

# DP-IU Model Solutions

## Spring 2012

### 1. Learning Objectives:

2. Understand the drivers of product design (the idea generation step).
4. Understand the design and purpose of various product types, benefits and features.
5. Understand the relationship between the product features, their inherent risks, and the selection of appropriate pricing assumptions, profit measures and modeling approaches.

### Learning Outcomes:

- (2b) Analyze how the following drive product design:
- Company strengths and weaknesses
  - Economic forces
  - Marketplace demographics
  - Consumer behavior
  - Distribution channel behavior
  - Competition
- (4b) Construct and recommend a design that is consistent with the market needs identified in the idea generation step.
- (5b) Identify and explain the setting of an appropriate assumption for risks and other factors such as:
- (i) Available Experience Data
  - (ii) The Marketplace
  - (iii) Underwriting
  - (iv) Distribution Channel Characteristics
  - (v) Reinsurance
  - (vi) Expense (Fixed, Variable, Marginal)
  - (vii) Taxes (Income and Premium)
  - (viii) Investment Strategy

### Sources:

LOMA, Insurance Marketing, 2010, Chapters 2 – 5 and 7 – 8

Designing & Pricing, LTCI Combination Insurance Products

## 1. Continued

Atkinson & Dallas, Life Ins. Products and Finance, Chapters 2 – 3, and 13 (Sections 13.3 and 13.4 only)

### **Commentary on Question:**

The goal of the question is to demonstrate an understanding of decisions a company has to make when launching a new product line. Candidates needed to understand how a new feature/rider can change the experience and how to reflect it in the pricing assumptions.

### **Solution:**

(a) Define the following pricing strategies:

- (i) Cost-driven
- (ii) Competition-driven
- (iii) Customer-driven

### **Commentary on Question:**

Some candidates missed “defining” the pricing strategy, as outlined in the question and instead just listed different pricing strategies.

Many candidates listed pricing strategies from Atkinson and Dallas Chapter 2. Although not specifically mentioned in the question, the subtle wording of the pricing strategies should have pointed candidates to the pricing strategies from LOMA Chapter 7 (Atkinson and Dallas uses “Buyer-Oriented” and “Competitor-Oriented.” Credit was given if pricing strategies listed from Atkinson and Dallas were correctly described.

#### Cost-driven pricing strategy

Company sets the price to cover their expenses for creating, distributing and servicing this product. It also includes a predetermined level of profit.

#### Competition-driven pricing strategy

Company sets prices relative to those charged by its competitors. There are 2 types of competition-driven pricing strategies:

- **Penetration pricing:** Charges low price to build market share and produce a large sales volume quickly
- **Flexible pricing:** Price charged varies with specific sales conditions.

According to Atkinson and Dallas:

- **Independent pricing:** Set price independent of prices charged by other companies
- **Cooperative pricing:** Companies match price changes, price changes move in parallel
- **Adaptive pricing:** Review prices of other companies and then determine where to set price

## 1. Continued

- **Opportunistic pricing:** Drive prices down to a level only the most efficient can survive
- **Predatory pricing:** Charge a price below cost, drive competitors out, then raise prices when competition is out

### Customer-driven pricing strategy

Company sets the price according to what customers are willing to pay for the value they receive. There are 4 types of customer-driven pricing strategies:

- **Relationship pricing:** Offering price reductions to customers who purchase multiple products from a company's product mix
- **Psychological pricing:** Based on belief that some prices or price range more attractive to client. E.g. Charging \$4.99 instead of \$5.00
- **Prestige pricing:** Set prices high to convey image of high quality
- **Promotional pricing:** Company sets lower than normal prices on certain products to stimulate sales of all of the company's products

According to Atkinson and Dallas:

- **Penetration Pricing:** Setting low prices to generate higher sales
- **Neutral pricing:** Setting prices that most buyers consider reasonable
- **Segmented pricing:** Setting different price levels for different kinds of buyers with different behaviors
- **Skim pricing:** High price to maximize a company's profit margin (This is NOT the same as Prestige pricing)

- (b) Recommend which pricing strategy DXM should use for the new LTC rider. Justify your recommendation.

### **Commentary on Question:**

Many candidates had a more conservative view and didn't focus on the fact that LTC is a growth product which is gaining popularity.

XYZ should go with a **competition-driven** pricing strategy, more precisely, they should use **penetration pricing**.

The LTC combo product is in its early stage, so DXM can gain rapid market share by setting prices lower than competition and even be a market leader. DXM can then increase prices in the future and make more profits. DXM has scale and has steady and predictable profits so it does not need to cover all expenses and can afford to be aggressive.

## 1. Continued

- (c)
- (i) Explain the Market Share/Market Growth Matrix.

**Commentary on Question:**

This part of the question was done very well. Most candidates opted to draw the matrix, with appropriate labels and descriptions, which was sufficient.

There were some candidates that drew a 3X3 matrix, which is wrong, and did not receive any credit.

The Market Share/Market Growth Matrix is a two dimensional matrix, split into 4 quadrants with one axis being relative Market Share, and the other axis being relative Market Growth. Placement of business unit/product line labels it as a star, a question mark, a cash cow or a dog.

- Star: has a high market growth rate and a high market share
- Question Mark (or problem child): has a high market growth rate and a low relative market share
- Cash Cow: has low market growth but a high market share
- Dog: has low market growth and a low market share

- (ii) Identify where this product would fall in the matrix. Justify your answer.

**Commentary on Question:**

This part of the question was also done very well. However, some candidates were confused with the fact that the product in question was the LTC rider (attached to the UL), not standalone UL. Some candidates saved themselves by describing both the standalone UL and UL with LTC.

UL with LTC is a **Question Mark**. This is a new product to DXM, so it currently has no market share. Since combo LTC is gaining popularity in the market, the growth potential is high. NOTE: it was not enough to just say “low market share, high market growth”, because that is the definition of a Question Mark. Candidates had to describe why DXM has low (no) market share and why the combo product has high market growth.

- (d) Recommend changes to the following stand-alone pricing assumptions to reflect the addition of the LTC rider:
- (i) Lapse
- (ii) Mortality

## 1. Continued

### **Commentary on Question:**

Part (i) was done very well.

Part (ii) had mixed results. Some candidates felt that with lower lapses, there would be lower mortality because healthy lives would persist – this is wrong because it would not make healthy lives have a higher persistency. Many candidates did not give a clear final answer as to whether or not to increase/decrease the assumption – they listed different factors that would increase/decrease each assumption, but did not give an overall recommendation.

#### (i) Lapses

- Adding the LTC rider will encourage people in poor health to persist and use LTC instead of surrendering.
- Healthy people should lapse at the same rate as on the original product.
- The original standalone UL product has low lapses to begin with (lower than any other product), but would have a spiked increase at the point surrender charges end. Adding LTC would make lapses lower, but still would see a spike.
- Overall lapses for the combo product will be lower than the original standalone UL product.

#### (ii) Mortality

- As a result of fewer lapses of unhealthy lives, overall mortality should deteriorate compared to original standalone UL product.
- The mortality assumption should be split between people on LTC claim and those not on claim.

- (e) Recommend a process for setting the morbidity pricing assumptions for the LTC rider.

### **Commentary on Question:**

This question was generally done poorly. Many candidates listed out the process of setting pricing assumptions, without relating the process to the question.

Should use industry tables to set the assumption and/or consult with a reinsurer or consultant who has expertise in this line of business to set the morbidity assumption. If using a blend of industry and reinsurer's experience, should apply a credibility factor.

## 2. Learning Objectives:

3. Understand the feasibility step of a new product and how it drives design.
5. Understand the relationship between the product features, their inherent risks, and the selection of appropriate pricing assumptions, profit measures and modeling approaches.

### Learning Outcomes:

- (3a) Explain considerations for prudent and practical decision making.
- (5a) Identify and explain the setting of an appropriate assumption for product characteristics such as the following:
  - (i) Riders
  - (ii) Policyholder Dividends
  - (iii) Equity Linked
  - (iv) Embedded Options
  - (v) Return of Premium
  - (vi) Secondary Guarantees
  - (vii) Payout Annuity Benefits
  - (viii) Crediting Methodology
  - (ix) Other Non-Guaranteed Elements

### Sources:

Marketing for Actuaries, 2000 Edition, All Chapters

ILA-D119-11: A Comprehensive Guide to Measuring and Managing Life Insurance Company Expenses by Gutterman, Chapter 5

### Commentary on Question:

### Solution:

- (a) Compare the types of agency distribution systems which would be most conducive to developing and maintaining a new group of career agents.
  1. Career agents  
There are two types of career agents: General agency and Branch office.  
General agency:
    - Appointed by the home office
    - Independent contractor
    - Receive an expense allowance to cover rent, clerical, travel, postage, phone, and computers  
Branch office:
    - Managed by agency managers
    - Directly supervised by the home office

## 2. Continued

2. Multiple Line Exclusive Agent
    - Sell P&C as well as life and annuities
  3. Home Service Agents
    - Work in a defined geographic location
    - Services lower to middle income markets
- (b) JJB Life wants to ensure it recruits new agents who will succeed.
- (i) Explain why it is difficult for insurance companies to compete successfully against other industries for entry-level sales candidates.
    - A substantial part of the compensation is postponed in the form of deferred first-year commissions and renewal commissions.
    - The skills and knowledge required to consummate a life insurance sale are more slowly developed than in the sale of many other goods and services.
  - (ii) Explain the advantages and disadvantages of the four types of financing plans most often used for new agents.
    1. Variable TAP
      - Advantages:
        - Agent experiences the effect of production on income
        - Less costly
      - Disadvantages
        - Income can fluctuate more than for established agents
    2. Fixed TAP
      - Advantages:
        - Income remains stable as production increases
        - Strong incentive to produce because commissions are paid
      - Disadvantages
        - High producers are not rewarded proportionately
        - Production does not have to be smooth
        - Income can fall below the level of income needs
    3. Salary
      - Advantages
        - Level income regardless of production
        - Attractive to prospective agents

## 2. Continued

### Disadvantages

- High producers are not always rewarded proportionately
- Costly if agents don't produce at expected levels
- Income may change significantly when agent goes off financing and onto straight commissions
- Requires close supervision and adherence to validation schedules

### 4. Line of credit plans

#### Advantages

- Income relatively stable if account credits and debits are constant
- Flexible, since it incorporates advantages and disadvantages of other plans

#### Disadvantages

- Agent could experience decline in income after financing because commissions are withheld
- Production does not have to be smooth
- More costly due to development and administration

(c) JJB Life is aware policy persistency typically increases with the length of service of agents. Given the large number of new agents, JJB will reevaluate persistency assumptions.

