ILA LPM Model Solutions
Spring 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.

Learning Outcomes:

(1m) Describe and apply the methodology for evaluating pricing sensitivities using a "Pricing Surface".

(1q) Describe and evaluate the types of assumptions commonly used in actuarial pricing and product development.

(1s) Describe the framework, process, and significant considerations for creating mortality tables. Describe and apply the methods for determining exposures, and considerations for developing select period mortality rates.

Sources:

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

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

Predictive Modeling for Life Insurance: Ways Life Insurers Can Participate in the Business Analytics Revolution, Product Matters, Jun 2018

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

Commentary on Question:

Commentary listed underneath question component.

1. Continued

Solution:

(a) 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) 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) 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) 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.

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.

(1n) Describe and apply the requirements of applicable ASOPs on Life and Annuity Product Pricing and Assumptions

(1q) Describe and evaluate the types of assumptions commonly used in actuarial pricing and product development.

(1r) Describe and evaluate the role of Behavioral Economics in understanding and modeling policyholder behavior in the life and annuity context.

Sources:

ASOP 54: Pricing of Life and Annuity Products, Jun 2018

ASOP 2: Non-guaranteed Charges or Benefits for Life Insurance Policies and Annuity Contracts, exposure draft, June 2020 (excluding Appendices)

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

Modeling of Policyholder Behavior for Life and Annuity Products, SOA, 2014, pp. 6, 9-16 & 19-73

LPM-142-16: Malcolm Life Enhances Its Variable Annuities, 2010

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) 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) 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) 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) 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) 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 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:

Pension Risk Transfer in Canada and the U.S., SOA Research Institute, Simmons, 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) 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)

(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)

(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 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.

(1g) Describe methodologies and considerations used in the regulation of nonforfeiture practices.

(1k) Describe what is meant by Life Settlements and assess their impact on insurance product pricing/management.

Sources:

Structured Settlement Annuities, SOA Research Institute, Sklar, 2022

LPM-166-20: Annuity Product and Features

LPM-121-13: 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) 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) 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) 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 theory of "Value Creation" for life and annuity products and how to evaluate the patterns of earnings emergence under various regulatory regimes.

Learning Outcomes:

(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.

Sources:

LPM-113-09: Economics of Insurance: How Insurers Create Value for Shareholders, pp. 4-31

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) 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

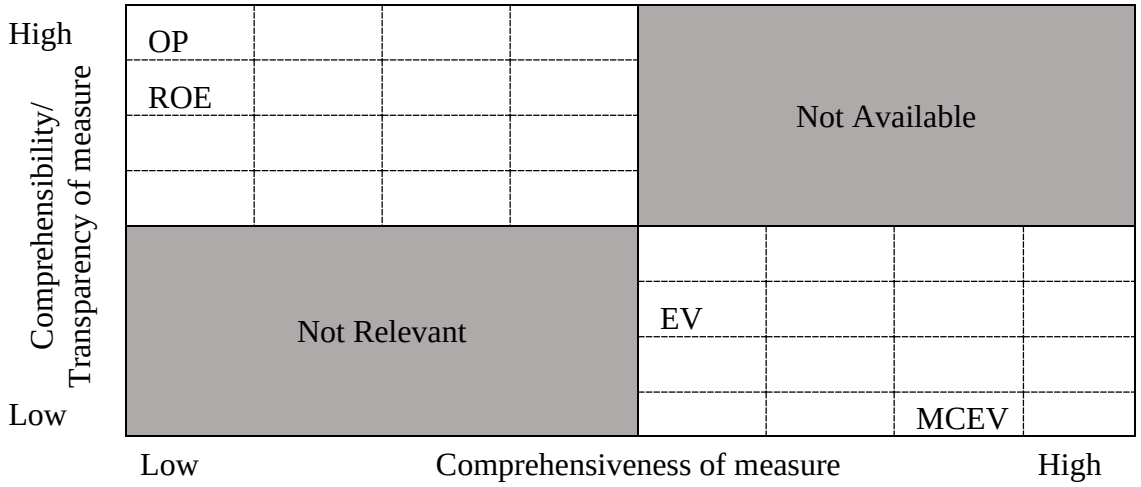
(b) Place the following profit measures in the table below. Justify your answer.

