DP-IU Complete Illustrative Solutions
Fall 2011

1. **Learning Objectives:**

6. Understand actuarial requirements of product implementation and the monitoring of experience versus product assumptions.

Learning Outcomes:

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

Sources:

ILA-D110-07: Policyholder Dividends

Commentary on Question:

The goal of this question was for candidates to demonstrate an understanding of experience monitoring and assumption setting for par policy dividends. Candidates were expected to assess the appropriateness of the proposed assumptions and recommend changes. The cognitive skill level is Knowledge Utilization.

Solution:

Evaluate these assumptions and recommend any changes.

Mortality:

Do not combine products.
Appropriate to combine several years experience.
Use Whole Life experience if credible, perhaps split out by risk class.
If Whole Life experience is not credible then it should be blended with an industry table.

Lapses:

Not necessary to explicitly reflect lapses.
Acceptable to reflect lapses directly or indirectly through other assumptions.
Lapse experience indirectly affects both mortality and expenses.

Expenses:

Need to update expense assumption to reflect increased costs according to the recent study.
Inforce should be reviewed separately from new business.
Do not want to favor new business at the cost of inforce business.
Expenses should be allocated by line of business.
Should tie expenses by line of business to actual total company expense.

1. Continued

Interest:
Can use either the portfolio method or the investment year method.
Portfolio method is appropriate in low interest rate environment.
If interest rates increase over time, consider IYM for new business only.

Policy Loans:
Important to reflect loans as it affects all dividends within the block.
Should reflect both the loan interest rate and the loan balance of each policy.

Capital Gains/Losses:
Need to decide how to distribute gains:

- Should go to the block of business that produced the cash flow
- Decide whether or not to include realized capital gains
- Decide whether or not to include any changes in unrealized capital gains

Here the assets are actively traded, therefore, the capital gains could be substantial and should be reflected.

2. 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:

(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, Chapter 11

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

Commentary on Question:

The goal of the question was for candidates to demonstrate an understanding of various profit measures, their advantages/disadvantages, appropriateness for the product in question and to state how to calculate them.

Retrieval skill level is part (a) and comprehension skill level is part (b). Students generally did well on part (a)(i) and (ii) where students were expected to define each of the four pricing measures: Embedded Value, ROI, ROE and Profit as a percentage of Premium and list some advantages/disadvantages for each measure. For part (a)(iii), many students did not receive full credit because they simply listed other profit measures without appropriate justification regarding its appropriateness for the question's Single Premium annuity product. In addition, many recommendations were made without recognition for the assumptions that were provided in the question itself (for example, recommending New Business Strain as a measure when the question states that the Product had no initial strain).

An example of an additional profit measure recommendation with appropriate reasoning is shown below. For part (b), to obtain full credit, candidates were expected to provide an analysis of:

- The analyst's assumptions/method of calculation used
- Appropriateness of each pricing measure itself for the product

While many students recognized the issues with the assumptions/method of calculation, many did not comment on the appropriateness of the measure itself for the product. For example, for ROE, many candidates recognized that after-tax stockholder earnings should be used instead of pre-tax solvency earnings and simply stated ROE was inappropriate because of this error in the calculation method. However, candidates were expected to evaluate ROE as a pricing measure for single premium annuities in general. Also, some candidates did not receive credit because they simply stated that the pricing measures were appropriate or inappropriate without any further analysis or justification.

2. Continued

Solution:

(a) For the pricing measures above:

(i) Define each measure.

Embedded Value:

- Definition: PV(Profits) at hurdle rate
- Can use after-tax solvency earnings or distributable earnings
  - Distributable earnings is preferable as better reflects the company's expected cash flows
- Discount rate should be company's hurdle rate
  - For a stock company, the hurdle rate should be the company's discount rate in-line with the company's weighted average cost of capital

ROI:

- Definition: Discount rate where PV(Profits) = 0
- Profits can be based on after tax earnings or distributable earnings (or contribution to free surplus)
  - Distributable earnings is preferable as better reflects company's expected cash flows

ROE:

- Definition: Income / Equity or After-Tax Stockholder Earnings/Equity Base (if it is a stock company)
- Can calculate using stockholder equity at the beginning of the year or the average stockholder equity at the beginning and end of year
- Can calculate a weighted average ROE to determine if a company's ROE goal will be met over the lifetime of the product

Profit as Percentage of Premium:

- Definition: PV(Profits)/PV(Premiums) or also called Profit Margin
- Profits and discount rate can be pre-tax or after-tax

(ii) List the strengths and shortcomings of each.

Embedded Value:

Advantages:

- Good way to evaluate blocks of business
- Identifies poor value blocks that need to be addressed
- One of simplest profit measure because one decision to make - hurdle rate

2. Continued

- Easy to calculate dollar profits
- Can show value created by new business
- Good macro pricing tool to compare different products

Disadvantages:
- Not comprehensive so often used with another measure
- May be sensitive if hurdle rate changes (i.e. sensitive to hurdle rate used)

ROI:
Advantages:
- Easy to understand by management as it is related to ROE
- Can compare various potential dissimilar investments
- Helps ensure adequate return from the shareholder perspective

Disadvantages:
- Doesn't capture dollar profit
- Does not convey emergence of profit (i.e. A 15% return will not necessarily return 15% each year)
- Not linear - changes in profit cannot be related to changes in IRR
- May produce more than one solution (i.e. Multiple ROIs)
- Too high if low strain in first year or if all years have positive profit (i.e. need to have initial strain or negative cashflows in first year)

ROE:
Advantages:
- Reflects capital (or can see how effectively capital is being utilized)
- Easy for CFO to relate to

Disadvantages:
- Doesn't capture dollar profit
- Varies from year to year

Profit as Percentage of Premium:
Advantages:
- Easy to use and explain and easy to calculate dollar profits from model projections
- Widely/commonly used

Disadvantages:
- Varies by product type
- Doesn't reflect capital needs

2. Continued

(iii) Recommend an additional profit measure commonly used for Single Premium Annuities.

Would recommend using Return on Assets (ROA) = PV(Profits)/PV(Assets). ROA is more appropriate for spread based products and more asset intensive products such as single premium annuities. ROA can be used to compare profit margins to the level of risk associate with product and assets

(b) Evaluate the analyst's assumptions and method of calculation used, and appropriateness of each pricing measure for this product.

Embedded Value:
Methods/Assumptions:
- Discount rate is incorrect: should discount with rate expected by stockholders = 15%

Appropriateness:
- Embedded value is appropriate for this product
  - Embedded value can generally be used on all products
- Embedded value should not be used alone, so it would be preferred to use in conjunction with other metrics as well (e.g. ROA, ROE)

ROI:
Methods/Assumptions:
- N/A

Appropriateness:
- Normally ROI is a good measure for annuities because must consider capital and if sales may be more than the company can afford
- However, in this question, it is not an appropriate measure because it was given that this product had no initial strain

ROE:
Methods/Assumptions:
- Should use after-tax stockholder earnings because is a stockholder company instead of pre-tax solvency earnings

Appropriateness:
- ROE is appropriate for annuities as need to consider capital (so company can ensure it has the capacity to support more sales)
- ROE is appropriate but meant as a supplementary measure which should use in conjunction with other measures
- Could use a weighted average approach which will allow the company to compare this result vs. the company's ROE goal

2. Continued

Profit as Percentage of Premium:

Methods/Assumptions:

- Incorrect discount rate: should use rate that company earns as discount rates

Appropriateness:

- Generally can be appropriate if used in conjunction with another measure
- Generally ROI or ROE is more commonly used for annuities or could use ROA as an alternative to Profit Margin

3. 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:

(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, Chapter 3, 7, 8, 9, 10, 11, 13, 14

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

Commentary on Question:

The goal of this question was to test the candidates' understanding of various profit measures, and to demonstrate their understanding in a numerical calculation.
This was a comprehension question.
To receive maximum points, the candidates needed to demonstrate their understanding of the formulas needed to calculate new business strain, and calculate the correct result based on the information given. Candidates were also expected to explain whether or not they agreed with the analyst's conclusion.
Candidates did well on this question, in general. It was more important to show a clear understanding of the variables needed to calculate new business strain than to provide a precise numerical answer based on the information provided. Thus, some candidates that only included numerical answers without also explaining the formulas used did not always receive full credit. Some candidates did not address whether or not the analyst's conclusion was correct, which was a key aspect of the question.