(i) Categorize the factors affecting persistency and indicate their impact on persistency.

#### **Buyer-related factors:**

Higher than average persistency is found among buyers who are:

- Older
- Professionals and executives
- Insuring the lives of juveniles or students

#### **Product-related factors:**

Higher than average persistency is found among policies that are:

- Permanent rather than term
- Higher in premium and/or account value
- Without policy loans
- Larger policies issued on a preferred risk basis
- Issued as applied for



## 2. Continued

### **Producer-related factors:**

- Persistency increases as the agent's length of service increases.
- Persistency is positively related to the level of the agent's product knowledge.
- Persistency bonuses have their intended effect.

### **Sales-process related factors:**

Higher lapsation occurs when:

- Only a partial premium or no cash is paid with the application.
- Needs selling is not employed.
- Policies are not delivered personally to the insured.
- Post-sale service is not employed.

### **Related to the outside environment**

- Persistency tends to be poorer during periods of unemployment and high interest rates.
- Persistency tends to improve when personal savings and effective buying incomes are high.
- Growing competition offered by competitive investment media increases replacements.

- (ii) Assess whether JJB Life should expect changes to the persistency of their products.

JJB Life should anticipate that persistency will not be as high as they transition to their young agents because:

- Persistency generally increases as the length of agent service increases.
- Persistency is positively related to the level of the agent's product knowledge. Since these are new agents their product knowledge will likely not be extensive initially.
- The retiring agents may create orphan policyholders which typically have worse persistency.

- (iii) Propose actions JJB Life could take to maintain its persistency given the turnover of their agents.

In order to maintain their persistency JJB could:

- Ensure the new agents are rigorously trained so they have strong product knowledge right away.
- Ensure the policyholders of retiring agents are reassigned to a current agent to avoid orphans.
- Initiate persistency bonuses, or continue the use of them.

## 2. Continued

(d)

- (i) Contrast the types of distribution expenses that need to be considered for a career agency force with those of brokerage distribution.

Expenses needed for both include incentive-based compensation expenses such as commissions and persistency bonuses, training, and advanced sales support.

Expenses for a career agency include salaries for trainees and managers, and more extensive training, administrative and technical support.

Brokers generally receive higher commissions because there is less direct company support.

- (ii) Calculate the financing cost per agent during the first 3 contract years, assuming 4% interest and ignoring the impact of unvested recoveries.

Agent Retention(t) = Agent Retention(t - 1) \* Agent Attrition(t - 1)  
where Agent Retention(t) is as of the beginning of the year.

$$\text{YR1} = 100\%$$

$$\text{YR2} = \text{YR1} * (1 - \text{YR1 Attrition}) = 1.0 * (1 - .04) = 0.96$$

$$\text{YR3} = \text{YR2} * (1 - \text{YR2 Attrition}) = 0.96 * (1 - .05) = 0.912$$

Commission Payment(t) = Validation(t) \* Agent retention(t)

$$\text{YR1} = 20,000 * 1.0 = 20,000$$

$$\text{YR2} = 25,000 * 0.96 = 24,000$$

$$\text{YR3} = 30,000 * 0.912 = 27,360$$

Subsidy Payment(t) = Commission Payment(t) \* Subsidy %(t)

$$\text{YR1} = 20000 * 1.2 = 24000$$

$$\text{YR2} = 24000 * 1.1 = 26400$$

$$\text{YR3} = 27360 * 0.8 = 21888$$

Discounted Payments = Subsidy Payment(t) \*  $v^t$  where  $v=1/1.04$

$$\text{YR1} = 24,000 * 1.0 = 24,000$$

$$\text{YR2} = 26,400 * 0.962 = 25,385$$

$$\text{YR3} = 21,888 * 0.925 = 20,237$$

$$\text{Financing Cost} = 24,000 + 25,385 + 20,237 = 69,622$$

### **3. Learning Objectives:**

3. Understand the feasibility step of a new product and how it drives design.
5. Understand the relationship between the product features, their inherent risks, and the selection of appropriate pricing assumptions, profit measures and modeling approaches.

#### **Learning Outcomes:**

- (3d) Identify gaps between the product design and the operations of the company, procedures and systems.
- (5a) Identify and explain the setting of an appropriate assumption for product characteristics such as the following:
  - (i) Riders
  - (ii) Policyholder Dividends
  - (iii) Equity Linked
  - (iv) Embedded Options
  - (v) Return of Premium
  - (vi) Secondary Guarantees
  - (vii) Payout Annuity Benefits
  - (viii) Crediting Methodology
  - (ix) Other Non-Guaranteed Elements
- (5e) Describe when a stochastic model should be used, its advantages and disadvantages, how to build it and how to analyze its results.

#### **Sources:**

Stochastic Pricing for Embedded Options in Life Insurance and Annuity Products, Milliman B (exclude appendices)

“What’s Backing Your Life Insurance Guarantee?, The Actuary, February 2005  
Atkinson & Dallas, Life Insurance Products and Finance, Chapter 3, 7, 8, 9, 10, 11, 13, and 14

ILA-D107-07: Experience Assumptions for Individual Life Insurance and Annuities

ILA-D114-09: CIA Research Paper, Life Insurance Costing and Risk Analysis, June 2008

“Hidden Costs of Administering Complex Products” in Nov. 2003 Issue of Product Matters

“Hidden Costs of Product Complexity” in Nov. 2003 Issue of Product Matters

Stochastic Pricing, RSA Vol 27, No 2 Session 86PD

### 3. Continued

Stochastic Pricing, Session 62 TS from November 2005 SOA Annual Meeting

#### **Commentary on Question:**

Goal: demonstration of an understanding of the relationship between the product features, their inherent risks, and the selection of appropriate pricing assumptions and modeling approach.

Overall, the range of points given for this question were not wide spread. It didn't seem that candidates did very well on this question.

#### **Solution:**

- (a) Define the no-lapse guarantee with shadow account design feature and explain its purpose.

#### **Commentary on Question:**

Candidates were able to answer this section easiest and receive at least a few points.

- As long as shadow account does not get depleted, contract won't lapse, even if CSV goes to zero.
  - Shadow accounts not used to determine CSVs.
  - Only purpose is to determine whether secondary death benefit guarantees are in effect.
  - Shadow account functions like the account value, except that all parameters are guaranteed, including the interest rate.
  - No lapse guarantee is secondary guarantee on a universal life policy.
- (b) Explain how the requested design changes would impact the following UL pricing assumptions:
- Lapse
  - Mortality
  - Expenses
  - Premium Persistency

#### **Commentary on Question:**

Candidates did best on this section since some of the answers were common sense. It was a great question.

#### **(i) Impact on Lapse Rates**

Generally, larger policy sizes mean lower lapse rates.

The spike in lapse rates should occur in year 7 now instead of year 10.

### 3. Continued

- The year prior to surrender charges vanishing should show very low lapse rates (i.e. year 6 should have low lapse rates).
- Lapse rates after year 7 should be similar to the rates in years 11+ prior to the change in surrender charge schedule.

If guaranteed minimum credited rate is in-the-money, lapse rates will decline.

- This will happen more frequently now that the guarantee has increased.

No-Lapse guarantee will eliminate involuntary lapses due to insufficient CSV, provided the shadow account balance is  $> 0$ .

**(ii) Impact on Mortality Rates**

Larger policies tend to experience lower mortality from more stringent underwriting, in addition to socio-economic factors.

Selective lapsation can occur (especially after surrender charge period ends) as healthier p/h looks for better deal elsewhere.

Lower lapse rates (from NLG and interest rate guarantee) would lead to lower mortality than normal.

**(iii) Impact on Expenses**

Increasing policy size means more policies will be subject to increased u/w requirements and related expenses.

More complicated - data collected by systems may be incomplete - experience cannot be properly monitored - leading to mispricing.

People Costs - could be expertise gap due to new features (e.g. NLG) - could require training for admin and distribution force.

**(iv) Impact on Premium Persistency**

If NLG is in effect - No incentive to make premium payments.

Compare interest guarantee to market - if company offering better rate, will see increased premium persistency on in-force business.

Better persistency prior to end of surrender charge period (to ensure contract remains in-force).

- (c) Recommend an approach to reflect the pricing impact of the requested increase in the minimum credited rate guarantee. Explain the advantages and disadvantages of your recommendation.

**Commentary on Question:**

Candidates didn't do that well on this section. They either got the recommendation of stochastic model or they didn't. If they didn't, they got zero points.

### 3. Continued

- (i) **Recommendation - Pricing should make use of a stochastic model.**
  - Assumptions should vary by interest rate scenario
  - Should project all CFs, liabs and capital requirements across many randomly generated interest rate scenarios
  - Likely changes in the interest rate assumption can lead to material changes in the results
  
- (ii) **Additional Advantages of Stochastic Modeling**
  - See a distribution of costs associated with variations in interest rate assumption and policyholder behaviour
  - Pinpoint interest rate scenarios of interest to investigate
  - Understand impact of risk mitigation and diversification strategies to manage the interest rate risk
  - Learn more about how the product and the real world interact - especially in the tails of the distribution
  - Better reflect the dynamic behaviour of the policyholder
  
- (iii) **Disadvantages/Challenges of Stochastic Modeling**
  - Requires significant computer resources (costly and complicated)
  - Assumption setting can be complicated due to interaction of variables
  - Stochastic modeling produces large quantities of data - can be overwhelming and difficult to interpret
  - Often insufficient data to parameterize a stochastic model with any confidence
  
- (d) Your actuarial student has run the traditional best estimate pricing model using each of the recommended changes in isolation and added up the incremental costs of each feature to determine the overall cost of adding all the new features to the product.

