DP-IU Model Solutions
Spring 2013

1. **Learning Objectives:**
2.   Understand the drivers of product design (the idea generation step).

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

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

Learning Outcomes:
(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

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

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

Sources:
LOMA, Insurance Marketing, 2010, Ch. 2 – 5 and 7 – 8

Marketing for Actuaries, 2000 Edition, All Chapters

1. Continued

Term Mortality and Lapses, Product matters, August (62) 2005
http://www.soa.org/library/newsletters/product-development-news/2005/august/pdn0508.pdf

Atkinson & Dallas, Life Insurance Products and Finance
- Chapter 3, Pricing Assumptions

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

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

Commentary on Question:
This question tested the student's understanding of term replacements and its effect on customer decision process and assumption setting.

Solution:
(a) List other strategies that can help manage replacements.

Commentary on Question:
The cognitive level of this part of the question is retrieval. This was a very specific list from a certain study note. The students either knew most of the list or they did not. Some students knew the list but applied in the context of helping the company to increase the number of replacements and not to manage them (i.e. keep current policies in-force), and received no marks.

The following items received credit most commonly:

- Do nothing
- Compensate sales representatives for high retention by using persistency bonuses or incentives/ recognition programs or chargeback commissions for early surrenders
- Increase face amount for the existing policies
- Reduce premiums for the existing policies
- Keep attractive products and product portfolio
- Ensure that the policies are well-written
- Design products that encourage persistency by offering a bonus or a gift
- Provide quality customer service as many lapses may be the result of poor service
- Establish a conservation unit or department whose sole focus is to improve persistency
- Establish computerized detection systems to identify internal replacements
- Inform sales representatives when a policy is about to lapse

1. **Continued**

- Provide guidelines for sales representatives to identify potential replacement situations
- Maintain frequent contact with customers through media

(b)   For a policyholder considering whether to replace their current term policy:

(i)   Describe the most appropriate problem-solving strategy.

(ii)   Describe the purchase decision process.

Commentary on Question:
The cognitive level of this part of the question is analysis. Most students did better on part (ii) than (i). Part (ii) was a very specific list from a study note. In part (i), students were asked to state the strategy and define it as it applies to renewing a term policy. Those students that did not provide the description lost points.

Part (i):

The policyholder that considers whether to replace their current term policy will use the Limited Problem-Solving Strategy. This strategy is most often used for minor new purchases or major rebuy purchases when the policyholder has a lot of experience with the product but needs to evaluate specific products within that category. Replacing an insurance policy is a major rebuy purchase since it is bought infrequently, relatively expensive and usually requires more time and thought than routine response.

Part (ii):

Stage 1: Problem Recognition
Policyholder recognizes that there is a difference between a desired state and the actual state. Variety of internal and external factors influences policyholder's ability to recognize problems that can be solved by purchasing product. For example, policyholder may realize that their premiums will increase on renewal of existing policy.

Stage 2: Information Search
Information search provides a way for policyholders to evaluate various options for product that might solve their problems or meet their needs. Sources of personal information include family, friends, internet or agent.

1. Continued

Stage 3: Evaluation of Alternatives
Policyholder evaluates a set of alternatives based on some evaluative criteria.
Criteria might include price, product features or company. Policyholders who
receive recommendations from agents are more likely to purchase than those who
do not receive recommendations.

Stage 4: Purchase Decision
Policyholder decides whether to buy the product and may move back to Stage 1 or
Stage 2 if decides not to buy.

Stage 5: Post-purchase Evaluation
Policyholder evaluates choice based on how well the product performs.
Dissatisfied policyholders may return products, complain, or take legal action.
Buyer's remorse and cognitive dissonance are common for insurance products.

(c) Evaluate whether the pricing assumptions for the currently sold fully underwritten
15-year renewable term product need to be changed when the "Term-to-Term
Replacement Program" is introduced. Justify your answer.

Commentary on Question:
*The cognitive level of this part of the question is knowledge utilization.
Candidates did poorly on this part of the question because most of the credit was
given for the description, reason and/or direction of each required assumption
change. Some candidates missed the question and evaluated assumptions that
need to be changed for the new simplified issue product.*

The pricing of the current term policy should be similar to the pricing of a reentry
or revertible term policy. The adequacy of the ultimate pricing will depend on
number of reverters, number of conversion to new term policy, and number of
lapses due to other causes. The following assumptions must be changed:

- Mortality rates will be higher for the remaining policyholders due to anti-
  selection. Healthy lives that can qualify for lower rates (i.e. pass
  simplified underwriting) can be expected to do so. Insureds whose health
  has deteriorated (i.e. failed new simplified underwriting) are more likely to
  stay with current policy to maintain their insurance coverage. When
  increasing mortality rates, should consider the rational policyholder theory
  (i.e. not every insured with good health will react immediately to the
  premium increase or new replacement policy).

1. Continued

- Lapses rates are expected to be higher at renewal due to the new program and since there is a temptation for "remained" insureds to lapse their policies in favor of a better deal elsewhere. Lapses after renewal period will be low because remained policyholders may be getting a very good deal considering their current state of health.

