# ILA LPM Model Solutions
# Fall 2022

**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:**
(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.

**Sources:**
Standards of Practice, Canadian Institute of Actuaries Actuarial Standards Board, 2022, Section 1600

LPM-149-22: Ch. 11, pp. 499-512 of Life Insurance Products and Finance, Atkinson and Dallas

Report on Premium Persistency Assumptions Study of Flexible Premium Universal Life Products, May 2012, pp. 9-15

LPM-165-20: Life Products and Features

**Commentary on Question:**
*Commentary listed underneath question component.*

**1.** **Continued**

**Solution:**
(a) Assess the following statements based upon the Canadian Institute of Actuaries' (CIA) Standard of Practice.

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

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

**Commentary on Question**:
*Candidates generally did well on this question.*

*In part A, most candidates understood that assumptions that were prescribed or mandated by law must be treated differently than other assumptions.*

*In part B, some candidates did not clarify that there are legitimate reasons the assumption should deviate from the status quo.*

A. The statement is partially correct. An actuary should identify and select each assumption that is needed for the work. However, for assumptions that are mandated by law or prescribed, the actuary needs to obey the applicable laws or regulatory guidance.

B. The statement is partially correct. The appropriate assumption for a matter, other than a model or data assumption, should be a continuation of the status quo. However, if there is no status quo, or if the actuary has a reasonable expectation that the assumption will change, then the status quo may no longer be followed.

(b) Describe two considerations when determining premium persistency assumptions for a flexible premium Universal Life (UL) product.

**Commentary on Question**:
*This question tested the candidates' knowledge of the impact that some components have on the premium persistency assumption.*

*Many candidates were able identify and explain two considerations.*

*Some candidates provided responses that recommended methodologies to conduct the experience study, such as using stochastic study methodologies. These responses were not given credit as this question is meant to test the candidate's knowledge on product feature impacts.*

# 1. Continued

1) The policyholder has flexibility on their premium payments. This means that they can choose to make payments more frequently than required. They also may choose to pay more, and in some cases, less than the original amount.

2) Some flexible premium Universal Life products contain minimum premiums, which may persist for one or more years. Due to these minimum premiums, the cash flows in these early years become more predictable for the actuary to predict.

(c) You are given the following three options for premium persistency assumptions for a new UL product with a No Lapse Guarantee rider:

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

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

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

**Commentary on Question**:
*(i) In this question candidates are asked to demonstrate knowledge of assumption setting for Universal Life (UL) products. Full credit is awarded for explaining an advantage and disadvantage for each option. Candidates generally answered this question well and received full credit. Some candidates did not describe both an advantage and disadvantage for each of the three assumptions and received partial credit.*

*(ii) Candidates are asked to decide with premium persistency assumption to use to price the product and support their decision. Full credit is awarded for selecting one of the three assumptions and providing a reason to support the decision. Note that any of the three premium persistency assumptions could be chosen – the model solution below is an example. Candidates generally performed well on this question.*

(i)
<u>100% premium persistency at all durations</u>

An advantage of this method is its simplicity. It is an easy assumption to model and explain. A disadvantage is that it will likely be inaccurate and does not account for things that can vary policyholder behavior. It is very unlikely that 100% premium persistency will hold so this assumption will be wrong the majority of the time.

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# 1. Continued

Premium persistency factors vary by duration

This assumption is likely to be more accurate than the first option of assuming 100% premium persistency across all durations. Premium persistency does tend to vary with duration, so building this assumption could limit asset liability mismatch. A disadvantage of this method is that only one variable is used. Many other variables, which can impact the accuracy of the assumption (policyholder age) is not used to set the assumption.

Dynamic premium persistency assumptions that vary with the interest rate

An advantage of this methodology is that many variables have an impact on determining premium persistency, such as premiums or interest rates. The company will develop assumptions that have a higher likelihood of being accurate. Disadvantage is the complexity of modeling and setting the assumption, especially on a new rider with little to no actual experience data.

(ii)
I recommend using a dynamic premium persistency assumption. Because of the flexibility and complexity of the UL product, assumption setting can be very difficult and should be performed using stochastic scenarios. Setting the premium persistency assumption to vary dynamically based on the market environment and other variables will give us the best chance at setting the assumption appropriately. Dynamic assumptions should be used in cases when the assumption is expected to vary greatly and can have a large impact on the product profitability, and premium persistency falls in that category for Universal Life.

(d) Calculate the following items. Show all work.

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

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

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

**Commentary on Question**:
*This question tested candidates' knowledge of premium persistency for Flexible Premium Universal Life products as well as profit measurement and analysis.*

*Most candidates showed an understanding of product cash flows and how to calculate pre-tax earnings for each policy year.*

# 1. Continued

*Many candidates did not accurately reflect the premium persistency assumption. They did not understand that premium persistency provided in the question was only for that duration, and a cumulative premium persistency must be used. Cumulative premium persistency is calculated by multiplying that duration's premium persistency by the prior year's cumulative premium persistency.*

(i)    For t=1, Average Premium (t) = 4,000

For t=2 to t=5
Average Premium (t) = Average Premium (t-1) * Premium Persistency (t)

For t=1 to t=5
Total Premium(t) = Average Premium (t) * BOY Inforce (t)

| Duration | Premium Persistency Ratio | Average Premium | Total Premium ($mm) |
|---|---|---|---|
| 1 | N/A | 4,000 | 52.0 |
| 2 | 85% | 3,400 | 42.7 |
| 3 | 95% | 3,230 | 39.1 |
| 4 | 98% | 3,165 | 36.8 |
| 5 | 100% | 3,165 | 35.1 |
| | | | **205.7** |

(ii)    Product Cash Flow(t) = Premium(t) - Benefit(t) - Expense(t)
Benefit(t) = Death Benefit(t) + Surrender Benefit(t) + Dividend(t)

| Duration | Product Cash Flows ($mm) |
|---|---|
| 1 | 38.8 |
| 2 | 27.2 |
| 3 | 19.3 |
| 4 | 18.7 |
| 5 | 18.6 |
| | **122.6** |

(iii)    Pre Tax Solvency Earnings(t) = Product Cash Flow(t) + Investment Income(t) – Increase In Solvency Resereve (t)

In t=1, the reserve increases from 0 to 85. In all subsequent years, the reserve decreases.

# 1. Continued

Take Present Value at 3%

| Duration | Pre Tax Solvency Earnings ($mm) | Present Value |
|:---:|:---:|:---:|
| 1 | (45.4) | (44.1) |
| 2 | 41.4 | 39.0 |
| 3 | 31.3 | 28.6 |
| 4 | 31.5 | 28.0 |
| 5 | 30.3 | 26.2 |
| | | **77.7** |

(e)

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

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

**Commentary on Question**:
*This question tested the candidates' knowledge of the difference between the various types or earnings.*

*Most candidates were able to articulate the differences.*

*Some candidates incorrectly indicated that one type of earnings calculation to be more accurate. Although the methodologies are used differently, it is inaccurate to say that one is more accurate than another.*

    (i)    Solvency earnings are done on a statutory reserve basis while stockholder earnings are based on a GAAP reserve basis. The GAAP basis uses the benefit reserves, as well as subtracting Deferred Acquisition Cost (DAC). Statutory reserves are typically more conservative.

    (ii)    One of the benefits of calculating profits based on earnings reserves is that it smooths the first-year acquisition costs through DAC amortization. This results in a smoother earnings pattern and generally no loss in the first year.

**2.** **Learning Objectives:**
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:**
(1f) Describe methodologies, approaches, considerations and tools related to the Underwriting function.

(1m) Describe how predictive analytics can be used in life and annuity pricing applications.