Solution:

Verify the analyst's conclusion using distributable earnings as the basis for profit. Justify your answer.

Commentary on Question:

One key to achieving a high score on this question was to understand that distributable earnings are generally calculated on a statutory basis as opposed to GAAP (as described in Atkinson and Dallas). Some of the information provided in the question did not impact the calculation of distributable earnings.

New Business Strain = Distributable earnings (1)/ Premium (1)

- Because distributable earnings in year 2 are positive, there is no strain on earnings after year one, therefore do not need to calculate the present value of distributable earnings.

3. Continued

Pre-tax Solvency Earnings = Premium – Benefits – Expenses + Investment Income – Increase in Solvency Reserve

Benefits = Death Benefit + Surrender Benefits
= 200 + 100 = 300

Expenses = Comp% x Premium x (1+ First Year Bonus Rate) + Acquisition Expense
= 50% * 1000 * (1+100%) + 200 = 1200

Thus, Pre-tax Solvency Earnings =
= 1000 – 300 – 1200 + 10 – 200 = -690

After Tax Solvency Earnings = Pre-Tax Earnings – Tax on Earnings
= -690 – (-50) = -640

Distributable Earnings = After Tax Solvency Earnings – Increase in Required Capital + Investment Income on Required Capital – Tax on Investment Income on Required Capital
= -640 – 30 + 10 – 3 = -663

New Business Strain = Distributable Earnings (1) / Premium (1)
= -663 / 1000 = -66.3%

I agree with analyst because the new business strain is 66.3%, more than the budget of 30%.

4. Learning Objectives:

1. Describe the product development process.

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

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

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

(3e) Recommend ways to close the gaps between design and the internal/external constraints.

Sources:

ILA-D101-07: Product Development Trends, pp 1-61

"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

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Evaluate the proposed Universal Life product with respect to Critical Success Factors.

Commentary on Question:

This was a very specific list from a certain study note, the students either knew most of the list or they didn't. Some students didn't know any of the list but tried to answer generically and were able to get some points.

1. Competitive Prices: Career agents can only sell this product so doesn't have to be as competitive against other products

2. Valuable Benefits: Agents have to feel comfortable with features before they will offer it to the customer

4. Continued

3. Flexibility: UL is a very flexible product and it can satisfy multiple needs

4. Harmonious with Company Strategy: Will the UL product fit in with RKA's sales growth goals and profitability goals

5. Complements Product Portfolio: UL is used for different insurance needs than term and group life, so should be a good fit

6. Satisfies the Agent (saleability, competitiveness, and compensation): UL is more complicated than term, more difficult sale, requires better compensation and training

7. Ability to Administer and Underwrite at Reasonable Cost: UL administration and underwriting will be more complicated and expensive than term and group life

8. Profitable: Higher comp requirements, and more expensive admin may make it difficult to achieve profit goals

9. Equitable to Various Classes and Generations of Policyholders: Fully underwriting status with multiple rating classes should allow equitability in pricing

10. Manageable Tax Status: UL will require TAMRA, Tefra, & Defra compliance and expertise not required of other products

(b) Identify and describe the hidden costs that might be associated with the proposed Universal Life product

Commentary on Question:
This section consisted of two lists from two separate study notes. It seemed that students gave more information regarding opportunity costs and deferred maintenance costs which were not on the outline. Most students did better on part (b) than (a).

People: Salaries and benefits are biggest insurance company cost

- RKA will have an expertise gap and will need to acquire or train existing staff, increasing expenses

Communication: UL will require extra time and effort to communicate and explain to agents and home office

- Training costs will escalate with increasing complexity, P&C agents will have difficulty with more complex product

4. Continued

- Market conduct issues can incur with inappropriate training

Scale: It will be more difficult to achieve critical mass because it shares fewer elements with current products

Features: Complex features may be difficult to properly price, leading to anti-selection

Administration System: Largest hidden cost is cost to purchase or modify admin system--RKA system will probably not be ready for UL

Product Design Constraints: Innovative features can't be handled by system and must be removed causing reduced product flexibility and decrease in competitiveness

Inefficient Operations: May have to implement manual processes leading to increased operational costs

Increased Time-to-Market: Solution to administration problems can lead to product delays and lost sales

Inability to Monitor Experience: This increases risk of mispricing and inability to identify problems quickly

Lost Cross Selling Opportunities: If system can't adequately link products by customer loses sales opportunities

Misleading Pricing Data: Customers are miss-categorized due to system limits and poor data quality results

Locked into Old Technology: Might not be able to easily upgrade system due to "hardwired" code in old system

Discounted Value of the Block: If RKA chooses to sell, acquiring company may have difficulty in economies of scale

5. 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.

Learning Outcomes:

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

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

Sources:

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

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

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Explain why mortality experience data from the company's existing products may not be appropriate for setting the mortality assumption for the proposed Universal Life product.

Commentary on Question:

Students performed very well on this portion of the question.

UL is fully underwritten and will have much different experience than term and group life. Fully underwritten experience should be better than GI and simplified. The target markets will be different between the 3 products and will vary by: personal risk factors, environmental risk factors, location risk factors, availability and quality of health care, and cultural differences.

Underwriting with multiple risk classes will be different than simplified or GI. The underwriting practices are different by product. Aggregate experience only has rates that vary by attained age whereas Select & Ultimate experience will vary by attained age, issue age, and policy year.

5. Continued

(b) Describe the design considerations that need to be balanced in pricing the proposed Universal Life product.

Commentary on Question:
Students performed poorly on this portion of the question. Many just listed pricing assumptions or product features. A well prepared student needed to describe the balance between features, competition, complexity, and cost that need to be considered in UL pricing. Credit was given for any item that talked about the tradeoffs necessary in product design.

The following were the items that most commonly received credit:

- More restrictive underwriting lowers mortality costs but limits sales.
- More underwriting classes make product more competitive but adds complexity and cost.
- Product flexibility makes the product more marketable but adds complexity and cost.
- Secondary guarantees are attractive but increase cost and risk.
- Minimum guarantees make more competitive but if too high increase risk and cost.
- The addition of riders make more attractive but increase complexity and cost.
- If premiums are set too low, policy at risk of lapse if interest rates decrease or COIs are increased.
- If premiums are set too high, not competitive and possibly pay out too much commission and might have tax issues.
- High commissions incent agents to sell more but too high reduces profitability and competitiveness.
- Death benefit options: competitiveness vs. complexity and cost.
- The credited interest rate is most visible to the customer but too high can decrease profit.
- The level of COIs are hard to compare but if too high will decrease cash values and competitiveness.
- Surrender charges and expense charges need to be high enough to maintain profit levels but too high will reduce competitiveness.

(c) RKA Life considers its distribution channel to be a customer and uses the following value matrix:

(i) Define Current Value and Potential Value based on the Lifetime Customer Value.

Commentary on Question:
Students performed well on this portion.

5. Continued

Current Value is the value of a transaction with the company and customer assuming the current pattern continues.

Potential Value is the realized value based on increased sales or spending and/or reduced expense.

(ii) Explain the goal and strategy for each quadrant in the Value Matrix.

Commentary on Question:
Most of the credit was given for the descriptions not the "buzz words." Credit was given for alternative "buzz words." Students performed very well on this section.

Quadrant A: Retain or Cash Cow. Retain customers but be careful about future investment in them.

Quadrant B: Develop or Star: Develop and maximize future profits represented by these customers.

Quadrant C: Maintain or Dog: Goal is to minimize or eliminate the drain on resources and profitability.

Quadrant D: Nurture or Question Mark. Goal is to improve profitability by increasing sales.

(iii) Determine the quadrant that RKA Life's distribution channel is in currently, and its potential quadrant with the addition of the proposed Universal Life product.

Commentary on Question:
Students performed well on this portion of the question. Many students did not divide by the cost of capital and as a result had answers in the wrong quadrant. They were given full credit with only a small marking point deduction.

Current Value =($60x.0075 + $40 x .015)/.15= $7m
$7m profit and less than $150 prem is in Quadrant C.

Potential Value = ($25 x .025)/.15 = $4.2m
Total value with addition of UL is $7m + $4.2m = $11.2m
$11.2m of profit and $125m prem is in Quadrant D.

6. Learning Objectives:

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

Learning Outcomes:

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

Sources:

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

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a)

(i) Describe pricing strategies outlined in Atkinson and Dallas.