- Overhead expenses per policy will increase since will be spread over less policies.

- Maintenance expenses will be higher for administering replacement activity (i.e. for canceling current policies).

- Average face amount might decrease for remaining insureds due to a higher premium at renewal (i.e. will be able to afford less).

- Interest rates/investment assumptions will need to be examined since the duration of the most policies will be shorter (i.e.) end at renewal.

- Profitability level will likely to decrease.

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:

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

Sources:

Stochastic Pricing, Session 62 TS from November 2005 SOA Annual Meeting
http://www.soa.org/files/pdf/062bk-annual05.pdf

Stochastic Pricing, RSA Vol 27, No 2 Session 86PD
http://www.soa.org/library/proceedings/record-of-the-society-of-actuaries/2000-09/2001/january/rsa01v27n286pd.pdf

Stochastic Pricing for Embedded Options in Life Insurance and Annuity Products, Milliman (exclude appendices)
http://www.soa.org/files/pdf/research-2009-stochastic-pricing.pdf

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) List the benefits of using stochastic modeling.

> **Commentary on Question**:
> *Almost all of the students were able to list the benefits of using stochastic models and most students did attempt to answer it using key phrases. This was basically a retrieval question and students performed well on this section of the question.*

- Suitable for volatile results and distribution
- Suitable for results with wide range of distribution
- Able to quantify the tail risk
- Look at distribution as a whole
- Able to pin-point the scenarios to investigate and analyze
- Better understand the risk mitigation
- Better understand the risk diversification
- Best for low frequency, high severity risks

(b) It has been proposed that you reduce the number of scenarios in a stochastic analysis. Critique this proposal.

2. **Continued**

Commentary on Question:
Almost all of the students attempted to answer this question. Credit was given for material from several different notes that pertained.

- You must have a model with an accurate distribution of results
- More scenarios can provide CTE
- More scenarios require more time and cost to run
- Tail risk might not be reflected if small size of data is simulated
- Reducing the number of scenarios may also reduce the accuracy of the results

(c) Describe the sources of volatility in the valuation of embedded options.

Commentary on Question:
Students were usually able to list the major source of volatility and some received points for the sub-sections. Students were able to answer this section of the question better than the other sections even though their answer was more of a list/retrieval type answer vs. a comprehension/cognitive level answer.

Sources of volatility include:
- Interest rates
  - Change in interest rates causes change in value of embedded options
  - Affects the discount rate and account value
  - It will impact the ITM of the guarantees
- Policyholder behavior
  - Policyholders will anti-select against the insurance company by varying their withdrawal rate according to the in-the-money situation of the guaranteed withdrawal benefit. More withdrawal if the guarantee is in the money, increase the volatility of embedded options
  - Includes partial withdrawals, policy loans, and surrenders
- Implied volatility
  - Higher implied volatility in the option market increases the prices of hedging instruments and thus increases the cost of the embedded options.
- Equity returns
  - Affects value of assets backing guarantees, hedging costs, and embedded options
- Assumptions
  - Variance built into assumptions and correlation between assumptions

2. **Continued**

(d)

    (i)   Construct an attribution analysis for the change in value of the option. Show your work.

    (ii)   Determine the percent of change explained by this analysis. Show your work.

Commentary on Question:
Most candidates did attempt to answer this question, but there were some that left the entire section of the question blank. The solution was almost exactly like the study note example, but it seemed that many of the students weren't quite sure of the method as outlined in the study note. Many people were not able to show the full attribution analysis but were able to calculate partial components of the analysis.

(i)
Attribution analysis is attributing the costs associated with hedging to its cost drivers

Delta = Change in Opt Val/Change in Fund
    S&P = (2990-3009) / 2 = -9.5
    Russell = (2992-3007) / 2 = -7.5
    NASDAQ = (2996-3003) / 2 = -3.5
    SBIG = (2996-3004) / 2 = -4.0
    EAFE = (2992-3007) / 2 = -7.5
    MM = (2994 – 3006) / 2 = -6

Rho = Change in Opt Val/Change in Interest Rates
    = (2900-3100) / 2 = -100

Vega = Change in Opt Val/Change in Volatility
    = (3200-2800) / 2 = 200

Actual change in option value = Opt val @ T=2 – Opt val @ T=1
                     = 2350 – 3000 = -650

Index of funds	Val @ T=1	Val @ T=2	% Change
S&P	1090	1070	= (1070-1090)/1090=-1.83%
Russell	1520	1490	-1.97%
NASDAQ	840	730	-13.10%
SBIG	1050	1060	+1.0%
EAFE	1010	1050	+3.96%
MM	1030	1070	+3.89%

2. Continued

Avg Forward rate   4.5%   5.25%   .75 pts
Implied Volatility   0%   0%   0 pts

Discount = (Opt val @ T=1)(one year forward rate) = 3000 x 4.25% = 127.50

Expected change in option value (Sum of fund changes %change (Delta))
+ %change interest(Rho)
+ %change volatility (Vega)
+ %change discount (Theta)=
(-1.83%)(-9.5)/1%+(-1.97%)(-7.5)/1%+(-13.10%)(-3.5)/1%+(1.0%)(-4)/1%+(3.96%)(-7.5)/1%+(3.89%)(-6)/1%
+(.75%)(-100)/.1%
+(0)(200)/1%
+127.50
 = -601.50

