

ILA LPM Model Solutions

Fall 2023

1. 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.
3. The candidate will understand common issues and practices related to In Force and New Business Product Management, and how experience studies are designed and used for evaluating past experience and for setting assumptions.

Learning Outcomes:

- (1a) Describe the designs of the common life and annuity products and evaluate their associated features and inherent risks.
- (1i) Describe how predictive analytics can be used in life and annuity pricing applications.
- (3g) Describe and apply the use of statistical credibility methods used for validating actuarial judgment when evaluating experience.
- (3h) Explain and apply the Limited Fluctuation and Buhlmann credibility methods to mortality and lapse experience study data.

Sources:

Structured Settlement Annuities, SOA Research Institute, Sklar, 2022

Credibility Methods Applied to Life, Health, and Pensions, Society of Actuaries, 2019
(only pages 1-25)

The Use of Predictive Analytics in the Development of Experience Studies, The Actuary,
Oct/Nov 2015, pp. 26-34

Commentary on Question:

Commentary listed underneath question component.

1. Continued

Solution:

- (a) 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) 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

$$\text{LFCT Credibility} = \text{MIN}(1, \text{SQRT}(N_{AC}/N_{FC}))$$

Where

N_{AC} = the actual observations = death claims

N_{FC} = the observations required to achieve full credibility = $(Z\text{-value}/\text{Margin of Error})^2$

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

$K = v / a = (\text{Expected Value of the Process Variance}) / (\text{Variance of the Hypothetical Mean})$

$v = 42,000$

$k = 13$

$K = v / a = 42,000 / 13 = 3,231$

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) 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 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.

Learning Outcomes:

- (1a) Describe the designs of the common life and annuity products and evaluate their associated features and inherent risks.
- (1b) Describe and evaluate methods and metrics used to design and price these products, and assess their profitability.

Sources:

Rise of Registered Index-Linked Annuities, Product Matters August 2022

LPM-166-20: 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) 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) 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) 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:

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.
3. The candidate will understand common issues and practices related to In Force and New Business Product Management, and how experience studies are designed and used for evaluating past experience and for setting assumptions.

Learning Outcomes:

- (1i) Describe how predictive analytics can be used in life and annuity pricing applications.
- (3f) Describe how alternative data might be used to supplement mortality rate estimates.
- (3j) Describe methodologies, approaches, considerations and tools related to the Underwriting function.

Sources:

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

LPM-173-23: NAIC Accelerated Underwriting In Life Insurance Educational Report (excluding Appendix A)

The Use of Predictive Analytics in the Development of Experience Studies, The Actuary, Oct/Nov 2015, pp. 26-34

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) 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) 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 $110 \geq 100$. 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) 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 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.
4. The candidate will understand the various forms of traditional reinsurance, will be able to assess how and when they are effectively used, and will be able to perform the associated accounting (from both ceding and assuming perspectives) for basic reinsurance transactions.

Learning Outcomes:

- (1b) Describe and evaluate methods and metrics used to design and price these products, and assess their profitability.
- (1k) Describe how taxes may be treated in a pricing model and the impact of tax reform on life products profitability.
- (4a) Evaluate and analyze traditional and advanced reinsurance transactions, and prepare related financial statement entries.
- (4b) Describe and evaluate indemnity reinsurance and evaluate its use, forms, and requirements.

Sources:

LPM-148-19: Ch. 9 of Life Insurance Products and Finance, Atkinson and Dallas

LPM-149-22: Ch. 11 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) 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.

$$\text{Pre-tax stockholder earnings} = \text{ProdCashFlow} - \text{BenResIncr} - \text{DACAmort} + \text{InvIncome} + \text{InvIncRC}$$

$$\text{ProdCashFlow} = \text{Prem} - \text{Ben} - \text{Exp}$$

$$\text{BenResInc}(t) = \text{BenRes}(t) - \text{BenRes}(t - 1)$$

$$\text{Year 2023: } (400 - 100 - 175) - (250 - 0) - -150 + 15 + 10 = 50.00$$

$$\text{Year 2024: } (390 - 125 - 0.5) - (500 - 250) - 25 + 68 + 25 = 82.50$$

$$\text{Year 2025: } (380 - 200 - 0.5) - (700 - 500) - 25 + 86 + 20 = 60.50$$

$$\text{Year 2026: } (350 - 995 - 0.5) - (0 - 700) - 100 + 85 + 35 = 74.50$$

- (b) 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.