Recommend using a stochastic pricing model

- Stochastic model must incorporate all new product features together - features may impact each other's assumptions simultaneously
- Use dynamic lapse assumption that accounts for interaction of various new features based on your stochastic pricing model
- Product features will interact if offered together - cost of any feature will be different depending on whether other features are added.

### **3. Continued**

Examples includes....

- Increased policy size may mean that CSV would be less likely to deplete; so NLG would be less likely to ever be in-the-money
- Existence of a minimum credited rate guarantee would also decrease the likelihood of the NLG coming into effect

#### 4. Learning Objectives:

4. Understand the design and purpose of various product types, benefits and features.
5. Understand the relationship between the product features, their inherent risks, and the selection of appropriate pricing assumptions, profit measures and modeling approaches.

#### Learning Outcomes:

- (4a) Describe in detail product types, benefits and features.
- (5e) Describe when a stochastic model should be used, its advantages and disadvantages, how to build it and how to analyze its results.

#### Sources:

ILA-D102-07: Equity Indexed Annuities: Product Design and Pricing Consideration

Stochastic Pricing

- RSA Vol. 27, No. 2, Session 86PD
- Session 62 TS from November 2005 SOA Annual Meeting

#### Commentary on Question:

Commentary listed underneath question component.

#### Solution:

(a)

- (i) Describe static hedging for this product design.

#### Commentary on Question:

Many candidates understood this question well and got credits through different portions of the grading outlines.

Synonymous with a buy-and-hold strategy

Purchase of call option with strike equal to current value

Sale of call option with strike equal to cap

Call spread price = Call (Strike = lower strike) – Call (Strike = upper strike)

Funding ratio may be less than 100% due to lapses

- (ii) Calculate the option price in policy year 2 based on a cap of 5.0% using the Black-Scholes method.

#### Commentary on Question:

Very few candidates got the final solutions. Most got partial points though a few steps, numbers and formulas.



#### 4. Continued

$$\text{Call Option Price} = S \times N(d1) - K \times e^{-rt} \times N(d2)$$

$$d1 = \frac{\ln\left(\frac{S}{K}\right) + \left(r + \frac{vol^2}{2}\right) \times t}{vol \times \sqrt{t}}$$

$$d2 = d1 - vol \times \sqrt{t}$$

$S$  = Current Price

$K$  = Strike Price

$t$  = time period, 1 year in this case

Call (Strike = lower strike):

$$d1 = \frac{\ln\left(\frac{100\%}{100\%}\right) + \left(0.01 + \frac{0.2^2}{2}\right) \times 1}{0.2 \times \sqrt{1}} = 0.15$$

$$d2 = 0.15 - 0.2 \times \sqrt{1} = -0.05$$

$$\text{Call Option Price} = 100\% \times N(0.15) - 100\% \times e^{-0.01 \times 1} \times N(-0.05) = 8.5\%$$

Call (Strike = upper strike):

$$d1 = \frac{\ln\left(\frac{100\%}{105\%}\right) + \left(0.01 + \frac{0.195^2}{2}\right) \times 1}{0.195 \times \sqrt{1}} = -0.10$$

$$d2 = -0.10 - 0.195 \times \sqrt{1} = -0.30$$

$$\text{Call Option Price} = 100\% \times N(-0.10) - 105\% \times e^{-0.01 \times 1} \times N(-0.30) = 6.3\%$$

$$\text{Call Spread Price} = 8.5\% - 6.3\% = 2.2\%$$

(b)

- (i) Compare the advantages and disadvantages of deterministic and stochastic pricing for this EIA product.

#### **Commentary on Question:**

Many candidates understand this question well and got credits through different portions of the grading outlines.

Deterministic Pricing:

Based on average (single scenario)

Create adverse scenarios (sensitivity tests) to create PfAD

Good when risks and costs are predictable

Good if volatility of outcomes is small

Faster and more straightforward

## 4. Continued

Stochastic Pricing:

Consider entire distribution (multiple scenarios)

May not have expertise in stochastic given other annuities are fixed

Useful when loss distribution is asymmetric

More complicated

Results have to be interpreted with care

- (ii) Recommend whether this new product should be priced deterministically or stochastically. Justify your answer.

**Commentary on Question:**

Most candidates provided reasonable recommendation and justification, and got full credits.

This new product should be priced stochastically because stochastic pricing is useful when the range of plausible distribution is wide and the volatility of outcomes is significant, as the volatility of equity prices is high. Stochastic pricing also considers the tail in loss distribution.

## 5. Learning Objectives:

1. Describe the product development process.
3. Understand the feasibility step of a new product and how it drives design.
4. Understand the design and purpose of various product types, benefits and features

### Learning Outcomes:

- (1a) Describe the steps in the iterative control cycle process within the context of product development;
  - (i) Idea Generation
  - (ii) Feasibility
  - (iii) Planning the Design
  - (iv) Actuarial Development
    - Assumptions
    - Profitability Regulatory Issues
    - Choice of Model
- (3e) Recommend ways to close the gaps between design and the internal/external constraints.
- (4a) Describe in detail product types, benefits and features.

### Sources:

Atkinson & Dallas, Life Insurance Products and Finance, Chapter 2 and 13 (Section 13.1 and 13.2 Only)

ILA-D105-07: Life and Annuity Products and Features

“Hidden Costs of Product Complexity” in Nov. 2003 Issue of Product Matters

### Commentary on Question:

Question 5 tested the candidate’s understanding of the characteristics and development of Joint Last Survivor product (JLS).

Part (a) tested the candidate’s knowledge of the product development and pricing of JLS. The cognitive level required is retrieval. Overall, the candidates did a fair job of answering part (i) and (iii), but they did a poor job of answering part (ii). Common mistakes made in part (i) and (iii) were candidates switching the single and dual status characteristics with each other, and not being able to distinguish between the types of JLS policies (single/dual status) vs. the approaches of reflecting dual status. In part (ii), it seemed that the candidate did not spend a lot of time in answering the question. Common mistakes made in part (ii) were confusing what was being asked in part (ii) with part (iii).

## 5. Continued

Part (b) tested the candidate's knowledge of the impact of the JLS product characteristics on mortality. The cognitive level required is retrieval. Overall, the candidates did a good job of answering this question.

Part (c) tested the candidate's knowledge of costs in the product development process of the new JLS product. The cognitive level required is retrieval. Overall, the candidates did a good job of answering this question.

### **Solution:**

(a) In developing and pricing a Joint Last Survivor product:

(i) Compare characteristics of a single-status and a dual-status product.

#### Single Status

- COIs, CVs, and reserves to not depend upon whether both lives are still alive
- Often called smooth cash value policies because values don't change markedly upon first death

#### Dual Status

- Values depend on whether both lives or one of single life are living
- PV of future benefit, reserves, and CVs increases dramatically after first death

(ii) Outline considerations in determining which status to use in product design.

#### Considerations in determining status to use:

- Perceived marketability of approach
- Administrative feasibility
- Insurance regulator attitude
- Perceived risk profile
- Implications of increase in term rider costs for dual status policies

(iii) Explain the various approaches used to reflect the dual-status in the pricing of a Joint Last Survivor policy and outline the advantages and disadvantages of these approaches.

#### Equivalent single age

- Attempt to equate pricing for dual status to that of one single life
- This approach results in a serious overcharge for mortality in the early years of the contract
- This approach results in a significant undercharging for mortality in the later years of the contract

## 5. Continued

### Joint equal ages

- Each combo of lives is assigned gross premiums, dividends, CVs, and reserves based on a roughly equivalent combo of 2 lives at equal ages
- Much simpler for companies to administer than reflecting actual age combinations
- Regulators want assurances that the actual cash values under joint equal age methodology will equal or exceed those provided under exact age approach

### Exact age approach

- Values are determined from first principles based upon exact age and risk class of each life
- These values are unique for each combination of lives
- This can create significant disk storage requirement
- Rates and values are calculated on an as-needed basis

- (b) Outline the special considerations in setting mortality assumptions for the new Joint Last Survivor product.

### Considerations in setting mortality assumptions:

- The underlying mortality of individual lives in the survivorship market may be markedly different than the company experience on their single life business
- Recent company experience for single life business is not necessarily a good source of data to use in building a last survivor mortality assumption
- The degree of underwriting concessions provided should be factored into the mortality assumption
- Contagion in the form of a provision for joint accident risk may be considered
- Contagion in the form of the "broken heart syndrome" may be considered
- Impact from virtually all survivorship insurance being medically underwritten
- The socio-economic class of lives insured
- The impact of very low lapses on long-term mortality
- Married individuals have lower mortality than aggregate

- (c) Explain any hidden costs, other than administrative systems costs, incurred due to the new product.

### People related costs

- There is an expertise gap between the company's skill set and that needed to launch the product successfully
- The company may choose to utilize its own resources and allow them to learn the skills needed for the complex product

## 5. Continued

- Alternatively, the company may decide to enlist the aid of a consultant  
Communication

- Complex products may require extra time and effort to communicate and explain them sufficiently to home office staff
- Training costs escalate with increasing complexity
- Regulators must understand the product to ensure quick approval

Scale

- It is more difficult to achieve critical mass in a complex product because of its unique nature

Features

- Complex product features may be difficult to properly price
- There is cost to correct the design flaw through redesign

## 6. Learning Objectives:

4. Understand the design and purpose of various product types, benefits and features.
5. Understand the relationship between the product features, their inherent risks, and the selection of appropriate pricing assumptions, profit measures and modeling approaches.