Attributed Opt val = 3000 – 601.5 = 2398.5

(ii)

Percent of change explained = 601.50/(2350-3000) = 92.5%

3. **Learning Objectives:**

1.   Describe the product development process.

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

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
- (v)   Implementing and monitoring the product

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

Sources:

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 2 and Chapter 13, sections 13.1 – 13.2 only

Hidden Costs of Administering Complex Products, Nov. 2003 Issue of Product Matters
http://www.soa.org/library/newsletter/product-development-news/2003/november/pdn0311.pdf

Annuity/LTCi Combinations, Product Matters, October 2009
http://www.soa.org/library/newsletters/product-development-news/2009/october/pro-2009-iss75.pdf

Commentary on Question:
Commentary listed underneath question component.

Solution:

(a)   List the key questions that should be answered at this stage of the product development process.

3. Continued

Commentary on Question:
Candidates generally had no trouble with part (a). It was a fairly straight forward retrieval question. The majority of candidates mentioned the Distribution-related items; the better papers also commented on the company-focused items – namely profit potential, sales potential and reinsurance considerations.

The following questions should be answered at this stage of the product development process:

1. Does the product fit with the company's mission, vision and goals?
2. What is the sales potential?
3. What is the profit potential?
4. What administrative capabilities are needed?
5. How much time/resources are needed?
6. Do we need to look into the availability of reinsurance?
7. What are the regulatory requirements?
8. How much education do sales representatives need?
9. Is the new product consistent with the current distribution system?
10. What is the target market?
11. Who will our competition be?
12. What is the estimated shelf life of the product?
13. What will the effect be on sales of existing products (i.e. cannibalism vs. generating new sales)?

(b)   While they determine whether to build a fully operational administrative system, ABC's approach is to put a manual administrative system in place so they can quickly launch their Annuity/LTCI product. Describe the advantages and potential hidden costs of this approach.

Commentary on Question:
Candidates generally answered part (b) well. It was application of a list to a specific situation so slightly more difficult than straight retrieval.

Advantages:

1. Avoid having to remove some design aspects because system cannot administer
2. Ability to address market needs more quickly and gain market share
3. Can keep initial costs low

3.   Continued

Hidden Costs:

1. Results in more expensive manual processes
2. Manual processes are more error prone
3. Need additional staffing, training, and documentation
4. Inability to monitor experience if system not collecting data completely
    a. Risk is product is mispriced
    b. Company may not be able to identify problems to prevent further loss (data errors down the road, ability to identify advisor anti-selection)
5. Lost cross-selling opportunities: Need ability to link policyholders across multiple products.
6. Locked into old technology/method of administering: May not be able to upgrade systems due to inability/cost of matching existing manual process
7. Discounted value of block if want to sell in future

(c)

    (i)   Describe the three common benefit structures of Annuity/LTCI combination products.

    (ii)   For each benefit structure, demonstrate how it works by using a simple numerical example with an initial premium amount of 100,000, and a LTCI benefit of 4% of account value per month.

Commentary on Question:
For part (i), candidates generally knew the names of the three common benefit structures although some didn't understand how they worked so lost out on many of the description points.

For part (ii), candidates had to apply knowledge and create their own numerical example. The readings did not provide numerical examples so the candidates had to really understand what the text was saying and turn it into a numerical example. The candidates who did well in part (i) generally did well in part (ii). In the examples, the key items that were commonly missed were:
- *Assuming a growth rate for the account value*
- *Making it clear they understood what happened after the account value was depleted*
- *Candidates often misunderstood the pool design structure (account value is also depleted; not just the pool)*

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3. Continued

The three common benefit structures are:

Tail design:
- Paid as accelerated benefits until benefit limit is reached
  - The benefit limit is often equal to the account value
- After benefit limit is reached, the benefit extension kicks in and benefits continue unreduced
- The benefit extension will only pay for a maximum number of months which is determined at issue
  - The LTCI requirements must still be met for benefit payments to continue during this extension period

Coinsurance design:
- Accelerated and independent benefits are paid at same time
- The proportion that is accelerated vs. independent is determined at issue and remains fixed for the entire benefit period
- Payments continue until the benefit limit is exhausted

Pool design:
- The maximum benefit that can be paid over the lifetime of the coverage is the LTCI pool amount which is determined at issue
- The LTCI pool amount is usually a percentage (>100%) of the account value
- Benefits paid reduce the LTCI pool amount and the account value on a dollar for dollar basis until the account value is depleted
- Benefits then continue to be paid until the maximum pool amount is paid in full as long as the LTCI requirements continue to be met

Example:

Assume account value growth rate = 0% for simplicity
LTCI benefit of 4% of account value = $4,000 benefit payment per month

Tail design:
- Assume benefit extension = 24 months
- $100,000 / $4,000 = 25 months of benefit payments before account value is depleted
- Benefit payments could then continue for another 24 months so 49 months of benefits payments would be the maximum assuming LTCI conditions continued to be met

