defaults to traditional YRT rate.
-Graded Approach – rates are increased in smaller steps rather than jumping to the YRT schedule immediately.
-Class-Continuation Approach – Rate increase varies based on the risk class at issue.

B. -Simplified Re-Underwriting: Advantage- Insurer has confidence in risk class – Disadvantage – May increase lapses by warning clients of impending – increases
Graded Approach: Advantage-The smaller steps appear to lower lapses – Disadvantage – More complex administration and no credible YRT – experience data as yet
Class-Continuation: Advantage – Considered the fairest approach – Disadvantage- Preferred risks will have the steepest increases to the ultimate – rate

5. Learning Objectives:

5. The candidate will understand various techniques for addressing the mitigation of risk within a life insurance and annuity context.

Learning Outcomes:

(5e) Describe basic terms, concepts, and types of life insurance reinsurance arrangements

Sources:

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

Commentary on Question:

This was a challenging question for candidates where the concepts were generally understood but had difficulty putting them into clear practice with the calculations.

Solution:

(a) **(LO 5e)** Explain the advantages and disadvantages of each reinsurance proposal for ABC.

Commentary on Question:

Candidates generally had a pretty good grasp of the key advantages and disadvantages of the reinsurance types.

Coinsurance Advantages

- Relatively simple to administers and well understood by regulators. Provides for a clear transfer of risk.
- As all risks are reinsured the accounting is simpler as a % of all premiums, claims, reserves, etc. are transferred.

Coinsurance Disadvantages

- Main disadvantage is the need to transfer assets from insurer to reinsurer. This brings exposure to credit risk of the reinsurer and investment strategy of the reinsurer
- If the reinsurance is terminated the reinsurer must transfer assets back which could lead to capital gains implications

5. Continued

YRT Advantages

- Typically a cheaper form of reinsurance as it is focused just on mortality risk
- Limits the reinsurance exposure to investment risk as unlike coinsurance assets are not transferred.
- The reinsurance pricing and yearly renewable feature may be competitive leading to lower cost

YRT Disadvantages

- The lower cost may lead to less possible future profits
- Also not the best form of reinsurance for surplus relief

(b) **(LO 5e)** 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.

Commentary on Question:
Many candidates understood the main point of why the gain from operations may be different with reinsurance. Some candidates got confused with other concepts and put information that was not relevant.

When facilitating reinsurance XYZ will incur its own maintenance and acquisition costs/expenses to process and assess the deal. These costs would not exist if it was just being assessed by ABC without reinsurance. These additional costs are why XYZ Re's gain from operations will not exactly mirror ABC's gain on a proportionate basis.

(c) **(LO 5e)**

(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.

(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.

Commentary on Question:
Candidates did reasonably well here. Many understood what was being asked and how to get at the answer. Few got full marks often missing a piece of the complete calculation along the way but still showed good understanding.

See accompanying Excel file.

5. Continued

(d) **(LO 5e)** 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.

Commentary on Question:
This question was very challenging for candidates. Many did not understand what was being asked or how to formulate a response. For those that did respond there was confusion about what were the relevant parts of the question to use and how to apply them in formulating a response.

See accompanying Excel file.

6. Learning Objectives:

1. The candidate will understand the designs of the common Life and Annuity products and their associated features and inherent risks, and the methods to design and price these products.

2. The candidate will understand different types of actuarial assumptions and how experience studies are designed and used for evaluating past experience and for setting assumptions.

3. The candidate will understand common issues and practices related to Product Management.

Learning Outcomes:

(1a) Describe and compare various life insurance and annuity product designs
(1b) Evaluate and apply pricing practices for life and annuity products
(2a) Describe types of actuarial assumptions commonly used for life insurance and annuity actuarial functions
(2b) Describe and evaluate mortality, lapse, premium persistency, term conversions and utilization assumptions used for various purposes, and apply methods and techniques for their development
(3c) Recommend and justify changes to non-guaranteed elements

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

Commentary on Question:

This question tested candidates' knowledge and understanding about "lapse-supported" insurance, the criteria of the actuary's principle and the relevant characteristics of product, and life insurance product feature and finance. The candidates are expected to demonstrate how to analyze the data and establish the appropriate assumptions commonly used in actuarial pricing and product development. The candidates are also expected to describe nonguaranteed elements (NGEs) and apply requirements of applicable ASOPs.

