DP-IC Complete Illustrative Solutions
Fall 2010

1. Learning Objectives:

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

Learning Outcomes:

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

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

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

Sources:

LOMA, Insurance Marketing, 2010, Ch. 2-5 and 7-8

Commentary on Question:

The question was trying to test the following:

- Demonstrate a thorough understanding of the pricing objectives of a company.
- Demonstrate a thorough understanding of the pricing strategies of a company.
- Demonstrate that the candidate can analyze the different aspects of a company and decide which objective and which strategy works best for that company.

Cognitive skill level for part (a) and (b) is comprehension, for part
(c) it is knowledge utilization.

Important considerations for receiving maximum points include the following:

- Part (a): Listing the correct objectives for each company and including one or two items describing the objective.
- Part (b): Listing the correct strategies for each company and including one or two items describing the strategy.
- Part (c): Answering which objective and which strategy best suited Met Life was the most important part of the question. Justifying the answer by analyzing Met Life and listing some of the company's strengths and weaknesses helped as well

For parts (a) and (b), most candidates seemed a bit confused on the difference between a pricing objective and a pricing strategy. A number of candidates put the pricing strategies as an answer to the pricing objectives and then described the strategies as an answer to what the pricing strategies actually were. Many candidates simply listed the objectives and strategies without any further analysis.

1. Continued

For the most part, many more candidates knew the pricing strategies rather than knowing the pricing objectives. For part (c), most candidates really struggled for what the question was asking for. Many candidates recognized that company C in the question was most similar to Met Life, but very few candidates actually listed the strategy or objective that most suited Met Life. Also, many candidates explained a few of Met Life's features, but very few listed the features from the answer key. There was a line in the answer key that gave credit for explaining features of Met Life not on the answer sheet and most candidates were able to get credit for that.

Solution:

(a) Explain the pricing objectives of each company.

Company A:

- Competition Oriented
- Uses Penetration Pricing to increase market share
- Could be Predatory Pricing if the price does not cover all the costs associated with selling the product
- Promotional efforts revolve around the company's low price

Company B:

- Sales Oriented
- Focus is on the level of sales that the company can achieve
- Increase in sales does not necessarily mean an increase in profits, but the company does hope that enhanced market status will eventually lead to more profits

Company C:

- Profit Oriented
- Focus is on product's return measures (ROI, ROA, etc…) or profit measures
- This objective can be used for the entire company or on a product by product basis

(b) Explain the pricing strategy used by each company for its product initiative.

Company A:

- Competition Driven
- Focus is on competitor's prices
- Penetration Pricing is used to build market share
- May be used to discourage potential competitors from entering the market

1. Continued

Company B:

- Customer Driven
- Focus is on a price that customers or distributors will find acceptable
- Promotional Pricing is used as the Term Life prices are reduced to increase the company's customer base which should result in future sales across other product lines
- Price leaders can use this strategy to attract new customers who will then buy additional, more profitable products

Company C:

- Cost Driven
- Focus is on setting a price that will cover company costs and then adding a margin
- Works best when companies have a great reputation for customer service or if they have great brand recognition (market leader)
- Strategy might not be effective in competitive markets

(c) Determine which pricing objective and pricing strategy best fit the profile of the company described in the case study. Justify your answer.

- Pricing Objective is Profit Oriented.
- Pricing Strategy is Cost Driven.
- Met Life is a market leader which means they can price based on profit targets, covering all costs with a margin for profit.
- Met continually reviews underwriting and pricing guidelines so policies stay competitive and supportive of their marketing strategies and profitability goals (from Case Study page 10).
- Some of Met's competitors have more competitive pricing (from Case Study page 29).

2. Learning Objectives:

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

5. Understand the relationship between the product features 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

(5b) Identify and explain the setting of an appropriate assumption for factors such as:
(i) Available experience data
(ii) The marketplace
(iii) Underwriting
(iv) Distribution channel characteristics
(v) Reinsurance
(vi) Expenses (fixed, variable, marginal)
(vii) Taxes (income and premium)
(viii) Investment Strategy, e.g. hedging

(5c) Analyze results and recommend appropriate action from an array of profit measures such as: Statutory, GAAP, Return on Equity, Market Consistent Pricing, Embedded Value.

Sources:

ILA-D109-09: Moody's Investors Service Corporate Default and Recovery Rates

Atkinson & Dallas, Life Insurance Products and Finance Chapters 4, 5 and 11

Marketing for Actuaries

Commentary on Question:

Part (a) definitions, and lists were relatively well done by students, most students described default accurately. Most listed bankruptcy but not all defined it. Distressed exchange was not answered as well.

Part (b) many students struggled with this question. Common errors were to not include formulas used to calculate distributable earnings and its components. Many students ignored the impact of the downgrade on the policies sold in 2008. Most students didn't consider investment income. The formulas for calculating premiums and expenses were fairly well done as well as identifying the number of policies and lapse rate under the two rating scenarios.

2. Continued

Part (c) was done well.

Solution:

(a) Define the three types of credit events encompassed by Moody's definition of default.

- Missed or delayed payment of principal or interest
- Bankruptcy, regulators or legal block of the timely payment of interest and principal
- Distressed Exchange – Offer a new security to its debt holders to diminish the financial obligation in order to avoid default or bankruptcy

(b) Calculate the change in 2009 distributable earnings if Moody's downgrades ABC in 2008 to a financial strength rating of Ba2.

Distributable Earnings = After-Tax Solvency Earnings – Increase in Required Capital + After-Tax Investment Income on Required Capital
After-Tax Solvency Earnings = Pre-Tax Solvency Earnings – Taxes
Pre-Tax Solvency Earnings = Product Cashflows + Investment Income – Increase in Solvency Reserves

For this question, Taxes = 0, Reserves = 0, and Required Capital = 0

<u>Aa2 Rating</u>
Premium
- New Business = 75*6.5*100000/1000 = 48750
- Inforce = 100*(1-0.001)*(1-4%)*6.5*100000/1000 = 95.904*6.5*100 = 62337.6

Commissions
- New Business = 48750*70% = 34125
- Inforce = 0

Maintenance Expenses
- New Business = 40*75 = 3000
- Inforce = 100*(1-0.001)*(1-4%)*40 = 3836.16

Death Benefit
- New Business = 75*0.001*100000 = 7500
- Inforce = 100*(1-0.001)*(1-4%)*0.002*100000 = 19180.8

Surrender Benefit
- New Business = 75*(1-0.001)*4%*4*100000/1000 = 1198.8
- Inforce = 100*(1-0.001)*(1-4%)*(1-0.002)*4%*10*100000/1000 = 3828.49

CFs beginning of 2009 = 48750+ 62337.6 -34125 – 3000 – 3836.16 = 70126.44
Investment Income at end of 2009 @6% = 70126.44*0.06 = 4207.59

2. Continued

Distributable Earnings Ba2 = 70126.44+4207.58 – (7500+19180.8+1198.8+3828.49)) = 42625.94

Ba2 Rating

Premium

- New Business = 15*6.5*100000/1000 = 9750
- Inforce = 100*(1-0.001)*(1-8%)*6.5*100000/1000 = 91.908*6.5*100 = 59470.2

Commissions

- New Business = 9750*70% = 6825
- Inforce = 0

Maintenance Expenses

- New Business = 40*15 = 600
- Inforce = 100*(1-0.001)*(1-8%)*40 = 3676.32

Death Benefit

- New Business = 15*0.001*100000 = 1500
- Inforce = 100*(1-0.001)*(1-8%)*0.002*100000 = 18381.6

Surrender Benefit

- New Business = 15*(1-0.001)*8%*4*100000/1000 = 479.52
- Inforce = 100*(1-0.001)*(1-8%)*(1-0.002)*8%*10*100000/1000 = 7337.93

CFs beginning of 2009 = 9750+59740.2-6825-600-3676.32= 58388.88
Investment Income at end of 2009 @6% = 58388.88*0.06 = 3503.33

Distributable Earnings Ba2 = 58388.88+3503.33 – (1500+18381.6+479.52+7337.93) = 34193.16

So the distributable earnings decreases by 42625.94-34193.16 = 8432.78 as a result of a rating downgrade from Aa2 to Ba2

3. Learning Objectives:

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

3. Understand the feasibility step of a new product and how it drives design.

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

Learning Outcomes:

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

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

(5b) Identify and explain the setting of an appropriate assumption for factors such as:
- (i) Available experience data
- (ii) The marketplace
- (iii) Underwriting
- (iv) Distribution channel characteristics
- (v) Reinsurance
- (vi) Expenses (fixed, variable, marginal)
- (vii) Taxes (income and premium)
- (viii) Investment strategy, e.g. hedging

Sources:

Marketing for Actuaries

Atkinson & Dallas (Chapters 2 and 3)

Experience Assumptions for Individual Life

NAIC Standard Non Forfeiture Law for Life Insurance (U.S. Only)

Life Insurance and Annuity Non Forfeiture Practices (U.S. Only)

Canadian Taxation of Life Insurance (Canada Only)

Solution:

(a) Determine whether the product fits the needs of the company's existing target market.

Met Life's target market is the large-middle income market as well as affluent individuals, owners of small businesses and executives of small- to medium-sized companies. This product does not fit the target market because:

- The minimum face amount is too low

3. Continued

- The target market would be looking for more sophisticated products (UL is a good start, but needs more :bells and whistles")
- Offers no guarantees (e.g. Lapse guarantees)

(b) Critique the lapse assumption originally set for the product as shown in the following table.