3.   Continued

Coinsurance design:
- Assume benefits stop when account value is depleted
- Assume accelerated benefit is 25% and independent benefit is 75%
- 25% * $4,000 = $1,000 accelerated benefit paid out of account value and 75% * $4,000 = $3,000 paid by independent benefit
- Benefit payments will be made for a maximum of 100 months assuming LTCI conditions continue to be met
  - $100,000 / $1,000 = 100 months

Pool design:
- Assume pool amount = 300% of account value or $300,000
- Benefit payments will reduce the account value and the pool until the account value runs out
- Benefit payments will then continue (assuming LTCI conditions continue to be met) until pool is exhausted
- Account value = $100,000 / $4,000 = 25 months of payments before account value is depleted
- At this point, there is still $200,000 left in the pool so payments could continue for a maximum of another $200,000 / $4,000 = 50 months
- Maximum of 75 months of benefit payments in total

4. **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:

(5b)   Identify and explain the setting of an appropriate assumption for risks and other factors such as:

    (i)   Available experience data
    (ii)   The Marketplace
    (iii)   Underwriting
    (iv)   Distribution channel characteristics
    (v)   Reinsurance
    (vi)   Expenses (fixed, variable, marginal)
    (vii)   Taxes (income and premium)
    (viii)   Investment strategy

Sources:
Atkinson & Dallas, Life Insurance Products and Finance, Chapter 7 Reinsurance

Commentary on Question:
Commentary listed underneath question component.

Solution:

(a)   Explain why partnering with a reinsurer could prove to be beneficial.

    Commentary on Question:
    Many candidates mentioned "tax benefits" with no further explanation. No credit was given in those cases.
    Many candidates mentioned "expertise" without elaborating on what kind. No credit given for those cases.

- Limits loss on any one death
- Gain underwriting experience through the use of facultative reinsurance
- Assist with design, pricing, and underwriting standards
- Reinsurer is willing to take majority of risk while company gets comfortable with the risk
- Allows company to write new business faster than available capital will allow
- Reinsurance can accelerate current profits for the company in exchange for a share of future profits.
- Accelerated profits will allow company to offset tax losses incurred while building its infrastructure and economies of scale.
- Company may not want to keep the risk of period-by-period swings that can occur with mortality results.

4. **Continued**

- By reinsuring a large portion of the business on a first dollar basis, the mortality results to become predictable.
- Reinsurer may offer rates that make it more attractive to reinsure rather than retain the business.
- Can help fill market need for product company would not otherwise offer

(b)   Describe the 2 major reinsurance methods available for term products.

Commentary on Question:
Most candidates did well on this section.
YRT expense allowances are not common and many candidates said they were. No credit given for those cases.
Credit given for saying FY YRT expense allowance is paid in lieu of first year YRT premium.

YRT Reinsurance
- Most common form of reinsurance where the company pays an annual reinsurance premium in return for a payment of part of the death benefit if and when the insured dies.
- Mortality Risk transfer only
- YRT Death benefits are based on the Net Amount at Risk
- Can be on a first dollar quota share or an excess basis
- YRT premium rates are typically expressed as a percentage of
  - i)   A company's mortality table for pricing
  - ii) Industry mortality table
  - iii) The Premium/Cost of insurance rates
- A zero first year premium can provide the ceding company with strain relief from writing new business
- Expense allowances are not common with YRT reinsurance. When they actually are provided, they are usually calculated as a % of the reinsurance premiums

Coinsurance
- Simplest and purest form of reinsurance
- In exchange for a share of the premiums paid to the reinsurer, the company receives from the reinsurer that same share of all the policy benefits in addition to an expense allowance
- The reinsurer holds its share of the policy reserves, with the company taking a matching credit
- Coinsurance typically transfers:
  - o   Mortality Risk
  - o   Investment Risk
  - o   Persistency Risk

4. **Continued**

- Expense Risk may remain with the ceding company as they may absorb the deviation between actual and allowable expenses.
- The reinsurer assumes and manages its own investment risk
- Mod-Co and Coinsurance with Funds Withheld allows the company to retain control of invested assets.

(c)   Critique the following statements.

Commentary on Question:
Most candidates did poorly on this section. It is important to justify your response. Simply agreeing or disagreeing is not sufficient. It is helpful to think "Under what circumstances could this happen?"
Parts (ii) and (iii): Partial credit for defining the terms and discussing how they apply to given situation.
Part (v): Accepted many reasonable answers regarding reinsurance quota share percentages, treaties, systems, etc for partial credit

(i) **The recapture feature in a treaty reduces the cost of insurance.**
If the original terms are still attractive, then the business need not be recaptured. If the original terms are no longer attractive, then the recapture provision can be used to terminate all of the reinsurance eligible for recapture. For this reason, recapture will have a significant effect on the net cost of reinsurance.