6. Continued

Solution:

(a) **(LO 1a, 1b, 2a)** 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.

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.

C. For a non-participating whole life product, cash values are fixed at issue, making current interest rates irrelevant to the consumer.

Commentary on Question:
In general, most candidates were able to articulate 20-pay limited pay may cause lapse-supportedness and adding the ROP can make the product more lapse-supported. However, most struggled with explaining why a product is lapse-supported (i.e. not paying the fair assets share or cash surrender value and competitive pricing are the drivers for lapse-supportedness). Most candidates did reasonably well in part (B) and articulate that the CMO is important in the designing and marketing of the products. Candidates did not do as well on part (C) as they did not articulate how interest rate change can impact the company's earnings and well non-forfeiture values but most able to articulate the disintermediation risk from lapse/surrender.

(a)

A – False:

- All limited pay policies have a degree of lapse support, but most are purely technical and will not cause problems for the company.
- Adding a ROP rider will result in backloaded pay out and convert the policy to be lapse supported.
- It is the cash values (which are benefits paid early) that help lower the degree of lapse support.
- Unrealistic lower initial premiums along with high ultimate lapse rates can cause the product to be lapse supported.

6. Continued

B – First sentence is true but second is false for the following reasons since chief marketing officer would know:

- What's the intended design objectives of the product
- What's the intended market, anticipated sales, and the competitive alternatives to
- the product
- How the product will be sold, for example, underwriting, distribution, and marketing

C – First part is true but second part is false:

- Interest rates affect the nonforfeiture values required by the states

- Interest rates may affect sales since consumer may want higher cash values/ lower premiums from a UL policies the reflects current interest rate environment
- Interest rates also affect the premium that is charged since pre-tax income would increase/decrease with higher/lower interest

(b) **(LO 2a, 2b)** 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.

Commentary on Question:
Many candidates didn't do well on this calculation question. A common mistake was to calculate the duration 20 mortality rate by taking the weighted average of male and female mortality at attained age 65. A few candidates were able to receive the full credit by correctly calculating the blended lx and then duration 20 mortality rate.

$$Male\ L_{45} = Female\ L_{45} = 100{,}000$$

$$Blended\ L_{45} = 60\% \times Male\ L_{45} + 40\% \times Female\ L_{45} = 100{,}000$$

$$L_{x+1} = L_x * (1 - Q_x/1000)$$

$$Blended\ L_{x+1} = 60\% \times Male\ L_{x+1} + 40\% \times Female\ L_{x+1}$$

$$Blended\ Q_x\ /\ 1{,}000 = \left(1 - \frac{Blended\ L_{x+1}}{Blended\ L_x}\right) \times 1{,}000$$

