ILA LPM Model Solutions
Spring 2020

1. **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.

5. The candidate will understand the role of the Investment Actuary and the Portfolio Management Process in the Life Insurance company context, as well as the common forms of Fixed income securities and their uses, and the methods and processes used for evaluating portfolio performance and asset allocation.

Learning Outcomes:

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

(5b) Describe and evaluate how a company's objectives, needs and constraints affect investment strategy and portfolio construction (including capital, funding objectives, risk appetite and risk return tradeoff, tax and accounting, accounting considerations, and constraints such as regulation, rating agency ratings and liquidity.

(5c) Describe and assess the role of and significant considerations related to the design and function of asset allocation strategies.

Sources:

Transition to a High Interest rate Environment: Preparing for Uncertainty, SOA Research, July 2015, Executive Summary, Sections IV.C.1-4 and 8-11, IV.D, IV.E and IV.H

Interesting Challenges for Insurers, Fenton, Scanlon, Iyer - Product Matters, June 2012, pp. 10 - 16

Managing Investment Portfolios, Maginn and Tuttle, Ch. 3 - Managing Institutional Investor Portfolios, section 4.1,

Managing Investment Portfolios, Maginn and Tuttle, Ch. 5 - Asset Allocation, 5.2 - 5.4

Managing Investment Portfolios, Maginn and Tuttle, Ch. 6 - Fixed-Income Portfolio Management, 6.1-5

1. **Continued**

Commentary on Question:
Commentary listed underneath question component.

Solution:
(a)   Describe risks AJZ could face in a rapidly rising interest rate environment.

Commentary on Question:
Although one or two risks were well known, the intent of this question was to have the candidate identify many of the risks, including ones that may not have been immediately obvious.

The majority of candidates received full credit for indicating that AJZ could face disintermediation risk, and describing why the risk was present.

Many candidates identified the implications when asset duration exceeds the liability duration and noted that credited rates may need to be increased.

Most candidates did not indicate that rapidly rising interest rates may impact capital / surplus, and that mortality rates of the policyholders that did not lapse may be difficult to predict

- Rising interest rate can introduce disintermediation risk, where policyholders surrender their policy with AJZ to purchase a new policy elsewhere with more favorable rates.
- If AJZ's asset duration exceeds the liability duration, the duration mismatch can create a net loss since the portfolio is made up of 100% fixed assets. Duration matching is only intended for small changes in interest rates, and the portfolio would likely need to be rebalanced.
- If surrender rates increase materially, it may be difficult to predict the mortality rates of the remaining cohort.
- AJZ would need to increase the credited rate for the remaining policyholders to entice them not to surrender their policies. This would lead to lower interest spreads.
- Since the asset duration would be longer than the liability duration, AJZ runs the risk that reserves are not sufficient to cover the liabilities in the short term, which may strain capital.

1. **Continued**

(b)   Critique the following recommendation:

After discussion with the Investment and Risk Officers, we recommend using a strategic asset allocation based on AJZ's long term exposure to systematic risk. The asset allocation should be reviewed and adjusted quarterly to ensure the allocation meets AJZ's risk and investment return objectives. We strongly recommend an asset-only approach to determine the asset allocation strategy. Asset-only should be adequate to achieve AJZ's needs.

Commentary on Question:
This question tested candidates' knowledge of asset allocation strategies. Most candidates received partial credit for supporting the recommendation to use a strategic asset allocation strategy and explaining why the strategy was appropriate.

Many candidates did not indicate that quarterly review was too frequent for a strategic asset allocation strategy and that annual or less frequent review was more appropriate.

Many candidates did not mention that using Tactical asset allocation to rebalance the portfolio quarterly was appropriate within the ranges set in the Strategic Asset Allocation.

Most candidates received full credit in explaining why the Asset-Liability Management (ALM) approach is more appropriate than the Asset-Only approach recommended by AJZ.

Strategic asset allocation (SAA) specifies an investor's desired exposure to systematic risk in alignment with return objectives, risk tolerance, and long-term capital market expectations. SAA is appropriate for AJZ because systematic risk is rewarded by the market in the form of higher returns.

Quarterly review is too frequent for SAA. SAA should be reviewed annually, or when AJZ's needs and circumstances change significantly.

Tactical asset allocation (TAA) rebalancing on a quarterly basis is recommended to ensure the asset portfolio tracks closely to the SAA.

An asset-only (AO) approach is not recommended for AJZ and an asset-liability management (ALM) approach should be used instead. ALM is a more appropriate strategy for the following reasons

1. Continued

- Liability duration needs to be considered when setting the SAA to help reduce sensitivity to short-term interest rate movements
- AJZ has below average risk tolerance and has minimal diversification across other product types (AJZ only sells fixed annuities)
- The penalties for not meeting liabilities are very high
- AJZ's liabilities are interest sensitive
- Insurance regulators favor holding fixed-income securities

(c) Calculate the amount of replacement bond to purchase without changing the duration profile of the asset portfolio. Show all work.

Commentary on Question:
Overall, candidates were able to calculate the duration of the portfolio. However, many candidates were not able to follow the calculation through to determine the value of the replacement bond. Common mistakes include
- *Using the portfolio duration to determine the bond value instead of dollar duration.*
- *Using par value instead of market value to calculate dollar duration.*
Partial credit was awarded to candidates who demonstrated the understanding to maintain the same duration before and after the changes to the bond portfolio.

Total portfolio duration = Sum of (Duration (security i) * Market value (security i)) / Market value of total portfolio = (6.5 * 100 + 10 *100 + 3*100 + 5*200) / 500= 5.9 years

Dollar duration (replacement security i) = Duration (replacement security i) * Market value (replacement security i) / 100 = 6.5 *98/100 = 6.37

Dollar duration (old security i) = Duration (old security i) * Market value (old security i) / 100= 3*100/100 =3

To maintain the portfolio duration when one security is being exchanged for another, the dollar duration of the securities being exchanged must be matched via dollar duration:

1) Dollar duration of old bond * old bond market value = Dollar duration of replacement bond * Replacement bond market value
2) 3*100 = 6.37 * Replacement bond market value
3) Replacement bond market value= 47.1 million
4) Replacement bond Par value = 47.1/0.98 = 48 million

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.

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

Sources:
Profit Measures and Analysis, Atkinson and Dallas, Ch. 11 - pp. 499-502

Pricing Surface, Product Matters, 2017

Long-Term Care Insurance: The SOA Pricing Project, SoA 2016

Understanding the Volatility of Experience and Pricing Assumptions of LTC, SOA Research 2014, pp. 4 - 46

Commentary on Question:
Commentary listed underneath question component.

Solution:
(a)   Propose three product feature changes that would reduce payout variability from the base design. Justify each proposal.

        Commentary on Question:
        This question tested the candidates' knowledge on product features and cash flow structures. To receive full credit, only three product feature changes with appropriate justification were required. Reasonable answers not listed below were also given credit. Candidates generally did well on this question. The most common area where candidates lost credit was not providing appropriate justification for their response.

2. **Continued**

Product feature changes that would reduce payout variability from the base design are:
1. A combination product such as life insurance and LTC
    a. Justification: since a benefit is guaranteed to be paid, either through LTC or a death benefit, variability is decreased
2. Reduced benefit period
    a. Justification: since the expected payout for a reduced benefit period is lower, the resultant variability must be lower.
3. Reduced inflation protection
    a. Justification: reduced inflation protection reduces variability in claim costs
4. Both premium and benefit indexed to CPI instead of fixed index
    a. Justification: since premium and benefits are being adjusted to the same index, the resulting correlation reduces variability
5. Offer the product with ROP rider
    a. Justification: with a ROP rider, it guarantees that a benefit will be paid as some point, therefore reducing variability.
6. Increase elimination period
    a. Justification: since the expected payout for a longer elimination period is lower, the resultant variability must be lower.

