DP-IC 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.

<u>Cost-driven pricing strategy</u>
Company sets the price to cover their expenses for creating, distributing and servicing this product. It also includes a predetermined level of profit.

<u>Competition-driven pricing strategy</u>
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.
YR1 = 100%
YR2 = YR1*(1-YR1 Attrition) = 1.0*(1 − .04) = 0.96
YR3 = YR2*(1-YR2 Attrition) = 0.96*(1 − .05) = 0.912

Commission Payment(t) = Validation(t) * Agent retention(t)
YR1 = 20,000*1.0 = 20,000
YR2 = 25,000*0.96 = 24,000
YR3 = 30,000*0.912 = 27,360

Sudsidy Payment(t) = Commission Payment(t) * Subsidy %(t)
YR1 = 20,000*1.2 = 24,000
YR2 = 24,000*1.1 = 26,400
YR3 = 27,360*0.8 = 21,888

Discounted Payments = Subsidy Payment(t) * v^t where v=1/1.04
YR1 =24,000*1.0 = 24,000
YR2 = 26,400*0.962 = 25,385
YR3 = 21,888*0.925 = 20,237

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 include….

- 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

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

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

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

$S = Current\ Price$

$K = Strike\ Price$

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

Call (Strike = lower strike):

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

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

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

Call (Strike = upper strike):

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

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

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

$$Call\ Spread\ Price = 8.5\% - \ 6.3\% = 2.2\%$$

(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.

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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 = **31.10**	(120.93 − 86)/1.12 = **31.19**	(222.41 − 151)/1.12 = **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

Atikinson & 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 the 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.

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

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

Annual margin offset = 12 x 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:

Commentary 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 * 5,000 * 0.05= 31,250
Actual to Expected Ratio = Actual Lapse by Amount / E(lapse by amount)
A/E = 5,000 / 31,250 = 16%

95% Confidence Interval for A/E Ratio by Amount
CI for A/E Ratio = [E(lapse) + -1.96 (Var(lapse)^(1/2))]/E(lapse)
Variance(lapse) = sum over all policies exposed (i): $\sum$ 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(lapse) − 1.96 * √Var(lapse)]/E(lapse)
Lower Bound for 95% CI = [31,250 − 1.96 * √(148,437,500)]/31,250
Lower Bound for 95% CI = 23.585% (24% rounded)
Upper Bound for 95% CI = [E(lapse) + 1.96 * √Var(lapse)]/E(lapse)
Upper Bound for 95% CI = [31,250 + 1.96 * √(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.
Recommend continuing to monitor lapse experience as more credible data becomes available.

10. Continued

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 Hedgable 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:

2. Understand the drivers of product design (the idea generation step).

4. Understand the design and purpose of various product types, benefits and features.

Learning Outcomes:

(2a) Identify customers and their needs – internal and/or external.

(4a) Describe in detail product types, benefits and features.

Sources:

ILA-D610-08: Pricing Critical Illness Insurance in Canada, Mooney

ILA-D611-08: Product Design of Critical Illness Insurance in Canada

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

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Recommend the consumer market segment(s) that would be most appropriate for a CI product. Justify your recommendation(s).

Commentary on Question:

Overall, candidates did not do very well on part (a). Many did mention segmenting by age, income and Life Cycle. Very few justified why those segments would or wouldn't be interested in CI. Also, very few mentioned segmenting by Cultural Origin or Gender.

Segmenting by Age
Generation Y members need health insurance because they are starting families
Would recommend targeting this market
Baby boomers and seniors need health insurance as likelihood of a claim is higher

Segmenting by Income
Segmentation by income places individuals into high, medium and low salaries
High income households may not see a need for insurance, they are more focused on minimizing taxes
Middle income households need protection if sole income provider cannot work
This group required both term and CI insurance so opportunity to cross sell
Would recommend targeting this market
Low income could not likely afford the CI premiums and so would not recommend this market

11. Continued

Segmenting by Life Cycle
Life cycle events include graduation, marriage, children, retirement
Single parent families would also need protection from CI (and term insurance)

Segmenting by Cultural Origin
Many new immigrants (Hispanic and Asian) have a strong desire to support their family members
Support for family would need both life and CI insurance

Segmentation by Gender
If more males are sole income providers they may look to CI insurance to continue to support their families

(b) Explain key assumptions and features affecting the price of a critical illness product and how they differ from term insurance.

Commentary on Question:
Candidates did better on part (b). A number of candidates not only described unique assumptions and features about CI, but they also did point out the differences between CI and Term.