Commentary on Question:

Some candidates listed other pricing strategies from other sources (e.g. LOMA Ch. 7) such as cost-driven strategies, psychological pricing, prestige pricing – no credit was given for those ones not on Atkinson and Dallas. Some candidates also thought skim and prestige pricing are interchangeable, but they are not. There is a difference in their definition. For cooperative pricing, some candidates implied companies talk to each other and set agreed-upon prices, this is not true.

According to Atkinson and Dallas, there are two levels of pricing strategies: Buyer-Oriented and Competitor-Oriented.

<u>Buyer-Oriented Strategies</u>

- Penetration pricing: involves setting prices low enough to generate a much higher level of sales and thus increase market share. The increased volume of sales may produce greater total profit. For companies that sell through independent agents, commissions can also be used as part of the strategy by paying relatively higher commission that is otherwise the same as competitor's products, this could induce independent agents to sell more of its product.
- Neutral pricing: involves setting prices at a level that most buyers would consider reasonable, which normally means setting prices not too far from the industry average. This is very common in life insurance
- Segmented pricing: involves setting different price levels for different kinds of buyers with different behaviors (e.g. Varying price by age, gender, risk class).

6. Continued

- Skim pricing: involves setting a high price that maximizes a company's profit margins. Usually done with products that are in short supply and high demand, which is rare in life insurance.

Competitor-Oriented Strategies

- Independent pricing: done by a company with no real competitors in its target market. Prices are set independent of competitors. This is most common with specialized market niches dominated by one company.
- Cooperative pricing: common when a few companies dominate a market segment. Companies will match price changes made, or changes in price will be made in parallel. Most likely to occur in the insurance arena where there is a large or expensive barrier to entry.
- Adaptive pricing: companies review prices of other companies and then determine where to set their price. Prices are typically set higher than price leaders, where the extra profit outweighs loss in sales. Also tend to compete based on image, quality, and service.
- Opportunistic pricing: driving prices down to a level where only the most efficient can survive. Market share is gained, or force less efficient competitors exit.
- Predatory pricing: setting prices below the cost of the product and drive competitors out of business. When the competition is gone, company will raise prices to recoup losses.

(ii) Identify which pricing strategies are being used by ABC Life and XYZ Life.

Commentary on Question:
Some candidates listed multiple strategies. There is one clear strategy for each company.

ABC Life is using the Penetration pricing strategy
XYZ Life is using the Adaptive pricing strategy

6. Continued

(b) Analyze the expense impact of the distribution strategies and goals for both companies.

Commentary on Question:
Some candidates missed comments on the broker vs. career agent expense impact. The key to this question is to read the question carefully, and make necessary assessments of expense impact. For example, look at the distribution strategy box for ABC life, it mentions "independent broker" and "term life."

ABC Life:

- A broker system typically costs less, because usually do not train, finance or house brokers. Brokers may earn lower commission rates as well.
- Term insurance is the simplest and cheapest product to offer.
- Possessing economies of scale gives a real competitive advantage.
- Cost savings may come from increased efficiencies.
- Measurement of decrease of unit cost due to automation varies based on measurement of incremental costs.

XYZ Life:

- Consider relationship between additional investment in recruiting and training of agents and long-term profit.
- An agency system typically costs more, because usually need to train, finance and house agents. There may also be other types of compensation such as salaries, bonuses, and security benefits.
- Complicated products (such as Variable Annuities, Universal Life products) are complex to administer.
- Although improving service standards affects costs over time, it would lead to improved persistency and profitability.
- Flexible premium products are more prone to human error.

(c) Evaluate the potential success of XYZ's new strategy.

Commentary on Question:
Many candidates did not even put an explicit statement down of whether or not this would be a successful strategy. Many candidates thought this could be a successful strategy, but they should've focused on making observations first (relate XYZ's target market, their current distribution system to the strategy), then making a statement on whether or not this would be a successful strategy.

Should note that the "Goals" of XYZ go hand-in-hand, the first goal was to "provide solutions for a wide variety of customer needs," with the second goal wanting to "obtain agents" business through competitive innovative products and outstanding support and services.

6. Continued

GI Term may meet the first goal of meeting the customer needs, but does not meet the second goal since Term is not an "innovative product." Also connecting the fact that GI Term and high-income executives is not a good product-target market combination, this should lead you to realize it's not a good strategy.

Evaluations/observations:

- The Term market is very competitive, and does not build on the core strengths/competencies of innovation. Term may not be popular with higher income consumers (they tend to look for the most sophisticated products). However, term is easy to administer, so that may not be a barrier.
- Should avoid developing a product that is out of sync with desires of target market
- The new market should be consistent with the company's goals, rather than a diversion
- Likely a better fit for ABC Life
- Distribution not consistent with current channels (cause distribution conflicts)
- May not have relevant internal experience to develop
- Company should have trained enrollment teams that visit employers' worksites to market and efficiently enroll a large number of people in a short period
- Company should have administration and billing systems that can communicate with the employers' payroll systems to handle payments through payroll deductions

Overall, this does not look like it will be successful as it does not fit XYZ Life's goals.

7. Learning Objectives:

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

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:

(2c) Describe the questions to ask sales and marketing (incl. agents, brokers and direct marketing).

(5d) Analyze the capital requirements for a product and describe solutions such as securitization.

Sources:

Atkinson & Dallas, Life Insurance Products and Finance, Chapters 3, 7, 8, 9, 10, 11, 13, 14

ILA-D120-11: PD-5 Pricing Best Practices (U.S. and Canada) (C)

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

Commentary on Question:

The question tested the student's ability to calculate Economic Required Capital and the Market Consistent Value of New Business and also tested an understanding of the different required capital methods. The cognitive level of the question was comprehension and retrieval. In order to get maximum points, the student needed to know how to calculate Economic Required Capital and the Market Consistent Value of New Business. Candidates had difficulty with the exact way to calculate both of these measures, and more specifically, which interest rates were appropriate in each step of the calculation.

Solution:

(a) State the objectives of Market Consistent Pricing Methodology.

The objectives of Market Consistent Pricing are to measure risk as consistently and objectively as possible between companies by striving to remove personal judgment from all assumptions. It replaces judgment with either observable benchmarks or well defined quantifying methods. It considers all identified risks on an observable basis, and also provides the company unbiased info with which to make decisions. It also facilitates proper evaluation of competing new business opportunities by comparing on a level basis.

7. Continued

(b) Describe the three different required capital methods. Compare and contrast the three methods according to the risk factors:
(i) Asset default
(ii) Insurance risk
(iii) Interest rate risk

Risk Based Capital (US)
The RBC formula specifies the required amount of capital to be maintained in the 4 risk categories, which are: C1- Asset Default Risk, C2-Insurance Risk, C3-Interest Rate Risk, and C4-Other Risk. Most companies target required capital as a percentage of regulatory minimum RBC. Asset Default factors are applied to a company's assets with different factors for different types of assets. Insurance Risk factors are applied for mortality and morbidity risk. Mortality risk factors are applied to company's total net amount at risk. Morbidity risk factors are expressed as a percentage of premium with a second morbidity risk factor expressed as a percentage of claim reserves. Interest Rate risk factors are applied to policy reserves, net of policy loans. Other Risk factors are applied as a percentage of premium. The RBC formula assumes that C2 risk is totally independent of the C1 and C3 risks. The company's final RBC is calculated by applying a covariance adjustment to the 4 components. The formula for the calculation of RBC is:
RBC=((C2)^2+(C1+C3)^2)^.5+C4)

Minimum Continuing Capital and Surplus Requirements (Canada)
The minimum capital standards are defined by the MCCSR. The minimum capital requirements are determined by applying factors to the 4 risk factors, which are Asset Default Risk, Insurance Risk, Interest Margin Pricing Risk, and Interest Rate Risk. The MCCSR is calculated by summing the results of each of the 4 components; and then this result is compared to the company's capital, which is comprised of Tiers 1 and 2. Asset Default factors are applied to the book value of the company's assets, with different factors for different types of assets. Insurance Risk factors are given for life insurance, AD&D, disability, annuities with life contingencies, and morbidity risks. Interest Margin Pricing risk is calculated by applying a factor to the policy liabilities. Interest Rate risk is calculated by also applying a factor to the policy liabilities.

Economic Required Capital
This is the level of capital required to ensure a given level of economic solvency. It can be calculated by using a Value at Risk methodology. ERC considers the change in economic value between the market value/best estimate value and the worst case scenario. Economic solvency means that the company is solvent if the market consistent value of assets is higher than the market consistent value of liabilities under a worst shock scenario.