Commentary on Question:
Most candidates got at least two of the key critiques, but many missed the other minor points about how lapse assumptions should vary. About half the candidates did not get points on the first key critique because candidates said "it is fine to have a difference between male and female" or even incorrectly said "male lapses are generally lower than females."

Key Critiques:
- Lapses are generally lower for females than males, which is opposite of what was in the table.
- It is appropriate to have a higher lapse rate once the surrender charge period is over.
- Should reflect product design, i.e. a spike in lapse after year 10 when COIs increase.

The lapse assumption should also vary by:
- Age at Issue
- Policy Size
- Marketing Method

(c)

(i) Contrast the portfolio method with the segmentation method.

Commentary on Question:
It's important to distinguish between "Assets" and "Rates." Many candidates used the terms interchangeably and made the graders question whether or not they understood the concepts.

<u>Portfolio Method</u>
- *Assets* are combined for different lines of business, different products or different periods of time.
- Single *interest rate* is credited based on the combined assets.
- Portfolio rate is more competitive so will attract more new business.
- Portfolio rate will fall faster in this environment than it will go up.

3. Continued

Segmentation Method

- *Assets* are segmented for different lines of business, different products or different periods of time.
- *Interest rate* is credited based on each asset segment.
- Credit interest rates based on interest rates available (or New Money rates).

(ii) Recommend a method to determine the credited interest rate for the new product in light of the 2008 financial turmoil described in the case study and its impact on sales.

Commentary on Question:
Many candidates recommended the segmentation method, which was not the original intent of the question, but some good arguments were made from a "risk management perspective" and credit was given if a good justification was given. Some examples of valid arguments for recommending the segmentation method are provided below.

Observations of the 2008 financial turmoil:

- **Interest rates are at a record low** so segmentation method would not give a competitive advantage. However, segmentation method would transfer the risk to the policy owner.
- **High sales are not predicted for this new product** so might not produce sufficient assets to establish a new segment.

Given the low interest rate environment, the fact that the sales should not be very high initially and to offer a more competitive product, it is recommended that the company opt for the **portfolio method**.

Examples for arguments to recommend segmentation method:

- Sales will be low anyway so the crediting method won't make much difference, so better to capitalize on market uptick later
- More risk averse to credit low rates immediately (and more equitable to the inforce policy owners of the portfolio method) especially since portfolio method rate will fall faster than rise in this environment
- Transfer risk to policy owner
- Better Asset Liability matching and better liquidity

(d)

(i) Define Exempt Policy according to the Canadian Income Tax Act.

- Exempt policy has to pass the exemption test to qualify as an exempt policy.

3. Continued

- Compares the actual policy with a theoretical benchmark (which is a 20-pay endowment at age 85).
- The accumulating fund (benchmark) is defined as the Maximum Tax Actuarial Reserve (MTAR) that the insurer may hold for the policy (amount that can be deducted from its income for income tax purposes).

Other points that could have been mentioned:

- To pass the test, accumulated funds cannot exceed the accumulated funds of the benchmark policy.
- The test must be passed at each anniversary and also on a *prospective* basis until the insured attains age 85.

(ii) Calculate the Adjusted Cost Basis (ACB) for each of the first 3 years.

Commentary on Question:
The premium formulas come from the recursive equation for Account Value: $AV_x = (AV_{x-1} + Prem_x – COI_x – Expenses_x) * (1 + int)$, then isolating premium.
A number of candidates did not deal with the interest piece correctly and so calculated incorrect premiums. Marks were not given for premiums, but marks were given for calculating the ACB (assuming they were done correctly) no matter which premiums were used.

Key observation: For each year, the policy AF should equal the benchmark policy AF (because the question mentions "*the policyholder always pays the maximum premium allowed each year to maintain exempt status under the Canadian Income Tax Act*")

Key Formulas:

- $Premium_1 = AV_1(benchmark) / (1+int) + COI_1 + Expenses_1$ (year 1 only)
- $Premium_x = AV_x (benchmark) / (1+int) + COI_x + Expenses_x - AV_{x-1}$ (year 2+)
- $ACB = \Sigma Premium - \Sigma NCPI$ (or $ACB_x = ACB_{x-1} + Premium_x – NCPI_x$)

$Premium_1 = 270 / (1.05) + 200 + 720 =$ **$1,177.14**
$Premium_2 = 540 / (1.05) + 200 + 300 - 270 =$ **$744.29**
$Premium_3 = 810 / (1.05) + 200 + 300 - 540 =$ **$731.43**

$ACB_1 = 1,177.14 – 104 =$ **1,073.14**
$ACB_2 = (1,177.14 + 744.29) – (104 + 123) =$ **1,694.43**
$ACB_3 = (1,177.14 + 744.29 + 731.43) – (104 + 123 + 145.2) =$ **2,280.66**

3. Continued

(iii) Calculate the taxable income and the ACB at the end of year 3 assuming a partial surrender of $500 occurs at the end of year 3.

Commentary on Question:
Some candidates noticed that the fund was already lower than the ACB, so there would be no taxable gain no matter what the withdrawal amount was.
Many candidates did not calculate the adjusted ACB not sure if there was no time, or they just forgot. The candidate needs to recognize the pieces the question is asking for in order to obtain full credit.

Key Formulas:

- Policy Gain (Taxable Income) = max(Proceeds of Disposition – Prorated ACB, 0)
- Prorated ACB = Partial Surrender / AF * ACB
- Adjusted ACB = ACB Before Disposition + Policy Gain – Disposition

Prorated ACB = 500/810 * 2,280.66 = **1,407.81**
Policy Gain = max (500 – 1,407.81, 0) = **0**
Adjusted ACB = 2,280.66 + 0 – 500 = **1,708.66**

4. 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.

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

Learning Outcomes:

(3a) Explain considerations for prudent and practical decision making.

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

(5c) Analyze results and recommend appropriate action from an array of profit measures such as: Statutory, GAAP, Return on Equity, Market Consistent Pricing, Embedded Value.

Sources:

Act. Aspects of Ind. Life Ins. & Annuity Contracts, Chapter 3, pg. 39

Life Insurance Products and Finance, Chapter 2, pg. 82 – 86, Chapter 11, pg. 516 – 526

ILA-D610-08: Pricing Critical Illness Insurance in Canada, pg. 104 – 107

ILA-D611-08: Product Design of Critical Illness Insurance in Canada, pg. 104 - 107

Solution:

(a) Prepare talking points for your distribution partners in response to the criticism that CI is too expensive.

Commentary on Question:

This was a comprehension question. Students generally answered this question fairly well but some struggled with its open-ended nature. In order to receive full marks students had to understand CI rates vs. term and why there was a difference.

Term and CI are different products and intended for a different purpose.
CI is more expensive than term because incidence rates are greater. As incidence rates are higher than mortality rates CI is an important product.

4. Continued

(b) Recommend actions you could take to lower the price of the product.

Commentary on Question:
This was a comprehension question where students had to go beyond just the listed items and state what changes could be made to lower the price. There were points for listing the key items but a lot of points also for explaining how the change would lower the price, which helps justify the recommended actions. Students generally answered this question quite well. They understood this was more than a list type question. Students generally did not get the points about lowering cost by reducing expenses, looking for reinsurance expertise, capital relief, etc. as they stuck to the listed sub-bullets in the question only.

Client has the option to choose Stand-Alone or Accelerated. Stand-Alone has the advantage of complimenting Term and is cheaper. However Accelerated is cheaper than having both Stand-Alone and Term because the face amount is only paid out once.

There are three options for CI – T10, T75 and T100. T10 would have the lowest initial premium and company has experience to this on the life side.

Need to consider which conditions should be covered. The fewer conditions that are covered lowers the price. However, need to cover the big four in the market. Could also lengthen the survival period or lengthen the waiting period which would help lower price.

Extra benefits, such as return of premium, will increase the price and could consider removing them to help lower the price.

Could also look at making premiums non-guaranteed or shorten the guarantee period to help lower the price.

Also, could look at improving systems to keep expenses low. Reinsurance should also be considered with thoughts on determining the optimal amount to reinsure to help lower the price. Also, obtain many quotes to help get the best rates and therefore lowering price.

(c) Recommend a price point and decision on reinsurance for each product that satisfies a minimum 10% ROI.

Commentary on Question:
This was a comprehension question where students received more points by explaining why they got their solutions as opposed to finding a solution to achieve the ROI. This section received a wide range of scores.

4. Continued

Not all students understood the mix between T10 and T100 were fixed (despite being listed in the question). Some students also thought each product had to meet the minimum ROI instead of an overall, weighted ROI. There was no "right" answer to this question as long as students explained how they got to their answer.

[*As long as student explained their choice with valid justification, full marks were given. Included below is one choice*]

Reinsurance – As XYZ is not in the critical illness business and so could use reinsurer experience and data to help develop their new products.

T10 is the target product and could set prices below market to help gain market share. T100 is not the target product, as it is not as popular, and so could set prices above market price.

Recommend setting T10 below market prices with reinsurance and T100 above market prices with reinsurance.