(b) Calculate the following profit measures:

(i)   Embedded value

(ii) Profit margin

Show all work.

Commentary on Question:
This questioned tested the candidates' knowledge of profit metrics. Candidates generally did well on part (i). Most candidates were not able to identify the correct rate to use for part (ii) and lost partial marks; either the weighted average cost of capital or the net investment earnings rate can be used for the Profit Margin, and credit was given for both for calculation of the profit margin.

(i)
Embedded Value = PV(Distributable Earnings) @ Hurdle Rate

Hurdle Rate
= % of equity * After Tax ROE + % of debt * Pre Tax Cost of Debt *(1-Tax rate)
= 0.65 * 0.13 + 0.35*0.07*(1-0.40)
= 9.9% =~ 10%

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2. **Continued**

Therefore, we use the values in the chart with 10%

PV(Distributable Earnings)
= PV(PreTaxSolvEarning) - PV(Tax) - PV(ReqCapInc) +
PV(AfterTaxInvIncOnReqCap)
= 29.5 – 11.8 – 12.3 + 1.2
= 6.6

Therefore, the embedded value at the 10% hurdle rate is 6.6.

(ii)
Profit Margin = PV(Profit)/PV(Premium)
Use 5% interest rate for asset backing liability.

PV(Profit) = PV(Distributable Earnings)
= PV(PreTaxSolvEarning) - PV(Tax) - PV(ReqCapInc) +
PV(AfterTaxInvIncOnReqCap)
= 35.2 – 14.1 – 8.6 + 1.5
= 14

Profit Margin = 14/382.7 = 3.7%

Therefore, the profit margin is 3.7%

(c)   For each of the following sensitivity tests:

- Morbidity decreases
- Mortality decreases
- Lapses decrease
- Interest rate drops

(i)   Describe the impact on profitability.

(ii)   Provide a realistic example that would lead to the above scenarios.

Commentary on Question:
This question tested the candidates' knowledge of the product assumptions and their relationship to profitability. Candidates generally did well on part (i), but many candidates failed to provide a realistic example in part (ii).

2. **Continued**

(i)
A morbidity decrease would increase profitability.
Any of a mortality decrease, lapse decrease, or interest rate drop would decrease profitability.

(ii)
A realistic example of each scenario is as follows:
- A morbidity reduction could be caused by medical advances to support improvement of disability and improved recovery
- A mortality reduction could be caused by medical advances or healthier living habits.
- A lapse reduction could be caused by a better understanding of the need for the product.
- An interest rate drop could be caused by poor economic environment which limits the choice of attractive investment assets.

(d) Propose an approach XYZ can use to better understand the impact on profitability for combined changes in morbidity and interest assumptions. Justify your answer.
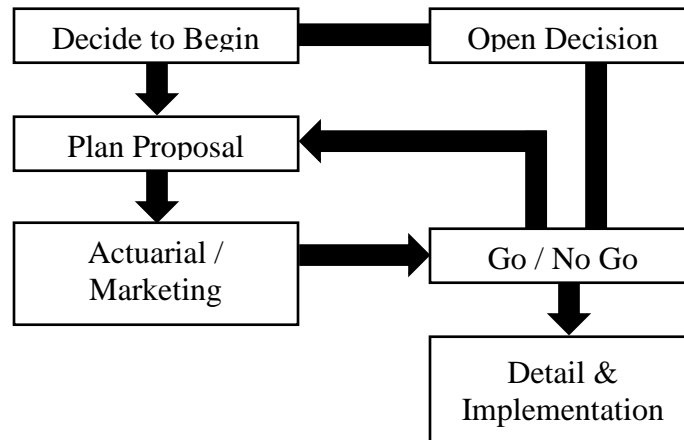
Commentary on Question:
This question tested the candidates' knowledge of pricing surface application and its advantages. Partial credit was provided for reasonable answers other than pricing surface, such as scenario testing or predictive modelling. Candidates generally did not perform well on this question. Maximum credit was received by demonstrating that they understood the benefits of pricing surface for the application of understanding profitability on multiple assumptions.

An approach that XYZ can use to better understand the impact on profitability for the combined changes in morbidity and interest is pricing surface. The pricing surface provides a joint distribution of the pricing results; actuaries not only get the mean and variance, but also its relationship with all pricing variables (interaction among these variables or cross effects). Diversification or magnification between two or more pricing variables is observable.

(e) Critique each of the statements about XYZ's product development process:

(i) *Profitability should be expressed as a percent of first year sales. This makes it easy for management to easily calculate and understand profitability with varying levels of sales.*

(ii) *Two profitability targets need to be set – one based on marginal expenses only and one based on fully allocated expenses.*

2. Continued

(iii) *The product development decision making process can be depicted by*:

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┌─────────────────┐        ┌─────────────────┐
│ Decide to Begin │───────▶│  Open Decision  │
└─────────────────┘        └─────────────────┘
        │                           │
        ▼                           │
┌─────────────────┐                 │
│  Plan Proposal  │◀────────────────┘
└─────────────────┘
        │
        ▼
┌─────────────────┐        ┌─────────────────┐
│   Actuarial /   │───────▶│    Go / No Go   │
│    Marketing    │        └─────────────────┘
└─────────────────┘                 │
                                     ▼
                           ┌─────────────────┐
                           │     Detail &    │
                           │ Implementation  │
                           └─────────────────┘
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This allows for an iterative process between pricing actuaries and marketing to develop a price that is agreeable to both parties.

Commentary on Question:
This question tested the candidates' knowledge of the macro pricing process. To receive full credit, the candidate had to demonstrate their understanding of the macro pricing process and how it applied to each of the statements presented. Candidates generally did not perform well on this question. Maximum credit was received by providing a fulsome critique of the statements.

(i)
This is a type of unit-based analysis – a traditional pricing method which is inferior to macro pricing method. This method creates goals between marketing (lower price to meet sales/production goals) and actuaries (higher price for financial stability/profitability metrics) that are mutually exclusive. Additionally, it does not take into account the law of demand - as price increases, sales decrease. I recommend using the macro pricing approach instead because it involves analysis over a broad range of possible production levels. The likely production levels are determined during the decision-making process that leads to the product price.

2. **Continued**

(ii)
By definition, overhead is not variable over the elements of the decision set, as such the inclusion of overhead cannot have an impact on the relative desirability of the various choices. Therefore, we can conclude that overhead is irrelevant to our decision. The inclusion of overhead does not affect the ordinal ranking of the choices. Additionally, the use of overhead in analysis is misleading in the determination of the value of a particular action to the decision-maker. Financial analysis based upon marginal expenses yields a statement of "marginal profit" or the marginal impact on the company's financial position. The use of overhead expenses in analysis yields a statement of profit that may be quite uncorrelated with the value of the action to the company. Furthermore, the allocation of overhead on a per-unit basis implies that this "unit" of overhead can in fact be saved by not selling a unit of production. This assumption is clearly at odds with reality. Macro pricing process seeks to maximize/optimize expected profits rather than hit an arbitrarily set of profitability.

(iii)
One issue is that an agreeable price between pricing actuary and marketing may not actually exist. These open decision points often lead to seemingly infinite human capital loops. Additionally, this inherently assumes that analysis used in the determination of price can also answer the question of overall company health or the ability to meet overhead expenses. A decision tree better allows for optimization at every level and incorporation of different objectives.

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.

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:
(1a)   Describe the designs of the common life and annuity products and evaluate their associated features and inherent risks.