7. Continued

The worst shocks are applied to the relevant risks, e.g., mortality/morbidity, lapse, investment mismatch and operational risks. ERC is calculated for each risk, and then aggregated, but not by simply adding all risks. A positive ERC may be offset by a negative ERC amount within the same risk, but the risks may not all happen at the same time. This effect is called diversification.

RBC and MCCSR produce balance results over a range of situations.
RBC and MCCSR both have the same categories for Asset Default, Insurance and Interest Rate risk.
RBC has the Other Risk category, while MCCSR has Interest Margin Pricing risk.
ERC has Investment Mismatch risk, versus Interest Rate risk of RBC and MCCSR.
ERC has mortality and morbidity risk, versus Interest Rate risk for RBC and MCCSR.
ERC Lapse risk has its own category.
ERC has Operational risk, similar to RBC's Other Risk, where MCCSR does not have a similar category.

(c) Calculate Economic Required Capital and Market Consistent Value of New Business.

For this answer, one only needs to look at Mortality, since there is no capital impact of the other risks in the calculation of RBC for this question. RBC is calculated:
PV Premiums-PV(Benefits and Expenses), under best estimates, minus
(PV Premiums - PV(Benefits and Expenses), under worst case shock. Use risk free rate.
1st year: (100 - 20 - (10/1.04)) - (100-20*1.2 - (10*1.2)/1.04)) = 5.92
2nd year: ((100 - 20)/1.04 - (10/1.04^2)) - (100/1.04 - (20*1.2)/1.04 - (10*1.2)/1.04^2)) = 5.70
3rd year: ((100 - 20)/1.04^2 - (10/1.04^3)) - (100/1.04^2 - (20*1.2)/1.04^2 - (10*1.2)/1.04^3)) = 5.48
ERC= 5.92 + 5.70 + 5.48 = 17.09
Calculation of MC VNB equals MV of Liabilities (MVL) at policy issue with opposite sign.
MVL =Transfer Price of Liabilities (TPL) + Transfer Tax on Liability (TTL)
MVL=MV of Savings component + MV of Financial Options and Guarantees + Best estimate value of insurance risks + Cost of capital for non-hedge risks + TTL
For traditional products, first 3 hedge risks=HVL=PVBenefits + PV Expenses - PV Premiums

7. Continued

For traditional products, MVL = HVL + MVM + TTL
Cash Flows are projected by using best estimate assumptions and discounted back by using the risk free interest rate for hedge risks.
1st Year: (20 + 10/1.04) - 100 = -70.38
2nd Year: (20/1.04) + (10/1.04^2) - (100/1.04) = -67.68
3rd Year: (20/(1.04)^2 + (10/1.04^3) - (100/1.04^2) = -65.07
HVL=-70.38 - 67.68 - 65.07 = -203.14
MVM for Mortality Risk=(PV best estimate Liabilities - PV Liabilities under mortality worst shock assumption)*(rate of cost of capital)
1st Year: .07*5.92 = .41
2nd Year: .07*5.70 = .40
3rd Year: .07*5.48 = 1.20
MVM = HVL + MVM = -203.14 + 1.20 = -201.94
MCVNB = -MVL = -(-201.94) = 201.94

8. Learning Objectives:

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

Learning Outcomes:

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

(4b) Construct and recommend a design that is consistent with the market needs identified in the idea generation step.

Sources:

Investment Guarantees, Hardy Ch. 13 Equity Indexed Annuities

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

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

Commentary on Question:

The candidate was expected to show the effect of a declining interest rate environment on an equity indexed annuity and make recommendations on changes to product design. Cognitive level of question: Recall, comprehension, and knowledge utilization.

Solution:

(a) Identify major differences between a Variable Annuity (VA) and an Equity Indexed Annuity (EIA).

Commentary on Question:

Most candidates performed well on this section. Comments in terms of guarantees and general design features were both acceptable.

- EIA contract has shorter term than VA contract
- EIA guarantees behave like call option, VA guarantees behave like put option
- EIA uses priced index as basis for participation
- EIA passes investment risk on to 3rd party by buying call options
- VA has wide variety of investment options and often invested in separate accounts
- VA administration more complex than for EIA
- VA regulated by SEC, EIA regulated under SNFL

(b) Calculate the present value of expenses and profit as a percentage of premium.

Commentary on Question:

Candidate performance was mixed.

8. Continued

Common errors:

- Discounting at 7% instead of 5%
- Applying 90%/100% instead of 87.5% in GMAV cost
- Introducing IAV into calculation

- PV(profits & expenses) = Premium – GMAV costs – Index based interest budget
- GMAV cost = (87.5% * Single premium * (1.03 ^ n) / ((1 + net earned rate)^n)
- GMAV cost = (87.5% * 1,000 * 1.03 ^ 5) / (1.05 ^ 5) = 794.78
- PV(profits & expenses) = 100% – 794.78 / 1,000 – 9.5% = 11.02%

(c) Calculate the payout under the indexation method for this EIA. Show all work.

Commentary on Question:
Candidate performance was mixed.
Common errors:

- Incorrect rollup of GMAV (see comments in part (b)) or not even showing guaranteed amount calculated in order to determine payout
- Incorrect application of ratchet (using point-to-point method instead of HWM)
- In IAV calculation, applying 5 years of compounding whereas HWM already includes accumulated gain in index
- Using 326 as base amount in HWM calculation at end of year 4 and calculating percentage increase as 23.26% for year 5

- Payout = max[Guarantee, Premium * (1 + participation rate *(S_{max}/S_0 -1))]
- Guarantee = 87.5% * Single premium * (1.03 ^ n)
- Guarantee = 87.5% * 1,000 * 1.03 ^5 = 1,014.36
- Payout = max[1,014.36, 1,000 * (1 + 100% * (403 / 327 – 1))] = 1,232.42

(d)

(i) Determine the impact on the cost of Guaranteed Minimum Account Value resulting from the drop in the net earned rate.

Commentary on Question:
Candidate performance was mixed.
Common errors:

- Introducing IAV into calculation
- Transposing 723.22 as 732.22

8. Continued

- GMAV costs @ 5% = 87.5% * 1,000 * (1.03 ^ 5) / (1.05 ^ 5) = 794.78
- GMAV costs @ 7% = 87.5% * 1,000 * (1.03 ^ 5) / (1.07 ^ 5) = 723.22
- GMAV cost impact = 794.78 – 723.22 = 71.56

(ii) Explain the significance of the change in net earned rate to the pricing of an EIA.

Commentary on Question:
Candidate performance tended to be weak. Most candidates recognized that the present value of GMAV would increase, but provided very little discussion on additional points.

- PV of GMAV will increase as net rate earned decreases
- Fund the GMAV, expenses and profit, and use remainder to fund option budget
- Most important in pricing is how EIA product will be funded
- Option budget based on current costs and determines what level of index based interest possible
- EIA funding premium = GMAV costs + PV (expenses/profits) + Indexed-Based interest budget

(e) Initial profit analysis shows a lower than desired profitability level. Recommend changes to the product design to improve profit results. Justify your answer.

Commentary on Question:
Candidate performance tended to be mixed.
Common errors:

- Suggesting floor on interest rate: this will increase costs
- Suggesting lengthening guarantee period: call option cost increases as time to expiry increases
- Discussion of reinsurance or hedging: not directly related to product design

- Shorter guarantee period can be used: allows insurer to reflect current conditions
- Change index growth method from high water mark to averaging or point-to-point
- Averaging smoothes volatility and dampens return
- Add provision to reset guaranteed rate if CMT rate goes down (according to SNFL calculation)

8. Continued

- Use lower participation rate
- Apply margin
- Apply cap
- Lower participation rate, margin, and cap reduce index based interest
- Order in applying changes may have effect on pricing

9. 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.

(4b) Construct and recommend a design that is consistent with the market needs identified in the idea generation step.

(4c) Evaluate the feasibility of the recommended design.

Sources:

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

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

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Identify the variable features of these products and their inherent risks.

Commentary on Question:

The intention was that the variable features would be listed along with what the risks were and who bore the risk and what the impact of the risk could be.

A number of papers did mention the investment risk behind the performance of the cash values is borne by the policyholders but very few mentioned that the cash value does vary directly with the performance of the separate accounts and fewer still mentioned that there is no minimum cash value guarantee.