### Learning Outcomes:

- (4a) Describe in detail product types, benefits and features.
- (5b) Identify and explain the setting of an appropriate assumption for risks and other factors such as:
  - (i) Available Experience Data
  - (ii) The Marketplace
  - (iii) Underwriting
  - (iv) Distribution Channel Characteristics
  - (v) Reinsurance
  - (vi) Expense (Fixed, Variable, Marginal)
  - (vii) Taxes (Income and Premium)
  - (viii) Investment Strategy

### Sources:

“Does Preferred Wear off?” Product Matters, July 2004

“Return of Premium Term” Product Matters, July 2004

ILA-D105-07: Life and Annuity Products and Features

### Commentary on Question:

Commentary listed underneath question component.

### Solution:

- (a) The career field force wants the ability to move any inforce client to the updated product at their attained age and the same preferred class, without underwriting.

Recommend whether QRS Life should accommodate this request. Justify your answer.

### Commentary on Question:

Almost every candidate did make a recommendation which is good. However, not many discussed the issue of whether preferred wears off or not.

There is **limited insured experience data** regarding whether "preferred" mortality wears off.

## 6. Continued

There are **different opinions**.

Some state that mortality rates for preferred and non-preferred risks would revert over time toward overall standard regular underwriting mortality rates

Some state that it would be reasonable to assume that the effects of preferred underwriting wear off over the select period

The **typical approach** is to apply the preferred discount over the experience period (the period supported by internal or industry mortality studies) and linearly grade the discount off over the remainder of the select period.

Because of the evidence that illustrates how underwriting wears off, many have leapt to the conclusion that preferred will wear off as well.

Given **select to ultimate ratios**, if one believes that preferred does wear off, then preferreds have a lower select to ultimate ratio.

Preferreds have better mortality in the early years (better select mortality) but must revert back to the same ultimate mortality.

If one believes that preferred does not wear off, then it can be argued that both preferreds and non-preferreds have the same select -to-ultimate ratio and have the same slope on their mortality curves.

**A common analysis to determine if preferred wears off** is to examine the actual to tabular mortality ratios for the preferred class, by duration.

If the ratios for the preferred group increased by duration, one might conclude that preferred is wearing off.

**This type of analysis is flawed due to:**

- The slope of the underlying mortality table would be pivotal in the analysis.
- The underlying table would have to be "right", particularly the slope of the underlying table.

**A better approach for examining "wearing off"** is to examine the ratio of preferred-to-residual mortality results.

This measures the mortality results of the preferred cohort against the mortality results of their non-preferred counterparts.

The **benefits of this approach** are:

- The results would be independent of the underlying table.
- The results would show that if the preferred-to-residual ratio converges over time, then preferred is wearing off.

**When there is limited industry experience, one approach is to analyze clinical studies.**



## 6. Continued

**Studies from the general population** often have data available that allow the researcher to "underwrite" the population to get an "insurable" subset of the clinical study.

The results showed that the mortality for the preferred class remained proportionally better than their residual counterparts during the second decade of exposure relative to the first decade.

**For mainstream products, preferred appears to not wear off.**

- (b) QRS is planning to add a return of premium rider to the updated product.
- (i) Explain why the addition of this rider might improve the marketability of the product.

### **Commentary on Question:**

Candidates did much better on part (b). They answered the question directly.

### **Marketability**

The marketing of return of premium term products offers great sales pitches.

- There is a death benefit to the beneficiary if the insured dies.
- The policyowner can convert to a permanent level premium plan in case the insured becomes uninsurable.
- The policyowner receives the return of premium if the policy persists to the end of the level premium term period.

Producers are able to quote a very high rate of return for the policyowner. Agents receive higher commission amounts.

Even though the return of premium rider increases the premium significantly, the premiums are lower than for a universal life policy. Similar to universal life insurance, the total premium paid is the basis in the contract and therefore there is no taxable gain in returning the premiums.

- (ii) Explain why the pricing assumptions that were used for the existing product might not be appropriate for the updated product.

### **Commentary on Question:**

This part of part (b) was also answered well. Most candidates did discuss lapses, reserves, and expenses. Fewer candidates discussed distribution and cash values.

## 6. Continued

### Lapses Rates

Lapse rates will be different but uncertain on what the ultimate rate is.

Recommend reducing ultimate lapse rate toward end of period since consumer will be incented to stay.

Reducing the ultimate lapse rates can reduce pretax profit margins by a significant amount.

### Reserves

The reserves are much higher for policies with the rider than without. Typically, the reserve is the higher of the XXX Model Regulation reserve and the present value of the endowment.

The reserve for the endowment may create deficiency reserves.

The higher reserves create a greater surplus strain.

Recommend increasing reserves to comply with NAIC regulations.

### Distribution

The relative premium levels by term period change the mix of business by term period which can change profitability.

Recommend redoing distribution of model to take into account total premium paid.

### Cash Values

The regulators recently completed an NAIC survey on return of premium riders and most of the respondents indicated that their state does require a demonstration of compliance with the Standard Nonforfeiture Law.

Recommend no change.

### Expenses

Need to reflect higher commission costs since premiums are higher.

- (iii) Explain how you would modify the pricing assumptions for the updated product.

### **Commentary on Question:**

Solution for part (iii) is listed above in (ii). Fewer candidates did explain how assumptions should be modified.

## 6. Continued

- (c) QRS is planning to add two options to the updated product: a Term Conversion Option to a special plan which is loaded for extra mortality, and a Guaranteed Insurability Option.
- (i) Explain the approach you would use to price each option. Justify your answer.

### **Commentary on Question:**

A number of candidates listed the three ways to price options, but did not recommend which method to use for each of the above options. Many candidates did not justify the option to use.

### **PRICING APPROACH**

#### **Guarantee Insurability Option**

**Costs are borne equally by all people willing to pay to have the option available, regardless of whether they elect the option or not.**

- In this case, extra premiums are charged until the option is available, or possibly for a shorter period.
- This works best for options which are not continuously available.
- Guaranteed insurability is usually priced this way.

**Recommend** GI Option use this method.

#### **Term Conversion Option**

**Costs are borne by people who exercise the option therefore lower premiums**

- Premiums on the basic plan do not include the price of the option.
- This is most common for options which can provide immediate financial gain for a living insured

**Recommend** this method for Term Conversion Option

- (ii) Describe additional pricing factors needed for each option.

### **Commentary on Question:**

A number of questions did mention lapses and mortality. Fewer listed Option Election Rate or Percentage of Coverage Opted. Not many candidates described the additional pricing factors. They just listed the pricing factors.

### **ADDITIONAL PRICING FACTORS NEEDED FOR EACH OPTION**

***Factors needed for Guaranteed Insurability Option Only***

**Determine the option election rate**

This is difficult to estimate.

## 6. Continued

In many cases, the conservative approach is to assume that options will be exercised.

### **Determine the percentage of coverage opted**

For example, a policy may be terminated because of option election, but perhaps a policy for a fraction of that amount is issued.

### *Factors needed for both the GIO and term conversion option*

#### **Determining the Lapse Rates**

Lapses are generally low for policies issued as the result of options.

#### **Determine the Mortality Rates**

Mortality is usually higher on such options.

This especially occurs when the election rate is low.

It also occurs when **mortality anti-selection** is possible.

Even when anti-selection does not occur, the body of non-underwritten insureds will not experience mortality similar to that of newly underwritten lives.

Excess mortality on policies issued as a result of the exercise of an option can be partially offset by other factors such as:

- Opted issues do not require underwriting
- Opted issues experience much lower lapse rates than normal issues

So, some of these policies can be quite profitable.

## 7. **Learning Objectives:**

1. Describe the product development process.
4. Understand the design and purpose of various product types, benefits and features.
5. Understand the relationship between the product features, their inherent risks, and the selection of appropriate pricing assumptions, profit measures and modeling approaches.

### **Learning Outcomes:**

- (1a) Describe the iterative steps in the control cycle process within the context of product development;
  - (i) Idea Generation
  - (ii) Feasibility
  - (iii) Planning the Design
  - (iv) Actuarial Development
    - Assumptions
    - Profitability
    - Regulatory Issues
    - Choice of Model
- (4c) Evaluate the feasibility of the recommended design.
- (5c) Analyze results and recommend appropriate action from an array of risk and profit measures such as: Statutory, GAAP, Return on Equity, Market Consistent Pricing, Embedded Value.

### **Sources:**

Atkinson & Dallas, Life Insurance Products and Finance, Chapters 3, 7 – 11, 13 – 14

ILA-D104-07: Easton and Harris actuarial Aspects of Individual Life Insurance and Annuity Contracts, Chapter 3, the Product Development Process

“Return of Premium Term” Product Matters, July 2004

“Term Mortality and Lapses” Product Matters, August (62) 2005

Predictive Modeling for Life Insurance, Deloitte

### **Commentary on Question:**

Commentary listed underneath question component.

## 7. Continued

### Solution:

- (a) Describe the underwriting predictive modeling process.

#### Commentary on Question:

Several candidates described the steps to build a predictive model system (i.e. gathering data, building model, validating model, etc.) as opposed to describing the process involved when using a predictive model.

- Application is received then a predictive model score is calculated.
- The policy is either issued or sent through traditional underwriting.
- Model is a triage process which determines if more information is needed.
- Model suggests whether additional underwriting is requested before an offer can be made.
- Predictive model uses data from sources such as MIB, MVR, prescription drug databases, other non traditional sources of data, etc.
- Data must be readily available electronically.

- (b) Explain how predictive modeling can help deliver a competitive advantage.

#### Commentary on Question:

Most candidates were able to at least get two or three of the advantages of using a predictive model.

Predictive models can be used to analyze a limited set of underwriting requirements and inexpensive third party marketing data sources to provide an early glimpse of the likely underwriting results.

The underwriting process can be made:

- Faster – faster response time to make underwriting decisions
- Less expensive – lower acquisition costs and more competitive prices
- More efficient
- More consistent decisions – limits subjectivity of underwriter
- Underwriter can focus on more complicated cases
- Less invasive for customers

## **8. Learning Objectives:**

1. Describe the product development process.
4. Understand the design and purpose of various product types, benefits and features.
5. Understand the relationship between the product features, their inherent risks, and the selection of appropriate pricing assumptions, profit measures and modeling approaches.