(ii) **A first dollar arrangement is always more desirable than an excess reinsurance arrangement.**
When designing a new product where the company has little experience, 1st dollar quota share is more desirable as it provides risk transfer on all policies sold. On products with credible experience, a company may choose among both structures

(iii) **Riskier policies are placed at a company that uses facultative reinsurance.**
Facultative reinsurance allows a company to place and then reinsure policies that are either too big or where the insured has complicating factors, such as poor health. Each reinsurer reviews the underwriting material and decides whether or not it wants to make an offer to reinsure the risk.

(iv)**Reinsurance cedes away all the expected profits to the reinsurers**
This is true if the expected cost of reinsurance is similar to the expected benefits of reinsurance. Reinsurer may offer rates that make it more attractive to reinsure rather than retain the business thereby increasing your expected profits at issue.

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4. **Continued**

(v) **Reinsurance administration is complex**
Reinsurance administration can be complex for products that have a Net Amount at Risk (NAR) that changes monthly. BAL's new term product has a level NAR.

5.   **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, Profit
Measurement and Analysis

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

Commentary on Question:
Commentary listed underneath question component.

Solution:
(a)   For the pricing measures above:

        (i)   Define each measure.

        (ii)   List the advantages and disadvantages of each.

        Commentary on Question:
        *Students did okay for the most part of this questions. Students who did better on
        this went the extra mile and defined the terms in depth.*

        Embedded Value
        (i)   Present value of profits discounted at companies hurdle rate
                For stock company hurdle rate is company's weighted average cost of
                capital
                Distributable earnings is preferable as better reflects expected cash flows.

        (ii)   Advantage:
                - Good macro pricing tool to compare different products
                - Shows value created by new business
                - Identifies poor value blocks that need to be addressed
                Disadvantages:
                - Not comprehensive so often used with other measures
                - May be sensitive if hurdle rate changes

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5. Continued

ROI
(i)   Discount rate where present value of profits equals 0
        Distributable earnings is preferable as better reflects expected cash flows.

(ii)   Advantage:
        - Easy to understand by management as it relates to ROE
        - Can compare various potential dissimilar investments
        Disadvantages:
        - Doesn't capture dollar profit
        - May be sensitive where there is low surplus usage
        - Does not convey emergence of profit

ROE
(i)   After-Tax Stockholder Earnings / Equity Base
        Can calculate using stockholder equity at beginning of the year or the avg.
        stockholder equity at beginning and end of year.
(ii)   Advantage:
        - Reflects Capital
        - Easy for CFO to relate to
        Disadvantages:
        - Doesn't capture dollar profit
        - Varies from year to year

Profit Margin
(i)   Present Value of profits divided by present value of premiums
        Profits can be pre-tax or after tax with discount rate pre-tax or after tax.
(ii)   Advantage:
        - Easy to use and explain
        - Widely used
        Disadvantages:
        - Varies by product type
        - Doesn't reflect cost of capital

(b)   Assess the pricing measures as calculated above and recommend changes where appropriate.

        Commentary on Question:
        The students did very well on this part of the exam. Some talked about the measure but didn't make a recommendation.

        - Embedded Value: Discount rate is incorrect, should discount with rate expected by stockholders which is 12%
        - ROI: not an appropriate measure since initial stain is low.

5. **Continued**

- ROE: Should use after-tax stockholder earnings.
- Profit as a percentage of premiums: calculation correctly used investment earns rate.

(c) Recommend other profit considerations to determine whether this product is viable.

Commentary on Question:
Overall the students had the most difficult time with this part of the question. Some students focused on other profits measures versus looking at other considerations you should take into account when looking at the profitability of a product.

- Use sensitivity analysis to see a range of results with likelihood that results will be in the range indicated.
- Look at sub class results to determine cross subsidization risk.
- Stochastic Modeling can be utilized to understand the risk profile
- Calculate breakeven year, which is the first year in which accumulated profits turn positive and stay positive. This is used as a danger sign, if break even after many years, may have higher lapse risk and require more capital for too long.

6. **Learning Objectives:**
1.   Describe the product development process.

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

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
(v)   Implementing and monitoring the product

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

Sources:
Atkinson & Dallas, Life Insurance Products and Finance, Chapter 2 and Chapter 13, sections 13.1 – 13.2 only

EIUL: The Devil's in the Details, Product Matters, August (62) 2005
http://www.soa.org/library/newsletters/product-development-news/2005/august/pdn0508.pdf

Commentary on Question:
Commentary listed underneath question component.

Solution:
(a)   Describe the considerations in entering the Equity-Indexed Universal Life (EIUL) market from the perspective of:

(i)   a company that only offers Variable Universal Life (VUL)

(ii)   a company that only offers Equity Indexed Annuities (EIA)

(iii)   a company that only offers Universal Life (UL)

Commentary on Question:
Candidates that did well described company considerations from entering into a new market and high level administrative constraints and they did not focus on the pricing considerations.