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

(4a)   Evaluate and analyze traditional and advanced reinsurance transactions, and prepare related financial statement entries.

Sources:
LPM-165-19 Life Products and Features

Life, Health, and Annuity Reinsurance (Tiller), chapter 4

Ending the Mortality Table (Living to 100 Symposium)

Commentary on Question:
Commentary listed underneath question component.

Solution:
(a)   The reinsurer's marketing actuary has made the following comment:

> *"Since the profitability numbers look similar, we should be indifferent to the choice of mortality table and propose both options to the ceding company to let them decide which one to use."*

Critique the statement. Justify your response.

Commentary on Question:
The expectation was candidates would indicate whether they agreed with the statement or not and give reasons for that opinion. Very few candidates discussed the issue of lapse or interest rate risks or the issue that a level NAAR posed. Very few discussed the different curve for the premiums and not many identified the RFP 2019 as the better option. However, credit was given for either table recommended, as long as there was valid justification.

3. **Continued**

Overall profitability might be similar, but the two different mortality tables, combined with their respective percentages will result in significantly different curves for premiums. This will result in a mismatch in the premium compared to the coverage. This is especially the case if a product has a level Net Amount at Risk (NAAR) which is the case for an increasing death benefit Universal Life product.

The Marketing Actuary may be neglecting the risk associated with the timing of reinsurance premiums in relation to expected claims. The RFP 2019 option will likely have a slope/curve that results in a better fit for most mortality assumptions at the older ages. The CIA 9704 table creates a mismatch at older ages which, if achieving the same profitability results, is likely subsidized by excess premiums at earlier durations. This creates lapse and interest rate risk arising from the need for reserves not typically associated with YRT treaties.

(b) The client is seeking to add a joint last survivor option to their UL product. It will be administrated on an equivalent single age (ESA) basis.

    (i) (*3 points*) The ceding company provides the following information about the joint last survivor option:

- The ESA will be based on mapping to male nonsmokers
- No changes in underwriting
- Single life lapse rates and independent mortality rates for each life are assumed
- Reinsurance premiums will be based on CIA 9704

The reinsurer determines male nonsmoker premium rates must increase from 50% to 80% of the CIA 9704 male nonsmoker table to support the joint last survivor business at an adequate profitability level.

Justify the premium rate increase to the ceding company.

    (ii) (*3 points*) The client has acknowledged the need to support substandard and uninsurable lives, and is proposing the following approach:

- For standard or substandard lives, the joint rating will be the greater of the individual life ratings and the rating will be applied to the ESA YRT premiums
- If one life is deemed uninsurable, a regular single life product will be offered to the insurable life

Assess the feasibility of this proposal. Justify your assessment.

3. Continued

(i) Equivalent Single Age (ESA) creates significant mismatch which is exacerbated by the choice of the CIA9704 table because of the low percentage applied. For Joint Last to Die (JLTD) mortality rates start very low and accelerate as the insured lives get older since as the likelihood of one life remaining increases, the mortality subsequently increases significantly. ESA premiums will be excessively high at early durations and subsequently inadequate at older ages. This results in even more lapse risk or interest rate risk than there already was.

Also, JLTD policies tend to be used for estate preservation or other financial planning purposes which, when paired with older age couples, commonly results in ultimate lapse rates which will be lower than those for single life. This may compound the impact of the mismatch associated with ESA.

Assuming fully independent lives is risky. While there might be a benefit from the target market impact of higher-than-average- socioeconomic status, there is also added mortality arising from correlated mortality for a couple which will drive mortality in the earlier durations when the joint mortality is very low. There might also be the need to price for the broken heart effect which causes temporarily elevated mortality immediately following the death of the first life.

(ii) Taking the greater of the two lives' mortality ratings does not guarantee the resulting premiums will be reasonable for the resulting expected mortality. For example, if one life is standard and the other is not, the initial mortality may be driven by the substandard life which corresponds to the greater rating, while at later durations, it will be driven by the standard life. If both lives are rated, taking the max rating might result in understated mortality at early durations but excessive mortality later.

3. **Continued**

If the company chooses to exclude the uninsurable life in a JLTD product, they may not be popular in the target market. The target market is extremely sophisticated and will be evaluating key financial metrics. The market may not be receptive to a single life policy that offers no benefits related to consideration for the uninsurable life.

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.

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:

(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.

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

(2e)   Describe and evaluate fundamental strategies for enhancing value through active in-force and operational management.

Sources:

ILA-Long-Term Care Insurance: The SOA Pricing Project

ILA-Understanding the Volatility of Experience and Pricing Assumptions of LTC

ILA-Experience Assumptions for Individual Life and Annuities

ILA-Life in-force management: Improving customer value and long-term profitability

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a)   Analyze how the following inforce experience assumptions will be impacted under each of the three options. Justify your responses.

     (i)   Morbidity

     (ii)   Mortality

     (iii)   Lapses

     (iv)   Expenses

4. Continued

Commentary on Question:
Candidates generally did fairly well on part (a)(i), (a)(iii), and (a)(iv) and not as well on (a)(ii). For full grading points on each option/assumption, an impact needed to be stated along with a justification. No points were awarded for stating the impact without justification. Partial credit was awarded for mentioning the impact on FGH's exposure (with no mention of the assumption impact) on coinsurance.

(i)   <u>Morbidity</u>
Option 1 – No impact. Policyholders are not aware of the change, and their behavior will not be impacted. FGH's exposure will be reduced as they will only be responsible for half of the morbidity claims.

Option 2 – Increase due to anti-selection. Individuals who know they are likely to go on claim will not accept the offer. The offer needs to be a value for the client, and this is only the case for people who think they are less likely to go on claim or were going to lapse already.

Option 3 – Decrease due to a reduction in the number of fraudulent claims paid out.

(ii)   <u>Mortality</u>
Option 1 – No impact because policyholders are not aware of the change, and their behavior will not be impacted. FGH's exposure will be reduced as they will only be responsible for half of the impact from mortality.

Option 2 - No impact because offering a paid-up policy does not reduce the likelihood of policies to die.

Option 3 - No impact because changing process efficiency or fraud detection has no impact on mortality. LTC does not pay a death benefit so mortality is not impacted by fraudulent claims or increased claim efficiency.

(iii)   <u>Lapses</u>
Option 1 – No impact because policyholders are not aware of the change, and their behavior will not be impacted. FGH's exposure will be reduced as they will only be responsible for half of the impact from lapses.

Option 2 - Temporary decrease because policyholders that were going to lapse are now going to elect the paid-up option. There will be similar levels or slightly lower long term because the paid-up policy would have been taken by people who were likely to lapse in the near future.

4. **Continued**

Option 3 – No impact because changing process efficiency or improving fraud detection will have little impact on lapses. There may be a slight decrease due to more satisfied customers.

(iv) Expenses
Option 1 – Increase due to the need to compensate the reinsurer for the risk they are taking so the reinsurance arrangement will increase cost. There may be an allowance offered by the reinsurer to offset the cost. Since the company is still maintaining the policy and claim administration, none of those costs will change.

Option 2 - Temporarily increase due to needing to process the paid-up policies. They will likely decrease in the long term due to less ongoing less administrative expenses. FGH will not need to process premiums or rate increases for those policies.

Option 3 - Mixed impact because there will expense reductions due to increasing efficiency and also expense increases from the additional resources needed to implement the fraud detection changes.

(b) Identify two advantages and disadvantages of each option for FGH.

Commentary on Question:
Candidates did fairly well on part (b). Additional points were not given for listing more than 2 advantages/disadvantages for each option.