The weighted average would be ROI = (0.75 x 6.75%) + (0.25 x 20%) = 10.1% therefore achieving the minimum targeted ROI.

4. Learning Objectives:

6. Understand the relationships between the product design and roll-out and, between pricing assumptions and monitoring of products sold.

Learning Outcomes:

(6c) Explain how to monitor a product throughout its life cycle.

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

Sources:

ILA-D803-07 Role of an Actuary in Product Roll-Out

Life Insurance and Modified Endowments Under IRC Chapters 1-4,6 and 9

Solution:

(a) List the significant provisions of the Model Life Insurance and Annuity Replacement Regulation.

Commentary on Question:

This was a retrieval question. Candidates generally answered this part of the question very well.

Important provisions of the replacement regulations include:

- Must deliver the NAIC pamphlet describing the pros and cons of a replacement
- Must identify that the sale is a replacement and subject to regulation
- Must contact the issuer of the policy to be replaced
- Must be able to provide summaries of replacement sales to regulators
- Must provide an inforce illustration to the client
- The free-look provision is extended from 10 to 30 days

(b) Discuss the tax considerations under 7702/7702A with respect to the exchange offer.

Commentary on Question:

This question was a comprehension question. Students needed to understand how the tax regulations would apply to the exchange of a policy. Most candidates did not answer this section well. They overlooked the exchange and simply outlined the various tax tests applicable to insurance policies. Very few points were given in this section. For a candidate to have done well they needed to be more specific concerning the taxation on exchanges vs. the taxation of life insurance policies in general.

4. Continued

- Must consider a 1035 exchange
- There is no gain or loss when one life insurance policy is exchanged for another
- The tax basis remains the same
- To qualify under 7702, the exchanged contract is treated as a new issue as of the date of the exchange; the cash value carried from the old contract to the new one is considered premium for the guideline premium limitation
- The MEC status cannot be eliminated on an exchange
- The older policy may lose grandfather protection – Policies issued prior to 6/20/88 cannot be MECs but may become a MEC on an exchange

(c) Evaluate the policyholder's considerations in accepting this exchange offer.

Commentary on Question:
The question was a comprehension question asking students to explain why or why not an exchange may be good for a policyholder. Most students listed what a policyholder should consider but did not state whether this would be good or bad for the policyholder (or in what circumstances it could be good or bad for the policyholder). To receive full marks they needed to explain their list of considerations and why they were important. Most common was an answer with a list of questions (e.g. will guarantees be higher) as opposed to stating whether an item would be good or bad for the policyholder (e.g. older policies tend to have higher guarantees which will be lost on an exchange).

Replacement may not be in the policyholder's best interest.

- As they are subject to new underwriting
- New acquisition expenses may lower early values
- Older policy may have more generous guarantees
- May lose the grandfathered tax status of their policy
- Features may differ e.g. suicide provision or surrender charge schedule may start over

Replacement may be in the policyholder's best interest.

- New policy may have options or benefits not available on older policies (e.g. new riders)
- Potential to improve underwriting class – Policyholder could receive a preferred underwriting rating which may not have been available on the old product
- Premiums may have decreased and so may be to the policyholder's advantage to exchange but must consider increase in age as well

5. Learning Objectives:

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

5. Understand the relationship between the product features 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) ROP
- (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 and how to interpret its results.

Sources:

Investment Guarantees Chapters 1, 6 and 9

Stochastic Pricing Session 62 TS

Stochastic Pricing, RSA Vol 27, No 2 S4ession 86PD

Variable Annuities, Kalbereer and Ravindran, Chapter 11

Solution:

(a) Explain why stochastic pricing is better suited than traditional pricing techniques for the pricing of equity-based guarantees.

Commentary on Question:

This section was generally done well, however, the main point immediately below was missed by most candidates.

5. Continued

Traditional pricing is better suited for more traditional forms of insurance where benefits are fixed and guaranteed.

Sensitivity to extreme scenarios and tail risk cannot be measured with a few deterministic scenarios.

Traditional actuarial techniques for pricing utilize deterministic techniques (i.e. best estimate, PFADs, sensitivity testing) because it relies heavily on diversification and the law of large numbers.

Equity linked insurance requires a stochastic approach because:

- Volatility of outcomes is significant
- Claims occur with low frequency and high severity
- Allows consideration of the entire distribution
- Allows modeling of dynamic policyholder behavior
- Individual risks are largely non-diversifiable (i.e. dependent)
- Provides a more thorough understanding of the risks

(b) Estimate the CTE(80) present value of liability using the simulations above, assuming no deaths or withdrawals.

Commentary on Question:
Well prepared candidates did well and received close to full credit for stepping through the calculation and completing the solution. Those who were less prepared generally did not get much credit for their answers. A common mistake made was to deduct the expense margin in month zero, when none should have been. Another common mistake was to discount using the discrete form (1/1.04)^t as opposed to the required force of interest (exp(-.04t)).

F(t) = Market Value of Separate Account at time t
F(t) = F(0) x [S(t) x (1-m)^t]/S(0)
F(1) = 100 x [0.98 x (1 – 0.03/12)^1] / 1.00 = 97.755
F(2) = 100 x [0.99 x (1 – 0.03/12)^2] / 1.00 = 98.5056
F(3) = 100 x [0.94 x (1 – 0.03/12)^3] / 1.00 = 93.2968

M(t) = Income at time t from guaranteed risk charge for t = 0, 1, 2
M(t) = mc x F(t)

C(t) = Liability cash flow at time t from the contract
C(t) = -M(t) for t = 0, 1, 2
C(t) = Max[0, G – F(t)] for t = 3

5. Continued

C(0) = -0.01/12 x 100 = -0.08333
C(1) = -0.01/12 x 97.755 = -0.08146
C(2) = -0.01/12 x 98.5056 = -0.08209
C(3) = Max[0, 100 – 93.2968] = 6.7032

L(0) = Present value of future liabilities, discounted at a constant risk free force of interest of 4%
L(0) = Sum of [C(t) x Exp(-rt)] sum from t = 0 to 3
L(0) = [-0.08333 x Exp(-0.04/12 x 0) – 0.08146 x Exp(-0.04/12 x 1)
-0.08209 x Exp(-0.04/12 x 2) + 6.7032 x Exp(-0.04/12 x 3)]
L(0) = 6.39

Estimated CTE(alpha) = mean of the largest N x (1-alpha) simulations
The two largest simulations are generated from scenarios 8 and 10.
Estimated CTE(80%) = (3.09 + 6.39) / 2 = 4.74

(c) Recommend changes to the product design to reduce risk to the company.

Commentary on Question:
This was the most challenging part of the question; very few candidates were able to identify the majority of relevant changes outlined below. The more successful candidates were able to identify three or four items. Recommendations made that were not relevant or were not specific to product design changes did not receive credit.

Longer GMMB maturity period than 3 months will give time for a recovery after a large initial market drop.

Asset allocation restrictions e.g. maximum equity percentage of 80%

Age restrictions – Age caps will reduce the mortality risk associated with the GMDB

Vary charge for guarantees based on volatility of fund choice

Reduce the guarantee percentage below 100%

Remove guarantees

Increase amount charge for guarantees

Cut off tail risk – Cap the tail loss on the death and maturity benefit

6. Learning Objectives:

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

6. Understand the relationships between the product design and roll-out and between pricing assumptions and monitoring of products sold.

Learning Outcomes:

(5b) Identify and explain the setting of an appropriate assumption for factors such as:
- (i) Available experience data
- (ii) The marketplace
- (iii) Underwriting
- (iv) Distribution channel characteristics
- (v) Reinsurance
- (vi) Expenses (fixed, variable, marginal)
- (vii) Taxes (income and premium)
- (viii) Investment strategy, e.g. hedging

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

Sources:

ILA-D110-07: Policyholder Dividends

ILA-D101-07: Product Development Trends

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

Solution:

(a) Contrast the pricing considerations for a single life vs. a joint last survivor product.

Commentary on Question:

This section was testing comprehension as the candidate has to compare the assumptions behind joint vs. single life policies. Candidates generally did very well answering this question and could outline the major assumptions and how they differed between single and joint policies

- Mortality will be different for a single vs. joint life policy due to joint products primarily being sold to older individuals and married individuals. With married individuals, need to consider that lives are not necessarily independent due to joint accident risk and lonely heart syndrome. Also must consider more substandard or declined lives.
- Persistency is better as clients of joint products are affluent and generally buy the product to fill a specific need.

6. Continued

- Expenses are higher as need to underwrite two lives and may need more complex administration and illustration systems.
- Retention limits and reinsurance rates may be higher for joint products as generally larger face amount policies.

(b) Explain the following methods to price a last survivor product:

Commentary on Question:
This section was a retrieval question testing to ensure candidates understand the different methodologies to price joint products. As it was a retrieval question, candidates generally answered this section well.

(i) Exact age;
Policy values are calculated from first principles based on the specific combination of lives. Most common approach is to calculate rates/values on a case-by-case basis.

(ii) Joint equivalent age;

Joint equivalent age determines an equal age for each life. This method is easier to administer than exact age.

(iii) Equivalent single age.

Rates and values are based on a single life status (one age for both lives). This results in wide fluctuations in experience as slope in mortality curve may not be accurate. However, this is the easiest method to administer.

(c) Analyze the appropriateness of this suggestion in the context of policyholder equity.