6. Continued

Age	Blended Qx	Male lx	Female lx	60% Male lx	40% Female lx	Blended lx	Qx / 1,000
45	1.47	100,000.00	100,000.00	60,000.00	40,000.00	100,000.00	1.47
46	1.58	99,813.00	99,914.00	59,887.80	39,965.60	99,853.40	1.58
47	1.70	99,614.37	99,818.08	59,768.62	39,927.23	99,695.86	1.70
48	1.83	99,404.19	99,710.28	59,642.51	39,884.11	99,526.62	1.83
49	1.98	99,180.53	99,589.63	59,508.32	39,835.85	99,344.17	1.98
50	2.13	98,942.49	99,455.18	59,365.50	39,782.07	99,147.57	2.13
51	2.30	98,689.20	99,306.00	59,213.52	39,722.40	98,935.92	2.30
52	2.49	98,418.79	99,142.15	59,051.28	39,656.86	98,708.13	2.49
53	2.69	98,128.46	98,962.70	58,877.07	39,585.08	98,462.15	2.69
54	2.91	97,817.39	98,767.74	58,690.43	39,507.10	98,197.53	2.91
55	3.15	97,482.85	98,556.38	58,489.71	39,422.55	97,912.26	3.15
56	3.41	97,121.19	98,327.73	58,272.72	39,331.09	97,603.81	3.41
57	3.70	96,730.77	98,081.91	58,038.46	39,232.76	97,271.22	3.70
58	4.02	96,308.05	97,816.11	57,784.83	39,126.44	96,911.27	4.02
59	4.38	95,849.63	97,529.51	57,509.78	39,011.80	96,521.58	4.38
60	4.80	95,351.21	97,219.36	57,210.72	38,887.74	96,098.47	4.80
61	5.27	94,806.75	96,882.98	56,884.05	38,753.19	95,637.24	5.27
62	5.79	94,211.37	96,516.77	56,526.82	38,606.71	95,133.53	5.79
63	6.39	93,559.42	96,117.19	56,135.65	38,446.87	94,582.53	6.39
64	**7.07**	92,844.63	95,678.89	55,706.78	38,271.56	93,978.33	**7.07**
65	7.85	92,059.16	95,196.67	55,235.50	38,078.67	93,314.17	7.85
66	8.73	91,194.73	94,662.62	54,716.84	37,865.05	92,581.88	8.73
67	9.73	90,242.65	94,070.98	54,145.59	37,628.39	91,773.98	9.73
68	10.87	89,193.13	93,412.48	53,515.88	37,364.99	90,880.87	10.87
69	12.16	88,036.30	92,677.32	52,821.78	37,070.93	89,892.71	12.16
70	13.63	86,762.41	91,854.35	52,057.45	36,741.74	88,799.19	13.63

The duration 20 mortality rate for issue age 45 (per 1,000) = Blended l_{65} / Blended l_{64} = (1-93.314.17/93.978.33) x 1,000= 7.07

(c) **(LO 3c)** 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.

(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.

6. Continued

Commentary on Question:
In general, most candidates struggled with this question. Most candidates were able to articulate how indeterminate premium structure helps with risk mitigation and competitiveness of the product design. However, most did not articulate the indeterminate framework and ASOP 2 requirements well. Candidates will receive bonus credit by commentating that a premium adjustment cannot be used to recoup past losses or distribute past gains.

(i) Explain how the proposal will reduce risk.

Indeterminate premiums: Some typically older term and permanent traditional products specify a guaranteed premium scale and a nonguaranteed premium scale (the indeterminate premium). The current premium scale may be guaranteed for some period of time.

- Levels of these NGEs are set at the time of product pricing based on anticipated future experience at the time. Once issued, contract language allows insurers to revise these elements and defines a guaranteed maximum or guaranteed minimum level for each element. Charges cannot be increased higher, and credits cannot be decreased lower than guaranteed levels, though the insurer typically enjoys broad discretion on adjustments within those guaranteed limits.
- From the insurer's perspective, product performance depends on how well the NGEs align with anticipated experience. At the time of product pricing, levels of NGEs are set based on anticipated experience factors to meet the insurer's profit objectives. In the future, if experience emerges differently than originally anticipated, the insurer, in accordance with the provisions in the policy form and insurance laws and regulations, may revise NGEs to reflect new anticipated experience factors

(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.

ASOP 2 provides guidance for the practicing actuary to consider when determining NGEs for life insurance and annuity policies written on individual policy forms, where NGEs may vary at the discretion of the insurer.

- Determination applies to both the initial NGE determination at product pricing or issue, and subsequent NGE determinations for inforce business at dates after issue.
- ASOP 2 introduces the concept of an NGE Framework, which is defined as a combination of the company's determination policy, method by which the insurer defines a policy class, and any other relevant criteria or principles that are used to determine NGEs.