Coinsurance
Advantages
- Limits FGH's exposure to future losses
- Provides capital relief for FGH
- Access to reinsurer expertise

Disadvantages
- Two parties (FGH and the reinsurer) being in control limits opportunities to achieve full operational, capital and other synergies
- Does not achieve finality for FGH because they are still responsible for half the product and administration
- Counterparty risk
- Need to transfer assets

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4. **Continued**

Exchange Program
Advantages
- Has potential to significantly lower FGH's exposure
- May align well with the policyholder's needs if their needs have changed since purchasing the product

Disadvantages
- Reputational risk for FGH if their program is not well received
- Risk that policyholders will anti-select and FGH will lose out on lapses
- Lose future premium/cashflow due to paid up policy

Claims Management
Advantages
- Improved client experience for FGH
- Reduced fraudulence for FGH which improves profitability

Disadvantages
- FGH cannot completely eliminate fraud
- FGH will have to incur expenses to make the changes

(c) Recommend two product design modifications to improve profitability. Justify your answer.

Commentary on Question:
Candidates did well on part (c). Two recommendations with justifications were needed to receive full credit.

Limit overall benefit period/cap. Products with longer benefit periods or higher inflation rates deteriorate claims experience, especially over longer projections periods due to compounding benefits, creating higher claims and therefore less profitable experience. Recommendations:
- Reduce length of benefit period
- Lower benefit inflation rate (eg. 3% instead of 5%)
- Replace compound inflation option with simple inflation option
- Implement a lifetime benefit cap
- Limit issue age
- Have permanent requirement on ADLs
- Longer elimination period

Offer a return of premium rider. This lowers overall benefit variance and lowers lapse rates.

4. Continued

Offer a Life/LTC combo product. Combo products are less risky due to the natural hedge between life insurance and standalone LTC products. FGH can also offer annuity/LTC combo product where LTC payments will reduce the accumulation of account value.

Index benefits and premiums to the CPI. Investment returns and interest rates are correlated Investment returns and interest rates are correlated. Losses associated with lower interest rates are offset by lower benefit increases. In the scenarios with higher inflation, higher returns are earned on the assets, and higher premiums are collected.

(d)   Compare and contrast Return on Equity (ROE) and Return on Asset (ROA).

Commentary on Question:
Candidates generally did not do well on part (d) and commonly only provided the formula for both measures.

ROA is calculated as profit/loss divided by total assets of a company. ROE is calculated as profit/loss divided by GAAP equity.

ROA is a pricing objective used in product development area but ROE is corporate profitability measure often used in financial reporting.

ROA is commonly used for deferred annuities but ROE provides an overall portfolio view and not a product view.

Both ROA and ROE may fluctuate due to impact of valuation under GAAP/IFRS.

Both ROA and ROE do not consider relative risk or the timing of profits.

5. **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:
(1q) Describe and evaluate the types of assumptions commonly used in actuarial pricing and product development.

Sources:
Credibility Theory Practices, SOA, 2009 (exclude appendices and formula derivations)
LPM107-07 Experience Assumptions for Individual Life Insurance and Annuities
Experience Study Calculations, Society of Actuaries, Ch. 2-4, 11, 12, 15, 17, 18
(excluding 18.2, 18.8, 18.9)

Commentary on Question:
Commentary listed underneath question component.

Solution:
(a) Compare and contrast the Limited Fluctuation and Buhlmann Empirical Bayesian credibility methods.

Commentary on Question:
This question tests candidates' understanding of the similarities and differences between two main types of credibility methods. Many candidates did well on this question. Full credit was awarded to candidates who made two valid comparisons below.

1) Limited Fluctuation is based on confidence intervals; Buhlmann method is based on a linear Baysesian model that relies only on the first two moments of the distribution
2) Limited Fluctuation is simpler than Buhlmann method, but has some drawbacks like arbitrary nature of parameters, no explicit model used or quantity optimized, accuracy of "a" parameter not factored into the calculation of Z; Buhlmann method addresses some limitations of Limited Fluctuation by beginning with a model for probability distribution of observations (based on past data/professional experience/opinion), then using observed results to formulate a predictive or posterior distribution (ie, Buhlmann method is empirical)
3) Limited Fluctuation only uses data from the company being studied to determine the credibility factor; Buhlmann method uses the observed data of both the company under study and all other companies to formulate the predictive A/E ratios for the company under study

5. **Continued**

4) Limited Fluctuation uses only the variation of a company's observations about that company's mean; Buhlmann method uses both the variation of a company's observation about that company's means, as well as the variation between each company's mean and the overall mean
5) In both the Limited Fluctuation and the Buhlmann method, the results are calculated with respect to a mean (A/E ratio) and incorporate a variance
6) Both methods assume the mean (overall A/E ratio) is constant over time

(b) Calculate the minimum number of claims required for full credibility under the Limited Fluctuation credibility method, assuming 95% confidence and a corresponding z-value of 1.96. Show all work.

Commentary on Question:
This question is a straightforward calculation using the credibility factor formula. Most candidates did well on this question and received full credit. No credit was awarded if the formula was not correctly set up.

Credibility factor $Z = r \times \sqrt{\text{claims}} \div \text{z-value}$
If full credibility => $Z=1$, then claims = $(\text{z-value} \div r)^2$
$r = 0.05$, so $(1.96 \div 0.05)^2 = 1537$ claims (rounded up to nearest whole number)

(c) You have decided to combine smoker and nonsmoker experience for increased credibility. Evaluate the credibility of experience as measured by Limited Fluctuation for each gender and propose mortality adjustment factors as needed. Show all work.

Commentary on Question:
This question requires candidates to perform two credibility calculations using the Limited Fluctuation method and evaluate the results accordingly. Many candidates did well on the Male section. Some candidates failed to derive the adjustment factor in the Female section when the data do not meet full credibility standard.

Male
Total male claims (actual)
= Male Non-smoker (actual) + Male Smoker (actual)
= 1000 + 600 = 1600 > 1537 from (b)
Male meets the full credibility standard

Total male claims (expected)
= Male Non-smoker (expected) + Male Smoker (expected)
= 830 + 510 = 1340

5. **Continued**

Male (A/E ratio)
= Total male claims (actual) ÷ Total male claims (expected)
= 1600 ÷ 1340 = 119%
Should apply 119% to industry mortality table

Female
Total female claims (actual)
= Female Non-smoker (actual) + female Smoker (actual)
= 850 + 50 = 900 < 1537 from (b)
Female does not meet the full credibility standard

Total female claims (expected)
= Female Non-smoker (expected) + Female Smoker (expected)
 = 945 + 55 = 1000
Female (A/E ratio)
= Total female claims (actual) ÷ Total female claims (expected)
= 900 ÷ 1000 = 90%
As female doesn't meets full credibility standard,
Female Z (credibility factor)
= √(actual claims ÷ minimum # of claims for full credibility)
= √(900 ÷ 1537) = 77%
Female adjustment factor
= Z × (company A/E) + (1 – Z) × (industry A/E)
= 77% × 90% + (1 – 77%) × 100% = 92%
For females, should apply a mortality adjustment factor of 92%

(d)   Describe the expected impact on the current mortality assumption for each of the differences above.

Commentary on Question:
This question tests candidates' understanding of the potential impact on the mortality assumption under different product design scenarios. Candidates needed to provide both expected impact and justification to receive full credit. Most candidates did well on the Target market, Distribution and Premium pattern scenarios, however, for the Risk classes scenario, many candidates failed to comment on the potential impact on the remaining non-smoker class when adding a new preferred class.

Target market: more sales to higher net worth individuals should yield a decrease in average mortality and A/E, due to their better access to healthcare, higher proportion of white-collar employees, and additional underwriting typically required for higher face amounts.