### **Learning Outcomes:**

- (1a) Describe the iterative steps in the control cycle process within the context of product development;
  - (i) Idea Generation
  - (ii) Feasibility
  - (iii) Planning the Design
  - (iv) Actuarial Development
    - Assumptions
    - Profitability
    - Regulatory Issues
    - Choice of Model
- (4c) Evaluate the feasibility of the recommended design.
- (5c) Analyze results and recommend appropriate action from an array of risk and profit measures such as: Statutory, GAAP, Return on Equity, Market Consistent Pricing, Embedded Value.

### **Sources:**

Atkinson & Dallas, Life Insurance Products and Finance, Chapters 3, 7 – 11, 13 – 14

ILA-D104-07: Easton and Harris Actuarial Aspects of Individual Life Insurance and Annuity Contracts, Chapter 3, The Product Development Process

“Return of Premium Term,” Product Matters, July 2004

“Term Mortality and Lapses,” Product Matters, August (62) 2005

Predictive Modeling for Life Insurance, Deloitte

### **Commentary on Question:**

Commentary listed underneath question component.

## 8. Continued

### Solution:

- (a) You are developing new term products which feature a level initial premium for 10 years and then a higher ultimate premium for the remaining term of the products. You are presenting these new products to marketing and senior management.
- (i) Recommend appropriate sensitivity tests for lapse and mortality assumptions for these products.

#### Commentary on Question:

Candidates knew that the end of the level period drove the need for sensitivities. But few candidates mentioned that different levels are needed to do a sensitivity test.

#### Lapse Assumption:

- Expect sharp increase in lapse rates after the level premium period when premium increases substantially.
- Test different levels of additional lapse rates after the initial premium period.
- Lapse rates vary by risk class, gender, issue age, etc.; test different levels of lapse rates for each.

#### Mortality Assumption:

- Mortality rates increase after the level premium period due to anti-selective lapsation.
- Test different levels of higher mortality rates after the level premium period based on selective lapses.

- (ii) List the key areas on which agreement is needed to complete the reconciliation stage of the product development process.

#### Commentary on Question:

Candidates were not familiar with reconciliation stage and just listed numerous steps in the product development process.

Need a set of pricing assumptions

Need a set of prices based on these assumptions

Expected profits

- (b) Recommend which alternative the company should choose, using embedded value as the criterion. Show all work.

#### Commentary on Question:

Many candidates missed that negative profits should be discounted at the after tax rate.



## 8. Continued

Embedded value is equal to the present value of profits discounted using the hurdle rate.

- When calculating embedded value, it is normal to base profits on either after tax solvency earnings or distributable earnings
- If  $PVFP(t) > 0$  then  $PVFP(t - 1) = PVFP(t)/(1 + i) + Profit(t - 1)$  where  $i =$  discount/hurdle rate of 12%
- Else  $PVFP(t - 1) = PVFP(t)/(1 + j) + Profit(t - 1)$  where  $j =$  after tax discount rate of 6%

Year	Product 1	Product 2	Combined
5	$-25/1.06 = -23.58$	$30/1.12 = 26.79$	$5/1.12 = 4.46$
4	$(-23.58 + 5)/1.06 = -17.53$	$(26.79 + 36)/1.12 = 56.06$	$(4.46 + 41)/1.12 = 40.59$
3	$(-17.53 + 33)/1.12 = 13.81$	$(56.06 + 43)/1.12 = 88.45$	$(40.59 + 76)/1.12 = 104.10$
2	$(13.81 + 98)/1.12 = 99.83$	$(88.45 + 47)/1.12 = 120.93$	$(104.1 + 145)/1.12 = 222.41$
1	$(99.83 - 65)/1.12 = \mathbf{31.10}$	$(120.93 - 86)/1.12 = \mathbf{31.19}$	$(222.41 - 151)/1.12 = \mathbf{63.76}$

Recommend alternative C:

- Combined embedded value for both products is greater than the individual products summed separately.
- PVFP is never negative for the combined product so all future profits (including the negative profits of product 1) are now discounted at 12% (rather than 6% for product 1 alone).

## **9. Learning Objectives:**

1. Describe the product development process.
3. Understand the feasibility step of a new product and how it drives design.
4. Understand the design and purpose of various product types, benefits and features.
5. Understand the relationship between the product features, their inherent risks, and the selection of appropriate pricing assumptions, profit measures and modeling approaches.

### **Learning Outcomes:**

- (1a) Describe the iterative steps in the control cycle process within the context of product development;
  - (i) Idea Generation
  - (ii) Feasibility
  - (iii) Planning the Design
  - (iv) Actuarial Development
    - Assumptions
    - Profitability
    - Regulatory Issues
    - Choice of Model
- (3b) Describe tax regulation and perform calculations to evaluate compliance.
- (4a) Describe in detail product types, benefits and features.
- (5e) Describe when a stochastic model should be used, its advantages and disadvantages, how to build it and how to analyze its results.

### **Sources:**

ILA-D116-10: Variable Annuities, Kalberer and Ravindran, Chapters 5 and 9 – 11

Investment Guarantees, Hardy, Chapter 8, Dynamic Hedging for Separate Accounts (pgs. 133-143)

Stochastic Pricing, Session 62 TS from November 2005 SOA Annual Meeting

Atkinson & Dallas, Life Insurance Products and Finance, Chapter 2 and 13 (Sections 13.1 and 13.2 Only)

### **Commentary on Question:**

Commentary listed underneath question component.

## 9. Continued

### Solution:

- (a) Outline the costs and benefits of this new product.

#### Commentary on Question:

Most candidates were able to answer the top five costs listed below but only a few were able to list more items. Most candidates were able to answer to majority of the benefits of introducing the new product.

Costs:

- Hiring outside consultant to leverage their expertise
- Training of home office employees and agents
- Developing new distribution channel and new marketing material
- Updating of administration system to support the new product
- Cost to hedging the product over its lifetime
- Implementation barriers
- Purchase of new software
- Maintenance of the software
- Cost to implement the product
- Cost of developing this product instead of devoting resources to other projects

Benefits:

- Increased sales
- Increased profitability
- Part of broader company strategy
- Increases reputation of company
- Ability to develop similar products in the future

- (b) Calculate the annual margin offset required to cover a GMDB option.

#### Commentary on Question:

Most candidates calculated the monthly margin and didn't multiply their answer by 12 to get the annual margin. Many candidates forgot to divide their monthly margin by the initial guarantee value of \$100.

$$\text{Margin offset rate} = \frac{\text{Value of Option}}{(\text{Initial Guarantee} \times \text{Value of Annuity})}$$

$$\text{Margin offset rate} = \frac{1.18}{(100 \times 45.9)} = 0.026\%$$

$$\text{Annual margin offset} = 12 \times 0.026\% = 0.31\%$$

## 9. Continued

(c)

- (i) Propose an effective risk management strategy for this product assuming reinsurance is not available. Justify your answer.

**Commentary on Question:**

Several candidates listed all the different risk management strategies without making a recommendation. Some other candidates recommended strategies other than dynamic hedging. Most of those that recommended a dynamic hedging strategy also mentioned replicating the liabilities and rebalancing the portfolio regularly.

Recommendation: Dynamic hedging

- Replicates the liabilities by matching the assets (i.e. matching the Greeks)
- Requires periodic rebalancing of the portfolio
- Static or semi-static hedging are not appropriate with this type of product
- Uses plain vanilla options
- Insulates portfolio against small movements in capital markets
- Complex product requires sophisticated strategy to manage the risk

- (ii) Recommend a pricing approach to support the proposed risk management strategy. Justify your answer.

**Commentary on Question:**

Several candidates recommended the actuarial approach instead of the stochastic pricing approach. Most of those who recommended stochastic pricing also mentioned the top four items listed below.

Recommendation: Stochastic Pricing

- Can model and understand the tail of the distribution
- Model gives a large distribution of results
- The product has high volatility of outcomes
- Provides a better understanding of risks
- Claims have low frequency and high severity
- Policyholder behavior risk – Use of dynamic assumptions
- Product has asymmetric and non diversifiable risks
- Complex product
- Deterministic pricing is not appropriate with this product

## 10. Learning Objectives:

5. Understand the relationship between the product features, their inherent risks, and the selection of appropriate pricing assumptions, profit measures and modeling approaches.

### Learning Outcomes:

- (5a) Identify and explain the setting of an appropriate assumption for product characteristics such as the following:
  - (i) Riders
  - (ii) Policyholder Dividends
  - (iii) Equity Linked
  - (iv) Embedded Options
  - (v) Return of Premium
  - (vi) Secondary Guarantees
  - (vii) Payout Annuity Benefits
  - (viii) Crediting Methodology
  - (ix) Other Non-Guaranteed Elements

### Sources:

ILA-D107-07: Experience Assumptions for Individual Life Insurance and Annuities

Atkinson & Dallas, Life Insurance Products and Finance, Chapter 11

ILA-D118-11: Traditional vs. Market Consistent Product Pricing, Sanjeep Kumar

### Commentary on Question:

Comments listed underneath question component.

### Solution:

- (a)
  - (i) Calculate the ultimate Actual to Expected (A/E) lapse rate by monthly benefit amount and the 95% confidence interval for the A/E ratio by amount for durations 4+.

### Commentary on Question:

Pretty much all of the candidates received all or most of the credit for (a)(i), but most of the candidates did not know how to calculate the 95% confidence interval for the A/E ratio by amount for (a)(ii). If candidates did know the formulas, they did not choose the correct components for the formula, and seem to miss that the question asked for the 95% confidence interval by amount.