Commentary on Question:
Candidates generally did not answer this section very well. They understood the mortality difference between exact and equivalent single age however many did not consider the other factors (different reserves which would impact the investment component of dividends, different expenses due to the complexity of an exact age approach).

Reasons for exact age:
Using an equivalent single age would have a different mortality slope than the actual mortality slopes of the two lives.
Select mortality gains will be smaller and less offsetting to acquisition expenses.
Reserve/cash values will be different which will impact the interest component of dividends.

6. Continued

Reasons for using equivalent single age:
Do not need complex administration and illustration capabilities (i.e. greatly reduces expenses).
Exact age assumes lives are independent which often they are not under joint products.

Recommend that the xxxxxx approach be used for the following reasons…
[Candidate needs to make a recommendation and explain why for full credit.]

7. Learning Objectives:

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

Learning Outcomes:

(5b) Identify and explain the setting of an appropriate assumption for factors such as:
- (i) Available experience data
- (ii) The marketplace
- (iii) Underwriting
- (iv) Distribution channel characteristics
- (v) Reinsurance
- (vi) Expenses (fixed, variable, marginal)
- (vii) Taxes (income and premium)
- (viii) Investment strategy, e.g. hedging

Sources:

Ending the Mortality Table (Living to 100 Symposium)

Does Preferred Wear Off? Product Matters, July 2004

Commentary on Question:

Student should demonstrate an understanding of concepts related to setting end-of-table mortality assumptions. Student should display the ability to analyze emerging experience relative to product assumptions. In part (a), many students failed to discuss the underlying theory of extreme older age mortality that underlies each of the methods for ending a mortality table. In part (b), the majority of students not only recognized the flaw in the actuarial student's method for analyzing whether preferred has worn off, but also correctly proposed an alternative analysis. To obtain full credit, the candidate should have performed a "preferred-to-residual" analysis for both the Issue Age = 45 and Issue Age = 65 cohorts.

Solution:

(a)

(i) Identify each method and indicate the associated line on the chart (A-D).

A – Blended Method
B – Less-than-One Method
C – Pattern Method
D – Forced Method

7. Continued

(ii) Describe each method and its underlying theory, identifying any advantages or disadvantages.

Blended Method
- Mortality hits 1.00 at the ultimate age.
- Pick age less than ultimate age and grade to 1.00.
- This eliminates discontinuity compared to forced method.
- May underestimate potential life span of individuals.
- Theory—No specific theory, but similar to theory behind ***forced*** method.

Less-Than-One Method
- Ultimate mortality is not 1.00 at an ultimate age.
- Ultimate age is selected and end-of-table mortality is defined to be whatever rate is produced at that age.
- Realistically reflects the experience of long-lived individuals.
- May result in administration systems issues.
- Theory—Extreme older-age mortality rates are asymptotic to an ultimate rate that is well below 100%.

Pattern Method
- Mortality pattern is allowed to continue until it approaches 1.00.
- The mortality rate increases with age, but the slope decreases over time.
- Mortality table may need to extend to fairly extreme age limit in order to extend to 100%.
- Theory—Eventually the mortality rate will approach 1.00.

Forced Method
- Mortality reaches 1.00 at an ultimate age.
- Mortality is forced to 1.00 at ultimate age (no grading).
- Creates discontinuity.
- Theory—There is a natural limit to life span that cannot be exceeded.

(b) Justify your agreement or disagreement with the student's conclusions.

Mortality experience has been very near expectations for issue age = 65.
Disagree.
- Aggregate mortality is actually better than expected in early durations (81% in durations 1-5).
- In durations 6-10, aggregate mortality ranges from 91% to 123%.

7. Continued

- As the impact of underwriting selection is becoming less in later durations, aggregate experience appears to be converging to a level of mortality in excess of tabular mortality.
- Favorable experience in early durations is likely attributable to impact of underwriting vs. relative to the mortality table's selection factors.
- Even the preferred A/E's are approaching 100% in the later durations.

Mortality experience has been favorable relative to expectations for issue age = 45.

Agree.

- Aggregate mortality ranges from 58% in early durations to 85% in duration 10.
- Since all A/E's are well under 100%, it is fair to say that experience has been favorable relative to expectations.
- Extremely favorable early-duration results is likely attributable to the impact of underwriting being greater than implied by the selection factors.

The "effect of preferred" appears to have worn off by duration 10 for issue age = 65 because the A/E ratios converge towards 100% but not for issue age = 45.

- The fact that preferred mortality is approaching 100% of expected DOES NOT imply that that preferred underwriting has worn off (common mistake in A/E analysis).
- Appropriate analysis involves consideration of ratio A/E (preferred) vs. A/E (residual) over time.
  - Analysis is not flawed by overall mortality improvement.
  - Analysis is not flawed by slope of underlying mortality table.

Effect of preferred has worn off by duration 10 for issue age = 65

Disagree.

- Effect of preferred has not worn off for issue age = 65.
- This is evident by the fact that the ratio of A/E(preferred) to A/E(residual) has not converged to 100% (see preferred/residual analysis below).

Effect of preferred has not worn off by duration 10 for issue age = 45

Disagree.

- Effect of preferred has worn off for issue age = 55.
- This is evident by the fact that the ratio of A/E(preferred) to A/E(residual) appears to have converged towards 100% by duration 10 (see preferred/residual analysis below).

7. Continued

Preferred/Residual Analysis

Cohort	Dur 1-5	Dur 6	Dur 7	Dur 8	Dur 9	Dur 10
IssAge = 45	0.44 / 0.64 = 69%	0.60 / 0.75 = 80%	81%	89%	95%	98%
IssAge = 65	0.61 / 0.85 = 72%	0.72 / 0.94 = 77%	76%	76%	75%	77%

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 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
  - Profit measures
  - Regulatory Issues
  - Choices of Model
- (v) Launch and Monitor the Product

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

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

Sources:

Atkinson and Dallas, Chapter 2, 3, and 13

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

ILA-D101-07: Product Development Trends

8. Continued

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

Solution:

(a) Identify key questions and issues that should be addressed by the consulting actuary in reviewing the feasibility of this new direction.

Commentary on Question:
This was a retrieval question, focusing on key words like competition, reinsurance, taxation, distribution, resource. In order to receive full credit, the student needs to demonstrate knowledge of the 4 key points below and be able to explain at least 2 sub-bullets. Students either did very well or very poorly on this question

- Product and Company Fit
  - Does product fit company's current distribution system and target market?
  - Does the product fit the company's long term goals, strategy, objectives?
- Implementation Barriers
  - Can the company's existing systems and infrastructure handle the product
  - Does company have appropriate resources to develop and launch product?
  - Is training required for staff/agents?
- Regulatory Barriers
  - Identify taxation issues to be handled
  - Are there any licensing or filing requirements?
- Impact on Current Products
  - What is expected shelf life of the product?
  - Is reinsurance available and feasible?

(b)

(i) Compare each of the above pricing assumptions for variable annuities and term insurance.

Commentary on Question:
Cognitive level of question was predominantly comprehension with some level of analysis. In order to receive maximum marks, one would need to:

- Compare (not many students did this);
- Explain how, by product, the assumptions can vary and what key risks are.

- Mortality
  - Mortality plays a different role between annuities and term products

8. Continued

  - Variable Annuities
    - Not as important, varies by size of death benefit
    - Anti-selection is due to longevity risk (people buying annuities because expect to live longer)
  - Term
    - Mortality is the most important assumption
    - Mortality varies by risk class and company's underwriting
    - Anti-selection due to unhealthy lives buying cheaper insurance products like term

- Persistency
  - Important assumption for both term insurance and annuities
  - Variable Annuities
    - Depends on in-the-money-ness of guarantee (surrender charges are major deterrent)
  - Term
    - Must consider product features that could encourage lapses when setting lapse assumption
    - Renewal lapses can be high as agents try to re-write business, particularly ART plans
  - Both products are in competitive markets; both have similar risks of agents trying to re-write the business to take advantage of high first year commissions

- Expenses
  - Term assumption very sensitive, annuities have smaller expense risk
  - Variable Annuities
    - Small issue expenses
    - Significant ongoing expenses associated with managing customer requests and communications, such as loans, withdrawals, terminations, statements, etc
  - Term
    - Simplest and cheapest product to administer
    - High early lapses make it difficult to recover high issue costs
    - Include inflation assumption
  - Both products are in competitive markets; both have similar risks of agents trying to re-write the business to take advantage of high first year commissions

8. Continued

(ii) Recommend appropriate changes to the pricing assumptions for the term insurance product.

Commentary on Question:
Cognitive level of question was knowledge utilization. Recommendations relative to the current state start with the variable annuity product, look at each assumption and think about how each one would change as one moves from the VA to the term product. Those that did this, did very well on this part.

- Mortality should not be the same for both products
  - Use industry table and adjusting appropriately for company's product
  - Can use reinsurance to help with pricing and support the unknown risk
- Persistency
  - Must use an industry table for term lapse rates
  - Can use reinsurance to help with pricing and support the unknown risk
- Expenses
  - Use existing annuity expense assumption as base for term product
  - Adjust expense assumption for product differences, especially the issue costs associated with underwriting

(c) Anticipate issues with this approach in reference to:

(i) The economic environment outlined in the case study;

Commentary on Question:
Generally students did not perform well on part (c). In order to receive points, candidates should outline key issues raised within the economic environment. Candidates should also review the information provided (new product and case study scenario) and determine how/why there will be issues with the approach proposed by the company.