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

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

**Commentary on Question:**
*This question tested the candidates' knowledge of topics related to accelerated underwriting and predictive modeling. Candidates generally did well on parts a and c but struggled with part b.*

**Solution:**
(a) Outline potential benefits from using an accelerated underwriting model.

**Commentary on Question**:
*Candidates generally did well on part a. Most candidates were able to recall at least two benefits from using an accelerated underwriting model. Candidates who received full credit listed six or more benefits. Partial credit was awarded for fewer responses. Other reasonable responses not included below were considered for full or partial credit.*

- Accelerated underwriting (AUW) does not require blood and urine testing and is therefore less invasive for the customer. This leads to a better customer experience.
- The use of digital imaging, pre-filled fields, and shorter application form make for greater application completion rate.
- AUW can help speed up the underwriting process to complete more applications - i.e., faster turnaround times.
- It can reduce cost and lead to expense savings.
- AUW leverages new data sources that can provide better understanding of the risks.

# 2.   Continued

- It can help reach the shift in demographics toward millennial & gen X buyers.
- It can reduce the friction of waiting times in the life insurance buying process and lead to an improved customer experience.
- It improves the quality and speed of assessing the customer's mortality risk.
- It has the potential to reduce human error in the underwriting process and standardize underwriting results.

(b) Explain key steps your company should take before implementing the smoker propensity model with confidence.

**Commentary on Question**:
*Candidates generally did poorly on part b. Candidates who did well described several steps the company should consider before implementing the model. Most candidates mentioned that the model should be validated against fully underwritten experience but failed to provide other steps or concerns. Many candidates listed the steps of building a predictive model or described what the company should do after implementing the model. These responses received partial credit. Examples of acceptable solutions are provided below.*

- Consider whether portions of the application can be pre-filled with data from internal and external sources
- Calculate the financial impact of misclassification error by conducting a cost benefit analysis
- Consider whether the model should predict the risk class or predict the expected mortality (which can then be converted to a risk class)
- Validate the predicted risk class against a training dataset of previously underwritten policies to confirm that the model works
- Consider regulatory and compliance concerns when using data; Legal and Compliance should review list of variables

(c) Your company would like to implement the use of a smoker propensity model to replace the smoking status question in the application and the urine sample.

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

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

## 2.    Continued

**Commentary on Question**:
*(i) Candidates who did well on c.i provided two or more concerns of eliminating the smoking status question and the urine requirement. Most candidates mentioned model accuracy as a primary concern, but few listed a second concern.*

*(ii) Candidates were given full credit for recommending one alternative approach with appropriate justification. Partial credit was awarded for recommendations with some justification. Examples of full credit responses are given below.*

(i)
- The model is not 100% accurate and introduces risk of misclassification, particularly the risk of classifying smokers as non-smokers.
- More work would be needed to set a rating for those that are not identified as smoker or non-smoker by the model such as a triage step for complex cases.
- Reliability and/or availability of some publicly available data such as social media data may be low.
- There may be potential for applicants and producers to game the system and exploit the reduced underwriting requirements, resulting in anti-selection.
- The company may lose out on other useful information that a urine test could provide beyond smoking status.

(ii)
- The company should continue including the smoker question on the application until it is determined that the model is accurate. The smoker question will serve as a check against the model output and does not feel invasive to the customer like a urine test would. If the model result does not match the customer's response to the smoker question, the customer can be sent through traditional underwriting.
- The company should feed the output of the predictive model into a triage step. Predicted low-risk applicants can then proceed ahead through the fast-track process while the predicted high-risk applicants are asked to proceed via the traditional underwriting process which should reduce misclassification risk.
- The company should complement the predictive model with an external rules engine (from proprietary on industry research studies) to apply a mortality load for increasing risk factors. This would use experience-based rules to further refine the risk class assigned to an applicant.

**2.** **Continued**

- The company should send a random sample of policies through traditional underwriting and compare against model results to validate model is working. Once the company is satisfied that the model is working correctly, they can cut off or limit the use of traditional underwriting for this product.

**3.** **Learning Objectives:**
1. The candidate will understand the designs 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:**
(1e) Describe considerations and practices related to "Lapse-Supported" insurance.

(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:**
LPM-152-19: Lapse Supported Insurance Analysis

ASOP 2: Non-guaranteed Charges or Benefits for Life Insurance Policies and Annuity Contracts, Exposure Draft, Jun 2020 (excluding Appendices)

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

LPM-165-20: Life Products and Features

**Commentary on Question:**
*Overall, candidates typically performed well on this question by being able to express their understanding of lapse supported products, nonguaranteed elements, and implications of pricing assumptions and lapse experience.*

**Solution:**
(a) Describe a method for determining if the IUL product is lapse-supported.

**Commentary on Question**:
*Most candidates were able to describe the profitability run to test if the IUL product is lapse-supported. The alternative answer of assuming zero lapses in all years received full credit too.*

One possible method of determining whether a product is lapse supported is the NAIC Illustration Model Regulation lapse-support test. This test involves determining whether the product is self-supporting given defined persistency assumptions during the first 5 years, and 100% persistency thereafter.

# 3. Continued

(b) Explain why lapse-supported products have caused profitability issues for some companies.

**Commentary on Question**:
*Candidates who described the 'moving target' nature of the implications of original pricing assumptions on premium rates and lapse experience received full credit. Partial credit was given to candidates who explained how lapse supported products with lower lapses can lead to high benefits in the future, with the potential of insufficient reserves, reducing profitability for the company.*

Assuming higher lapses in pricing can result in lower premium rates being justified, which improves the marketability of the product. However, lower premium rates result in the product being more desirable to maintain, so lapse rates end up being lower than expected.

(c) Critique each of the following statements with respect to ASOP 2 – Non-Guaranteed Elements for Life Insurance and Annuity Products:

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

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

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

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

**Commentary on Question**:
*Candidates did not perform as well on this question, as they needed to critique each statement with a well justified response to receive full credit. Identifying whether each statement was acceptable or not only received partial credit.*

A. This practice is not acceptable. According to ASOP 2, NGE scales should be determined based on reasonable expectation of future experience and may not be determined with the objective of recouping past losses or distributing past gains.

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# 3.    Continued

        B.  This practice is acceptable. For newly-issued policies, NGE scales can be determined based on anticipated experience factors, and NGE scales should be structured to cover costs under the product design.

        C.  It is not an acceptable practice to modify policy classes for this reason. Instead, the actuary should recommend that inforce policies remain assigned to their policy classes unless there is new information about anticipated experience factors, not based on past performance or profitability.

        D.  This is not acceptable. ASOP 2 states that the actuary should document the determination policy that led to the determination of the NGE scales, including items such as anticipated experience factors, marketing objectives, profitability, policy provisions and applicable law, and so on. In addition, the actuary should recommend that an NGE framework be developed or updated if the NGE framework is inadequate or nonexistent.

(d)     You have been asked to analyze why lapse rates have not materialized as expected.

     (i)     Describe two hypotheses for why life insurance policyholders decide to lapse a product.

     (ii)    Identify two reasons lapses may be lower than expected on the IUL product. Justify your answer.

**Commentary on Question**:
*Candidates generally did well on this question, for both parts (i) and (ii).*

*(i) Most candidates were able to describe the hypotheses well. Candidates were given full credit for describing other reasonable scenarios that would lead to lapse rates not materializing as expected.*

*(ii) Most candidates struggled to identify reasons that related specifically to the IUL product. The majority of candidates were able to provide two general comments about lapsation, which earned partial credit. Candidates who provided other reasonable responses justifying lower lapses on the IUL product received full credit.*

     (i)     1. Interest rate hypothesis: lapse rates are negatively related to internal rates of return and positively related to external rates of return. If external interest rates are higher than their currently earned rate, policyholders are likely to lapse to earn a higher rate elsewhere.