(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:

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.

(4c) Describe risk transfer considerations, and evaluate their impact on reinsurance agreement provisions.

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

Life, Health & Annuity Reinsurance, Tiller, John E. and Tiller, Denise, 4th Edition, 2015 - Ch. 7: Reinsurance of Inforce Risks

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) 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) 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) 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.

7. Learning Objectives:

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:

(3h) Describe how credit scores and other alternative data might be used to supplement mortality rate estimates

Sources:

LPM-168-20: LexisNexis® Risk Classifier – stratifying mortality risk using alternative data sources

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Describe the protective and predictive benefits of using data base credit scores.

Commentary on Question:

Nearly all candidates identified that data-based credit scores can be used as an indicator of mortality. However, benefits beyond that were generally omitted, thus most candidates obtained only partial credit here.

Protective and predictive benefits include:

- Improved mortality segmentation
- An underwriting process that is simplified and expedited
- Removal of friction, pain, cost, and time for the acquisition process
- Correlations to persistency, fraud/recissions, smoking habits, agent behaviors, and others

(b) Outline the primary high-level findings of the assessment of stratifying mortality risk using the LexisNexis® Risk Classifier.

Commentary on Question:

Most candidates were able to identify 2-3 key findings. Other findings from the source materials not listed below were also considered.

Key findings include:

- Mortality risk decreases as the Risk Classifier score increases
- Risk Classifier stratifies mortality risk across age, gender, and duration
- Risk Classifier effectively segments mortality across wealth levels
- Individuals with superior public record and credit information have better mortality

7. Continued

(c) Evaluate the impact on profitability of the new WL product with respect to each distribution channel.

Commentary on Question:
Candidate results were mixed on this question. To receive full points, candidates needed to answer with the correct profitability expectation along with a clear rationale that included the LexisNexis Risk Classifier and related items.

Direct Marketing P&C:

Expect average profitability (between captive and independent agents). The average Risk Classifier score is 500, which is the midpoint of the LexisNexis study. This means mortality should be in-line-with expectations.

Captive Agents:
Expect better profitability (higher than direct marketing and independent agents). The average Risk Classifier score is 600, which is higher than the midpoint of the LexisNexis study. This means we can expect better mortality.

This distribution channel also has an average age of 70. The LexisNexis study noted lives with ages greater than 70 have less relative mortality differentiation between low and high scores. This indicates mortality – and therefore profit – is stable.

Independent Agents:

Expect worse profitability (lower than direct marketing and captive agents). The average Risk Classifier score is 350, which is lower than the midpoint of the LexisNexis study. This means we can expect worse mortality.

(d) Recommend four changes to the underwriting or product design to improve both the sales and profitability of the new WL product.

Commentary on Question:
A wide variety of answers were accepted. Full credit was given for 4 different recommendations to distribution or product design. A number of candidates pointed out that more comprehensive underwriting may be needed. Answers covering other points were seldom included.

1. Add a minimum LexisNexis Risk Classifier score, such as 300, to the application process and reject applicants who fall below the threshold. This will help reduce mortality risk and increase profitability.

2. Target younger issue ages and/or lower the maximum issue age. This will help to achieve higher mortality differentiation across scores.

7. Continued

3. Eliminate the independent distribution channel. This distribution channel is bringing in applicants with low scores which is hurting profitability. Note this channel accounts for 50% of sales, so will need to replace those sales to help with expenses.

4. Add a knock-out question that disqualifies an applicant with prior felony convictions such as DUI, bankruptcies, or liens. This will improve the average score which in turn will improve mortality and profitability.