$$\text{TaxableEarn} = \text{ProdCashFlow} + \text{InvIncome} - \text{TaxResIncr} + \text{PermDiff}^\dagger$$

OR

$$\text{TaxableEarn} = \text{Prem} + \text{InvIncome} - \text{Ben} - \text{Exp} - \text{TaxResIncr} + \text{PermDiff}^\dagger$$

$$\text{TaxResIncr} = \text{TaxRes}(t) - \text{TaxRes}(t - 1)$$

$$\text{TaxOnEarn} = \text{TaxableEarn} \times \text{EarnTaxRate}$$

[†] PermDiff was given in the question as 0 in all years.

$$\text{Year 2023: } [125 + 15 - (325 - 0) + 0] \times 21\% = -38.85$$

$$\text{Year 2024: } [264.5 + 68 - (650 - 325) + 0] \times 21\% = 1.58$$

$$\text{Year 2025: } [179.5 + 86 - (603 - 650) + 0] \times 21\% = 65.63$$

$$\text{Year 2026: } [-645.5 + 85 - (0 - 603) + 0] \times 21\% = 8.93$$

- (c) 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.

$$\text{DefTaxLiab} = (\text{TaxRes} - \text{EarnRes}) \times \text{EarnTaxRate}$$

$$\text{Year 2024: } [650 - 375] \times 21\% = 57.75$$

$$\text{Year 2025: } [603 - 600] \times 21\% = 0.63$$

- (d) 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) 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:

4. The candidate will understand the various forms of traditional reinsurance, will be able to assess how and when they are effectively used, and will be able to perform the associated accounting (from both ceding and assuming perspectives) for basic reinsurance transactions.

Learning Outcomes:

- (4a) Evaluate and analyze traditional and advanced reinsurance transactions, and prepare related financial statement entries.
- (4b) Describe and evaluate indemnity reinsurance and evaluate its use, forms, and requirements.

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) 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) 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

	<u>BBB Re</u>
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

	<u>GHI Life</u>
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 statutory 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 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 the theory of "Value Creation" for life and annuity products and how to evaluate the patterns of earnings emergence under various regulatory regimes.
4. The candidate will understand the various forms of traditional reinsurance, will be able to assess how and when they are effectively used, and will be able to perform the associated accounting (from both ceding and assuming perspectives) for basic reinsurance transactions.

Learning Outcomes:

- (1b) Describe and evaluate methods and metrics used to design and price these products, and assess their profitability.
- (1d) Describe considerations and practices related to "Lapse-Supported" insurance.
- (2a) Describe, evaluate and apply the economic value creation framework.
- (2b) Describe and apply the common profit metrics (IRR, Value of New Business, Embedded Value, ROE) used in pricing insurance products.
- (2c) Describe and evaluate fundamental strategies for enhancing value through active in-force and operational management.
- (4b) Describe and evaluate indemnity reinsurance and evaluate its use, forms, and requirements.

Sources:

LPM-113-09: Economics of Insurance: How Insurers Create Value for Shareholders

LPM-155-19: Understanding Profitability in Life Insurance

Life, Health & Annuity Reinsurance, Tiller, John E. and Tiller, Denise, 4th Edition, 2015
- Ch. 6: Assumption

LPM-152-19: Lapse Supported Insurance Analysis

LPM-165-20: Life Products and Features

LPM-166-20: Annuity Product and Features

6. Continued

Commentary on Question:

Commentary listed underneath question component.

Solution:

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

Critique the following statements:

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

PV of 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 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.
3. The candidate will understand common issues and practices related to In Force and New Business Product Management, and how experience studies are designed and used for evaluating past experience and for setting assumptions.

Learning Outcomes:

- (1a) Describe the designs of the common life and annuity products and evaluate their associated features and inherent risks.
- (1d) Describe considerations and practices related to "Lapse-Supported" insurance.
- (1j) Describe and apply the requirements of applicable ASOPs on Life and Annuity Product Pricing and Assumptions
- (1p) Describe how product designs are impacted in a rising interest rate environment.
- (3b) Describe and evaluate the challenges insurers face in a low and potentially rising interest rate environment.

Sources:

LPM-165-20 Life Products and Features

LPM-166-20 Annuity Product and Features

ASOP 54 Pricing of Life and Annuity Products, Jun 2018

Report on Premium Persistency Assumptions Study of Flexible Premium Universal Life Products, May 2012

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) 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) 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) 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 rationale 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.