**3.** **Continued**

        2. Emergency funds hypothesis: policyholders surrender their policies due to financial distress, as they need the additional cash. For example, unemployment or an economic downturn could lead to this.

(ii)    1. Interest rates - if external interest rates are less than the index floor guaranteed on the policy, policyholders are likely to persist.

        2. Relative choices - policyholder will determine whether a policy is a good deal by comparing against outside products. If the IUL product was lapse-supported and was priced with high lapses, it likely has a competitive premium. Policyholder wouldn't be able to lapse and get a better priced product elsewhere.

**4.**  **Learning Objectives:**
1. The candidate will understand the designs 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.

(1d) Describe and evaluate the impact of VM-20 on pricing.

(1e) Describe considerations and practices related to "Lapse-Supported" insurance.

(1j) Describe the operation of Life Acceleration Riders and their role in meeting market needs.

(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.

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

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

Ending the Mortality Table, Living to 100 Symposium

Impact of VM-20 on Life Insurance Product Development, SOA Research, Nov 2016, pp. 1-31 (excluding discussion of 20-year term)

Life Insurance Acceleration Riders, SOA Reinsurance News, 2013, pp. 35-38

**Commentary on Question:**
*Commentary listed underneath question component.*

**4.** **Continued**

**Solution:**

(a)     List four examples of guaranteed elements that are relevant to the new ULSG product.

**Commentary on Question**:
*This question tested the candidate's understanding of ULSG features. Most candidates were able to list some guaranteed elements to receive partial marks. The candidates are required to list 4 elements correctly to receive full marks. Few candidates listed the feature of Seg Fund/Variable Annuity and did not receive marks.*

Examples of guaranteed elements include
- maximum premium charges,
- maximum expense charges,
- minimum credited interest rates,
- maximum cost of insurance charges,
- maximum gross premiums,
- minimum index parameters,
- maximum mortality and expense (M&E) risk charges, and
- maximum policy loan interest rates

(b)     The industry data shows there is an equal likelihood that the shock lapse could be 50% or 60%.

Recommend an appropriate shock lapse. Justify your answer.

**Commentary on Question**:
*This question is generally answered well by the candidates. Candidates were able to receive full credit by providing the following:*
*1. ULSG is a lapse supported product and mentions that a lower lapse assumption is more conservative for lapse supported products.*
*2. Recommend that the 50% shock lapse should be used given the more conservative choice would be chosen if two choices are deemed equally likely.*

*Candidates recommended the correct shock lapse without appropriate explanation received partial marks.*

Universal Life with secondary guarantee is a lapse supported product.

The 50% shock lapse assumption is more conservative than the 60% assumption.

The 50% shock lapse should be used since "if two choices are deemed equally likely, the more conservative choice would generally be chosen"

# 4. Continued

(c) The current Universal Life product used the Blended Method to end the mortality table at age 120.

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

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

**Commentary on Question**:
*Candidates generally did well on this question. Most candidates were able to describe the impact of the 3 approaches. Candidates are also required to disclose the name of the approaches to receive full marks.*

The Forced Method: Select an ultimate age and set the mortality rate at that age equal to 1.000 without any changes to other mortality rates. This creates a discontinuity at the ultimate age compared to the penultimate and prior ages.

There is a natural limiting wall to the life span and that the rate of mortality jumps to a rate very close to 1.000 at the ultimate age, irrespective of the shape of the curve before the ultimate age.

The Pattern Method: Let the pattern of mortality continue until the rate approaches or hits 1.000 and set that as the ultimate age.

Mortality rates at the oldest ages continue to increase with age, but probably at a lower rate than for the younger ages, until the rate of mortality approaches 1.000. Proponents of this theory would probably accept the fact that the mortality rate is never actually 1.000, but would argue that it eventually becomes close enough to 1.000 for practical purposes in designing a mortality table.

The Less-Than-One Method: Select an ultimate age but end the table at whatever rate is produced at that age so that the ultimate rate is less than 1.000.

Rates at the oldest ages are asymptotic to an ultimate rate that is well below 1.000. For instance, if 0.500 is set as the ultimate rate, the rates probably slowly decelerate until they hit but do not exceed 0.500.

(d)   ABC life has adopted VM-20.

   (i)   Describe the VM-20 reserve calculation.

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

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

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

      *C.* Prescribed mortality margins will decrease.

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

**Commentary on Question**:
*Candidates generally performed well on this question.*

*(i)    Most candidates were able to identify and describe the VM-20 reserve. The candidates are also required to describe NPR, DR and SR to receive full marks.*

*(ii)   Candidates are required to provide explanation on the reserve movement to receive full marks. Candidates provided accurate reserve movement without appropriate explanation received partial marks.*

(i)
The VM-20 reserve is equal to the NPR, plus the excess, if any, of the maximum of the DR and SR over the NPR adjusted for due and deferred premium.

Net Premium Reserves
The NPR is a seriatim formulaic calculation using specified CSO mortality tables, prescribed lapses and prescribed valuation interest rates. The NPR for a policy after issue may reflect valuation mortality tables and prescribed lapses different from those in effect when the policy was issued. The valuation interest rate does not change after policy issue.

Deterministic Reserves
The DR is an aggregate gross premium reserve developed as the present value of pretax liability cash flows at discount rates, using a prescribed scenario. Another way to think of the DR is the amount of general account assets at the valuation date that will fully satisfy the company's obligations for a group of policies over the lifetime of the policies under the specified DR scenario.

# 4.    Continued

Stochastic Reserve

The SR is an aggregate reserve calculation using an asset liability model developed as a starting asset amount plus the greatest present value of accumulated deficiencies over a range of stochastic scenarios, with the SR set at the 70th conditional tail expectation (CTE). The liability cash flows reflected in the SR calculation are projected under the same assumptions used in the DR calculation and subject to change from the items listed above. Prudent estimate assumptions within the SR vary from scenario to scenario where appropriate, reflecting scenario-dependent risks.

(ii)
A.  Higher mortality experience results in higher mortality assumption which increases the reserve.
B.  Lower lapses result in lower lapse assumption which increases the reserve (ULSG is lapse supported).
C.  Lower mortality margin results in lower mortality assumption which reduces the reserve.
D.  Higher treasury rates result in higher discount rate which reduces the reserve (if not already floored at NPR).

(e)    The marketing department recommends adding an accelerated benefit chronic illness rider to the ULSG product.

    (i)    Describe the chronic illness rider.

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

**Commentary on Question**:
*(i)    Most candidates were able to describe the chronic illness rider appropriately. Few candidates mixed the chronic illness requirement with critical illness requirement and received no marks.*
*(ii)    Most candidates were able to list a few recommendations limiting the risks. Candidates received full marks if they listed 4 ways accurately.*

(i)
A chronic illness rider is one that allows policyholders to accelerate a portion of their face amount when they are unable to perform two or more activities of daily living (ADLs) without assistance from another person. Activities of daily living are bathing, continence, dressing, eating, toileting and transferring.