6. Continued

- The determination policy reflects the insurer's governing principles or objectives for determining NGEs. The policy could be a single document or a collection of documents. It includes profitability and capital objectives, along with requirements for and frequency of reviews of NGEs. Per ASOP 2, while a specific cadence is not prescribed, the company should declare a "maximum time period" that is not exceeded between successive reviews of NGEs.
- Each of these reviews affords the actuary the opportunity to assess whether the existing NGE scale can be revised given the currently anticipated experience factors applicable to the inforce business in question.
- Policy classes are policies that are grouped together when determining NGEs. The methodology for defining classes for both future sales and inforce policies is included in the NGE framework. Different NGEs can have different class definitions, as long as they are appropriately reflective of differences within anticipated experience factors.
- Class definition is not expected to change after issue but if necessary, it can be redefined or combined if new information supports the change.

7. Learning Objectives:

3. The candidate will understand common issues and practices related to Product Management.

Learning Outcomes:

(3a) Describe and assess insurance and annuity distribution approaches and underwriting approaches

Sources:

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

Commentary on Question:
The question attempted to test the candidate's knowledge of the strengths and weaknesses of an accelerated underwriting approach. A well prepared candidate was able to discuss not only the actuarial considerations but also regulatory and data integrity issues when using an non-traditional underwriting approach.

Solution:

(a) **(LO 3a)**

(i) List three non-traditional data sources used in the life insurance underwriting process.

(ii) Describe considerations for use of these non-traditional data sources according to the NAIC Life Accelerated Underwriting in Life Insurance Educational Report.

Commentary on Question:
In this section most candidates performed well. They did a good job identifying non-traditional data sources but struggled to recall how the Educational Report should be applied. No credit was given for traditional data sources.

(i) Three examples of non traditional sources include public records, marketing and social media, and wearable device data

7. Continued

(ii) Considerations for the use of non-traditional data sources include the following:

- Risk characteristics should lead to an expected outcome
- Rating factors may not have a disparate impact on demographic groups
- Consumers may not have access to how data may have impacted their application.
- Some data may not be required to be disclosed to consumer
- Privacy concerns with non-traditional data

(b) **(LO 3a)** 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.

(ii) Explain how regulatory considerations may impact the use of data inputs and predictive models/algorithms.

(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.

(iv) Critique the triage process of routing only applicants assessed as standard and below risk classes to the traditional underwriting process. Justify your response.

Commentary on Question:
Candidates had a more difficult time with this section. The main issue was that candidates did not provide additional insights beyond what was described in the case study. No credit was given for restating information from the case study.

(i) There are two ways to predict mortality risk using RAS tool:
1) use it to predict the risk class or
2) use it to predict mortality and the associated risk class.

Using the RAS tool, the predicted risk class can be different than what a traditional underwriter would have determined.

(ii) Regulatory considerations may have an impact in the following ways:
1) Ensure data is transparent, accurate, reliable and without bias.
2) External data sources, algorithms and predictive models must be based on sound actuarial principles.
3) Ensure models or machine learning algorithm forecasts its intended outcome accurately.

7. Continued

4) Confirm that models and algorithms are not unfairly discriminatory.
5) Have a correction mechanism in place, if needed.

(iii) One possible shortcoming of the RAS system is that it does not use any external rules engines, which would complement a predictive model. The RAS system only addresses a few non-medical questions. The external rules engine would calculate a risk factor that would be used to determine a risk class.

(iv) There are times where algorithmic based underwriting has difficulties with the fast-track process, such as when an applicant has a poor RAS score. Other carriers may have a different algorithm that may accept qualified applicants that were rejected from TTPD systems. To minimize this problem, TTPD must have a means to direct these unique applicants to traditional underwriting.

(c) **(LO 3a)**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.

Commentary on Question:
Candidates performed well on this section and provided a wide variety of good quality recommendations which were awarded credit. Such an example is provided below but is not the only solution eligible for full credit.

The following changes could improve preferred risk class placements and/or improve mortality:

1. Include an external rules engine to add experienced-based rules for non-medical questions, which could include family history questions related to early mortality due to cancer, heart attack, stroke and diabetes.
2. Try to determine if applicant has any risky avocations (e.g. skydiving) by adding a question to the application or relying on other data sources. This will help decrease the risk of anti-selection.