A number of papers did mention the death benefit guarantee and the Management fees on separate accounts as variable features but very few mentioned the risk was adverse investment experience and even fewer mentioned that this risk was borne by the company.

- Cash values vary directly with the investment performance of the separate accounts: => investment risk borne by the policyholder. There is no minimum CV guarantees.

9. Continued

- Death benefit guarantees => Insurance company is exposed to the risk of adverse investment experience. => Performance is insufficient to cover the guarantees.
- Management fees on separate accounts => Company is exposed to adverse investment experience and lower persistency resulting in lower fee revenue.
- Higher administrative expenses due to regulatory requirements and unit value calculations.

(b)

(i) Propose product design measures the case study company may use to enhance risk management of its variable annuity products.

Commentary on Question:
A number of papers did talk about diversifying funds and/or providing the customer with fund choice, and limiting the amount invested in any one fund. Very few discussed a Deferral Period option or provided any examples of deferrals.

Deferral period option:

- A deferral period is imposed before the first withdrawal, or income.
- Aim to set a price that would cover the cost in a stress scenario.
- Value optimal behavior across a range of deferral periods , i.e. Like an American option.
- Fixed deferral period => lower price => can set at start date of the policy taking into account expected retirement date for the customer.
- Flexible deferral period with an optimal point.

Fund and fee structure:

- Fund revenue is an important source of margin to help subsidize the cost of the guarantee.
- Use of index trackers to minimize cost to customers and focus on having best value guarantee.
- Use of fund allocation to maximize diversification while offering non-index funds to give some alpha to clients.
- Use guided architecture to give customer fund choice, but with constraints on amt invested in any 1 fund, sector.
- A choice allowing consumers to elect any combination of the above, but with lower prices for the more basic features and higher prices for enhanced features.

9. Continued

Commission and fee levels:

- Lower commission lead to lower fee for p/h in an up-markets
- Lower commission is better for the insurance co. In up & down markets
- Lower sales and market shares
- Need simpler product design

(ii) Propose non-product-related measures the case study company may take to manage the risk associated with its variable annuity products.

Commentary on Question:
A number of papers did mention using Reinsurance; increasing the capital and hedging the exposure of the guarantees.

Fees are charged for minimum DB and minimum living benefit guarantees.

- The amount charged may be inadequate => pricing risk.

Target Market is defined, diversified and use of multiple distribution channel => diversification to manage the biometric risk (e.g. Death, lapses).

Periodic monitoring of mortality assumptions.

Use of reinsurance to hedge risk => reinsure 100% of the living and death benefits.

RBC ratio in excess of required level => extra capital is available to cover shortfalls in adverse scenarios.

Implement freestanding derivatives to hedge the economic exposure of the guarantees.

(c) Define the following risks that are associated with such a hedging strategy:

(i) Long-term volatility risk

Commentary on Question:
Most papers said this is the risk that the volatility will be long term. Very few mentioned that this is about the volatility increasing over time. Very few discussed the impact of this risk.

9. Continued

- Implied market volatility of the underlying funds increases overtime resulting in losses when trying to roll over a potential hedge of the product
- Few or no hedge instruments for this risk

(ii) Gamma risk

Commentary on Question:
Most papers did touch on, in some fashion, that this risk is regarding the hedge developing differently from the guarantees. Some papers did mention the hedging instruments being linear and the guarantees being non-linear. However, some papers gave part of this answer but didn't complete the answer.

- Hedge does not work perfectly => the hedge develops differently from the guarantees
- Arise when hedging instruments are linear (e.g. Futures) while the value of the guarantee is non-linear

(iii) Basis risk

Commentary on Question:
A number of papers did not answer this question well. Many did mention about the hedging assets developing differently than the guarantees. Very few talked about hedging instruments not being available.

- When hedging instruments not available=> funds mapped to portfolio of assets which can be hedged => benchmark portfolio
- The values of the hedging assets can develop differently from the values of the guarantees

(iv) Fund choice risk

Commentary on Question:
Most papers did mention that the policyholder can choose from a list of available funds. Virtually no paper discussed that the information must be received in a timely manner to hedge efficiently

- The underlying funds are not fixed and the policyholder can choose from a list of available funds.
- Pricing issue and hedging issue if the funds listed are hedgable => their basis risk is so high that the benefit of hedging is lower than the cost.
- The information from policyholder must be received in a timely manner to hedge efficiently.

10. 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

(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.

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

Sources:

Investment Guarantees, Hardy, Chapter. 1 Investment Guarantees

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

Investment Guarantees, Hardy Chap. 6 Modeling the Guarantee Liability

Investment Guarantees, Hardy Chap. 9 Risk Measures

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

Investment Guarantees, Hardy Chap. 2 Modeling Long-Term Stock Returns

10. Continued

Commentary on Question:
Commentary listed underneath question component.

Solution:

(a) Define types of minimum guarantee variable annuity riders.

Commentary on Question:
Cognitive Level: Retrieval

GMAB – Guaranteed Minimum Accumulation Benefit
Option to renew at maturity at new guarantee level
Like a lapse and re-entry option

GMIB – Guaranteed Minimum Income Benefit
Guaranteed annuity payment upon annuitization

GMWB – Guaranteed Minimum Withdrawal Benefit
Withdrawals allowed up to a maximum amount
$x per year for y years or z% of the AV

(b) Compare real world and risk neutral scenarios.

Commentary on Question:
Cognitive Level: Retrieval

Real world:
Equity returns based on historic returns and volatility
Returns may be excess over risk-free rate or purely average historic
Risk neutral:
Mean returns based on current swap curve
Volatility based on long dated options
Scenarios replicate actual derivative prices

(c) Compare the 95% quantile and CTE95.

Commentary on Question:
Cognitive Level: Analysis

95% quantile is the 95^{th} percentile of the loss distribution
95% CTE is the expected value of the loss given the loss falls in the upper 5% of the distribution

95% CTE is a "coherent" risk measure – 95% quantile is not coherent
95% CTE uses an average – 95% quantile is a point on the distribution

10. Continued

95% CTE considers the tail/shape of the distribution – 95% quantile does not
95% CTE is less sensitive to sampling variability than the 95% quantile

(d) Calculate each of the following under both real world and risk neutral valuation:

Commentary on Question:
Cognitive Level: Comprehension

(i) The fund values at maturity for each of the "in-the-money" scenarios.

$S(t+1) = S(t) * \exp(\mu + \sigma*\varepsilon) * (1 - \text{annual charge})$
Scenario 1 real world fund values:
year 1 = 10000*exp[.08+.18*(-.483)]*(1-.006) = 9871
year 2 = 9871*exp[.08+.18*(-1.516)]*(1-.006) = 8091
year 3 = 8091*exp[.08+.18*(-1.087)]*(1-.006) = **7164**

Scenario 1 risk neutral fund values
year 1 = 10000*exp[.015+.25*(-.483)]*(1-.006) = 8943
year 2 = 8943*exp[.015+.25*(-1.516)]*(1-.006) = 6177
year 3 = 6177*exp[.015+.25*(-1.087)]*(1-.006) = **4749**

(ii) The GMAB payoffs at maturity for each of the "in-the-money" scenarios.

GMAB Payoffs = Max(0, GMAB amount - Fund Value)
Real world = .9*10000 - 7164 = **1836**
Risk neutral = .9*10000 - 4749 = **4251**

(iii) The GMAB option value.

GMAB option value = (average of GMAB Payoffs) x (Persistency) x (Discount Factor)

GMAB Values:
Real world=1836 * .995 / (1.04^3) = 1624
Risk neutral = 4251 * .995 * exp(-.015*3) = 4043

GMAB option Values:
Real world = (1624 + 122 + 850 + 0 + 0 + 0 +……)/100 = **26**
Risk Neutral = (4043 + 2490 + 3259 + 0 + 0 + 0 +……)/100 = **98**

(iv) The 95% quantile for the GMAB value.

95^{th} quantile = **0** for both

10. Continued

(v) The CTE95 for the GMAB value.

95 CTE = average of worst 5% of scenarios for both
Real world = **519**
Risk neutral = **1958**

(e) Explain the considerations in setting the lapse assumption for a stochastic valuation.

Commentary on Question:
Cognitive Level: Retrieval

Lapse assumption should be dynamic
Total Lapses = (base lapse assumption) x (dynamic factor)
Dynamic factor should vary based on the in-the-moniness (ITM) of the guarantee
If ITM, insured will not lapse as much as "normal"
One sided factor only decreases lapses and dynamic factor capped at 1
Two sided factor allows lapses to increase above base assumption if deep OTM
May apply a floor to Total Lapses (not 0) as some insureds lapse regardless

(f) Explain the shortfalls of a lognormal model. Recommend a better model.