Expected Lapse by Amount = sum over all policies exposed (i):

$$\sum \text{Amount}(i) * q(i)$$

Average amount of monthly benefit = Amount Exposed / Number Exposed

## 10. Continued

Average Amount = 625,000 / 125 (for duration 4+)

Average Amount = 5,000

Expected Amount of Lapses (4+) =  $\sum 5000 * (.05)$  for all 125 policies exposed

=  $125 * 5000 * 0.05 = 31,250$

Actual to Expected Ratio = Actual Lapse by Amount / E(lapse by amount)

A/E =  $5000 / 31250 = 16\%$

95% Confidence Interval for A/E Ratio by Amount

CI for A/E Ratio =  $[E(\text{lapse}) \pm 1.96 (\text{Var}(\text{lapse})^{(1/2)})] / E(\text{lapse})$

Variance(lapse) = sum over all policies exposed (i):  $\sum \text{Amount}(i)^2 * q(i) * (1 - qi)$

- from above average amount = 5,000

For Duration 4+ (Ultimate):

Variance of Amount of Lapses (4) =  $\sum 5000^2 * (.05) * (.95)$  for all 125 policies

Variance (lapse) =  $125 * (5000^2 * (0.05) * (0.95))$

Lower Bound for 95% CI =  $[E(\text{lapse}) - 1.96 * \sqrt{\text{Var}(\text{lapse})}] / E(\text{lapse})$

Lower Bound for 95% CI =  $[31,250 - 1.96 * \sqrt{(148,437,500)}] / 31,250$

Lower Bound for 95% CI = 23.585% (24% rounded)

Upper Bound for 95% CI =  $[E(\text{lapse}) + 1.96 * \sqrt{\text{Var}(\text{lapse})}] / E(\text{lapse})$

Upper Bound for 95% CI =  $[31,250 + 1.96 * \sqrt{(148,437,500)}] / 31,250$

Upper Bound for 95% CI = 176.415% (176% rounded)

95% CI for A/E by Amount is 24% to 176% (using rounded values)

- (ii) Recommend adjustments to the lapse assumptions for pricing going forward. Justify your answer.

### Commentary on Question:

Many of the candidates did not know to use the 95% Confidence Interval for A/E by Amount column given in the question, in determining whether to change the lapse assumption.

Recommend not changing assumed lapse rate for durations 1.

A/E lapse rate for durations 1 is within 95% CI.

Recommend not changing assumed lapse rate for durations 2.

A/E lapse rate for durations 2 is within 95% CI.

Recommend not changing assumed lapse rate for durations 3.

A/E lapse rate for durations 3 is within 95% CI.

Based on Calculation in Part A:

Recommend lowering ultimate lapse assumption for durations 4+.

A/E lapse rate is lower than the 95% CI.

## 10. Continued

Recommend continuing to monitor lapse experience as more credible data becomes available.

Low lapse rates (especially ultimate lapse rates) are expected to be much lower for lapse supported products like LTC.

- (b)
- (i) Calculate the Present Value of Profit as a Percent of Premium using the traditional pricing approach.

### Commentary on Question:

Most candidates knew to calculate Distributable Earnings when calculating the Present Value of Profit, but some calculated After Tax (and Pre-Tax) Solvency earnings only. The question assumed that Present Value of Investment Income on Required Surplus is After Tax, although not stated as such. Credit was also given if the Candidate assumed it was Pre-Tax, and then calculated an appropriate After Tax number.

Calculation of Profit as a % of Premium (i.e., Profit Margin)

PV of Profit as % Premium (Profit Margin) = PV of Distributable Earnings / PV of Premium

PV of Distributable Earnings = PV of After-Tax Solvency Earnings – PV of Increase in Required Cap + PV of AT Investment Income on Required Capital

PV of After-Tax Solvency Earnings = PV of Pre-Tax Solvency Earnings - PV Tax

PV of Pre-Tax Solvency Earnings = PV of Product Cash Flow + PV of Investment Income – PV of Increase in Solvency Reserves

PV of Product Cash Flow = PV of Premiums – PV of Benefits – PV of Expenses

PV of Product Cash Flow = 10,000,000 – 6,000,000 – 1,500,000 = 2,500,000

PV of Pre-Tax Solvency Earnings = 2,500,000 + 475,000 – 1,000,000 = 1,975,000

PV of After-Tax Solvency Earnings = 1,975,000 – 200,000 = 1,775,000

PV of Distributable Earnings = 1,775,000 – 500,000 + 35,000 = 1,310,000

(Note: Assumes PV of Investment Income on RS is AT. If candidate uses a tax rate to calc tax on Investment Income or RS, give credit as appropriate.)

PV of Profit as % of Premium (Profit Margin) = 1,310,000 / 10,000,000 = 13.1%

## 10. Continued

- (ii) Calculate the Market Consistent Value of New Business.

**Commentary on Question:**

Common mistakes were incorrect signs in the formulas, and also incorrect calculation of Total Impact of Tax Consequences.

Calculation of MC VNB (Market Consistent Value of New Business  
MC VNB = - MVL (i.e., Market Value of Liabilities with the opposite sign)

MVL = Transfer Price of Liabilities (TPL) + Transfer Tax on Liability (TTL)

MVL = Market Value of Hedgeable Risks + Value of Economic Required Capital on Non-Hedgeable Risks + Total Impact of Tax Consequences  
Market Value of Hedgeable Risks = PV of Benefits + PV of Expenses – PV of Premiums

Market Value of Hedgeable Risks = 6,000,000 + 1,500,000 – 10,000,000 = 2,500,000

Total MVM = Total MVM Morbidity Risks + Total MVM Lapse Risks + MVM Investment Income Mismatch Risk + MVM Operation Risk

Total MVM = 750,000 + 1,250,000 + 375,000 + 250,000 = 2,625,000

Total Impact of Tax Consequences = Transfer Tax on Liabilities (TTL) + Value of Tax Liability Timing Difference (VTLD)  
= -50,000 + 25,000 = -25,000

MVL = -2,500,000 + 2,625,000 + -25,000 = 100,000

MC VNB = -100,000

- (iii) Recommend whether or not to continue selling the current LTC product as priced, based on the results above.

**Commentary on Question:**

Most candidates knew if the traditional pricing approach resulted in higher than target profits, but the Market Consistent Value of New Business approach resulted in below target profits, then the product should not be sold. However, some did not understand this concept.

Current projected profit margin is above 13% target (13.1% from above > 13% target).

This would suggest current pricing is still appropriate on a traditional basis.

However, MC VNB shows a negative value which is not desirable.

This implies a negative true economic profitability.

The MC VNB is negative which implies traditional pricing does not account for all the risks inherent in the product.



## 10. Continued

Negative MC VNB also demonstrates the sensitivity of the profitability of the product to economic/market conditions.

Recommend discontinue selling current product under current pricing as price doesn't appropriately reflect true risks.

Recommend repricing product with higher premiums to account for additional economic risks.

Could also recommend a potential better matching of product cash flows to reduce economic sensitivity.

## 11. Learning Objectives:

3. Understand the feasibility step of a new product and how it drives design.
5. Understand the relationship between the product features, their inherent risks, and the selection of appropriate pricing assumptions, profit measures and modeling approaches.

### Learning Outcomes:

- (3b) Describe tax regulation and perform calculations to evaluate compliance.
- (5b) Identify and explain the setting of an appropriate assumption for risk and other factors such as:
  - (i) Available Experience Data
  - (ii) The Marketplace
  - (iii) Underwriting
  - (iv) Distribution Channel Characteristics
  - (v) Reinsurance
  - (vi) Expense (Fixed, Variable, Marginal)
  - (vii) Taxes (Income and Premium)
  - (viii) Investment Strategy

### Sources:

Life Insurance and Modified Endowments Under IRC S7702 and S7702A, Chapters 2 – 4 and 6

### Commentary on Question:

The question requires the ability to perform the Guideline Premium Test and calculations of tax on life insurance withdrawals.

### Solution:

- (i) Determine whether it qualifies as life insurance under Section 7702. Show all work.

### Commentary on Question:

Common mistakes included not showing that the Guideline Premium Test passed every year and adding the rider charges as additional premiums (since this is a UL policy, charges would be taken from account value).

Policy A:

At each point in time perform Guideline Premium Test:

$$\sum \text{Premiums} \leq \text{Max}(\text{GSP}, \sum \text{GLP})$$

A term rider on a business partner is not a Qualified Additional Benefit (QAB). Therefore GSP is unchanged at \$10,000 and GLP stays at \$1,000.

## 11. Continued

Year	1	2	3	4	5
GSP	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000
GLP	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000
$\Sigma$ GLP	\$1,000	\$2,000	\$3,000	\$4,000	\$5,000
Guideline Limit	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000
$\Sigma$ Premium	\$3,000	\$6,000	\$9,000	\$10,000	\$10,000

Contract qualifies as life insurance as the sum of premiums paid does not exceed the guideline limit in any year and the death benefit easily exceeds the maximum corridor percentage of 250% times the cash value in every year.

Policy B:

The family term rider is a Qualified Additional Benefit (QAB).

Therefore  $GSP = \text{base } GSP + QAB \text{ charge} \times \ddot{a}_{45:20} = 10,000 + 1,000 \times 10 = 20,000$ .

$GLP = \text{base } GLP + QAB \text{ charge (no postfunding)} = 1,000 + 1,000 = 2,000$

Year	1	2	3	4	5
GSP	\$20,000	\$20,000	\$20,000	\$20,000	\$20,000
GLP	\$2,000	\$2,000	\$2,000	\$2,000	\$2,000
$\Sigma$ GLP	\$2,000	\$4,000	\$6,000	\$8,000	\$10,000
Guideline Limit	\$20,000	\$20,000	\$20,000	\$20,000	\$20,000
$\Sigma$ Premium	\$3,000	\$6,000	\$9,000	\$10,000	\$10,000

Contract qualifies as life insurance as the sum of premiums paid does not exceed the guideline limit in any year and the death benefit easily exceeds the maximum corridor percentage of 250% times the cash value in every year.

- (ii) Calculate the Federal Income Tax due in year five. Show all work.

### Commentary on Question:

The most common mistake was not showing sufficient work in the calculation of the investment basis.