5. **Continued**

Risk classes: adding a new preferred risk class will have ripple effects on non-smoker mortality; previous A/E ratio for non-smokers will likely no longer apply, since we would expect better risks to fall under the preferred rating and the remainder to fall under the residual/standard non-smoker rating. This may require a new set of A/E factors.

Distribution: addition of new third party distribution channel to existing career force will likely make a portion of the business less sticky, resulting in potentially higher lapses and ripple effects on mortality (healthier risks are more likely to seek better rates by getting re-underwritten once the level term period ends, leaving a greater proportion of less healthy risks remaining). Expected mortality should be re-calibrated to reflect expected antiselective lapsation of healthier risks after the level term period ends.

Premium pattern: smaller premium jump (400% -> 150%) in post-level term period premium rates should reduce anti-selection from excessive lapses, which should improve mortality on remaining block. May want to consider mortality adjustment factors that apply by duration (e.g. before and after level term period).

(e) The experience studies team is exploring mortality assumption adjustments for the following products:

Product Description	Deaths	A/E Ratio
Universal Life offered on Simplified Issue basis	200	200%
Permanent life insurance sold to issue ages 18-25	600	105%
Term life insurance for substandards	10,000	130%
Permanent life insurance with 2 years of sales	20,000	60%

(i) Evaluate the use of the Limited Fluctuation credibility method for each product, assuming the minimum number of deaths required for full credibility is 2,000 and the A/E ratios were developed using industry mortality rates.

(ii) Recommend refinements to the mortality assumption for each product.

Commentary on Question:
Candidates generally did poorly on this question. The question asks candidates to assess and make recommendation on appropriate mortality assumption adjustments for different product types. Candidates are expected to understand how different product types are reflected in the industry mortality tables and how to evaluate or blend the experience accordingly. Most of the candidates only compared the actual deaths with minimum number of deaths required for full credibility or commented on the A/E ratios in isolation.

5. Continued

(i)
Universal Life offered on Simplified Issue basis:
Simplified Issued products are not represented in industry tables; therefore, credibility weighting to the industry table would be aggressive.

Permanent life insurance sold to issue ages 18-25:
Permanent products are typically included in industry tables; as the claims are below threshold level (600 < 2000), credibility weighting still applies (limiting issue ages to 18-25 does not have any impact)

Term life insurance for substandards:
Substandard lives are typically excluded from mortality studies, therefore credibility weighting to the industry table would be aggressive.

Permanent life insurance with 2 years of sales:
Permanent products are typically included in industry tables. However, only 2 years of sales means the experience is based on durations 1 and 2 experience; credibility weighting may apply although it meets full credibility standard (20,000 > 2,000)

(ii)
Universal Life offered on Simplified Issue basis:
Based on a separate simplified issue study, an adjustment may be applied to standard mortality rates. However, it might be difficult to find simplified issue data; input from reinsurers could be solicited, and underwriting loads can vary depending on the product design.

Permanent life insurance sold to issue ages 18-25:
Credibility can be applied to derive a mortality adjustment factor to industry mortality rates. In the long run, the development of a separate internal mortality table should be considered.

Term life insurance for substandards:
In an actual to expected study, substandard lives are often included by increasing their expected mortality commensurate with their underwriting classifications (e.g. a life with expected 100% extra mortality would have its expected mortality doubled). Alternatively, a separate study on substandard lives may be performed to determine an adjustment to standard mortality rates.

Permanent life insurance with 2 years of sales:
The first few durations may be adjusted to reflect lower mortality, but grade to a higher ultimate A/E ratio consistent with industry experience.

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.

(4b)   Describe and evaluate indemnity reinsurance and evaluate its use, forms, and requirements.

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

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

Tiller, 4th edition, Chapter 7: Reinsurance of Inforce Risks

Tiller, 4th edition, Chapter 9: Risk Transfer Considerations

Commentary on Question:
Commentary listed underneath question component.

Solution:
(a)   You are given the following reinsurance methods

- Yearly renewable term
- Coinsurance

(i)   Describe how each reinsurance method alleviates surplus strain.

(ii)   Evaluate which method is more effective.

Commentary on Question:
Most candidates answered the question that was asked, but a number of candidates explained the difference between YRT and Coinsurance, with little or no reference as to how each alleviates surplus strain. The answer provided below would have resulted in full credit.

6. Continued

(i) YRT reinsurance provides very little to no surplus strain relief. If a company was to use YRT for this purpose, having a zero first year reinsurance premium would provide a modest reduction in surplus strain on new issues.

With coinsurance, the reinsurer shares proportionately in the risk of losses. The reinsurer also shares in the in the surplus strain of new issues, where the amount of relief to the insurer being a function of the relation of the first-year expense allowance to the acquisition expense of the ceding company.

(ii) Based on the information provided in (i), coinsurance would be more effective in providing surplus strain relief to ABC Life.

(b) Identify reasons ABC might choose modified coinsurance (Mod-co) instead of coinsurance with XYZ Re.

Commentary on Question:
For the most part, candidates answered this section appropriately and received full credit.

As ABC Life is primarily concerned with surplus strain relief, a key issue in reinsuring with XYZ Re is the fact that they are a non-licensed reinsurer. The use of mod-co eliminates potential ceded reserve credit problems when using a reinsurer that is either not licensed, accredited, or certified in the ceding company's state of domicile.

The use of Mod-co will also provide the following benefits:
- ABC would retain control of the investment policy of the block of business and keeps the original assets in place for use in determining dividends or interest crediting rates.
- The reinsurer may prefer this as they would avoid the need to manage the assets, which could be significant if the reinsurer's investment department doesn't have the required expertise.

It would be more appropriate for ABC Life to use Mod-co instead of coinsurance.

6. **Continued**

    (c)   Recommend one of the two reinsurance methods based on their impact on the following:

        (iii)   Group term life policyholders

        (iv)   Speed of execution

        (v)   Ability for ABC to recapture the business

    Justify your answer.

Commentary on Question:
Most candidates answered this question as required, but a number of candidates did not see that the question was asking for the difference between Indemnity Reinsurance and Assumption Reinsurance, and instead answered the question based on YRT or Coinsurance reinsurance. For those candidates who answered the question based on Indemnity/Assumption reinsurance, most received full credit.

Indemnity reinsurance is recommended for the following reasons:

    (i)   Indemnity reinsurance is not generally disclosed, which means agents and policyholders need not be made aware of the change. Insurers may believe this to be preferable to assumption reinsurance for reputational reasons as policyholders must be notified in the event of an assumption reinsurance transaction.

    (ii)   Indemnity reinsurance is a quicker process, typically needing less or no approvals from regulators or shareholders. Products with short life spans, such as group term life and health business or credit insurance, normally terminate before an assumption process, including approvals and policyholder responses, can be completed.

    (iii)   If there is any expectation that the ceding company might take the risks again at some point, indemnity reinsurance allows for recapture with relative ease. Reversing assumption reinsurance treaty would require an assumption reinsurance transaction back to the original company, which would be confusing and costly.

    (d)   Calculate the ABC's Mod-co adjustment in year 2. Show all work.

6. Continued

Commentary on Question:
Most candidates answered this question appropriately. Some candidates did however use the total face amount in the calculation of the Mod-co adjustment in year 2 instead of the reinsured face amount which resulted in some deducted points. For the most part, candidates received full credit for this question.