Commentary on Question:
Cognitive Level: Knowledge Utilization

Shortfalls of Lognormal Model:
Not good for long term modeling
Fails to capture more extreme price movements
Does not allow autocorrelation in data
Does not capture volatility bunching

Recommended model: Regime Switching Lognormal Model
An easy way to introduce stochastic volatility
Still maintains simplicity of Lognormal
More accurately captures extreme behavior

11. 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, their inherent risks, and the selection of appropriate pricing assumptions, profit measures and modeling approaches.

Learning Outcomes:

(3e) Recommend ways to close the gaps between design and the internal/external constraints.

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

Return of Premium Term, Product Matters July 2004

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

Commentary on Question:

This question tests the candidate's knowledge of the ROP product feature and the considerations which an actuary will have when developing a ROP product, how to do an experience study and how to develop assumptions. Questions (a) and (b) require candidates to retrieve the information from study notes. Question (c) tests the candidates' familiarity and understanding of experience study formulas. Question (d) requires the candidates to analyze and find the most appropriate solution using the given information.

11. Continued

Solution:

(a) List the anticipated benefits of the ROP feature from both the policyholder perspective and the company perspective.

Benefits of ROP feature:
From a policyholder perspective:

- Premium lower than permanent (e.g.UL) products with the similar cash surrender value
- Fill a gap between a permanent (e.g. UL) life products which offer permanent insurance and flexible premium and term life products
- Get all premiums back at the end of the term

From the insurance company perspective:

- Mitigate anti-selection, and better mortality experience
- Allow recovery of deferrable costs
- Can be marketed as "No cost Term" product.

(b) List the pricing considerations when adding ROP to a term life product.

The considerations in pricing ROP term life product:

- ROP feature makes the product lapse-supported
- The profitability depends heavily on net investment earned rate
- Higher reserves; hence higher surplus strain

(c) Calculate the mortality and lapse rate for age 40.

Commentary on Question:
Some candidates used preservation of total deaths to solve this question, although this question tests exposure, experience study.

Exposure for mortality = A+(1-r)N-(1-s)W;
A: Number of policies at year start attain age x,
N: New policies attain age x,
W: Lapses of age x,
D: Deaths of age x,
r: time when the new policy is issued to life 40,
s: time when a life 40 policy lapse

r = 0.5, because new issues are uniformly distributed over the year
s = 0.5, because lapses are uniformly distributed over the year
Exposure for attained age 40 (mortality) = 10000 + 2500(1 - 0.5) - 800(1-0.5) = 10,850

11. Continued

Exposure for lapse = A + (1-r)N - (1-t)Q;
Q: Number of deaths
t = 0.5, deaths are uniformly distributed over the year

Exposure for attained age 40 (lapse) = 10000 + 2500(1 - 0.5) - 50(1-0.5) = 11225
Mortality rate = Deaths / Exposure
Mortality rate of age 40: QdActual (40) = 50 / 10850 = 0.00461

Lapse rate = Lapses / Exposure
Lapse rate: Qw (40) = 800 / 11225 = 0.07127

(d) The Pricing Actuary is using the experience of the existing term product to set the mortality assumption for the new enhanced product.

(i) Evaluate the mortality assumption of the new product and recommend changes, if any.

Commentary on Question:
Some candidates recommended lowering anti-select lapse from 80% to 20% and calculated mortality rate under this assumption. However, ROP product doesn't have anti-select lapse at all.

Using mortality rates developed from the existing term life insurance product is not appropriate for the new product with ROP feature because:

- Normal term products, (without ROP), usually have high lapse rates, and many could anti-select.
- Term life with ROP product is lapse-supported. The persistency of this product is usually very high.
- Recommend changes to the mortality assumptions.
- The mortality rate without anti-selection should be developed for the new term life product with ROP feature.

11. Continued

(ii) Calculate the mortality rate for age 40 based on your recommendation in (i).

The mortality without anti-selection can be derived from the following formula
QdActual = [(1 - QwNorm - QwNonSel) * QdNorm - QwSelect * QdSelect] / (1 - QwNorm - QwExtra)

QdNorm = (1 - QwNorm - QwExtra) * QdActual / (1 - QwNorm - QwNonSelect - QwSelect*(1-25%))
QdNorm = Regular/Normal mortality rate without taking into account selective lapsation
QdSelect = mortality rates of the selective lapses
QwNorm= Regular/Normal lapse rate without taking into account selective lapsation
QwExtra= Extra lapse rate = total lapse rate - normal lapse rate
QwSelect = Selective lapses = total lapse rate * 80%
Total Lapses = QwNorm + QwExtra
QwNorm + QwNonSelect = Total lapses * (100%-80%) = Total non-selective lapses

QdActual (40) = 0.00461 (from answer in b)

QwNorm (40) + QwExtra(40) = 0.07127 (from answer in b)

QdNorm (40) = (1 - 0.07127) * 0.00461 / (1 - 0.07127 * 20% - 0.07127 * 80% * 75%) = 0.00454

12. 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.

6. Understand actuarial requirements of product implementation and the monitoring of experience versus product assumptions.

Learning Outcomes:

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

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

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

(4b) Construct and recommend a design that is consistent with the market needs identified in the idea generation step.

(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.

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

Sources:

ILA-D803-07: Role of the Actuary in Product Roll-out

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

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

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

12. Continued

Commentary on Question:
Commentary listed underneath question component.

Solution:

(a) Outline the role of the actuary in rolling out this product with respect to developing policy form language for the Critical Illness product.

Commentary on Question:
This was a retrieval question. Candidates generally answered this part of the question well; however, a number of candidates put the product development processes as an answer to this question.

In developing the policy form language, the actuary must ensure that:

- Policy language is clear and simple, and avoids multiple interpretations
- Policy language accurately describes the product
- Specification pages include all guaranteed charges and credits correctly
- Riders and their provisions coordinate properly with the base policy
- Variable provisions are placed in brackets [xxx]
- Contract includes information required by statue
- Text accurately describes the calculation values

(b) Compare the key differences between traditional pricing and market consistent pricing methodology for this product.

Commentary on Question:
This was a retrieval question with some level of comprehension, focusing on the key words like asset, liabilities, capital, valuation and profitability. In order to receive full credit, the candidate needs to demonstrate the knowledge of the 5 key differences between traditional and market consistent pricing methodologies and be able to explain them. The candidates either did very well or very poorly on this question, however, many missed points about profitability.

Assets:

- Under traditional pricing methodology, the investment returns assumptions are based on management view.
- Under market consistent pricing methodology, no investment return assumption is necessary as the current risk free interest rate is assumed.

12. Continued

Liabilities:

- Statutory reserves are used in the calculation under traditional methodology.
- Under market consistent methodology, hedgeable risks are valued consistent with financial market and valuation of non-hedgeable risk is based on the cost of economic capital.

Capital:

- Traditional methodology uses solvency margin as stipulated by the regulator.
- Market consistent methodology uses economic capital

Valuation:

- Under traditional methodology, the discounted distributable earnings are used.
- Under market consistent methodology, the market value of liability at issue is used.

Profitability:

- Products that are profitable under traditional pricing methods may look unprofitable under market consistent pricing.
- Under market consistent pricing methods, no risks are ignored but the profitability may change significantly with the change in the economic conditions and availability of additional information relating to lapses, mortality, etc.

(c) Assume premiums are payable in all years.

(i) Calculate the extra gross premium charge for a substandard policy with an average size of 25,000 for a 45-year old policyholder assuming level premiums payable in all years.

Commentary on Question:
The gross extra premium charge for a substandard policy is calculated as the excess of the substandard total gross premium less the standard gross premium. A number of candidates did not know how to calculate the net premium piece correctly and so calculated incorrect gross premiums. Marks were not given for the net premium but marks were given for calculating the gross premiums (assuming they were done correctly) no matter which premiums were used.