The critical illness incident rate is the key differing assumption between CI and term.
Term looks at a mortality rate over a one-year period.
Critical illness looks at the probability of being diagnosed with a covered illness over a one-year period.
Unlike mortality, there is no industry table to use and so judgment is required.
Data must come from government sources and/or reinsurers.
CI rates can be three times what term premium rates are but incidence rates are three times higher.

Other assumptions, like sales compensation, expenses and taxes will likely require little changing from term.
The ROP rider makes the product a lapse-supported product and so the lapse assumption is critical.
One percentage point higher than actual lapses can results in millions of dollars lost.
Interest is also very important as ROP doesn't occur for many years.
The framework is identical to term life insurance (10-year renewable, level term to 75, level term to 100).
CI payment is dependent on the definition of the condition - term insurance is just dependent on death.
Survival period is used in critical illness not life insurance.

11. Continued

Return of premiums are quite popular on CI but not on term insurance.
ROP will increase the cost of the product.
ROP is offered on death, surrender or maturity.
There are many combinations of premium rates for CI, but really only vary by product type for term.
The additional features can make CI much more expensive than term.
Anti-selection at issue: similar to term. There is a moratorium period for CI.
The potential high cost of benefits for some conditions beyond age 75 – e.g. Alzheimer disease: similar to Term?
The potential high cost of long-term guarantees due to advances in medical science leading to earlier detection: specific concern for CI.

(c) Outline ABC's considerations in determining whether to enter the critical illness market and provide a recommendation.

Commentary on Question:
Candidates did even better on part (c). Almost everyone did make a recommendation as the question asked. Candidates also supported their recommendation.

Points For

- There are many market segments in which term and CI could be cross-sold
- Have a captive distribution agency so could train to sell a more complex product
- Could begin with a simplified product so the system set-up would be similar
- Company has been selling term and so many of the assumptions can be similar (except incidence rates)
- Could use reinsurance partners to help determine CI incidence rates

Points Against

- Product is too complex and premium increase will not be popular
- May require large system costs to fully administer all the rider options
- May require large expenses to illustrate properly
- Product is complex and if term is typically sold, this is a big change for the distribution channel
- May just replace term sales instead of compliment
- Could offer an Accelerated product instead which is cheaper than both term and CI

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:

Commentary 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
2. Offer products that build on core competencies
    a. Each company has different strengths

12. Continued

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:

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:

(3b) Describe tax regulation and perform calculations to evaluate compliance.

(6a) Describe and evaluate compliance with illustration regulation and other policy form regulations.

Sources:

ILA-D614-11: Guideline G6 – Illustrations, CLHIA

Marino and Grobe, Canadian Taxation of Life Insurance, 5th Edition, Chapters 1, 3, 4, 14, 15 and 19

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Recommend modifications needed to make this illustration compliant with Canadian Life and Health Insurance Association Inc. (CLHIA) Guideline G6.

Commentary on Question:

This question was trying to test the candidate's ability to analyze the illustration for UL product and analyze whether it is compliant with the CLHIA Guideline G6. The cognitive level of the question was analysis. In general, the candidates that knew the material did very well.

- Must identify agent involved in the purchase.
- Must identify age, gender and rate basis used in illustration.
- Must state that mortality and expense charges are guaranteed for life of the contract.
- Since interest rates not guaranteed, must include at least one additional scenario that is less favorable than primary scenario.
- Must include references to any tax considerations.
- Need to identify and explain interest rates that affect premium paying period.
- Must include pagination (i.e. page X of Y) on the illustration.
- Need to identify the existence of a minimum credited rate guarantee and what that minimum is.
- Need to provide policyholder with information on where they can find historical rates of return and volatility for product.

13. Continued

(b) Explain the purpose of the exempt test and the steps that must be taken to ensure the UL policy qualifies as an exempt policy.

Commentary on Question:
This part of the question was relatively straightforward and most candidates did a good job answering it. The cognitive level of this part of question was comprehension.

The purpose of the exempt test is to ensure that an exemption from accrual taxation is provided for policies acquired primarily for insurance protection and not investment accumulation.

Exempt testing is performed by comparing the actual policy with a theoretical benchmark exempt test policy (ETP), where ETP is the endowment at age 85 with a 20-year premium payment period. The policy is not exempt, if the accumulating fund within actual policy exceeds that of ETP.

Exempt testing must be performed on every policy anniversary and the policy must pass the test on a prospective basis at each future anniversary until age 85. If the policy fails the exempt test, it will always remain non-exempt. However, if the policy ceases to be exempt on an anniversary, it may be retested after 60 days.