- Pricing interest rate of 10% is too high for current economic conditions; current portfolio rate will not be sustainable
  - Recommend using a lower interest rate, especially in the low rate environment
  - Something in the 3-5% range would be more appropriate
- Profitability will be affected; lower than expected

8. Continued

(ii) Lapse supported products

Commentary on Question:
In order to receive points, candidates should:

- Define a lapse supported product and what its key risks are;
- Review the information provided and determine how/why there will be issues with the approach proposed by the company.

- Term-to-100 products are lapse supported – Increase in lapses increases profitability
- Lapse rate is most critical assumption
- Ultimate lapse rate is too high
  - Recommend a lower lapse assumption – In the range of 0-2%
- Lower lapses rates should be used for:
  - Market sophistication
  - Issue ages and lifestyle
  - Back to back annuities
  - Agent quality - Quality of sale and service
  - Viatical business

9. Learning Objectives:

6. Understand the relationships between the product design and roll-out and, between pricing assumptions and monitoring of products sold.

Learning Outcomes:

(6c) Explain how to monitor a product throughout its life cycle.

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

Sources:

ASOP #23 – Data Quality

ILA-D111-07: Product Design for Life Insurance & Annuities, Chapter 2

Atkinson & Dallas, Life Ins. Products and Finance Chapter 2-3

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

Commentary on Question:

Student should demonstrate an understanding of an actuary's responsibility to ensure data quality. Student should demonstrate an understanding of the difference between "assumed" and "expected."

Areas where candidates did well/had trouble:

- Most candidates did not formulate their response effectively in part (a) as a critical review.
- Also in part (a), many students went on tangents related to implications of sharing data with competitor XYZ without tying-in syllabus material.
- In part (b), many students incorrectly categorized deviations as adverse/favorable by comparing Actual to Expected rather than to Assumed.
- Many students opted to express deviations as a percentage of assumed rather than a difference from assumed (this received full credit).

Solution:

(a) Critique this review of the data.

ABC Life's Reliance on Data from Third Party Vendors:

- In general, can rely on data from vendor (disclose reliance in actuarial communication)
- Documentation of data evaluation process is required
  - Material defects
  - Adjustments
  - Modifications
- Must comply with requirements of ASOP 41 and ASOP 23

9. Continued

Actuary Should Review Data:

- Review for reasonableness and consistency
- Identify questionable data values
- Compare to data from recent period to ensure consistency
- If it is apparent the info contains errors or is unreliable the actuary should not use info

Limit's on ABC Actuary's Responsibility:

- Not required to determine if data has been falsified
- Not required to audit data
- A review of data with sole purpose of searching for questionable or inconsistent data is not required

Use Professional Judgement—ABC Actuary Must Decide Whether:

- Data is of sufficient quality to perform analysis
- Data requires enhancement before analysis can be performed
- Judgmental adjustments or assumptions that allow actuary to perform analysis
- Determine if a more extensive review of the data is needed
- Actuary should pursue finding different data

(b)

(i) Determine which of the products should have been labeled as UL and T100.

Product 1:

- This is the T-100 product.
- T-100 is a lapse-supported product.
- Assumed lapse rates (4%) are less than expected lapse rates (5%).
- Assumed values for lapse rates would be less than expected lapse rates for a lapse-supported product in order to be conservative.

Product 2:

- This is the UL product.
- Assumed lapse (10%) and mortality (80%) rates are greater than expected lapse (5%) and mortality rates (60%).
- Assumed values for lapse/mortality rates would be greater than expected values for a non lapse-supported life insurance product such as UL.

9. Continued

(ii) For each product, calculate the deviation in mortality, lapse and administration expenses and categorize the deviation as adverse or favorable.

Product 1:

Mortality:
Deviation = Assumed – Actual = 50% - 55% = -5%
Even though lapse-supported, since this is a life insurance product, mortality being higher than assumed is unfavorable.

Lapse:
Deviation = Assumed – Actual = 4% - 1% = 3%
Lapses being lower than assumed is unfavorable since Product 1 is a lapse-supported product.

Admin Expenses:
Deviation = Assumed – Actual = 40 - 375 = -335
Expenses being higher than assumed is unfavorable.

Product 2:

Mortality:
Deviation = Assumed – Actual = 80% - 90% = -10%
Mortality being higher than assumed is unfavorable.

Lapse:
Deviation = Assumed – Actual = 10% - 5% = 5%
Lapses being lower than assumed is favorable.

Admin Expenses:
Deviation = Assumed – Actual = 30 - 400 = -370
Expenses being higher than assumed is unfavorable.

10. 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 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
  - Profit Measures
  - Regulatory Issues
  - Choice of Model
- (v) Launch and Monitor the Product

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

(5b) Identify and explain the setting of an appropriate assumption for factors such as:
- (i) Available experience data
- (ii) The marketplace
- (iii) Underwriting
- (iv) Distribution channel characteristics
- (v) Reinsurance
- (vi) Expenses (fixed, variable, marginal)
- (vii) Taxes (income and premium)
- (viii) Investment strategy, e.g. hedging

(5c) Analyze results and recommend appropriate action from an array of profit measures such as: Statutory, GAAP, Return on Equity, Market Consistent Pricing, Embedded Value.

Sources:

Atkinson & Dallas, Life Insurance Products and Finance, Chapters 2, 4, 11 and 13

ACT. Aspects of Ind. Life Ins. & Annuity Contracts Chapter 3

10. Continued

Commentary on Question:
The question was trying to test the following:

- Demonstrate a thorough understanding of the feasibility stage of the product development process.
- Demonstrate an understanding of joint-and-last-survivor mortality and the calculation of income annuity benefit cash flows.
- Demonstrate an understanding of various profit measures.
- Demonstrate proper "evaluation" of client needs for various income annuity types

Cognitive skill level for part (a) is retrieval, for parts (b) and (c) it is comprehension.
Important considerations for receiving maximum points include the following:

- Part (a): List the key points for the feasibility steps and at least two concepts for each of the key points.
- Part (b): Identify the proper annuity to be used in each of the four clients' situations. Elaborate on their choices.
- Part (c)(i): There were several ways in which the candidate could have performed the calculations. Demonstrating their approach was correct and getting the right answers.
- Part (c)(ii): The candidate could receive full credit by showing the formulas and discussing the use of hurdle rate for the embedded value calculation. Assigning credit was independent of benefit calculations in part (i). In other words, the product cash flows were counted correctly even if the benefits calculated in part (i) were incorrect.
- Part (c)(iii): The candidate could receive full credit by showing the formulas and discussing the use of discount rate for the profit margin calculation. Assigning points was independent of benefit calculations in part (i). In other words, the product cash flows were counted correctly even if the benefits calculated in part (i) were incorrect.

Candidates performed well on parts (a) and (b). Candidates either performed very well on part (c) or very poorly. It seemed that on both Canadian and US exams, a fair number of candidates ran out of time on part (c) and could have performed much better without the time constraint.

Solution:

(a) Identify and describe the considerations that must be addressed during the feasibility stage of the product development process.

Product and Company Fit

The product should fit the company's:

- Goals, Strategies and Culture
- Mission and Vision
- Distribution System
- Target Markets

10. Continued

Regulatory Barriers

- Assess expense and uncertainty of regulatory approval
- How many versions of the product will be needed for different jurisdictions

Implementation Barriers

- Assess new administrative processes and procedures
- Determine new software needs with respect to integration, development issues, delivery time and costs
- Need to train staff and agents on the new product
- Assess the pricing and availability of reinsurance

Effect on Existing Products

A new product may:

- Replace an existing product
- Reduce sales of other products
- Trigger upgrades to existing products

(b) Recommend the type of income annuity most suitable for the following clients.

(i) Client A is a married couple and both are retired, have no children, have paid off their house and prefer to exhaust their estate.

- Joint and last survivor immediate annuity
- In the form of a reverse mortgage as they prefer to exhaust the estate and have paid off their house
- Payments commence immediately

(ii) Client B is disabled, has 10 years of payments remaining from an insurance settlement and wants to maintain the level of payments for an additional 15 years to pay off his 25-year fixed-rate mortgage.

- Ten year deferred annuity that will annuitize when the structured settlement payments are done
- Include a 15-year fixed, term certain annuity provision to pay off the mortgage
- Consider a lifetime annuity portion to cover other living expenses, possibly with underwriting, due to the disability which may reduce the mortality cost

10. Continued

(iii) Client C, a widow, wishes to maintain her purchasing power for the rest of her life.

- This Client needs the annuity to start immediately
- Life fixed annuity because payments are needed to last for the rest of her life
- Indexation is required because she wants to maintain her purchasing power

(iv) Client D wants to maximize his potential for future payment increases and is not concerned with downside risk.

- Life Annuity
- Variable Income Annuity because this Client wants to maximize the payments, and "at any cost" implies that he's willing to take risks with equity investing
- Indexation is not required if variable annuity income is chosen because this Client is already trying to beat inflation with the choice of variable

(c)

(i) Calculate the expected payments at the end of each of the first 3 years.