Key formulas:

$$\begin{aligned} \textit{Extra Premium} &= \textit{Gross Premium for Substandard } (GP_S) \\ &- \textit{Gross Premium for Standard } (GP) \end{aligned}$$

12. Continued

$$\begin{aligned}&\textit{Gross Premium}\\&= \textit{Net Premium} \times (1 + \textit{Claim Cost})\\&+ [\textit{Acq Exp} + \textit{Gross Premium} \times (\%\ 1\textit{st yr Prem} + \%\ 1\textit{st yr Comm})]/\ddot{a}_{x:\overline{n}|}\\&+ \textit{Maint Exp}\end{aligned}$$

$$\textit{Net Premium } (NP) = \textit{FaceAmount}(FA) \times {}^{A_x}/_{\ddot{a}_{x:\overline{n}|}}$$

Calculate Standard Gross Premium:
NP = 25,000 * 0.28 / 5
NP = 1,400

GP = 1,400 * (1 + 0.1) + [100 + GP * (0.15 + 1)] / 5 + 50
GP * (1 – 1.15 / 5) = 1,400 * 1.1 + 100 / 5 + 50
GP * (0.77) = 1,610
GP = 2090.91

Calculate Substandard Gross Premium:
NP = 25,000 * 0.36 / 3
NP = 3,000

GP = 3,000 * (1 + 0.1) + [150 + GP * (0.15 + 1.2)] / 3 + 50
GP * (1 – 1.35 / 3) = 3,000 * 1.1 + 150 / 3 + 50
GP * (0.55) = 3,400
GP = 6181.82

Extra Premium for Substandard Policy:
Extra Premium = 6181.82 – 2090.91
Extra Premium = 4090.91

(ii) Evaluate the appropriateness of the assumptions above for substandard lives relative to standard lives.

Commentary on Question:
Cognitive level of the question was predominantly comprehensive with some level of analysis. The question was asking the candidates to compare and assess whether the assumptions set for substandard lives are appropriate. Most candidates did well evaluating lapse, expense and commission assumptions and received minor points for how incidence assumptions should vary.

12. Continued

Incidence Rate:

- It is appropriate to use a multiple of standard incidence rates
- Using a constant substandard multiple may present inaccurate results because the relationship of substandard to standard incidence may not be a constant percentage for all ages and it should recognize more favorable incidence experienced by females.
- The incidence assumption should also vary by:
    - Smoking status
    - Duration since issue

Acquisition Expenses:

- Acquisition expenses should be higher for substandard cases because they are more expensive to issue and require more underwriting information than standard cases.
- Non-taken rates for substandard policies are higher than for standard policies leading to a high acquisition expense.

Commissions:

- Commissions should be paid using the same commission scales.
- Paying higher commission on substandard business will increase the cost to the policyholder.
- Paying lower commission on substandard business will decrease the commissions paid to the agents and may decrease interest for extra effort to issue substandard CI.

Maintenance Expenses:

- Maintenance expenses on substandard business are generally the same as on standard.
- Maintenance expenses may be higher due to additional expense incurred in connection with request for reduction or removal of rating.

Lapse:

- Higher lapse rates are expected due to higher premiums

(iii) Due to time constraints, the actuary suggests that the policies with substandard risk will not be modeled. Critique the actuary's suggestion.

12. Continued

Commentary on Question
Many candidates recognized the degree of inappropriateness in the suggestion and provided a recommendation that "substandard risk should be modeled," but very few candidates listed the reasons as to why the suggestion could or could not be problematic.

In order to receive maximum marks, one would need to:

- Explain why the suggestion may be inappropriate (many candidates simply stated that it is inappropriate);
- Explain why the suggestion may be appropriate (not many candidates did this);
- Identify possible solutions to support the decision for not modeling substandard business (many candidates suggested that modeling is a must and received partial marks).

Substandard cases are generally more expensive and can cause unfavorable financial impact if not properly priced. The Actuary should consider the materiality of what is not being modeled. If the substandard business is not material, it is ok not to model. However, the Actuary must consider that items that may seem immaterial might have a significant impact on the results in the future. If the substandard risk is not modeled, the Actuary should put a process in place to become comfortable that non-modeled cells are valued appropriately. At the very least, the Actuary should perform the sensitivity testing.

13. 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.

6. Understand actuarial requirements of product implementation and the monitoring of experience versus product assumptions.

Learning Outcomes:

(1b) Describe how the actuary interacts with other stakeholders within the product development process.

(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 risk and other factors such as:
- (i) Available Experience Data
- (ii) The Marketplace
- (iii) Underwriting
- (iv) Distribution Channel Characteristics
- (v) Reinsurance
- (vi) Expense (Fixed, Variable, Marginal)
- (vii) Taxes (Income and Premium)
- (viii) Investment Strategy

(6b) Evaluate, through the use of Experience Studies, how actual experience varies from expected relative, but not limited to mortality, investment returns, expenses and policyholder behavior such as policy and premium persistency.

Sources:

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

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

Atkinson & Dallas, Life Insurance Products and Finance, Chapters 3, 7, 8, 9, 10, 11, 13, 14

ILA-D101-07: Product Development Trends pp 1-61

13. Continued

Commentary on Question:
Candidate must understand how reinsurance can help reduce a product's risk and affect a product's profitability.
For full credit, candidates not only had to give a recommendation but explain the reasons for their recommendation.
Where points were lost on this question is candidates did not explain the reasons for their recommendation.

Solution:
(a) Explain some of the concerns with launching a T100 product and how reinsurance could help address these concerns.

- Mortality is an important assumption for a T100 product and may be difficult to set as you must consider:
  - T100 is popular for issue ages over 60 – need to focus on underwriting and issue age limits.
  - There is a possibility of anti-selection.
  - How long should mortality improvement apply for?
- Lapses rates will impact financial results as T100 is lapse supported.
  - T100 has very low lapses, especially at higher ages where the long-term goal is understood.
  - Low level of lapsation generally leads to low mortality rates (less anti-selection).
  - Less lapses means more paid in death benefits.
  - Back-to-backs will lower lapses even further.
- T100 has a very long interest rate guarantee
  - Low interest rate environment makes it difficult to price aggressively.
  - T100 has no cash values and so can invest in longer term assets as not much liquidity concern.
- Expenses are low for a term product.
  - With low lapse levels there is a longer period to amortize acquisition expenses.
- Reinsurer can help to develop a new product including proper design and pricing.
- Reinsurer can take on the majority of the risk where the company is not comfortable.
- Reinsurer can help with capital costs.
- Reinsurer can help smooth mortality results.
- Reinsurer can help with underwriting - accept business beyond a company's retention limits and company can FAC-shop business (e.g. facultative reinsurance).
- Reinsurer can help reduce expenses due to expense allowances.
- Reinsurance can affect the taxes payable.

13. Continued

(b) Recommend whether reinsurance should be used on this new product considering New Business Strain as the profit measure and ignoring any decrements in the first year.

New Business Strain = Distributable Earnings / Premium at t=1
Dist. Earnings = After-Tax Solvency Earnings – Required Capital Increase + After-Tax Investment Income on Required Capital
NAAR = Death Benefit – Reserve

No Reinsurance
Strain = (1,000,000 – 1,125,000 – 75,000 – 2,500) / 1,000,000 = -20.25%

20% Reinsurance
NAAR = 0.2 x 12,000,000 – 48,000 = 2,352,000 (reserve already adjusted for reinsurance)
Reinsurance premium = 0.5/1,000 x NAAR = $1,176
Reinsurance allowance = 100% of reinsurance premium = $1,176
Strain = (1,000,000 – 1,176 + 1,176 – 1,125,000 – 48,000 – 1,000)/1,000,000
= -17.4%

40% Reinsurance
NAAR = 0.4 x 12,000,000 – 36,000 = 4,764,000 (reserve already adjusted for reinsurance)
Reinsurance premium = 0.5/1,000 x NAAR = $2,382
Reinsurance allowance = 120% of reinsurance premium = $2,858
Strain = (1,000,000 – 2,382+ 2,858 – 1,125,000 – 36,000 – 800)/1,000,000
= -16.1%

Recommend to proceed with 40% reinsurance because:

- Results in improved strain position
- It's a new product so can rely on reinsurers to help develop the product
- Mortality is a large component of T100 so can use reinsurance to smooth results
- Reinsurer can help provide capital support and expense allowances for starting up a new product

14. Learning Objectives:

1. Describe the product development process.

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

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

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

Sources:

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

Life Insurance and Modified Endowments Under IRC §7702 and §7702A, Chapters 2, 3, 4, and 6

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Describe how the proposed universal life product will fit within the case study company's product strategy, applying the product strategy framework as described by Atkinson and Dallas.