6. **Continued**

    (i)   VUL company entering the EIUL market should consider:
- It should not compete with VUL's current distribution so there would not be channel conflict.
- It also should not take away from existing sales
- The primary concern may be setting up the administration of the product
- VUL is registered, but EIUL is not
- The company could use EIUL to move into a new distribution channel

    (ii)   EIA company entering the EIUL market should consider:
- They could leverage their equity indexed product knowledge and apply it to the life insurance side
- EIUL requires sales illustrations which would be new to an annuity only company
- The distribution system that is only focused on annuities may have a challenge selling life insurance
- It could be harder to enter the market in this situation

    (iii)   UL company entering the EIUL market should consider:
- The administrative capabilities for a UL product will already be set up, so that is a positive but they would need to add capabilities to track the equity market and other details associated with the equity portion of the product
- They will need to train their agents on the new equity indexing concept
- They may be best positioned in terms of speed to market

(b)   KWR Life is considering the launch of its first EIUL. Describe the potential costs and benefits that KWR Life should consider in determining whether to move forward with the development of the new product.

Commentary on Question:
Some students focused too much on the product benefits that would make this product attractive to a customer or less risky from the company's perspective and that was not the intent of the question. A good paper described the iterative steps a company goes through in analyzing costs and benefits within the context of product development and deciding whether to move forward with a product.

- It is important to keep in mind some costs and benefits are intangible or not easily measured

6. **Continued**

- Costs:
    - The purchase or development of software and the maintenance of that software
    - There will be new administration procedures and employees will need to be trained on them
    - Agents and other company staff will need to be trained on the new product
    - Introduction to distribution systems and possible entrance into a new channel
    - Opportunity cost of choosing this project over other projects
    - Potential lost sales or profits on other current products
- Benefits:
    - Potential to increase the company's profits and sales numbers
    - Potential for the company to sell similar products in the future
    - Positive for the company's reputation

(c)

(i)   Critique the proposed product design.

(ii)   Recommend an alternative design which balances the needs of the potential customer and KWR.

Commentary on Question:
Some candidates combined parts (i) and (ii) and did not explicitly make a recommendation and therefore did not receive full credit for that portion of the question. There could be many different answers for part (ii), so the answer shown here is just one example of an answer that would receive full credit.

(i)   Crediting Method: Monthly averaging is not as common as point to point which is simpler for customers to understand and simpler for the company to administer. Although if monthly averaging is used than a higher participation rate or cap can be used since this method reduces hedge costs.

Participation Rate: A rate less than 100% will reduce hedging costs. But using a rate lower than 100% is not perceived well by customers and agents may view it negatively as well. Most companies use 100% and change the index cap instead to lower hedge costs.

Index Cap: Some state regulators discourage changing both the participation rate and the index cap. Changing the index cap has become the primary moving piece in the market. Some companies use a monthly cap rather than an annual cap.

6. **Continued**

Index: The Dow Jones index has been utilized by some in the industry but the S&P 500 is the most popular index with these products. That is primarily because there are more hedging options available for the S&P vs. the Dow Jones and so hedging is more expensive for the Dow Jones.

Initial Index Allocation: When premiums are not transferred very frequently, such as only on the 15th of the month, this allows for better matched hedges for the company. Another option used by some companies is to perform hedges on monthaversaries rather than a set calendar date. But more frequent transfers are perceived more positively by customers.

Fixed Account: Fixed accounts have become popular and an important feature of EIUL product designs. The company has to consider how fees will be assessed and where withdrawals will be deducted from. Also they need to consider how often interest will be credited; monthly is administratively more difficult than annual crediting. Unlimited allocation to the fixed account can result in policyholder anti selection.

No Lapse Guarantee: Including this feature is perceived positively by customers. But it may not be appropriate for an accumulation product. The company would need to consider how indexed interest would be credited if the AV falls to zero and how it would impact reserves for the product. The cost for this guarantee is higher on this product than on a traditional UL product due to the lower guaranteed rate.

(ii)   The following alternative design is recommended for KWR:
   - Recommend changing the monthly averaging to Point to point crediting. This is most common in the industry and easier to understand.
   - Recommend changing the participation rate to 100% and making the index cap the primary moving part to reduce hedge costs. Customers won't feel like they are getting cheated out of part of the index return and 100% is in line with industry practice.
   - Recommend adding the S&P 500 index. Hedging costs could be reduced as there are numerous options for the S&P 500.
   - Recommend adding limitations to the number of allocations and timing of allocation to the fixed account. This will reduce the risk to the company.
   - Recommend not including the No-lapse Guarantee. This option is risky and costly to the company.

7. **Learning Objectives:**
2.   Understand the drivers of product design (the idea generation step).

Learning Outcomes:
(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

Marketing for Actuaries, 2000 Edition, All Chapters

Commentary on Question:
This question tests candidates' knowledge of marketplace demographics, segmentation methods, and agent financing costs. The question is intended to assess knowledge of the material, the ability to synthesize knowledge and support a recommendation, and quantification ability.

Most candidates demonstrated strong knowledge of market segmentation methods. Nearly all candidates recommended and supported a segmentation method, although the degree to which the recommendation was supported varied greatly.

The calculation portion of the question was challenging. Very few candidates provided a fully correct answer. However, many candidates were able to successfully compute the key components.

Solution:
(a)

(i)   Describe each of the consumer market segmentation methods.