The Mod-co adj in Year 2 =   Year 2 Ending Policy Reserve
                    - Year 2 Beginning Policy Reserve
                    - Interest on Year 2 Beginning Policy Reserve

Year 2 Ending Policy Reserve   = \$7.15 per 1000 * 80% * \$500,000/1000
                                     = \$2,860

Year 2 Beginning Policy Reserve   = \$0.95 per 1000 * 80% * \$500,000/1000
                                     = \$380

Interest on EOY1 Policy Reserve   = 5% * \$380
                                     = \$19

Therefore, the Mod-Co adjustment in Year 2 is \$2,860 - \$380 - \$19 = \$2,461

(e)

    (i)   Identify two reinsurance treaty terms which could cause concern from a regulatory risk-transfer perspective.

    (ii)   Propose a better alternative for each. Justify your answers

Commentary on Question:
Although most candidates answered this question as asked, a number of candidates highlighted potential issues with the treaty terms that were related to surplus strain relief and not from a regulatory risk-transfer perspective. For those candidates that answered the question from a risk-transfer perspective, most identified "XYZ Re being able to unilaterally terminate the treaty" as an issue but neglected to comment that using a "fixed interest rate" was also a problem from a risk-transfer perspective. Because of this, most candidates received half the available points on this question.

6. **Continued**

(i)   The following treaty terms would cause concern from a regulatory risk-transfer perspective:

a. The ability for XYZ Re to unilaterally terminate the treaty at any time and force ABC Life to recapture the business is problematic as it reduces risk transfer.

b. The use of fixed interest rates allowed the ceding company to guarantee asset performance for the reinsurer's portion of the business, thus not ceding asset risk.

(ii)   A better alternative to the treaty terms listed in (i) that would provide acceptable risk-transfer are:

a. The option to terminate the treaty and recapture the risks reinsured must be an option of ABC Life only and must be an absolute option, and not an obligation.

b. Use an interest rate tied to actual asset performance

7.

Learning Objectives:

5. The candidate will understand the role of the Investment Actuary and the Portfolio Management Process in the Life Insurance company context, as well as the common forms of Fixed income securities and their uses, and the methods and processes used for evaluating portfolio performance and asset allocation.

Learning Outcomes:

(5b) Describe and evaluate how a company's objectives, needs and constraints affect investment strategy and portfolio construction (including capital, funding objectives, risk appetite and risk return tradeoff, tax and accounting, accounting considerations, and constraints such as regulation, rating agency ratings and liquidity.

(5c) Describe and assess the role of and significant considerations related to the design and function of asset allocation strategies.

(5d) Describe and assess Fixed Asset Portfolio management methods, and immunization (including derivatives) and cash matching strategies, including:
- Considerations such as managing funds against a bond market index, the classification of possible strategies, the impact of risk factors and tracking risk, and the use of indexing and active strategies
- Considerations such as managing funds against liabilities, the use of dedication strategies and immunization strategies, the assessment of risk minimization for immunized portfolios, and the use of cash flow matching and combo strategies
- The use of derivative enabled strategies, and the use of futures, swaps, and options

Sources:

Managing Investment Portfilios, Magnin and Tuttle, Ch. 5 - Asset Allocation, 5.2 - 5.4

Managing Investment Portfilios, Magnin and Tuttle, Ch. 6 - Fixed-Income Portfolio Management, 6.1-5

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Calculate the risk aversion value that would make SEV indifferent between the two portfolios in terms of risk-adjusted expected return. Show all work.

7. Continued

Commentary on Question:
Most candidates did this question very well. Candidates who did not get the correct final answer but included the formula and showed their work were given partial credit as they demonstrated an understanding of what the question was asking. Candidates set up the formula in 2 ways (shown below in the solution) which both led to the correct answer

risk-adjusted expected return = expected return - 0.5 * risk aversion * variance of return

Solution 1:
Equation 1
risk-adjusted expected return A = $0.1 - 0.5$ * risk aversion * 0.18^2

Equation 2
risk-adjusted expected return B = $0.08 - 0.5$ * risk aversion * 0.12^2

Set equation 1 equal to equation 2 and solve for risk aversion
$0.1 - 0.5$ * risk aversion * $0.0324 = 0.08 - 0.5$ * risk aversion * 0.0144
$0.2\ 0.02 = 0.009$ * risk aversion
0.3 risk aversion $= 2.22$

Solution 2:
Equation 1
risk-adjusted expected return A = $10 - 0.005$ * risk aversion * 0.18^2
Equation 2
risk-adjusted expected return B = $8 - 0.005$ * risk aversion * 0.12^2

(b) Due to the long duration of the liabilities, SEV has invested primarily in fixed income assets. Over the next quarter, equities are forecasted to significantly outperform fixed income investments and the CEO has asked the investment team to adjust their portfolio allocations.

Recommend how the investment team should respond to the CEO.

Commentary on Question:
Most candidates understood the relationship between liabilities and assets and the impact changes in the asset strategy would have on the portfolio. The candidates were expected to make a definitive recommendation on what action the CEO was to take with supporting justification.

7. Continued

Recommend that the investment team should not follow the CEO's suggestion because of the following:

- Equities are riskier than fixed income assets
- With long-term liabilities for SEV's life insurance products, we should use the strategic asset allocation approach that focuses on the long-term strategic goals rather than short term (tactical allocation)
- We should not make any changes to the asset allocation of the portfolio based on short term asset performance and fluctuations
- Using equities over fixed income securities as investment instruments is too risky and may lead to the inability to pay future liability obligations

(c) SEV is anticipating a spike in mortality as a result of a pandemic impacting the regions where their policyholders are located.

Evaluate how this would impact the investment team's strategy and propose appropriate actions.

Commentary on Question:
Most candidates pulled from their experience in the current pandemic to evaluate the impact. They understood what would happen as the mortality rates spiked, however, most failed to give a clear recommendation on what steps the investment team should take. For most candidates, even if full credit wasn't awarded, partial credit was given if reasonable actions were proposed.

- The pandemic will increase mortality rates, claims will be more than expected and happen earlier than expected which will then reduce the claim liability duration
- The investment team will now need to focus more on short term considerations as there may be larger amounts of claims sooner due to the pandemic
- Because the goal shifted from long term to short term, they should now utilize tactical asset allocation, which involves making short term adjustments to asset-class weight
- The spike in mortality will lead to a mismatch between the asset duration and liability duration. Given the increased short-term liability, the investment team can take an ALM approach compared to asset only approach for the short term to better match cash flow

7. **Continued**

(d) Critique the following statements:

A. *The fixed income portfolio manager should focus on maximizing returns in order to increase product competitiveness.*

B. *To achieve immunization, the entire portfolio does not have to be turned over to rebalance. Furthermore, rebalancing need not be done on a daily basis.*

C. *Use both effective duration and key rate duration to capture non-parallel shifts in the yield curve.*

D. *SEV investing in coupon-paying bonds to support the liability of its life insurance product is appropriate.*

Commentary on Question:
Candidates did not receive credit for merely saying the statement was correct or incorrect. Full credit was given with justification. Most candidates provided an explanation with their evaluation of each statement and therefore received at least partial credit.

(d) (i): *Statement is incorrect.*
- The purpose of the asset is to support the life insurance liability. The fixed income portfolio manager should focus on matching the asset cash flows with the liability cash flows to ensure that the liabilities can be fulfilled when needed.
- In other words, meeting the liabilities is the investment objective, not maximizing returns.

(d) (ii): *Statement is correct.*
- It is true that the entire portfolio does not have to be turned over to rebalance because shifting a small set of securities is usually enough
- In addition, rebalancing doesn't need to be done on a daily basis as this can be costly.

(d) (iii): *Statement is incorrect (also accepted partially correct).*
- Effective duration is used for parallel shifts and does not work for non-parallel shift.
- Key rate duration captures non-parallel shifts
- Key rate duration measures impact in key points along the yield curve.