# 4.   **Continued**

(ii)
- Use of a supplemental underwriting application for any acceleration riders. The supplemental underwriting typically consists of questions related to the applicant's medical history with respect to the triggers that are used for the acceleration benefit. Those coverage questions are intended to determine if it appears that the individual is over-insured for these benefits (overinsurance may imply that the applicant is intending to anti-select against the writing company).
- Limiting the issue ages at which the chronic illness rider can be added and/or incorporation of cognitive testing at particular issue ages.
- Holding the accelerated amount as a lien against the death benefit and charging interest against that lien OR payment of a discounted amount relative to the face amount that is being accelerated.
- Limiting both the annual and the maximum acceleration amount to some specific dollar amount.
- Requiring that an approved licensed health care practitioner certifies that the policyholder is unable to perform the ADLs that are the triggering events for the benefit payment. The writing company often reserves the right to pay for an independent examination of the insured by a licensed health care practitioner to confirm the validity of the claim.
- Defining the loss of ADLs as expected to be permanent can be an important risk control. In the absence of such a definition, an otherwise healthy individual could claim under the rider when there is a situation that involves a temporary loss of ADLs.
- The rider form may have certain exclusions such as some mental or nervous disorders, alcoholism, drug addiction, act of war (declared or undeclared), suicide or intentional self-inflicted injury.
- The rider is typically only available on policies that are issued up to some maximum rating (such as Standard or Table D).
- The contestability rights for the writing company with respect to the rider typically follow those of the base policy.
- Limiting the maximum benefit to be less than 100 percent of the death benefit on the life insurance policy.

**5.**

**Learning Objectives:**
1. The candidate will understand the designs 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.

(1e) Describe considerations and practices related to "Lapse-Supported" insurance.

(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.

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

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

LPM-166-20: Annuity Product and Features

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

**Commentary on Question:**
*This question tested candidates' knowledge of predictive analytics techniques used in setting assumptions, issues related to data gathering and data quality in a predictive analytics study, and understanding of how decision-making shortcuts impact policyholder behavior.*

**Solution:**
(a) List the advantages and disadvantages of using predictive analytics over the traditional approach when setting assumptions.

**Commentary on Question**:
*Candidates who discussed predictive analytics in the context of assumption setting generally performed well. These candidates displayed good knowledge of advantages and disadvantages of predictive analytic approaches.*

# 5. Continued

*Some candidates gave answers that related to underwriting processes rather than assumption setting. Although some of these responses received partial credit, in general these answers received lower scores as they did not answer the question in the context given.*

- Using predictive analytics provides better insight into the interaction of various factors and allows for better use of the available data.
- Using predictive analytics could lead to a different expectation of profitability both overall and at a cell level which may assist in optimizing competitiveness.
- Regulators are requesting increased sophistication in assumption setting which can include use of predictive analytic techniques.
- However, without significant expertise, predictive analytic models can be misinterpreted and may be built with unintended flaws.

(b) Describe the steps you would take to collect and organize the data.

**Commentary on Question**:
*Candidates were generally able to correctly identify several steps that are used to collect and organize data. Some candidates described general considerations related to data quality. Such responses received credit only if they also described steps that would be taken in the data collection process to address those considerations.*

- The first step is variable generation, including the mapping of input data and creating synthetic variables where necessary.
- Then, exploratory data analysis should be performed to understand the distribution of variables and any correlations between predictive and target variables.
- Variables should be transformed where necessary to group excessive categorical values, replace missing values, and cap extreme values or outliers.
- Finally, the data should be divided into a training, validation, and test set to carry out an iterative process that produces the strongest model.

**5.** **Continued**

(c)    Explain how each of the following should be addressed during the preparation of the data for a study:

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

(ii)     Annuity payout offering transitioned from 'Life with 10 years certain' to 'Life only' over the study period.

(iii)    Sales channels expanded to include internet sales.

(iv)    Target market shifted towards individuals with high net worth.

(v)     Charges were changed five years ago from front-end loading to back-end loads.

(vi)    For the last three years, the focus has been on sales campaigns offering deposit and persistency bonuses.

**Commentary on Question**:
*For each part, candidates received full credit if they described a method to address the given issue and gave justification for their answer. Answers which only described a method without justification received partial credit, as did answers that described possible impacts of the issue without explaining a method to address it.*

(i)      Since the crediting rates in the study are incorrect, we will either need to adjust the study for this issue. If this is not possible, these policies could be excluded from the study as the number of policies is small.

(ii)     A dummy variable should be created to track which policies were sold with which annuity type, since annuitizations become less valuable with the "life only" payout type.

(iii)    Using a variable to distinguish between distribution channels in this case will enable differentiation between internet sales and non-internet sales, as these channels may have different sales incentives and products available.

(iv)    A variable should be added to the study to identify policies with large deposits or balances as these are likely to be high net worth individuals. This will help identify any differing behavior that these individuals may exhibit.

(v)     A dummy variable should be set up in this case to distinguish policies before the change from policies after the change, since moving from front-end loading to back-end loading may impact early lapses.

# 5. Continued

    (vi)    Lapses would likely decrease for policies sold with persistency bonuses, so a dummy variable should be set up to identify policies sold with these types of incentives.

(d)    Interpret how policyholder behavior, using decision shortcuts, may impact each of the following possible scenarios:

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

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

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

**Commentary on Question**:
*Most candidates were able to correctly identify decision making shortcuts that applied to these scenarios. To receive full credit, candidates needed to both describe the decision-making shortcut that was applicable and apply that shortcut to the given scenario. Also, several responses were possible for some of these scenarios, and candidates who gave reasonable and justified answers using other shortcuts received credit.*

    (i)    Many people are more likely to take advantage of opportunities that appear to be free, referred to as the "love of free" shortcut. In this scenario, if withdrawals can now be made tax free, policyholders will now be more likely to take withdrawals from their policies even if the economics of their policy are otherwise unchanged.

    (ii)    Advertising in this way changes the framing of the investment decisions for the policyholder, meaning that although the available options have not changed, the way the options are portrayed is likely to lead to a different decision. In this case, seeing volatility rather than return may steer the policyholder toward safer investments and lower both their risk and return.

    (iii)    This change takes advantage of policyholders' reliance on defaults, where a proportion of policyholders are likely to remain with whatever default option the insurer has selected, often believing that the insurer likely knows best. As a result, more policies will tend to annuitize which may benefit the insurance company if annuitizations are more profitable for the company.

**6.**  **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.

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

Evolving Strategies to Improve Inforce Post-Level Term Profitability, Product Matters, Feb 2015, pp. 23-29

LPM-153-19: Life in-force Management: Improving Consumer Value and Long-Term Profitability

**Commentary on Question:**
*Commentary listed underneath question component.*

**Solution:**
(a)     Describe four of the six areas identified by the Swiss Re Institute *sigma* publication that life insurers can leverage to effectively manage their in-force business.

**Commentary on Question**:
*This question tests candidate's understanding of the key levers of in-force management of life products and how to improve consumer value and long-term profitability.   Candidates need to describe in detail how each type of activities help the insurer with enhanced profitability to get full credit.  Some candidates failed to list and/or describe Swiss Re's publication on in-force management. Simply listing out the activities would only be award partial credit.*

- Steering liability portfolios
  Allocating capital to the most attractive product types and business lines to achieve the company's projected strategic ambitions and financial targets, boost in-force profitability by growing high-performance business and exiting unprofitable areas

- Increasing persistency
  Preventing deviations in lapse experience from expectations that can otherwise significantly weaken profitability and change the risk profile of a specific book of business

**6.** **Continued**

- Improving claims management
  Implementing an efficient, consumer-friendly claims department that helps the
  insurer manage their liabilities efficiently, as well as enhances the customer
  experience/helps to retain and win new business

- Managing assets / aligning asset and allocation strategy
  Managing investment income from assets as a key source of profitability,
  adjusting asset duration to match duration of future liabilities, managing asset
  and reinvestment risk

- Stabilizing cash flows and freeing up/optimizing capital
  Improving the insurer's returns on in-force business by customizing the
  release of funds from their balance sheets, restructuring the risk profile of a
  product portfolio, and/or increasing available capital/liquidity via excess
  reserve financing or other securitizations

- Increasing operational efficiency / reducing operating costs

  Expense management, reducing in-force management inefficiency from a
  legacy IT landscape, unnecessary business complexity, an inefficient or un-
  optimized operating model, and/or inadequate performance measurement
  techniques

(b)     Critique each of the following statements:

A.      *Protection-oriented products do not require repricing in a low interest
        rate environment.*

B.      *There are limited benefits associated with offering buyouts of in-force
        policies.*

C.      *Deviations in lapse experience from expectations can impact the insurer's
        ability to match the durations of their assets and liabilities.*

D.      *Excess reserve financing is primarily used to free up trapped capital for
        term life (Regulation XXX) products.*

**Commentary on Question**:
*This question continues to test candidate's understanding of the key levers of in-
force management.  For each of the four statements, the candidate should clearly
state whether edits are needed and provide their rationale to receive full credit.
Most candidate did well on A. B. C, but some failed to recognize that excess
reserve financing is not only used to free up trapped capital for term life products
but also Universal life with secondary guarantees.*

# 6. Continued

    A. Edits are needed - persistently low interest rates can also affect the profitability of risk protection products (e.g., the low rates slow down the speed by which the reserves of risk protection products accumulate).