- A joint and two-thirds survivorship annuity can be modeled by adding 1/3 of a joint FTD annuity and 2/3 of a joint LTD annuity
- IncomeBen(t) = \$10,000 * [1/3 * FTD SurvFactor(t) + 2/3 * LTD SurvFactor(t)]
- FTD SurvFactor(t) = FTD SurvFactor(t-1)* pxy(t)
- pxy(t) = px(t) * py(t) = (1-qx(t))*(1-qy(t))
- FTD SurvFactor(1) = (1 - 0.04)*(1-0.01) = 0.95040
- FTD SurvFactor(2) = 0.9504*(1 - 0.05)*(1-0.02) = 0.88482
- FTD SurvFactor(3) = 0.88482*(1 - 0.06)*(1-0.03) = 0.80678
- LTD SurvFactor(t) = SurvFactorx(t) + SurvFactory(t) - SurvFactorx(t)*SurvFactory(t)
- LTD SurvFactorxy(1) = (1-.04) + (1-.01) -(1-.04)*(1-.01) = 0.99960
- LTD SurvFactorxy(2) = (1-.04)*(1-.05) + (1-.01)*(1-.02) - (1-.04)*(1-.05)*(1-.01)*(1-.02) = 0.99738
- LTD SurvFactorxy(3) = 0.99159

10. Continued

Solve for the per unit issued income benefit:
IncomeBen(1) = 10,000*[1/3*(0.95040) + 2/3*(0.99960)] = $9,832.00
IncomeBen(2) = 10,000*[1/3*(0.88482) + 2/3*(0.99738)] = $9,598.60
IncomeBen(3) = 10,000*[1/3*(0.80678) + 2/3*(0.99159)] = $9,299.87.

(ii) Calculate the Embedded Value profit measure, using distributable earnings as the basis for profits.

First calculate distributable earnings at the end of the first 3 years.

- DistrEarn(t) = AfterTaxSolveEarn(t) - ReqCapIncr(t) + ATInvIncRC(t)
- AfterTaxSolvEarn(t) = Prem(t) - Ben(t) - [AcqExp(t) + Comm(t) + MaintExp(t)] + InvIncome(t) - SolvResIncr(t) - Tax(t)

DistrEarn(1) = 29,496 - 9,832.00 - [250 + 0.005*29,496 + 0] + 0 - 19,120 - 0 - 0.045*(19,120) + 0 = -713.88

DistrEarn(2) = 0 - 9,598.60 - [0] + 0 - (9,620 - 19,120) - 0 - 0.045*(9,620 - 19,120) + 0 = 328.90
DistrEarn(3) = 0 - 9,299.89 - [0] + 0 - (0 - 9,620) - 0 - 0.045*(0 - 9,620) + 0 = 753.03

- Embedded Value = PV of Future Profits (Distributable Earnings)
- Calculated using a discount rate equal to the company's hurdle rate i.e. DiscFactor(t) = 1/(1.15)^t

Embedded Value = Sum of [DistrEarn(t) * DisFactor(t)]
= (-713.88/1.15) + (328.90/1.15^2) + (753.03/1.15^3)
= 123.06

(iii) Calculate Profit as a Percent of Premium using distributable earnings as the basis for profits.

- Profit as a Percentage of Premium = PV of Future Profits / PV of Premiums
- Use a discount rate of 6% i.e. DiscFactor(t) = 1/(1.06)^t
- PV of Profits = Sum of [DistrEarn(t) * DiscFactor(t)]
  = (-713.88/1.06) + (328.90/1.06^2) + (753.03/1.06^3)
  = 251.51
- PV of Premium = Single Premium at Issue = 29,496
- PV Profits / PV Prem = 251.51 / 29,496

= 0.85%

11. Learning Objectives:

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

Learning Outcomes:

(5c) Analyze results and recommend appropriate action from an array of profit measures such as: Statutory, GAAP, Return on Equity, Market Consistent Pricing, Embedded Value.

(5e) Describe when a stochastic model should be used, its advantages and disadvantages and how to interpret its results.

Sources:

Risk Based Pricing – Risk Management at Point of Sale "Product Matters" June 2009

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

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

Commentary on Question:

Special Note: This question had an incorrect number in the data supplied for the UL product, so the correct ROE's did not match despite the question asking for candidates to demonstrate that they did. The grading of this question gave full credit for getting the correct ROE's for each product and did not penalize for not demonstrating that they match. Also, despite this minor flaw in the question design, candidates performed extremely well on this question overall, as measured by average scores in relation to 'full credit' scores.

- Ability to differentiate between various ROE formulas.
- Understanding of difference between Solvency and Statutory earnings.
- In order to receive maximum points:
  - In part (a) candidate must have displayed and applied correct formulas for calculation of ROE.
  - In part (b)(i) for each product feature, candidate must identify and explain which pricing model (deterministic vs. stochastic) is most appropriate.
  - In part (b)(ii) candidate must recommend several strategies for improving Risk Based pricing results based on the product features offered.
  - Points were considered for correct answers outside the scope of the question if appropriate.

11. Continued

Solution:

(a) Demonstrate that the single-year ROE for each product is the same, assuming the income tax rate is 30%.

Commentary on Question:
Most candidates were unable to calculate the correct ROE's because they confused the solvency earnings formula and statutory earnings formula when determining the After-Tax stockholder earnings. Candidates struggled with the correct formula for Tax.

ROE = After-Tax Stockholder Earnings / Equity Base

Stock Equity = Stock Assets – Stock Liabilities
Equity Base for T10 = 600 – 400 = 200
Equity Base for UL = 850 – 600 = 250

After-Tax Stockholder Earnings = Pre-Tax Stockholder Earnings – Tax – Def. Tax Provision
Tax = (Pre-Tax Solvency Earnings + Investment Income on Required Capital) * Tax Rate
Def. Tax Provision = Def. Tax Liability (EOY) – Def. Tax Liability (BOY)

T10
After-Tax Stock Earnings = 56 – (45+15)(0.3) – (85-85) = 38
ROE = 38/200 = 19%

UL
After-Tax Stock Earnings = 188 – (260 + 75)(0.3) – (140-110) = 57.5
ROE = 57.5/250 = 23%

In the question, the "140" should have been "150". In that case, the ROE for UL would have been 19% as per the question.

(b)

(i) Analyze the appropriateness of the pricing actuary's model with respect to each product feature.

Commentary on Question:
Most candidates performed well on (b)(i), but those that omitted a product feature did not get full credit.

- Deterministic model is not appropriate for the shadow account guarantee. There is tail risk and low frequency/high severity events associated with this guarantee.

11. Continued

- Equity investment options should not be modeled with a deterministic model. Equity returns are highly volatile and have a wide distribution of results, should be priced with stochastic model.
- There is a DB guarantee of FA plus max (AV, 75% prem). This is like a GMDB, should not be modeled deterministically.
- YRT COI can be modeled deterministically since mortality risk is diversifiable.

(ii) Suggest changes to the UL Plus product to improve its Risk-Based pricing results.

Commentary on Question:
Candidates answered part (b)(ii) well for the most part, however, many just gave 2 or 3 recommendations and missed out on several possible points by not making more recommendations.

- Risk based pricing is pricing that takes into account the risk inherent in the product
- 2 methods: Replicating portfolio or adjust CFs for risk
- In order to improve the risk-based pricing results must reduce the risks in the product and make CFs less risky
- Limit the equity market options to those that are less volatile
- Limit the death benefit to face + AV; this removes the risk of the GMDB associated with the 75% premium paid guarantee
- Offer a lower minimum guarantee on the fixed income option; this will lower the interest rate risk for the company

12. Learning Objectives:

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

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 and the selection of appropriate pricing assumptions, profit measures and modeling approaches.

Learning Outcomes:

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

(3f) Identify gaps between the product design and the operations of the company and procedures and systems.

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

(4b) Assess and construct designs to meet market needs.

(5b) Identify and explain the setting of an appropriate assumption for factors such as:
- (i) Available experience data
- (ii) The marketplace
- (iii) Underwriting
- (iv) Distribution channel characteristics
- (v) Reinsurance
- (vi) Expenses (fixed, variable marginal)
- (vii) Taxes (income and premium)
- (viii) Investment strategy, e.g. hedging

Sources:

ILA-D111-07: LOMA Product Design for Life Insurance & Annuities, Chapter 1B

Combination Annuities – A Market to Get Into? Small Talk Newsletter, June 2009

Annuity/LTCi Combinations, Product Matters, October 2009

Long Term Care News, December 13, 2004, "Designing & Pricing LTCI Combination Insurance Products."

12. Continued

Solution:

(a) According to LOMA, list and describe the steps of the product development cycle.

Commentary on Question:
Candidates knew how to list the components of the product development cycle for the most part. Some confused other non-LOMA product development components.

1. Idea Generation
   - Gather ideas that fit Company's needs and those of specific market segments
   - Include competitive intelligence in the discussion
2. Idea Screening
   - Quick and inexpensive evaluation of new product ideas
   - Purpose is to select those ideas that deserve more investigation
3. Comprehensive Business Analysis
   - Analyze feasibility of new product idea
   - Evaluate whether the product will meet all legal and regulatory requirements
4. Technical Product Design
   - Design a contract form
   - Set prices for the product design
   - Conduct studies to ensure that the product will be financially sound
5. New Product Implementation
   - File contract forms to gain approval for product
   - IT systems and admin processes are verified to handle new sales
   - Plan to advertise and promote new product
   - Have training materials available for sales staff and employees
   - Compliance review
   - Sales reps receive training
   - Product is offered for sale
6. Product Evaluation
   - Ensure product is meeting financial goals and legal requirements
   - Monitor product's performance vs. expectations
   - If results are not satisfactory, could adjust, abandon or replace product

(b) Criticize the Marketing Officer's comments.