(ii)   Recommend one method for GTA Life. Justify your answer.

Commentary on Question:
The candidate is expected to list and describe the five market segmentation methods. The question provides several reasons that behavioristic segmentation is appropriate, along with several reasons that the other segmentation methods are not appropriate. However, if a candidate chose a method other than behavioristic, some credit was still given if the recommendation was adequately supported.

7. **Continued**

Geographic Segmentation - Divides the total market for a product based on the needs and desires of populations in different jurisdictions or physical locations.

Demographic Segmentation - Based on the personal characteristics of people in the markets such as age, gender, nationality, or occupation.

Geodemographic Segmentation - Divides consumer markets into segments by classifying people with similar demographic characteristics into geographically defined clusters.

Psychographic Segmentation - Divides consumer markets based upon attitudes and beliefs and opinions.

Behavioristic Segmentation - Divides markets according to consumers' behavior towards a product or company, such as benefits, usage rate, and buyer readiness.

Because profitability is greatly influenced by the buyers' usage rate, I recommend behavioristic segmentation. Operations are entirely in one state, which implies that geographic segmentation is not as valuable. GTA believes its product will appeal to buyers of all ages, incomes, and attitudes; the lack of differentiation between ages and incomes demonstrates demographic segmentation is not as valuable, and the same with attitudes demonstrates that psychographic segmentation is not as valuable.

(b) Calculate the minimum number of policies that must be sold to ensure all new agent financing costs and issue expenses are covered. Show all work.

Commentary on Question:
The key components to calculate are the cost of first year commissions, the cost of non-vested commissions, and cost of financing new agents. The sum of these components is compared to the gross annual premium to determine expected profit per sale, which is used to derive the number of policies that must be sold to break even.

Total cost of First Year Commissions as percent of gross annual premium (TC$FYV) = 50%
Dollar cost of commissions = (TC$FYC) x (Gross Annual Premium per Policy)
300 x 50% = $150

PV at time t = NVC_t x $(1-O_t)$ x P_t x V_t
Year 1 = 0 x 1 x 1 x 1 = 0
Year 2 = .05 x .95 x .80 x .971 = 3.869%
Year 3 = .02 x .80 x .60 x .943 = 0.905%

7. **Continued**

Total cost of nonvested commissions as a percent of gross annual premium
= sum all years of PVs NVC
= 4.594% (TC$NVC)

Dollar cost of commissions = (TC$NVC) x (Gross annual premium per policy)
= (4.594%) * 300
= 13.7826

Commission[1]	Subsidy	Finance Cost[2]	Cost as % of 1st Year Premium
10,000	15,000	15,000	75%
7,500	7,500	6,000	37.5%
5,000	2,500	500	4.167%
			44.792%

[1] Commission = Commissions required * Agent retention rate
[2] Finance Cost = Subsidy – Unvested Recoveries

Dollar cost of financing new agent = (TC$FNA) x (Gross annual premium per policy)

= (44.792%) * 300

= 134.375

Total cost of issuing one policy = TC$FYC + TC$NVC + TC$FNA

= 150 + 13.7826 + 134.375
= 298.158

Expected profit per sale

= Gross Annual Premium – Total cost of issuing one policy

= 300 – 298.158
= 1.842

Minimum number of policies that must be sold for zero profit

= (Fixed cost of issuing new Universal Life product) / (Expected profit per sale)
= (100,000) / 1.842

➔ Must sell 54,289 policies to cover total agent financing and issue expenses.

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8.   **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

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

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

ILA-D802-07: NAIC Standard Non-forfeiture Law for Individual Deferred Annuities

Stochastic Pricing, Session 62 TS from November 2005 SOA Annual Meeting
http://www.soa.org/files/pdf/062bk-annual05.pdf

Commentary on Question:
This question has a mix of quantitative and qualitative sub-parts. Quantitative results were quite good with most candidates understanding the material and knowledge application. Candidates need to make sure to show their work, and if possible add some short commentary on why calculations are done a certain way. There was relatively weaker performance on the qualitative parts of the question as it seemed like less time was spent on thinking about these.

8. **Continued**

Solution:
You are given the following for an Equity Indexed Annuity:
- Index Period: 4 Years
- Net Earned Rate: 4%
- Guaranteed Minimum Account Value (GMAV) = 95% of premium accumulated at 1% annually
- Commissions: 5% of premium
- No other expenses or charges
- PV of Profit: 3% of premium

(a)   Calculate the option budget. Show all work.

Commentary on Question:
This part was answered correctly by most candidates.

Premium = GMAV Cost + PV(Expenses) + PV(Profit) + Option Budget
$100\% = 0.95*(1.01)^4/(1.04)^4 + 0.05 + 0.03 + \text{Option Budget}$
Option Budget = 7.5% of premium

(b)   Calculate the multi-year guaranteed option cost. Show all work.

Commentary on Question:
Most candidates were able to determine the fund growth correctly but did not continue to calculate the option cost of the multi-year guarantee. Also a lack of explanation on why the option cost is calculated in this way lost marks for the candidates.