    B. Edits are needed - insurer benefits as long as the policyholder's willingness to give up future claims (i.e., the compensation offered to relinquish income guarantees) is less than the reserves that need to be set aside for the future guarantees, while the policyholder benefits from receiving a payout upfront (e.g., they may have greater need for cash today, they may want to reinvest their money in other ways, or they may not need the product any longer).

    C. No edits are needed - this can unexpectedly shift the duration of liabilities, especially if policyholder behavior is correlated with interest rates for certain products, e.g., if rates rise sharply, a policyholder may drop an existing savings policy for another one with a higher guarantee, requiring the insurer to sell fixed income assets at a loss to pay this.

    D. Edits are needed - excess reserve financing is also used to free up trapped capital for ULSG (Regulation AXXX) products, not just term life (Regulation XXX) products.

(c) In order to improve the risk profile of new level-premium term product with annual renewable term (ART) rates after initial term, your team has been tasked with reducing post-level term lapsation.

    (i) Describe anti-selective mortality on a level-premium term plan.

    (ii) Compare and contrast the four approaches companies are weighing to retain healthy lives after reaching their post-level term.

**Commentary on Question**:
*This question tests candidate's familiarity and understanding of product design implications for term policies post level term and how each strategy to improve in force post-level term profitability. Almost all candidates generally did well in part (i) to describe anti-selective mortality. For part (ii), some candidates only described how the four approaches work, without providing any comparison and contrast details.*

    (i) Anti-selective mortality refers to the increase in a block's policyholder mortality due to asymmetric information (information available to the policyholder but not the insurer).
While some policyholders with low mortality do not lapse after the post-level term, this is mainly due to inertia or not seeking a new policy until after the level-premium period is over.

# 6.  Continued

Policyholders who remain and agree to pay the large increase in premiums know that they cannot be re-underwritten or know that they would have relatively higher premiums if they did. Depending on the level of the premium increase after the post-level term, the worse the resulting cohort's mortality. This has been referred to as a death spiral.

(ii) Traditional Approach
Level-premium term can be thought of as two components: a fixed of level premium and a YRT rate schedule thereafter. Depending on the company, the rate difference between the last level premium and the first YRT rate can be significant. While most rate jumps average 5-8 times, we have seen some schedules that allow for up to a 30-multiple jump.

The aggregate rate design is much simpler to administer than a multi-class structure and companies have a large amount of experience to leverage for YRT premium structures.

The combination of uncertain mortality combined with the loss of the best lives (perhaps to a competitor) make the traditional approach the least appealing in today's environment.

Simplified Re-Underwriting
In this scenario, the company offers the insured the option to answer a simplified issue underwriting questionnaire as the PLT approaches. The carrier uses these answers to determine the insured's PLT risk class, possibly simplified from 5-7 to 2 smoker/nonsmoker classes.

This approach is less arbitrary compared to other approaches - policyholders and regulators would both look favorably on this. Unfortunately, this also 'alerts' policyholders who may have persisted that premiums are increasing, resulting in higher lapsation among better risk policyholders.
In addition, unhealthy lives may have conversion options and be reminded to exercise them.

The Graded Approach
This involves using a graded approach, where PLT rates increase at much smaller increments until a future anniversary (e.g., 5 durations post end of term). Following the end of this graded period, rates jump to the original YRT schedule.
This encourages healthier lives to persist rather than be re-underwritten in early PLT years.

**6.** **Continued**

One issue is that the best risks still have motivation to replace coverage, as a new level premium policy will likely have lower rates.
Another is that many of the companies that have experimented with this approach have yet to collect any reliable YRT experience.

The Class-Continuation Approach
This approach involves modifying the rate increase based on the insured's select risk class, with rates converging to an ultimate rate in later durations. The best risk classes would experience the lowest initial increases, but would also have higher rate increases in future years which could result in worsened anti-selective lapsation.

Compare/Contrast of the 4 Approaches
The traditional approach may be the least appealing approach, given the uncertain mortality compared with the loss of the best lives. It is potentially the most dangerous from an image perspective, given the potential for the large increase in premium.

The Simplified Re-underwriting approach may offer the most promising results, in a world where we want the policyholder to persist.

The Graded approach seems to have the most actual supportable experience. Comparing the alternatives to the Traditional Approach, from both a mortality and lapse perspective, the experience seems to be positive. However, companies using this approach are switching to the traditional approach, given the unknown source of better experience.

The Continuing Class approach seems to be the fairest, as it relies on select underwriting to determine the magnitude of the Post Level Term jump. However, this structure lends itself to the highest selective lapsation risk among the approaches.

**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:**
(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).

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

**Sources:**
Mechanics of Dividends, SOA Research Institute, Dale Hagstrom

Transition to a High Interest Rate Environment: Preparing for Uncertainty, SOA Research, Jul 2015, Executive Summary, section IV: parts C (1-4 & 8-11 only), D, E & H

**Commentary on Question:**
*This question tested the candidate's knowledge of dividends, and dividends best practices. In general, candidates did well on this question. Commentary listed underneath question component.*

**Solution:**
(a) Describe the four-step process a company follows in setting dividends.

**Commentary on Question**:
*Most candidates were able to identify some of the four step processes but tended to focus too much time explaining the calculation of the dividends instead of the process of setting dividends.*

- The Board of Directors determines an aggregate amount of distributable surplus, balancing cost competitiveness against the future needs for surplus

- The Board authorizes the allocation among policies with consideration of a dividend scale recommended by management and/or the dividend actuary

- The dividend actuary sets formulas that can be programmed and put into production to allocate dividends to individual policies

- The final allocation is documented as a dividend scale adopted by the Board

# 7. Continued

(b) Assess the appropriateness of each of the following statements to ensure dividend allocations are "fair and equitable":

A. *The insurer may introduce distinctions in the dividend scale that benefit "better" lives which contribute more earnings over other lives which produce less earnings.*

B. *The insurer does not need to consider marketing materials and sales illustrations that were used to sell its participating policies since dividend scales should be based on actual results, not initial expectations.*

C. *The insurer should reflect differences in experience between different classes of policyholders, even if those differences result in complex formulas.*

D. *With rising interest rates, the company has suggested that switching the interest rate strategy from portfolio yield to new money would not cause issues with the regulator.*

**Commentary on Question**:
*Candidates either did very well or very poorly on these questions. Those that did poorly did not provide reasoning as to why the statements were or weren't appropriate.*

A) This statement is accurate. Because the insurer has the responsibility to serve the public well by keeping the pool healthy and not have all the "healthy lives" leave the pool, insurers often must consider introducing distinctions that will benefit the "better" lives that contribute more earnings.