7.   **Continued**

(d) (iv): *Statement is correct.*
- This is appropriate for life insurance products
- The cashflows are similar
- Liabilities are paid out later
- Also appropriate because an investment strategy is cash flow matching assets to liabilities

8. **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:

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

(3a) Recommend and justify changes to nonguaranteed elements such as credited rates, policy charges, policyholder dividends and guaranteed renewable premiums.

(3b) Describe and evaluate compliance with applicable regulations (including NY Reg. 210).

Sources:

New York State Department of Financial Services 11 NYCRR 48 (Insurance Regulation 210), pp. 4-9

A Ticking Clock: New York's Pending Non-Guaranteed Elements Rule for Life Insurance and Annuity Products, Carlton Fields, 2017

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Explain why the regulation applies to this UL product and how it benefits both existing and new customers.

Commentary on Question:

To get full marks, the candidate should separately explain how the regulation benefits (1) new customer and (2) existing customer. Many candidates provided a combined comment. Additionally, many candidates answered on how the regulation was intended to protect policyholders (i.e. not recoup losses or increase profits), rather than how it educated policyholders.

The Insurance Regulation 210 applies to this product because it is issued in NY and had non-guaranteed elements such as Cost of Insurance (COI) charges.

8. Continued

It benefits new customers in better educating them on how the Non-Guaranteed Elements (NGEs) work and what charges are guaranteed or not.

It benefits existing customers in understanding upcoming NGE changes, improving customer satisfaction and reducing lapses.

(b) List four criteria that an insurer should follow in assigning policies into classes of policies for the purpose of determining non-guaranteed elements.

Commentary on Question:
In general, candidates did well with answering this question.

Policies can be grouped as follows. Candidate only needed to list four out of the list below:

- Issue year
- Underwriting class
- Marketing/distribution
- Nondiscriminatory manner and/or with sound actuarial principles
- Similar expected costs
- Similar cost of guarantees

(c) The product management team is proposing an increase in Cost of Insurance (COI) charges on existing policies from year 3 onwards, which leads to the updated projected profit margins as outlined in the table below:

Projected Profit Margins	Year 1	Year 2	Year 3	Year 4	Years 5+
Using original COIs	5.5%	4.0%	3.5%	3.0%	3.0%
Using revised COIs	5.5%	4.0%	4.0%	3.5%	3.5%

Evaluate their proposal and its compliance with Insurance Regulation 210.

Commentary on Question:
To get full marks, the candidate should clearly state that the proposal violates Insurance Regulation 210 and provide justifications. Some candidates only provided one justification. To get full marks, the candidate should include both.

This proposal is not in compliance with regulation 210 and should not be pursued for the following reasons:
- It recoups past losses. This is explicitly disallowed by the Regulation.
- It increases profit margins in years 3+ above the original projection. Charges cannot be increased for the purpose of increasing profit margins above the original projection.

8. Continued

(d) Critique the following statements in accordance with Insurance Regulation 210:

    A. *Prior to implementing a COI increase, the product management team sent policy owners a document outlining the original and revised COI charges.*

    B. *The revised COI charges are approved by the Board of Directors and the filing is submitted to the Superintendent. No additional documentation is required from the product management team.*

    C. *The company's Board of Directors requires a reasonableness examination of anticipated experience factors and non-guaranteed elements to occur every four to six years.*

    D. *The product management team is considering proposing a decrease to its interest-crediting rate due to an increase in reinsurance costs.*

Commentary on Question:
To get full marks, the candidate should state whether they agree with the statement and provide an explanation.

A. False. The product management team should also disclose a prominent description of the changes, its nature and that it is adverse.

B. False. An annual summary of adverse changes in the NGEs also need to be filed by May 1st of each year.

C. False. The review should not exceed 5 years; 6 years it too long.

D. False. Reinsurance costs cannot impact NGEs nor be passed on to policyholders. This violates Regulation 210. The NGEs can only change if the insurer expected future experience to change.

9. **Learning Objectives:**
5. The candidate will understand the role of the Investment Actuary and the Portfolio Management Process in the Life Insurance company context, as well as the common forms of Fixed income securities and their uses, and the methods and processes used for evaluating portfolio performance and asset allocation.

Learning Outcomes:
(5a) Describe the portfolio management process in an insurance company, and the role of Investment Policy, the Investment Actuary, and external portfolio managers.

(5d) Describe and assess Fixed Asset Portfolio management methods, and immunization (including derivatives) and cash matching strategies, including:
- Considerations such as managing funds against a bond market index, the classification of possible strategies, the impact of risk factors and tracking risk, and the use of indexing and active strategies
- Considerations such as managing funds against liabilities, the use of dedication strategies and immunization strategies, the assessment of risk minimization for immunized portfolios, and the use of cash flow matching and combo strategies
- The use of derivative enabled strategies, and the use of futures, swaps, and options

Sources:
Managing Investment Portfolios, Magnin & Tuttle, Ch. 6 – Fixed-Income Portfolio Management, 6.1-6.5

Managing Investment Portfolios, Magnin & Tuttle, Ch. 12 – Evaluating Portfolio Performance, 12.4

Commentary on Question:
Commentary listed underneath question component.

Solution:
(a)
  (i) Calculate the monthly time-weighted return. Show all work.

  (ii) Explain why time-weighted return might be more appropriate than the money-weighted return.

  Commentary on Question:
  Candidates generally did well on this question. Most candidates were able to calculate the time-weighted return correctly. Some candidates did not receive full credit for calculating the money-weighted return. For part (ii), most candidates correctly identified that the time-weighted return was not sensitive to external cashflows. However, full credit was only given for mentioning the second bullet below as well.

9. **Continued**

    (i)   Calculate each subperiod rate of return:
R1 = ((77,500-7,500)-75,000)/75,000 = -6.7%
R2 = ((80,000-2,500)-77,500)/77,500 = 0%
R3 = (90,000-80,000)/80,000 = 12.5%

Time-weighted return (TWR) is the product of the subperiod rate of returns:
TWR = (1+R1)*(1+R2)*(1+R3) - 1
= (1-6.7%)*(1+0%)*(1+12.5%) - 1
= 5%

    (ii)   - Time-weighted return is not sensitive to the size and timing of external cash flows.
- Time-weighted return reflects how an investor would have fared over the evaluation period if funds were placed in the account at the beginning of the period.

(b)   Explain the assumptions that support classical immunization theory.

Commentary on Question:
Several candidates mentioned the mechanics of classical immunization theory (eg. duration matching) as opposed to the underlying assumptions and received no credit. Parallel changes in the yield curve was the most common answer with few candidates correctly identifying the second and third bullets.

- Any changes in the yield curve are parallel changes.
- The portfolio is valued at a fixed horizon date and there are no interim cash inflows or outflows before the horizon date.
- The target value of the investment is defined as the portfolio value at the horizon date if the interest rate structure does not change (ie. there is no change in forward rates).

(c)   All yields provided in this question are quoted on a bond-equivalent yield basis.

    (i)   Describe how contingent immunization addresses a shortfall of the classical immunization approach.

    (ii)   Calculate the initial dollar safety margin. Show all work.

    (iii)   You decide to invest 100 million in 10-year 6% Treasury notes at par. The following present values of cash flows of the 10-year Treasury notes at different discount rates are provided:

9. Continued

Discount Rate	Present Value of Cash Flows
2%	136,091,106
4%	116,351,433
6%	100,000,000
8%	86,409,674
10%	75,075,579

Calculate the revised dollar safety margin if the yield to maturity suddenly increases to 10%. Show all work.