Policy A:

Investment = Premiums less Distributions (where distributions = withdrawals + non-QAB charges)

Gain on distribution = distributions after investment is exhausted (is FIFO due to non-MEC status)

## 11. Continued

Year	1	2	3	4	5
Distributions	\$500	\$500	\$500	\$500	\$600
Investment (net of dist.)	\$2,500	\$5,000	\$7,500	\$8,000	\$7,400
Gain on Dist	\$0	\$0	\$0	\$0	\$0
FIT owed	\$0	\$0	\$0	\$0	\$0

Policy B:

Investment = Premiums less Distributions (where distributions = withdrawals)

Gain on distribution = distributions after investment is exhausted (is FIFO due to non-MEC status)

Year	1	2	3	4	5
Distributions	\$0	\$0	\$0	\$0	\$100
Investment (net of dist.)	\$3,000	\$6,000	\$9,000	\$10,000	\$9,900
Gain on Dist	\$0	\$0	\$0	\$0	\$0
FIT owed	\$0	\$0	\$0	\$0	\$0

## 12. Learning Objectives:

3. Understand the feasibility step of a new product and how it drives design.
4. Understand the design and purpose of various product types, benefits and features.

### Learning Outcomes:

- (3c) Describe how investment policy and policy loans can impact design.
- (4c) Evaluate the feasibility of the recommended design.

### Sources:

Atkinson & Dallas, Life Insurance Products and Finance, Chapters 2 - 3 and 13 (Sections 13.1, 13.2, 13.3 and 13.4 Only)

Life Insurance and Modified Endowments Under IRC S7702 and S7702A, Chapters 2 – 4 and 6

ILA-D105-07: Life and Annuity Products and Features

### Commentary on Question:

Comments listed underneath question component.

### Solution:

- (a) Describe key elements of a product strategy that RNC should implement to achieve its goal and outline possible tactics RNC can use.

#### Commentary on Question:

Performance was mostly weak on this part of the question. The question was looking for an understanding of how a company determines what products that it will offer. A great number of candidates focused on pricing or marketing strategies which are different concerns.

A company's product strategy determines what products it will offer to the marketplace. To improve its likelihood of success, a company should:

1. Understand its target market
  - a. This will allow the company to effectively focus its efforts and serve its market
  - b. To be useful, a target market should:
    - i. Be precisely defined
    - ii. Have a clear method of being reached
    - iii. Have members with similar characteristics
    - iv. Be sufficiently large that it is cost-effective

## 12. Continued

2. Offer products that build on core competencies
  - a. Each company has different strengths
  - b. Examples of some are:
    - i. Operational efficiency
    - ii. Underwriting expertise
    - iii. High persistency
    - iv. Sophisticated distribution
    - v. Low cost of capital
3. Offer products with a risk profile that fits with the company's goals

### Recommendations:

1. Increase recruitment of agents
  2. Implement programs to increase:
    - a. Persistency
    - b. Mortality results
    - c. Investment returns
  3. Lower costs through automation and economies of scale
  4. Eliminate products that are low-value
- (b) You are given the following information on the assets backing the Deferred Annuity policyholder account:
- (i) Calculate the annuity account's crediting rate.

### Commentary on Question:

Most candidates performed well on this part of the question. Those that had trouble typically struggled to determine the asset mix as they did not recognize that 20% in junk bonds maximizes the return. Some had trouble solving for the mix using the average term to maturity. Many candidates were able to get partial credit by assuming a mix of assets and demonstrating their ability to calculate a crediting rate from an assumed mix.

### Common mistakes were:

- Setting  $\%G = (100\% - \%C)$  rather than  $(100\% - 20\% - \%C)$
- Neglecting to subtract the spread from the net yield for the crediting rate
- Not keeping the decimal point straight when subtracting default costs and investment expenses from bond yields

Mix of assets: Junk bonds have the highest return, so overall return is maximized by investing up to the limit in junk bonds. Therefore, invest 20% in junk bonds. The remaining 80% is corporate bonds (%C) and government bonds (%G).

## 12. Continued

Since the average term to maturity is 10,  
 $10 * \%G + 15 * \%C + 7 * \%J = 10$   
 $10*(80\% - \%C) + 15 * \%C + 7 * 20\% = 10$   
 $\%G = 68\%, \%C = 12\%$

Calculate the yields:

Gov Bonds:  $5\% - 0 - 0.02\% = 4.98\%$

Corp Bonds:  $6.5\% - 0.01\% - 0.04\% = 6.45\%$

Junk Bonds:  $10\% - 1\% - 0.1\% = 8.9\%$

Calculate the net yield:

Net Yield =  $68\% * 4.98\% + 12\% * 6.45\% + 20\% * 8.9\% = 5.94\%$

Calculate credited rate:

Credited rate = Net yield – spread =  $5.94\% - 1.25\% = 4.69\%$

- (ii) Discuss the purpose of the interest rate spread (i.e. 1.25%) in the crediting rate strategy.

### **Commentary on Question:**

Performance was very strong on this section. Most candidates were able to clearly articulate the purpose of the interest rate spread. Some candidates recognized that spread contributed to profit but did not mention other items that need to be covered as well.

The spread is a source of revenue and profit for the insurance company. For deferred annuities, it is typically the only source of revenue available.

The spread covers:

- Expenses
- Product features
- Asset risks
- Profits

- (iii) Critique the crediting rate strategy methodology in a rising interest rate environment.

### **Commentary on Question:**

Performance was mixed on this section. Candidates who had trouble typically did not recognize that the yield on the invested assets is fixed and does not rise in step with market rates.

## 12. Continued

The assets backing this portfolio are fixed at issue. Therefore, in a rising interest rate environment, policyholders would have the opportunity to receive a higher crediting rate from the market if they lapse their policies and purchase new ones. Therefore, lapse rates would tend to increase forcing the company to sell assets at a time when the value of the assets has gone down.

This behavior by policyholders is anti-selective, because they would tend to persist in a declining interest rate environment. The actuary should perform an asset-liability analysis under various scenarios that includes both rising and declining interest rates in order to develop a crediting strategy that fits the companies risk profile.



### 13. Learning Objectives:

2. Understand the drivers of product design (the idea generation step).
6. Understand actuarial requirements of product implementation and the monitoring of experience versus product assumptions.

#### Learning Outcomes:

(2b) Analyze how the following drive product design:

- Company strengths and weaknesses
- Economic forces
- Marketplace demographics
- Consumer behavior
- Distribution channel behavior
- Competition

(6c) Describe how to ensure the quality of data.

(6d) Recommend changes to non-guaranteed elements for deviations from expected.

#### Sources:

LOMA, Insurance Marketing, 2010, Chapters 2 – 5 and 7 – 8

ASOP #41, Actuarial Communications

ASOP #23, Data Quality (All except transmittal memo and appendices)

#### Commentary on Question:

Commentary listed underneath question component.

#### Solution:

- (a) Evaluate the various Internet Lead Generation techniques and their likelihood for success.
  1. Targeted e-mail marketing
    - Very inexpensive and an easy way to contact a large number of prospects
  2. Newsletters
    - Most successful
    - E-mail may contain the contents of the newsletter or allow recipient to access via the company's website
  3. Search Engine Marketing
    - Sites that appear at the top of a search list have been determined to be the most relevant
    - "Search engine optimization" meets search engine criteria for key words

## 13. Continued

- Company may use Sponsored Links, in which they pay a search engine a fee to be listed at the top of a results page
- 4. Web advertising
  - Company advertises on other websites
  - Charges can be based on the number of visits to the advertiser's site or on a periodic basis
- 5. Aggregators
  - Provide info and then direct the consumer to the company's website
  - Usually receive a fee from insurer for each lead or submitted app

Some companies determine the success of lead generation techniques by Click-through-Rate (CTR)

CTR is the percentage of total times an ad is seen that results in a visit to the company's website

- (b) Explain why ASOP 41, Actuarial Communications, applies.

**Commentary on Question:**

The majority of candidates did well on this part and demonstrated that they understood why ASOP 41 applies to the situation.

An actuarial communication is a written, oral, or electronic communication to a principal or intended audience by an actuary with respect to actuarial services. This includes significant communication regarding methods, assumptions, data, or other information required to complete the work. According to ASOP 41, the e-mail was an actuarial communication.

- (c) Identify the requirements under ASOP 41 which should have been followed in the communication from the ASA.

**Commentary on Question:**

There was some overlap between parts (c) and (d). Candidates were given appropriate credit for answering under either part in this situation.

If the actuary showed the faulty data in the communication to MKH, the company should have noticed the error.

The communication should have considered:

1. Principal and Scope of the engagement – identify the principal for whom findings are made and make clear the scope of the assignment
2. Form and Content – the communication should be clear and appropriate for the circumstances, considering the audience

## 13. Continued

3. Timing of Communications – the communication should be issued within a reasonable period following the completion of the analysis
  4. Identification of Responsible Actuary – the actuary issuing the communication should ensure it clearly identifies the actuary as being responsible
  5. Non-independence – the actuary should disclose any non-independence (financially or organizationally) and any conflicts of interest
  6. Reliance on Other Sources – the actuary assumes responsibility unless it is stated in the communication that the actuary relied on other sources; the actuary in this situation should have stated that he relied on the accuracy of the data supplied by MKH, but the extent of that reliance should be stated
  7. Methods or Assumptions Prescribed by Principal – the actuary should disclose if any methods or assumptions were prescribed by the principal
  8. Obligations Imposed by Law or Regulation – the actuary should disclose that work was performed in compliance with such requirements
- (d) Identify the data requirements from ASOP 23 Data Quality which should have been in the analysis performed by the ASA.

### **Commentary on Question:**

Most candidates were able to identify that the actuary should review the data. For full credit, the candidate should also identify the considerations for the selection of data and use of data, as well as the necessary documentation.