Commentary on Question:
Candidates who did better knew disadvantages of the LTC product but also needed to state the advantages of the Combo product.

12. Continued

Reasons for falling LTC sales are the following:

- Poor publicity on existing standalone policies
- Rate increases on existing policyholders
- Relatively high prices of existing standalone plans
- Major resistance to use it or lose it idea
- Limited distribution, as LTC is sold mostly through specialists
- Underwriting is difficult and takes a long time

The Combo Product is now more appealing. This is due to:

- Much lower cost and much lower than a standalone plan, primarily because owner using own money as a copay
- No more use it or lose it
- A simplified app yet still rigorous can be designed

(c) Explain the impact of the Pension Protection Act of 2006 on the product's marketability and product design for the Annuity/LTCI Combination product.

Commentary on Question:
Candidates did well in describing the tax advantages of the LTC portion of the Combo product. They did not do as well describing impact of 1035 Exchange. Also, few candidates explained the differences between Qualified and Non-Qualified plans.

The PPA of 2006 opened the door for Combo Products with LTCI riders on non-qualified products by addressing the tax treatment.

- -PPA specifies that effective 1/1/2010 qualified LTCI benefits payable out of these plans are generally paid tax-free.
- -Law also allows for 1035 exchanges into Combo plans.

One key factor when designing the benefit structure is that the contract must be an insurance contract, which requires that a meaningful amount of risk exists for the Insurance Company.
For the tail design, it is less clear that there is a meaningful amount of risk than the coinsurance design.
Qualified LTCI riders may only be written in non-tax qualified annuities.
Charges deducted from the account value to pay for QLTCI are not taxable distributions from the annuity contract. Such distributions reduce the cost basis in the contract.

12. Continued

(d) Assess the appropriateness of each item and identify suitable alternatives.

Commentary on Question:
Less successful candidates did not give sufficient reasons for their answers and did not come up with reasonable alternatives for the given plan design.

One key consideration is that the product should be designed from the buyer's need, and the product should be built that way.

- The $300 indemnity benefit is greater than the 2009 maximum tax free benefit of $280. The limit varies from year to year as a function of the living indices so need to check the year.
- The $300 should cover charges for a number of geographical areas. Alternatives include amounts $500 or greater since average LTCI semi-private room is $500 in 2007. Consider expense reimbursement since all legit benefits are tax free.
- A 2 year benefit helps keep the cost down and should cover the needs of most insureds.
- 5% compound inflation per year is the min required under LTCO Model Reg. Inflation protection is expensive, and need depends on the design structure.
- Target market for Combo plans vary by Company.
- The 50-80 age group is the prime group to target.
- The max issue age for LTCI is usually 80, due to affordability and underwriting concerns.
- Most under age 80 lack interest or assets to buy product.
- Tail design pays benefits first as accelerated benefits until the max accelerated benefit limit, usually the account value has been exhausted. This is followed by a benefit extension provision.
- Tail design has greatest appeal among producers, as it is least costly option, simplest to explain and has benefits increase as account value grows.
- Tax treatment of tail design is not as clear as coinsurance design that there is level of risk.
- Coinsurance and pool designs have their own advantages.
- Accelerated death benefit rider with payments based on current death benefit can become an implicit future purchase option. No reserve has been built up for this benefit. An alternative is payments based on original death benefit account.
- For annuity producers, they need simple plan design since they are not familiar with LTC products. Most are transaction oriented, so need to keep this part of process.
- Broker dealers are comfortable with simplified underwriting if limited time to a decision and minimal producer involvement in underwriting.
- Annuity producers, LTCI producers, and financial planners should be successful in selling the Combo product.

13. Learning Objectives:

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

6. Understand the relationships between the product design and roll-out and, between pricing assumptions and monitoring of products sold.

Learning Outcomes:

5c) Analyze results and recommend appropriate action from an array of profit measures such as: Statutory, GAAP, Return on Equity, Market Consistent Pricing, Embedded Value.

(5e) Describe when a stochastic model should be used, its advantages and disadvantages and how to interpret its results.

(6d) Evaluate how actual experience varies from expected relative to mortality, investment returns, expenses and policyholder behavior such as policy and premium persistency through the use of Experience Studies.

Sources:

ILA-D107-07, pages 17 – 40

Atkins & Dallas page 186

Stochastic Pricing for Embedded Options in Life Insurance and Annuity Products pages 17-35

Solution:

(a) With respect to the independent review that was performed:

(i) Critique each of the assumptions and conclusions made by the reviewer;

Commentary on Question:

The idea was to have the candidate review the statements made and determine if they agree with the statement. In order to critique the assumption the candidate needed to perform the calculations implied. Finally they needed to state if they agree with it or not

Comment #1 (Mortality):

- Given n = 10,000, e=nq then 30 = 10,000q so q = 30/10000 = .003
- Variance = npq = 10,000(.997)(.003) = 29.91
- Confidence Interval = $e \pm 1.96\sqrt{variance} = 30 \pm 1.96\sqrt{29.91} =$ (19.28,40.72)
- Do not agree with statement because death experience is not within the 95% confidence interval.

13. Continued

Comment #2 (Lapses)

- 95% confidence interval is $1000 \pm 1.96\sqrt{900} = 1000 \pm 58.8 =$ (941.2,1058.2)
- Agree with statement because lapse experience is within 95% confidence interval.

Comment #3 (Investment Income)

- Normal formula is i = (2 * I) / (A+B-I) »

$$i(A + B - I) = 2I$$
$$(A + B)i - Ii = 2I$$
$$(A+B)i = 2I + Ii$$
$$(A + B)i / (2+i) = I$$

- Agree with statement because the formula given for investment income is correct.

Comment #4 (Expenses)

- Do not agree with the statement because the formula given for per unit expenses is incorrect.

Comment #5 (IRR)

- Do not agree with statement since IRR formula may not be appropriate since when there are two sign changes there are two solutions. When profits start positive and then turn negative and stay negative, the rate of interest is the rate you are borrowing money.

(ii) Recommend changes to the reviewer's report including any improvements needed in their analysis.

Commentary on Question:
The candidate should make recommendations on improvements that can be made to the report especially where they disagree with the statement.

Comment #1 (Mortality):

- Recommend adjusting the expected mortality rate.
- Improvement – Examine experience over several years to gain greater credibility.

13. Continued

Comment #4 (Expenses)

- Recommend using correct formula : Per Unit Expense = expenses incurred in calendar year divided by [(policies inforce at beginning of year + number of new policies issued + policies inforce at end of year)/2]
- Improve by understanding how company allocated expense to line of business.

Comment #5 (IRR)

- Recommend using generalized IRR approach which uses a discount rate equal to the company's after-tax interest rate earned on invested assets or rate company is willing to pay for borrowed money when Present Value of Future Profits is negative.

(b) With respect to valuing embedded options:

(i) Define the embedded option being valued for a ULSG product.

Commentary on Question:
Generally the candidates were able to identify the embedded option but did not articulate that it was a series of put options.

- The policyholder has the option of continuing to pay premiums to keep the no-lapse guarantee in force.
- Another way to characterize the embedded option is that it is equivalent to the company being short a series of put options (policyholder is long a series of put options).

(ii) Explain the approach typically used to value the embedded option for a ULSG product, including the key considerations.

Present values of death benefits paid less the stipulated premiums, after the primary account value goes to zero, are averaged over many stochastic paths where the embedded option cash flows are discounted using the one-year rates along each stochastic path. This process would be performed at each future valuation date and the results would be added to the base reserve at each valuation date.

(iii) Describe how attribution analysis may be helpful in analyzing embedded options.

Commentary on Question:
The idea was to state what attribution analysis was for the embedded option not what the break down in target spread was for the product.

13. Continued

An attribution analysis will look at the change in the embedded option value over a period of time and break the change into components. The point of the attribution analysis is to show how the major drivers of the value flowed through the change in the embedded option value.
Sources of Volatility for a ULSG are:

1. Interest Rates
2. Policyholder Behavior

14. 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 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
  - Profit Measures
  - Regulatory Issues
  - Choice of Model
- (v) Launch and Monitor the Product

(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) ROP
- (vi) Secondary Guarantees
- (vii) Payout Annuity Benefits
- (viii) Crediting methodology
- (ix) Other non-guaranteed elements

(5b) Identify and explain the setting of an appropriate assumption for factors such as:
- (i) Available experience data
- (ii) The marketplace
- (iii) Underwriting
- (iv) Distribution channel characteristics
- (v) Reinsurance
- (vi) Expenses (fixed, variable, marginal)
- (vii) Taxes (income and premium)
- (viii) Investment strategy, e.g. hedging

14. Continued

Sources:
The Response of Life Insurance Pricing to Life Settlements, Product Matters, September 2006

Variable Annuities, Kalberer and Ravindran, Chapters 2, 5, 9, 10 and 11

ILA-D101-07: Product Development Trends U.S. pp. 1 – 45, Canada pp. 46 – 61

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

Atkinson & Dallas, Life Insurance Products and Finance, Chapter 13

Solution:
(a) Explain life settlement transactions and why they would be attractive to policyholders and XYZ.