Exempt testing is subject to limitations and provisions. A separate ETP is required for any increases in death benefit exceeding 8 percent. Also, if any lump-sum deposits are made after 7th anniversary, the accumulating fund cannot exceeds 250% of the accumulating fund on 3rd preceding anniversary after the 9th year.

(c)

Commentary on Question:
This part of the question was relatively straightforward and most candidates did a good job answering it. The cognitive level of the question was predominately comprehension with some level of analysis.

(i) Calculate the after-tax value of a partial withdrawal of 15,000 in year 11. Show all work.

Commentary on Question:
Students performed well on this section.

A partial surrender is a disposition of an interest in a life insurance policy, and the policy gain is therefore subject to taxation.

13. Continued

Formulas:
For tax purposes, Accumulated Fund = Cash Surrender Value
After Tax Payment = Surrender Proceeds - (Policy Gain * Tax Rate)
Policy Gain = Surrender Proceeds - Pro-Rated Adjusted Cost Basis (ACB)
Pro-Rated ACB = (Partial Surrender Amount) / (Cash Surrender Value) * (Non-Pro-Rated ACB)
ACB = (Cumulative Deposits) – (Cumulative NCPI)
Tax Rate = 40%

Calculations:
ACB = 100,000 – 25,579 = 74,421
Pro-Rated ACB = 15,000 / 78,421 * 74,421 = 14,234.90
Policy Gain = 15,000 – 14,234.90 = 765.10
After Tax Payment = 15,000 – 765.10 * 0.4 = 14,693.96

The after-tax value of a partial withdrawal is $14,693.96.

(ii) Explain the advantages of taking a policy loan instead of a partial withdrawal in year 11.

Commentary on Question:
The performance on this part was mixed. The candidates either knew the answer or they did not.

Proceeds from a policy loan are only taxable to the extent that they exceed the full adjusted cost basis of the policy whereas partial withdrawal results in proportional recognition of accrued policy gains because ACB is pro-rated. If policy loan is less than ACB then taxation of the policy loan will be less than a partial withdrawal. Also, a policy loan can be repaid at any time but partial withdrawal represents a permanent withdrawal from the insurance policy.

(iii) Calculate the amount of the policy loan to generate the same after-tax value in year 11 as the partial withdrawal of 15,000.

Commentary on Question:
The question asked the candidate to calculate the amount of loan that will have the same after-tax payment as the partial surrender in part (c)(i). Some candidates calculated the amount of the policy loan that provides the same policy gain as the partial surrender in part (c)(i) and received full marks.

13. Continued

AT = After-Tax
AT Partial Withdrawal = AT Policy Loan = 14,693
AT Policy Loan = Policy Loan – Tax Rate * Max (Policy Loan – ACB, 0)
ACB = 100,000 – 25,579 = 74,421
Policy Loan – 40% x Max (Policy Loan – 74,421, 0) = 14,693.96
Since policy loan is less than ACB, policy loan = (14,693.96 – 15,074.44) = 14,693.96

Therefore, a policy loan of $14,693.96 will generate the same after-tax value in year 11 as the partial withdrawal of $15,000.

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 = Prem * (1-Load) * (Invested %) / Unit Value
Units Withdrawn = (Gross Withdrawal) * (Investment %) / (Unit Value)
Gross Withdrawal = (Withdrawal Amount) / (1-Surrender charge)
Account Value (AV) = Total Units * 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 x 9.25 = 260.11
Total Units Fund B = 21.9 + 49.77 = 71.67 = 438 + 995.34
AV Fund B = 71.67 x 20 = 1,433.40
Total AV = AV Fund A + AV Fund B + Fixed AV
= $260.11 + $1433.40 + $0 = $1,693.51

(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 question. 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:
Current Fund Value (FV) at age 65 = 1,000 * a(65) @ 3%
= 1,000 * (12)
= 12,000

GMIB Cost:
GMIB Cost = GMIB FV – Current FV
GMIB FV = Initial Premium * (1 + GMIB guaranteed interest rate)^(# of years in accumulation period)
Initial Premium = Current FV / (1 + 3%)^10
Initial Premium = 12,000 / (1 + 3%)^10 = 8,929.13
GMIB FV = 8,106.77 * (1 + 5%)^10 = 14,544.61
GMIB Cost = 14,544.61 – 12,000 = $2,544.61

GAO Cost:
GAO Cost = g * Fn * a(65) – Current FV
GAO Cost = 90 / $1,000 * $12,000 * 12 – 12,000 = $960

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