#### Selection of data

- The actuary should consider the scope and intended use of the analysis in order to determine the data needed and whether any alternative data sources should be considered
- Should consider any known material limitation of the data

#### Review of data

- The actuary should review the data for reasonableness and consistency, unless a review is not necessary or practical
- Should make an effort to determine the definition of each data element
- Should identify questionable data values
- Should consider reviewing any prior data

#### Use of Data

- The actuary should consider whether the data is of sufficient quality to perform the analysis
- Judgmental adjustments or assumptions may be applied; if results are still uncertain, the actuary should disclose this uncertainty

### **13. Continued**

- If the data is so inadequate that it cannot be used, the actuary should request different data or decline to complete the assignment

Documentation should include:

- The process followed to evaluate the data
- A description of any material defects the actuary believes are in the data
- A description of any adjustments or modifications made to the data

## **14. Learning Objectives:**

4. Understand the design and purpose of various product types, benefits and features.
5. Understand the relationship between the product features, their inherent risks, and the selection of appropriate pricing assumptions, profit measures and modeling approaches.

### **Learning Outcomes:**

- (4a) Describe in detail product types, benefits and features.
- (5a) Identify and explain the setting of an appropriate assumption for product characteristics such as the following:
  - (i) Riders
  - (ii) Policyholder Dividends
  - (iii) Equity Linked
  - (iv) Embedded Options
  - (v) Return of Premium
  - (vi) Secondary Guarantees
  - (vii) Payout Annuity Benefits
  - (viii) Crediting Methodology
  - (ix) Other Non-Guaranteed Elements

### **Sources:**

ILA-D105-07: Life and Annuity Products and Features

ILA-D116-10: Variable Annuities, Kalberer and Ravindran, Chapters 5 and 9 – 11

Atkinson & Dallas, Life Insurance Products and Finance, Chapters 3, 7 – 11 and 13 – 14

ILA-D114-09: CIA Research Paper, Life Insurance Costing and Risk Analysis, June 2008

Stochastic Pricing, RSA Vol. 27, No. 2, Session 86PD

Investment Guarantees, Hardy, Chapter 12 Guaranteed Annuity Options

### **Commentary on Question:**

Commentary listed underneath question component.

### **Solution:**

- (a) Calculate the annuity account value as of January 1, 2014 after the transfer. Show all work.

## 14. Continued

### Commentary on Question:

Candidates performed well on this portion of the question. Many students did not apply surrender charge to the withdrawal from Fund A. They were given full credit with only few marking point deductions.

### Formula:

Units Purchased =  $\text{Prem} * (1 - \text{Load}) * (\text{Invested } \%) / \text{Unit Value}$

Units Withdrawn =  $(\text{Gross Withdrawal}) * (\text{Investment } \%) / (\text{Unit Value})$

Gross Withdrawal =  $(\text{Withdrawal Amount}) / (1 - \text{Surrender charge})$

Account Value (AV) =  $\text{Total Units} * \text{Unit Value}$

### Calculations:

*Date: Jan 1, 2010: 1000 premium deposited 100% into Fixed Account.*

Units of A purchased = 0

Units of B purchased = 0

Fixed AV = 920

*Date: Jan 1, 2011: 1000 premium deposited 50%/50% into Fund A/B.*

Units of A purchased =  $1000 * (1 - 8\%) * 0.5 / 9 = 51.11$

Units of B purchased =  $1000 * (1 - 8\%) * 0.5 / 21 = 21.9$

Fixed AV =  $920 * (1 + 2\%) = \$938.40$

*Date: Jan 1, 2012: \$200 is withdrawn from Fund A. Assume \$200 is net after surrender charges.*

Surrender charge as of Jan 1, 2012 is 13%.

Gross withdrawal =  $200 / (1 - 13\%) = \$229.89$

Units of A withdrawn =  $229.89 / 10 = 22.99$

Total Units Fund A =  $51.1 - 22.99 = 28.12$

Units of B withdrawn = 0 (because all withdrawn from Fund A)

Fixed AV =  $938.40 * (1 + 2\%) = \$957.17$

*Date: Jan 1, 2013: no transactions, same number of units in Fund A & B as of Jan 1, 2012.*

Units of A purchased = 0

Units of B purchased = 0

Fixed AV =  $957.17 * (1 + 2\%) = \$976.31$

*Date: Jan 1, 2014: Total Fixed Account Value to be transferred to Fund B.*

Fixed AV =  $\$976.31 * (1 + 2\%) = \$995.84$

Amount Transferred to Fund B (after fee) =  $\$995.84 * (1 - 0.05\%) = \$995.34$

Units of Fund B Purchased =  $\$995.34 * (1 - 0\%) * 100\% / 20 = 49.77$  (note no loading because is not new premium)

## 14. Continued

*Values on Jan 1, 2014 (after the transfer):*

Fixed AV = 0

AV Fund A =  $28.12 \times 9.25 = 260.11$

Total Units Fund B =  $21.9 + 49.77 = 71.67 = 438 + 995.34$

AV Fund B =  $71.67 \times 20 = 1433.40$

Total AV = AV Fund A + AV Fund B + Fixed AV  
=  $\$260.11 + \$1433.40 + \$0 = \$1693.51$

- (b) IRM Life is considering adding either a Guaranteed Minimum Income Benefit (GMIB) or Guaranteed Annuity Option (GAO) to this VA product.
- (i) Outline GMIB pricing and modeling considerations.

### **Commentary on Question:**

Candidates performed poorly on this portion of the questions. Many students just listed general pricing and modeling considerations applicable to variable annuity contract and/or other products. A well prepared student needed to outline pricing and modeling considerations applicable only to GMIB option.

### Pricing considerations:

- Without GMIB, annuitization of variable annuity is uncommon.
- When GMIB is in the money, it is more valuable to annuitize at the guaranteed rates.
- Other factors influencing annuitization rates:
  - Waiting period before the GMIB annuity can be elected
  - Age at retirement
  - Need for income
  - Tax implications
  - Lapses and other policyholder behavior
  - Formulas may be linear, stepwise, exponential arctangent or parabolic
- Use dynamic assumptions.
- Understand impact of economic assumptions and have periodic reviews of the impact.
- Consider longevity risk/mortality improvement in rates.

### Modeling considerations:

- GMIB payments are rarely modeled explicitly as cash flows until runoff. It is more common to model commuted value of guaranteed payments.
- Use stochastic modeling.
- Perform sensitivity testing.

## 14. Continued

- Consider using static replication or dynamic hedging to limit tail risk.
  - Consider using term structure model using real world scenarios rather than risk neutral.
- (ii) Recommend a design for this contract that minimizes the cost of the guarantee to the company.

### **Commentary on Question:**

This part of the question was the most difficult part for most candidates. The intent of the question was for the candidate to determine the cost of GAO and GMIB and recommend a least expensive design. Many candidates simply put a general list of items that minimize the cost of the guarantee and received no marks. Partial marks were given to candidates that justified a less expensive option (GAO, GMIB or no option) without doing a calculation.

### Without GMIB or GAO:

$$\begin{aligned}\text{Current Fund Value (FV) at age 65} &= 1,000 * a(65) @ 3\% \\ &= 1,000 * (12) \\ &= 12,000\end{aligned}$$

### GMIB Cost:

$$\text{GMIB Cost} = \text{GMIB FV} - \text{Current FV}$$

$$\text{GMIB FV} = \text{Initial Premium} * (1 + \text{GMIB guaranteed interest rate})^{(\# \text{ of years in accumulation period})}$$

$$\text{Initial Premium} = \text{Current FV} / (1 + 3\%)^{10}$$

$$\text{Initial Premium} = 12,000 / (1 + 3\%)^{10} = 8,929.13$$

$$\text{GMIB FV} = 8,106.77 * (1 + 5\%)^{10} = 14,544.61$$

$$\text{GMIB Cost} = 14,544.61 - 12,000 = \$2,544.61$$

### GAO Cost:

$$\text{GAO Cost} = g * F_n * a(65) - \text{Current FV}$$

$$\text{GAO Cost} = 90 / \$1,000 * \$12,000 * 12 - 12,000 = \$960$$

Since GAO Cost < GMIB Cost, recommend using GAO option design because is cheaper for this particular policy.



## 15. Learning Objectives:

3. Understand the feasibility step of a new product and how it drives design
6. Understand actuarial requirements of product implementation and the monitoring of experience versus product assumptions.

### Learning Outcomes:

- (3c) Describe how investment policy and policy loans can impact design.
- (6a) Describe and evaluate compliance with illustration regulation and other policy form regulations.

### Sources:

ILA-D804-09: NAIC Life Insurance Illustrations Model Regulation

### Commentary on Question:

Commentary listed underneath question component.

### Solution:

- (a) List six of the requirements in the NAIC Life Insurance Illustrations Model Regulation you must perform for the Annual Certification.

#### Commentary on Question:

The question tested the candidates' ability to recall the appropriate guidelines for a specific purpose. Most candidates listed the general requirements of the NAIC Illustration Model Regulation as whole, but had trouble identifying the specific requirements for annual certification.

- Must be a member in good standing of the AAA and know Illustration ASOP
  - Must not have been convicted of fraud or other violation
  - Must disclose if in the past 5 years any changes in scale other than experience
  - Non-guaranteed elements must be consistent with what is in force
  - Non-guaranteed elements must be consistent with what is currently being paid
  - Disclose overhead expense assumption used (fully allocated/marginal)
  - Disclose annually for in force and new business
- (b) Recommend modifications needed to make this illustration compliant with the NAIC Life Insurance Illustrations Model Regulation.

## 15. Continued

### **Commentary on Question:**

This question tested the candidate's ability to evaluate a given set of information against prescribed standards and stipulations and make appropriate recommendations. Candidates with the best scores were able to identify what was wrong, why it was wrong, and what the best approach to resolve the issue would be.

- There is incomplete information for both the agent and the policyholder. Include the agent's name and address for accountability. Include the policyholder's gender and risk class to indicate that this illustration corresponds to this policyholder.
- Signatures are missing. The agent needs to certify that everything was explained. The policyholder needs to sign to indicate understanding.
- The statement of non-guaranteed values needs to be added. This is a pretty clear requirement of the Model Reg, and needs to explicitly state that non-guaranteed elements are not guaranteed, subject to change, and actual results may be more or less favorable.
- The illustration itself is poorly constructed. The guaranteed element needs to be shown first. Also the 10% rate is above the current paid rate and should not be illustrated. Instead show the midpoint between the current and guaranteed rate.