B) This statement is not accurate. Regulators are concerned with how companies' marketing materials and sales illustrations reflect their administrative practices. For example, Policyholder Reasonable Expectations arising from marketing materials must be considered in Canada, and US financial reporting includes interrogatories related to illustrations and policyholder treatment.

C) This statement is not accurate. Although insurers should consider differences in experience between different classes to the extent practical, the insurer must also balance complexity with practicality in determining a dividend scale that can be implemented in a cost-efficient and effective manner.

D) This statement is not accurate. Portfolio yield companies have told Regulators for years that this strategy was not subsidization of new policyholders by existing clients because they would use the portfolio strategy throughout the entire interest rate cycle.

(c)     Evaluate how each of the following scenarios are likely to affect the dividend scale of a company that uses the three-factor formula (Contribution Method or Asset Share Method formula):

*A.*     Mortality experience has been higher than normal for the last year but is not anticipated to be a long-term trend.

*B.*     High inflation has caused allocated expenses to be substantially higher than in past five years.

*C.*     The insurer has been reporting increasing earnings as its investment portfolio earned rate has been substantially higher than the reserve valuation interest rate.

*D.*     The insurer has been reporting decreasing earnings as assets are invested at rates lower than the current portfolio rate. Management has decided to peg the dividend rate to avoid a loss in sales.

**Commentary on Question**:
*Similar to Part B, candidates either did very well or poor on these questions depending on if they provided an explanation of the impact on the dividend scale. Candidates that did poorly had a difficult time explaining the movement / impact on the dividend scale and tended to just state the impact.*

A.  No change. The company may conclude that no reduction to the mortality component of the dividend formula is appropriate because the q'' mortality factor in the dividend formula does not represent actual mortality but may use industry experience or an average over a few years rather than recognize a one-time shock in mortality.

B. Decrease. The expense component of the dividend formula is intended to estimate actual insurer expense experience, so an increase in expenses would result in a reduction to the expense component of the dividend scale.

C.  Increase. When investment yields have increased so that they are substantially higher than previous rates, the interest component represented by (i''-i) in the dividend scale will increase, and so the overall dividend scale will also increase

D. No change. When the insurer decides to peg dividend rates, it means that the prior year's dividend scale will continue to be used even though a reduction may be indicated, until the dividends once again grow to exceed the pegged floor. So, in this case, even though investment yields would lower the interest component of the dividend formula, the dividend scale would not decrease.

**8.**   **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.

(4d)   Describe and evaluate nonproportional reinsurance arrangements and their use.

(4e)   Describe and evaluate how strategic/customized reinsurance solutions may enhance insurer prospects.

**Sources:**

Life, Health & Annuity Reinsurance, Tiller, John E. and Tiller, Denise, 4th Edition, 2015, Ch. 17:  Nonproportional Reinsurance

LPM-160-19: Strategic Reinsurance and Insurance: The Increasing Trend of Customized Solutions, pp. 1-4, 14-15 & 18-31

LPM-153-19: Life in-force Management: Improving Consumer Value and Long-Term Profitability

**Commentary on Question:**
*Commentary listed underneath question component.*

**Solution:**

(a)   Explain the benefits and/or limitations of the following types of reinsurance for a ceding company:

   (i)   Stop Loss

   (ii)   Catastrophe Coverage

   (iii)   Spread Loss

   **Commentary on Question**:
   *Candidates answered consistently on this question, however, most only provided about half of the solution. There seemed to be some confusion on exactly what response the question was looking for as there were several sources of information that could have been used as an answer to this question.*

# 8. Continued

### Stop Loss
- Provides protection against an excessive amount of claims, above an attachment point
- Ceding company can increase its retention limit
- Not guaranteed to be available in the future and therefore not a long term tool

### Catastrophe Coverage
- Protects the ceding company against multiple individual claims from a single catastrophic event
- Unlikely it will replace proportional insurance
- Risk concentration is also a consideration

### Spread Loss
- Similar to stop loss but payments are spread out over several years
- Not considered reinsurance
- Does not qualify for statutory reserve credit
- Rarely used in the US and Canada
- Risks to the reinsurer are similar to the risks of a loan rather than mortality, morbidity, etc

(b) An insurance company is considering the use of a Stop Loss agreement for a block of life insurance policies to provide protection from a future pandemic.

A reinsurer has provided two options with the same price of 100,000 for one year.

Assume that the specific individual life limit has been applied when calculating total claims for both options.

| | Option A | Option B |
|---|---|---|
| Maximum Retention | 100,000 per life | 100,000 per life |
| Expected Claims | 10,000,000 | 10,000,000 |
| Attachment Point | 105% of expected claims, subject to a minimum of 10,500,000 | 115% of expected claims, subject to a minimum of 11,500,000 |
| Limits | 90% of all covered claims in excess of the attachment point amount, up to a total maximum of 1,000,000, with a maximum on any single life of 100,000 | 90% of all covered claims in excess of the attachment point amount, up to a total maximum of 3,000,000, with a maximum on any single life of 100,000 |

**8. Continued**

    (i)    Calculate the net claims paid by the company under both options assuming actual claims for the year are 12,000,000.

    (ii)    Recommend which option the company should proceed with in preparing for a future pandemic. Justify your answer.

**Commentary on Question**:
*Almost all candidates answered part (i) of this question in Excel even though it wasn't stated explicitly.*
*Most candidates demonstrated an understanding of Part (i) and received full credit. For Part (ii), credit was given for choosing an option and justifying the choice. Either option got credit.*

Part (i)
- Option A
  - pays 90% of $1.5M = $1.35M
  - capped at $1M
  - Total claims paid by the company = $12M - $1M = $11M
- Option B
  - Pays 90% of $0.5M = $0.45M
  - Capped at $3M
  - Total claims paid by the company = $12M - $0.45M = $11.55M

Part (ii)
- Option A would cover higher claims at a lower amount but is limited to $1M
- Option B would provide greater coverage if pandemic claims are much higher but coverage doesn't kick in until the company has paid claims up to the higher attachment point of $11.5M but does provide up to $3M in coverage
- Option B would be preferred if the company is worried about a major increase in claims

(c)    Explain the issues and concerns a reinsurer will have with writing Stop Loss coverages for life insurance.

**Commentary on Question**:
*Very few candidates received full credit for this question. Most got about 50% or less. As stated above, it looks like the candidates were not sure which set of answered were correct for which section so if they provided the answer if Part A above, they wouldn't repeat it here, even though if they did, they would have done better on this section.*

# 8. Continued

From a reinsurer's perspective, Stop Loss coverage in the U.S. and Canada:
- Has very little market demand
- Must be renegotiated each year
- Future expected claims will be higher, driving up premium cost
- Administration can be difficult and gathering of the necessary data
- There is also correlation risk in that claims may occur in multiple companies at the same time
- Difficult to write enough stop loss coverage to provide an adequate spread of risk
- Reinsurers may only write to accommodate existing client relationships
- Reinsurer may be concerned that insurer will not do due diligence

(d) Rather than proceeding with the Stop Loss options, the ceding company would like to use a coinsurance solution for an inforce block of Universal Life insurance policies.

Explain the disadvantages that a ceding company would have in coinsuring an inforce block of interest sensitive life insurance policies.

**Commentary on Question**:
*Candidates did fairly well on this question and demonstrated an understanding of what the question was looking for even if they didn't provide all the details needed for full credit.*

The chief disadvantage of coinsurance is:
- The need to transfer assets
- For Interest sensitive products, the reinsurer may want control or veto power
- Both parties need to agree on asset management and crediting approaches
- Ceding company may be unable to take credit for reserves
- Ceding company may be subject to additional credit risk
- If the reinsurer becomes insolvent, the ceding company may be unable to get full reimbursement

(e) Explain how selling the block would be advantageous or disadvantageous over reinsurance.