Commentary on Question:
Candidates generally did poorly on this question. Common errors include expressing the safety margin as the spread between the returns or incorrectly adjusting the value of the current portfolio amount in part (ii). Many candidates did not use semi-annual rates and did not receive full credit as a result. For part (iii), most candidates received partial credit for correctly identifying that the portfolio value would decrease to 75.1M but incorrectly calculating the revised required initial portfolio amount.

(i)   Contingent immunization provides flexibility in pursuing active strategies while ensuring a certain minimum return in the case of a parallel rate shift. In other words, contingent immunization serves as a fallback strategy if the actively managed portfolio does not grow at a certain rate.

(ii) The initial dollar safety margin is the difference between the current and required portfolio amounts.

Starting with 100M, the portfolio needs to grow at 4% for 5 years:
$100M*(1+(0.04/2))^{(2*5)} = 121.9M$

Discounting at 6%, the required initial portfolio amount is:
$121.9M/(1+(0.06/2))^{(2*5)} = 90.7M$

Therefore, the initial dollar safety margin is:
$MAX(0, 100M – 90.7M) = 9.3M$

(iii) If the yield to maturity suddenly increases to 10%, the portfolio value will decrease from 100M to 75.1M.

The revised required initial portfolio amount is:
$121.9M/(1+(0.10/2))^{(2*5)} = 74.8M$

Therefore, the revised initial dollar safety margin is:
$MAX(0, 75.1M – 74.8M) = 0.3M$

9. Continued

(d) Critique the following statements regarding immunization strategies:

A. *The portfolio manager should strive to rebalance the portfolio more frequently to adjust its duration.*

B. *Dollar duration is a measure of the change in duration for a 0.1% change in market yields. Furthermore, a portfolio's dollar duration is a weighted average of the dollar durations of the component securities.*

C. *Regardless of the shape of the yield curve, the yield to maturity of a portfolio should roughly approximate the immunization target rate of return.*

Commentary on Question:
Candidates generally did well on this question. For statement A, most candidates received partial credit for correctly mentioning increased transaction costs. Fewer candidates mentioned the impacts to the target return and balancing the costs and benefits of rebalancing which was required for full credit. For statement B, most candidates were able to correct both errors in the first sentence. While the source material states that the second sentence is true, other sources state that this should be the sum of the dollar durations; as a result, both answers were accepted. For statement C, partial credit was awarded if a candidate mentioned that the shape of the yield curve did have an impact on the yield to maturity but did not elaborate on all three cases.

A. This statement is false. The appropriate frequency will depend on balancing the costs and benefits of rebalancing. More frequent rebalancing can increase transaction costs, thereby reducing the likelihood of achieving the target return. However, less frequent rebalancing causes the duration to deviate from target which also reduces the likelihood of achieving the target return. Therefore, there is a tradeoff between the level of transaction costs and duration mismatch.

B. The first statement is false. Dollar duration is a measure of the change in portfolio value, not duration. It measures the change in portfolio value for a 1% change in market yields, not 0.1%. The second statement is correct.

Also accepted: Both statements are false. Dollar duration is a measure of the change in portfolio value, not duration. It measures the change in portfolio value for a 1% change in market yields, not 0.1%. A portfolio's dollar duration is the sum of the dollar durations of the component securities, not the weighted average.

9. Continued

C. This statement is false. The shape of the yield curve does have an impact on the yield to maturity. For a flat yield curve, the yield to maturity would roughly approximate the target rate of return. For an upward-sloping yield curve, the yield to maturity would be greater than the target rate of return. For a downward-sloping yield curve, the yield to maturity would be less than the target rate of return.

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.

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

Sources:
LPM-166-19: Annuity Product and Features

ASOP 2: Non-guaranteed Charges or Benefits for Life Insurance Policies and Annuity Contracts

ASOP 54: Pricing of Life and Annuity Products

Setting Assumptions, Exposure Draft, ASOP

Commentary on Question:
The goal of this question was to test knowledge of FIA product designs, and to test knowledge of how ASOPs can be applied to new product pricing. Candidates struggled with the first two sections but did better on the third. Commentary listed underneath question component.

Solution:
(a)
    (i)   Propose two different ways the product design could be modified to allow for a higher credited rate each year without increasing the hedging budget. Justify your answer.

    (ii)   Evaluate how the crediting rate would vary between the two proposals depending on the one-year index return.

    Commentary on Question:
    Candidates struggled with this question. Most candidates did not receive maximum credit because the proposed design changes did not alter the cap. Many candidates also failed to address the impact to the hedging budget.

10. Continued

(i)
Design change option 1

Remove/increase the cap as this is the feature that limits the upside on the credited rate

Set the participation rate each year (presumably lower than 100%) so that the option costs are equal to the hedging budget. This is done by decreasing the notional amount needed for the call option

Design change option 2

Again remove/increase the cap as this is the feature that limits the upside on the credited rate

Keep the 100% participation rate, but charge a fee. As the fee would not be allowed to cause the return to go negative, the effect is to increase the strike price. The fee would be set each year such that the higher strike price.

(ii)
For index returns less than zero, neither option would result in a greater return as they would both be zero

Option 1 will have a higher return from 0% index return up to the point where the higher participation rate overtakes the disadvantage Option 2 has with the higher strike price.

Option 2 will then have the higher return for any index return higher than that crossover point.

(b)   Identify an example of each of the following items defined in "ASOP 2: Non-guaranteed Charges or Benefits for Life Insurance Policies and Annuity Contracts" for a non-guaranteed benefit in the given FIA product information:

(i)   Determination Policy

(ii)   Policy Factor

(iii)   Policy Class

10. Continued

(i) Determination Policy:

The company has stated the objective that it would set its cap based on what it is able to afford from its hedging budget.

(ii) Policy Factor:

The guaranteed minimum cap of 2.00%

(iii) Policy Class:

Each issue year determines the policy class for the cap

(c) Critique the following statements on the FIA pricing model with respect to the following actuarial standards of practice (ASOP):

(i) ASOP 54: Pricing of Life and Annuity Products

(ii) Setting Assumptions, Exposure Draft, ASOP

   A. *I set the net earned rate assumption based on data from the investment department. Their data showed the average yield of the bond investment portfolio over the past 5 years.*

   B. *Since we can manage the cap to get the desired pricing spread, we can rely on a single pricing model run with our baseline pricing assumptions to understand the product's profitability.*

   C. *I have applied the same lapse rate assumptions of an existing fixed annuity product to this FIA product because it is being sold by the same distribution channel.*

   D. *I used the existing annuity maintenance expense assumption set by the Chief Actuary.*

10. Continued

Commentary on Question:
Candidates did well on this section of the question. While many candidates provided acceptable critiques for statements A and B, answers for C and D were often generic and incomplete. Alternative answers were received and considered for partial or full credit, below are critiques that would get full credit.

(i) ASOP 54:

(B) When performing a profitability analysis, a risk analysis should also be performed. This could be done with a sensitivity analysis or a stochastic analysis, which would supplement the standard pricing run.

(C) When setting the lapse rate assumption, the actuary should consider additional causal variables beyond just the distribution channel and product form. There could be different age or policy size characteristics. Also, economic factors could affect lapsation on FIA differently than an FA product.

(ii) Assumption ASOP draft:

(A) The pricing actuary should consider whether there have been any "change in conditions" that would cause the net earned rate assumption to be different now than it was over the past 5 years. This would be driven by external economic changes that may be different

(D) Assumptions set by the chief actuary should still be assessed for reasonableness. If, after assessing the assumption for reasonableness, the pricing actuary feels they need to disclaim responsibility they should provide the appropriate disclosures as described by ASOP 41 and make sure they are upholding the code of conduct.