Commentary on Question:

Question was testing the candidates' knowledge on how product strategy aligns with a company. Candidates were able to identify that product fits with the target market but were not always able to identify the fit with core competencies, risk profile or new markets.

14. Continued

Target Market - Product is consistent with Retirement and Wealth Strategies Product.
Core Competencies – Product can be sold by the Company's current distribution and the company has underwriting expertise so no barriers to entry.
Risk Profile – Spread is key to net income but by guaranteeing 3.5% for life may be too risky.
New Markets – Product is not currently part of the portfolio and will expand companies offering and increase sales.

(b) Define and calculate the guideline annual premium, guideline single premium and the 7 pay premium.

Commentary on Question:
Question was designed to test the understanding of US tax law for life insurance products. Candidates knew the correct level of interest rate and mortality charges to use but had difficultly knowing which riders to include. To get full credit only one method of calculating the GLP or 7 pay premium was needed to be shown.

GSP uses the greater of 6% or the guaranteed interest, lessor of guaranteed mortality or the 2001CSO, and expenses and load are taken into account.
GLP uses the greater of 4% or the guaranteed interest, lessor of guaranteed mortality or the 2001CSO, and expenses and load are taken into account.
7-pay uses the greater of 4% or the guaranteed interest, lessor of guaranteed mortality or the 2001CSO, and no expenses and loads are taken into account.
2 approaches to including QABs charges are: QAB charges amortized over the term of the QAB or that of the contract.
QABs are Guaranteed insurability, ADB, Family Term and Waiver of Premium.

GSP = $[100{,}000 * A_{55:100\ 6\%} + 10 * a_{55:5\ 6\%}] / .95 = \$28{,}614.90$
GAP = $[100{,}000 * A_{55:100\ 4\%} / a_{55:100\ 4\%} + 10] / .95 = \$2{,}704.40$ or
GAP = $[(100{,}000 * A_{55:100\ 4\%} + 10) / a_{55:100\ 4\%}] / .95 = \$2{,}697.0$
7pay = $[100{,}000 * A_{55:100\ 4\%} / a_{55:7\ 4\%}] = \$6{,}527.54$ for 5 years but will need to be recalculated in year 6 without rider charges from the beginning. or
7pay = $[(100{,}000 * A_{55:100\ 4\%} + 10 * a_{55:5\ 4\%}) / a_{55:7\ 4\%}] = \$6{,}520.07$

14. Continued

(c) Recommend changes to improve the riders from a tax perspective.

Commentary on Question:
Candidate was asked to demonstrate how tax law affects product design.

Change terminal illness accelerated benefit rider to define terminal illness as a life expectancy of less than 24 to qualify for tax-free benefits if utilized.

Change the child rider to last for at least 7 years so there will be no reduction in benefits.

Eliminate the DI rider to allow for lower cost without changing the guideline and 7 pay premiums.

15. **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, their inherent risks, and the selection of appropriate pricing assumptions, profit measures and modeling approaches.

Learning Outcomes:

(3c) Describe how investment policy and policy loans can impact design.

(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:

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

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

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

"Pricing in a Return-on-Equity Environment", TSA XXXIX, 1987

Atkinson & Dallas, Life Insurance Products and Finance, Chapters 3, 7, 8, 9, 10, 11, 13, 14

15. Continued

Commentary on Question:
This question tested the candidate's knowledge of the considerations that need to be taken when analyzing a product's company or industry experience. It also tested the candidate's ability to analyze a projected ROE pattern for a product and analyze whether the pattern would be acceptable to shareholders and how to improve the pattern if possible.
Part (b)(ii) and part (c)(ii) showed the highest level of cognitive thinking on the question as those parts asked the candidate to propose adjustments for the experience that they were seeing and then recommend approaches to adjust the ROE pattern they were analyzing. These parts forced the candidate to think on their own and not to just recite an answer from a text book.
Some areas where the candidates had trouble receiving the maximum points included section (b)(i) and (c)(i). In section (b)(i), many candidates explained the variables that affect mortality and persistency instead of explaining the considerations that need to be taken when analyzing experience assumptions. The candidates that did answer this part of the question in the correct manner usually listed the considerations without giving much detail behind the list which made full credit hard to earn.
Most candidates did well on parts (a), (b)(ii), and (c)(ii). Most candidates struggled on parts (b)(i) and (c)(i).

Solution:

(a) Explain the pros and cons of using the company's current distribution channel for its new UL product.

Commentary on Question:
This part of the question was relatively straightforward and most candidates did a good job answering it. Most candidates focused on the cons of using a direct mail distribution channel for UL instead of focusing on the pros, but that seems logical since UL is not a good product for a direct mail distribution channel.

Cons:

- UL is a complex product which is not easily understood by customers through mail.
- Personal discussions are needed to explain the features of UL.
- The target market for UL is high net worth individuals who prefer higher service from professional advisors.

Pros:

- The current direct mail distribution is set up and is low cost.
- Developing a new system would be time consuming and may cost a lot to set up.
- Other distribution systems may require higher commissions and higher expenses which would have to then be reflected in pricing.

15. Continued

(b) With respect to the mortality and lapse assumptions:

(i) Outline the various considerations that should be addressed when analyzing experience for these assumptions.

Commentary on Question:
This part of the question was the most difficult part for most candidates. Most candidates discussed factors that affect mortality and persistency instead of outlining the considerations that should be addressed when analyzing assumptions based on prior experience. Because of this, most candidates did not score well in this section.

a. Evaluate the credibility of the data
    i. Results should be reasonable and not biased
    ii. Need to adjust if portions of the experience are not representative of the experience as a whole
b. Evaluate the quality of the data
    i. Data should be consistent, reasonable, and appropriate
    ii. Alternate sources of data should be considered
c. Use actual or similar experience
    i. Preference is to use actual data if credible
    ii. Similar experience with adjustments can be used if actual experience is not appropriate
d. Reflect trends in experience
    i. Need to adjust data for trends such as mortality improvement
e. Reflect company and external factors
    i. Need to reflect how the company's business practices will affect the experience and adjust if needed
    ii. Need to reflect any economic or technological developments that have occurred since the data was analyzed
f. Sensitivity test the assumptions
    i. Assess any sensitivity tests that could have a material financial impact

(ii) Propose adjustments that need to be made to the term pricing assumptions in order to appropriately price this new UL product.

Commentary on Question:
Candidates did much better on this part of the question. Most candidates could explain that UL products would have better mortality and persistency than term products and many candidates listed several factors that contributed to this assumption.

15. Continued

a. Mortality will be better for the UL product
   i. High net worth individuals will have better mortality as they have access to better health care
   ii. UL will utilize underwriting where preferred risks will have better mortality
   iii. UL will not have the mortality deterioration that the term product experiences after the YRT premium increase
   iv. UL should use a different distribution channel which should experience a lower mortality than the term product will experience using the direct mail distribution channel

b. Persistency will be better for the UL product
   i. UL product is marketed towards higher net worth individuals who have an easier time paying premiums and understand the value in the product – both lead to better persistency
   ii. UL products have surrender charge or persistency bonus schedules which affect persistency – term products do not have these features
   iii. The term product will see shock lapse after the YRT premium increase as well as poorer persistency in the years following the premium increase – the UL product will not experience this

(c)

(i) Analyze the ROE pattern.

Commentary on Question:
This part of the question proved to be very difficult for most candidates. Most candidates explained the shape of the ROE curve instead of analyzing how the shape of the ROE curve would affect the shareholders.

- The ROE target is not met until duration 10.
- Shareholders may not be happy with the ROE below the target for the first 10 durations.
- This kind of ROE pattern makes the company's profits very sensitive to early lapse rates – earlier lapse rates will reduce the profitability of the company.
- Large ROE's are needed in later years so that the overall ROE meets the company's targets.
- This type of ROE pattern may cause significant capital strain in the early policy years which might not be acceptable since the capital level of the company is low.

15. Continued

(ii) Recommend approaches the company can take to improve or achieve the ROE objective.

Commentary on Question:
Most candidates did much better on this part of the question. Most candidates answered the two most common approaches, re-pricing the product or leveraging new business with inforce business.

- The company could re-price the product to meet the ROE objective, but this might result in an uncompetitive product.
- The company could leverage the inforce business (higher ROE) with the new business (lower ROE).
- The company could add a surrender charge or a persistency bonus period which would discourage early duration lapses.
  - These features might require re-pricing with lower ROE's seen in the years in which the persistency bonuses are paid.