**Commentary on Question**:
*Based on the responses from the candidates, this question was not clearly worded. Most candidates provided an answer on either reinsuring the closed block or selling the block altogether. Credit was given if candidate provided an answer on one or the other, but they didn't have to answer for both reinsuring and selling to get full credit.*

# 8.    **Continued**

Reinsuring the closed block
Advantages:
- Limits exposure to future losses
- Provides capital relief
- Frees up management attention to focus more on other blocks of business
- Administration can be held either inhouse or outsourced

Disadvantages:
- Does not achieve finality for the ceding company
- There are always two parties in control
- Introduces counterparty risk and reputation risk if reinsurer defaults
- May need policyholder approval

Selling the block
Advantages:
- Quick and effective way to exit the business
- No long-term dependence on external providers or any additional fees
- Capital may be redeployed to support new business
- Migration to another system could create operational, capital and tax efficiencies

Disadvantages:
- High upfront losses for the seller
- May need policyholder or regulator approval

**9.** **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.

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:**

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

(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.

(5g) Describe the principles of Liquidity Risk Management in an insurance company portfolio management context.

**Sources:**
LPM-165-20: Life Products and Features, pp. 31-40

LPM-162-19: Liquidity Risk Management, Best Risk Management Practices

**Commentary on Question:**
*This question tested a candidate's knowledge related to liquidity risk management as well as designs and risks of common life and annuity products and features. Candidate is expected to understand objectives of liquidity risk management and how product design impacts liquidity risk.*

**Solution:**

(a) List the principles that underlie the establishment of best practices for the management of liquidity risk within an insurance company.

**Commentary on Question**:
*Candidates generally performed well on part (a). Many candidates were able to list a few principles of liquidity risk management, with a few providing the complete list. Candidates received full credit if they were able to list 6 out of 8 principles.*

**9.** **Continued**

- Liquidity risk is an asset/liability concern. Effective liquidity risk management starts with a careful assessment of the liquidity characteristics of the company's assets and liabilities.
- Management should set its tolerance for liquidity risk by using qualitative and quantitative tools.
- The cost of securing adequate liquidity should be reflected in the product. The company's strategic asset allocation and contingent liquidity planning should directly reflect the expected and contingent liquidity needs of its liabilities and potential sudden extreme shifts.
- A company should manage its access to the financial markets and have an ongoing presence in its chosen funding channels.
- Management should require that a written liquidity risk policy be maintained. Policy should be reviewed regularly.
- A company should maintain a written liquidity stress management plan that is approved by senior management.
- Requiring capital to provide for liquidity risk is an ineffective means of managing this risk. Liquidity risk needs to be managed at all times - before, during, and after any stress event.

(b) Critique the following elements of the company's liquidity management policy:

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

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

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

        A. Surrender benefits 20% higher than expected

        B. Death benefits 10% higher than expected

**Commentary on Question**:
*Candidates didn't do well on part b). Many candidates were unable to provide critiques with the right rationale. Very few candidates were able to receive full credit by giving critique with good rationale and providing appropriate recommendation.*

**9.** **Continued**

    (i)    Corporate bond may be purchased with different durations to develop maturity and coupons to have a predefined cash flow pattern. The cash flow pattern may not align with UL surrender benefits.
Corporate bonds, if sold prior to their maturity date, may lead to market losses. When constructing asset portfolio, consideration should be given to asset types that can be quickly and easily converted to cash without losing significant value in the process. Examples of such assets include US Treasuries or cash.

    (ii)    With respect to establishing the liquidity sources, premiums are considered as an important source of liquidity before asset cashflows. Premiums should be used to offset expected liquidity needs, but not excess surrender benefit.

    (iii)    The two excess claim scenarios listed are not overly server and very short term.
The liquidity coverage ratio of 100% is low, which doesn't provide buffer for losses on sale of assets or other uncertainty.
Stress test should test a company's expected liquidity adequacy in extreme market and business conditions. Examples include but are not limited to:
- Catastrophic claim scenario, for example, 'run on the bank'
- Impaired market scenario, where it's impossible or very difficult to sell assets to raise cash
- Disintermediation scenario, where the company may face significantly increased withdrawal activity due to a sudden material rise in interest rate
- Customer panic scenario, where the company experience a sharp increase in lapse due to a material company downgrade.

(c)    Propose changes to the UL product design to address liquidity risks. Justify your answer.

**Commentary on Question**:
*Candidates generally did well on part c). Most candidates were able to list a few product designs that could mitigate liquidity risks. Some candidates received full credit by providing initial thoughts, plus 4 product design ideas with logical justification. Common mistakes include proposing to decrease crediting rate and remove minimum guarantee.*

# 9. Continued

Depending upon a number of factors, including surrender options granted, the size of new money rates increases, the variety and appeal of alternative investment choices, and the company's product preservation efforts, the magnitude of the resulting disintermediation could vary dramatically. There are many mitigating elements (tax penalties, surrender charges, deferral of payment clauses, etc) that can help mitigate the liquidity risk.

UL has a risk of interest rate anti-selection. If external interest rates are higher, the policyowner may withdraw and invest it elsewhere. It's suggested to consider improving credit rates or minimum guarantees to encourage clients to keep their policies

The company could consider tying credited rate to external index with shorter guarantee period, which may be more reactive as interest rates rise and lower

A feature of UL not found in most traditional products is that of partial withdrawal. Introducing an administrative fee may discourage frequent partial withdrawals.

To mitigate liquidity risks from early surrenders, the company should consider adding surrender charges in early years or at least beyond crediting guarantee periods to discourage early surrenders.

The company could consider a persistency bonus after 10 or 15 years to encourage persistency

A higher interest rate can be credited after the policy reaches a certain or fund amount. This type of reward could be more effective to improve persistency and is less tontine-like.

## 10.

**Learning Objectives:**

5. The candidate will understand 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:**

(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, Ch. 6: Fixed-Income Portfolio Management (sections 1-5)

**Commentary on Question:**

*The question was wanting candidates to indicate an understanding of asset portfolios and matching strategies.*

**Solution:**

(a) Define the following dedication strategies:

    (i)     Immunization

    (ii)    Cash Flow Matching

**Commentary on Question**:

*Many candidates did discuss managing the duration of assets and liabilities or the management of the cash flows of the assets and liabilities. Many also discussed constructing a portfolio that would earn a predetermined return regardless of interest rate changes. A smaller number of candidates discussed the Classical Single Period Immunization that produces an assured return for a specified time horizon. Partial credit was given for each of the above. Full credit required discussion of all variations and what they involve.*

# 10. Continued

*For ii) Most candidates did discuss selecting securities to match the timing and amount of the liabilities. Very few candidates discussed that it provides a future funding of a liability stream from the coupon and matured principal payments of the portfolio. Even fewer discussed that it's an alternative to multiple liability immunization. Partial credit was given. Full credit required discussion of all three points. Click here to enter text*

**i) Immunization**
Aims to construct a portfolio that will earn a predetermined return regardless of interest rate changes
Popular for "locking in" a guaranteed rate of return over a particular time horizon
Requires management of duration to offset price risk and reinvestment risk
Three variations:
Classical Single-Period Immunization
Produces assured return for specific time horizon
Multiple Liability Immunization
Produces enough funds to pay all liabilities when due
Immunization for General Cash Flows
Given schedule of liabilities met by investment funds that are not fully available at the time portfolio is constructed
**ii) Cash flow matching**
Provides future funding of a liability stream from the coupon and matured principal payments of the portfolio
Alternative to multiple liability immunization
Select securities to match timing and amount of liabilities