Commentary on Question:
This section first tested the candidate's understanding of a life settlement transaction, and how that type of transaction could apply to products other than life insurance. It also tested whether the candidate could review the circumstances surrounding the situation described in the question and explain why a settlement could be attractive to both parties.
Most candidates understood a life settlement and why it would be attractive in general, very few assessed why the other circumstances described (low interest rates, high market volatility) could cause this transaction to be especially attractive. This level of analysis was required for full credit.

A life settlement transaction traditionally has involved a settlement company purchasing a life insurance policy from the policyholder. The settlement company purchases the policy for more than the current cash value. This is especially attractive for policyholders that are medically impaired, or have an immediate cash flow need. The settlement company underwrites the policyholder and determines the life expectancy, and pays an amount to the policyholder that is less than the present value of future death benefits minus the present value of future premiums. In this particular situation, the settlement company would purchase the annuity and earn the right to receive the GMDB when the policyholder died.
This could be attractive to policyholders in this situation because, due to the environment of low interest rates and high market volatility, the GMDB will be particularly valuable. This environment in particular could also cause a greater than average need for a policyholder to tap into the value of this benefit.

14. Continued

This could be attractive to XYZ Settlement Group because, generally speaking, if they are purchasing policies on impaired lives, they are likely to die soon, thus providing a short-term death benefit payoff to XYZ. In this situation, XYZ is purchasing the right to gain equity exposure via the variable annuity (by making additional purchase payments into the contract), with the added downside protection of the GMDB, regardless of when the policyholder dies.

(b)

Commentary on Question:
First, this section expected the candidate to describe the hedging risks for variable annuity guarantees. They were then expected to review the scenario described and analyze which risks were most relevant (and describe why). They were then asked to focus specifically on the policyholder behavior risk, and its overall impact on ABC's hedging strategy. Points were given for listing the relevant risks (which most candidates did), but few candidates explained these risks and specifically addressed why they were relevant in the situation described. Addressing the relevancy of these risks in this situation was required for full credit. About 60% of candidates discussed that selective lapsation was a particular concern, and about 70% of those addressed the impact of the selective lapses on the hedging program.

(i) Identify and explain the hedging risks for variable annuity guarantees that are most relevant in this situation.

The most relevant variable annuity hedging risks in this situation are: long-term volatility risk, interest rate risk, basis risk, funds choice risk, counterparty credit risk and policyholder behavior risk. Each of these risks is addressed below.
Long-term volatility risk is the risk that volatility increases over time. Very few instruments exist to hedge this risk. This is relevant in this situation because volatility has increased since these variable annuities were issued.
Interest rate risk is the risk of interest rate changes, which result in losses to the insurance company. This is relevant because interest rates have decreased since these policies were issued. If XYZ chose to make additional deposits into the contract to take advantage of the GMDB, this would increase the risk.
Basis risk is the risk that the value of the hedging assets develops differently than the value of the policyholder guarantees. This is especially relevant given that ABC offers company managed investment options, which likely cannot be explicitly hedged.
Funds choice risk is the risk in offering the policyholder several available fund options. The available funds could have large differences in volatility, and it may be more difficult to hedge some funds vs. others.

14. Continued

In this situation, XYZ would be likely to allocate the value of the contracts they purchase into the most high-risk, volatile funds that ABC makes available.
Counterparty credit risk is the risk that the counterparty defaults on their obligations. In this situation, ABC is purchasing hedging instruments from a third party, and they could default on these guarantees. This is more likely to occur in an environment such as this one with high market volatility.
Policyholder behavior risk is the risk that the actions taken by policyholders differ from expected, causing hedging losses. This is explained in further detail in the section below.

(ii) Predict how actual policyholder behavior on policies settled by XYZ may differ from what ABC assumed at the time the GMDB was priced.

Most importantly, XYZ is now the owner of these policies. Because XYZ is an intelligent counterparty and these GMDBs are in-the-money, ABC will realize anti-selective lapsation. XYZ will hold these policies until the policyholder dies or the GMDB is no longer in-the-money. In addition, XYZ is more likely to make additional deposits into the contract to gain additional benefit from the GMDB.

(iii) Analyze the impact of XYZ's actions on ABC's hedging strategy.

XYZ's hedging strategy likely assumed a particular lapse rate over time. As explained above, lapse rates will likely be anti-selective given the XYZ is now the policyholder. Because lapse rates will be lower when the GMDB is in-the-money, ABC will be under-hedged in the exact market environment where the hedges are needed causing hedging losses when the guarantee is in-the-money. ABC can purchase additional hedges given this knowledge, but this will increase the cost of their hedging program and reduce overall profitability.

(c) Describe each benefit and assess how each might impact the future actions of companies like XYZ.

Commentary on Question:
This section tested whether the candidate understood the design of two different variable annuity living benefits. They were then expected to assess how the availability of these benefits could impact the future actions of life settlement companies. A minority of the points were given based on basic knowledge of the benefits. Most points tested whether the candidate understood how these benefits would impact this particular situation. A large majority of candidates understood the benefits, but most did not describe their relevancy in this situation.

14. Continued

A guaranteed minimum maturity benefit provides a guaranteed amount upon maturity of the contract. For XYZ, this could be attractive because it would guarantee a payoff at a specific point in time, even if the policyholder was still alive. This also means that a variable annuity contract could be attractive not just because the policyholder's health was impaired, but because their contract was close to maturity so XYZ could focus on healthy lives as well. XYZ could be less likely to purchase policies with a GMMB if the annual GMMB cost is particularly high.

A guaranteed minimum income benefit provides that the accumulated value of a contract provides annuity income at a guaranteed rate (or a guaranteed dollar amount). This is only valuable if the annuitant lives a long life, which is different than XYZ's current market, so this feature may not be valuable today. However, it is more likely than average that this guarantee is valuable given the low interest rate environment. It will be even more valuable if there is a further decline in rates, or if mortality rates decrease over time. Again, XYZ could be less likely to purchase policies with a GMIB if the annual GMIB cost is particularly high.

15. Learning Objectives:

3. Understand the feasibility step of a new product and how it drives design.

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

6. Understand the relationships between the product design and roll-out and, between pricing assumptions and monitoring of products sold.

Sources:
Atkinson & Dallas, Life Insurance Products and Finance, Chapter 3, 4, 5, 7, 9, and 13.4

Does Preferred Wear Off? Product Matters, July 2004

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

Solution:

(a) State the considerations in setting the mortality assumption for a preferred term product.

Considerations in setting the mortality assumptions:

- The level of underwriting will determine what % are preferred
- The lower the bar for being preferred the higher the mortality in both the preferred and standard group
- Need to consider where the competition places this bar
- How many different risk classes will we have
- Does the lower mortality of being preferred wear off over time
- Can we assume mortality improvement
- Need to think about the effect of selective lapses in the standard block

(b) Calculate the blended duration 5 mortality rate assuming a 75%/25% mix of industry and XYZ experience.

Commentary on Question:
Generally this section was well answered. Candidates who did poorly here did not allow for survivorship. A number of candidates calculated values for all 5 years which cost them some time.

L_4 (industry)= (1-1.53/1000)(1-1.59/1000)(1-1.68/1000)(1-1.78/1000) = .99344
L_4 (XYZ)= (1-12.17/1000)(1-12.55/1000)(1-12.92/1000)(1-13.30/1000) = .95002

15. Continued

Then blended Q_5 /1000 =(1000x$deaths_5$)/($survivorship_4$)
=(.75x.99344x1.90 + .25x.95002x13.61)/(.75x.99344+.25x.95002)
= 4.73

(c) Assess the appropriateness of blending the mortality rates of XYZ with industry experience in setting the mortality assumption for the preferred term product.

Commentary on Question:
Those candidates doing poorly on this section did not address the appropriateness of the assumptions based on the specifics of the case as outlined in the question.

Rates for XYZ and the industry are very different. Simply averaging them is probably not appropriate.
In any case inappropriate to use XYZ's mortality since new product involves preferred underwriting which is new to XYZ.
New product uses brokers rather than career agents to sell product which may affect mortality

- Problems in using industry mortality:
  - XYZ's debit/credit underwriting approach is unique to the industry and so would not be reflected in the industry mortality
  - Industry data may not be credible at later durations - Preferred term hasn't been around that long
  - Other differences in target markets, distribution channels, etc.

(d) Predict the effect on XYZ's sales and its current block of term policies if:

(i) XYZ decides not to introduce a preferred term product.

XYZ doesn't introduce product;

- Sales will continue to suffer with better risks going to competitors
- Existing policies will lapse if insured can qualify for competitors' preferred class
- May attract poorer risks from standard class of competitors
- Mortality will deteriorate in the block, hurting profitability

(ii) XYZ decides to introduce a preferred term product.

XYZ introduces product:

- Healthy lives in existing block will lapse and buy the new product
- Healthy lives that might have bought the existing policy will buy the new one instead
- Mortality will deteriorate in this existing block
- Any new policies the existing block gets couldn't qualify for preferred on either XYZ's or the competitors' products