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

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

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

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

# 10. Continued

**Commentary on Question:**
*This question was not answered well overall. Even calculating the new Book Value and Market Value based on the split, were often not calculated correctly. Many candidates did calculate the new Book Value based on the split but did not update the Market Values based on the split.*

*Most Candidates did calculate Dollar Duration correctly. However, a number of candidates just added the dollar durations for the portfolio dollar duration, where full credit for this part required candidates to weight average the dollar duration by book value in order to calculate the variance.*

*Many candidates did not provide an assessment of the effectiveness of the changes, as asked by the question, thereby not receiving credit for that portion of the question. Candidates that commented on whether their calculated value for portfolio duration was inside or outside the range received credit for that statement.*

| (i) Replace medium with 50/50 split of short/long | | | | |
|---|---|---|---|---|
| Asset Class | Book Value | Market Value | Duration | Dollar Duration |
| Short term bonds | 212,500 | 170,000 | 1.50 | 2,550 |
| Medium term bonds | - | - | 5.25 | - |
| Long term bonds | 182,500 | 192,105 | 9.75 | 18,730 |
| Total Bonds | 395,000 | 362,105 | | 10,026 |
| | | | | |
| Liability dollar duration | | | | 8,000 |
| Duration variance(%) | | | | 25.3% |
| | | | | |

| (ii) Replace 25% short term bonds with long term bonds | | | | |
|---|---|---|---|---|
| Asset Class | Book Value | Market Value | Duration | Dollar Duration |
| Short term bonds | 93,750 | 75,000 | 1.50 | 1,125 |
| Medium term bonds | 175,000 | 200,000 | 5.25 | 10,500 |
| Long term bonds | 126,250 | 132,895 | 9.75 | 12,957 |
| Total Bonds | 395,000 | 407,895 | | 9,060 |
| | | | | |
| Liability dollar duration | | | | 8,000 |
| Duration variance(%) | | | | 13.3% |
| | | | | |

| (iii) Shifting to 33/33/33 split | | | | |
|---|---|---|---|---|
| Asset Class | Book Value | Market Value | Duration | Dollar Duration |

| | | | | |
|---|---|---|---|---|
| Short term bonds | 131,667 | 105,333 | 1.50 | 1,580 |
| Medium term bonds | 131,667 | 150,476 | 5.25 | 7,900 |
| Long term bonds | 131,667 | 138,596 | 9.75 | 13,513 |
| Total Bonds | 395,000 | 394,406 | | 7,664 |
| | | | | |
| Liability dollar duration | | | | 8,000 |
| Duration variance(%) | | | | -4.2% |

i)  BV(ST) = 125,000+.5(175,000)  ie Starting BV for ST + .5 Starting BV Med.

MV(ST) = 100,000x212,500/125,000  ie Starting MV for ST x Calculated BV for ST/starting BV for ST

Dollar Duration(ST) = 170,000x1.5x.01  ie Calculated MV(ST)xDuration(ST ...given) x.01

Total portfolio duration = sumproduct Calculated BVxCalculated Dollar Duration/Total calculated BV = 10,026

Duration Variance = (Calculated total portfolio dollar duration – given liability dollar duration)/given liability dollar duration = 25.3 %

This is outside the 10 % variance (7200-8800) therefore not effective.  Do not implement.

ii) Same approach as above.

Variance = 13.3 %

Outside the range therefore not effective.  Do not implement.

Also gave marks for … 13.3 % is fairly close so could be effective and could implement.  Consider shifting less than 50% of short bonds.

 Iii)  Same approach as above.

Variance = -4.2 %

Total Dollar Duration is within the range.  It is effective and should be implemented.

# 10. Continued

(c)     Explain how leverage can be used to increase an asset portfolio's rate of return.

**Commentary on Question**:
*The question was wanting candidates to indicate an understanding of what leverage is and how it works as well as any risks/rewards. Credit was given for discussion of this. Most candidates did indicate an understanding of leverage, but a number did not go further, in terms of discussing what can increase or decrease the impact of leverage. Further credit was given for discussing what can increase or decrease the impact of leverage. Full credit was given for the above as well as discussion of the repo market.*

To be successful the manager must earn a rate of return that is in excess of the cost of the borrowed funds.
If unsuccessful (ie if the rate of return is lower than the cost of the borrowed funds) leverage will decrease profit.
The larger the amount of borrowed funds, the greater the variation in potential outcomes.
The greater the variability in the annual return of the invested funds. The greater the variation in the possible outcomes.
r (total) = r (funds) + B/E (r (funds) – r (Borrowed))
where r is return; B is borrowed funds; E is equity.
Repurchase agreements, or repos, are a favourite financial instrument in leverage deals.
Repos involve the sale of securities coupled with an agreement to repurchase the same securities at a later date.
The repo market presents a low-cost way for managers to borrow funds and it allows investors to earn a return above the risk-free rate on treasuries.

**11.** **Learning Objectives:**

5. The candidate will understand 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:**

(5i) Describe the attributes of US Treasuries, Agency Debt Securities, Municipal bonds, Corporate bonds, Private Money Market securities, Floating Rate Agreements, Agency Mortgage Backed securities, Agency Collateralized Mortgage securities, Interest Rate Swaps and Swaptions, Credit Derivatives and High Yield Bonds, and the markets they are traded in.

**Sources:**

Handbook of Fixed Income Securities, Fabozzi, Frank J., 9th Edition, 2021 - Ch. 4: Bond Pricing, Yield Measures and Total Return (pp. 76-93)

Handbook of Fixed Income Securities, Fabozzi, Frank J., 9th Edition, 2021 - Ch. 22: Agency Mortgage Passthrough Securities

**Commentary on Question:**
*The purpose of this question was to test candidate's understanding of the risk profile and impact of interest rate changes on interest-bearing securities based on a specific company's financial needs and priorities.*

**Solution:**

(a) Calculate the Conditional Prepayment Rate (CPR) if the Single Monthly Mortality (SMM) rate is 0.008.

**Commentary on Question**:
*Candidates generally did well on this question. Most candidates were correctly able to identify the CPR as the annualized SMM rate. Candidates received partial credit if they annualized incorrectly (e.g., multiplied by 12).*

The Conditional Prepayment Rate (CPR) is the annualized Single Monthly Mortality (SMM) rate.

$$CPR = 1 - (1 - SMM)^{12}$$
$$CPR = 1 - (1 - 0.008)^{12}$$
$$CPR = 0.0919 \text{ or } 9.19\%$$

# 11. Continued

(b) Critique the following statements:

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

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

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

**Commentary on Question**:
*Candidate results were mixed on this question. To receive full credit, candidates needed to demonstrate an understanding of the impact of interest rate changes and the relative reinvestment, prepayment, volatility, and default risks for the two securities.*

*For statement A, the candidate needed to understand how interest rate changes impact investment performance.*

*For statement B, both correct and incorrect were acceptable answers with the appropriate justification.*

*For statement C, most candidates knew MBS has lower default risk. However, most candidate struggled to note MBS has lower volatility since it has been heavily refinanced in the past.*

Statement A:

Correct. If mortgage rates are 50 bps lower, then there will be refinancing activity, which means MBS will have lower returns and higher volatility. The priority for TPL Life is stable cash flows over the next five year, which corporate bonds are better suited to provide.

Statement B:

Correct. MBS has minimal reinvestment risk; the key risk is prepayment risk. Corporate bond return depends heavily on interest-on-interest, so there is high reinvestment risk. Corporate bond reinvestment risk also increases with duration and we are considering a 30-year bond here.

# 11. Continued

Statement C:

Incorrect. Heavily refinanced MBS tends to be less responsive to future refinancing opportunities, which leads to less volatile performance. MBS was issued by Fannie Mae, which is implicitly backed by the US government, so there is little-to-no default risk.