TIME	INDEX	IAV	OPTION COST (BEGIN OF PERIOD)
1	1020 / 1000 = 2%	102%	3%
2	975 / 1020 = -4.41%, floor at 0%	102%	3% (102%) = 3.06%
3	1050 / 975 = 7.69%	109.9%	3% (102%) = 3.06%

PV (Option cost) = $0.03 (10,000) + 0.03 (10,200) / (1.02) + 0.03 (10,200) / (1.02)^2 + 0.03 (10984) / (1.02)^3 = 1204.65$

8. Continued

(c)   Explain the benefits of stochastic pricing.

Commentary on Question:
This is a good question for candidates to write in list form. Few candidates were able to get a majority of these points, but most candidates were able to get 2 or 3 of them.

- Useful when the loss distribution is asymmetric, has a wide range of outcomes, significant volatility, and non-diversifiable risks
- Can model dynamic assumptions, most notably policyholder behavior
- Provides a more fulsome understanding of risks
- Changes to product design, features, pricing can be made based on results
- Provides a more realistic projection and range of plausible outcomes
- Sometimes the best estimate assumptions would not lead to any claims.
- Important to model the tail of the distribution
- Distribution of outcomes allows for assessment of likelihood and acceptability of profit (or loss) compared to target

(d)   Senior management wants to buy one year options in hopes the option price will decrease for future years. Explain the risks with this approach.

Commentary on Question:
This part of question 8 was answered most poorly by the candidates. This question asked candidates to apply their knowledge in a realistic situation.

Management is hoping that option prices will decrease but this may not happen. Option prices could increase instead. If future volatility increases, this will increase option prices. The reinvestment rates are also unpredictable. As well, there is no guarantee that the options needed will be available in the future at prices or with transaction costs that are predicted today. Failing to manage the risks behind the GMAV could cause the product to become very unprofitable.

(e)   For a contract issued July 1, 2012:

(i)   Determine the minimum non-forfeiture amount allowed at the end of the Index Period. Show all work.

(ii)   Determine whether the GMAV is above the required minimum. Show all work.

8. **Continued**

Commentary on Question:
Regarding the accumulation rate, candidates could have arrived at the same rate several ways (taking the last reported month, using the value that would give the lowest min NF value, or taking the average). All these methods were acceptable, but marks were given for explaining the logic behind the choice. Even if certain parts of the calculation were wrong, candidates were still able to gain points if they were able to complete the remaining calculations correctly.

Minimum NF requirement: 87.5% x (premium – withdrawals – 50 / year – premium tax – loans) $(1 + I)^t$

Where accumulation rate I = 5 year CMT – 225bp (normally 125bp but EIAs are allowed 225bp), this is subject to a 1% minimum and 3% maximum.

5 year CMT as of date or average over a period within the last 15 months, rounded to nearest $1/20^{th}$. Use 5 year CMT as of Oct 1, 2011 to give the lowest min NF value, round to nearest $1/20^{th}$ = 3.5%

Accumulation rate I = 3.5% - 2.25% = 1.25%

Min NF Amount year 1 = (.875 * 10,000 - $50) * 1.0225 = 8895.75
Min NF Amount year 2 = (8904.45 - 50) * 1.0225 = 9044.78
Year 3 = 9197.16
Year 4 = 9352.97

Contract Value
Year 1 = .95 * 10000(1.01^1) = 9595 > 8896
Year 2 = .95 * 10000(1.01^2) = 9691 > 9045
Year 3 = .95 * 10000(1.01^3) = 9788 > 9197
Year 4 = .95 * 10000(1.01^4) = 9886 > 9353

Yes, since the contact value is greater than the minimum NF value every year, this contract would meet the minimum NF requirements.

9. **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.

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

Learning Outcomes:

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

Hidden Costs of Administering Complex Products, Nov. 2003 Issue of Product Matters
http://www.soa.org/library/newsletters/product-development-news/2003/november/pdn0311.pdf

Hidden Costs of Product Complexity in Nov. 2003 Issue of Product Matters
http://www.soa.org/library/newsletters/product-development-news/2003/november/pdn0311.pdf

ILA-D110-07: Policyholder Dividends

Commentary on Question:
The question tested the candidates' knowledge of transitioning to a new dividend scale, the taxation of dividends, and the hidden costs of an administrative change of a manual to an automated process. The area which caused the most difficulty was the tax treatment of dividends. Most of the candidates did well on the other sections, but those that did well on the tax question differentiated themselves from those that did not.

Solution:
(a)

(i) Compare and contrast the various methods to transition to new dividend scales.

(ii) Evaluate how these methods impact the overall cost.

(iii) Evaluate the proposed scale.

Commentary on Question:
Most candidates answered the key parts of the answer, particularly for Part (i). Many candidates did not provide a good response to (ii), and ended up just repeating their response to (i) and not properly evaluating how the methods impacted costs. In (iii), most students did not evaluate any of the transition methods when evaluating the proposed scale.

9. Continued

(i) The methods are Pegging, Substitution, and Experience Premium. Pegging is a smoothing method that is used if the current dividend to be paid is lower than the prior years' dividend. The method tries to pay a dividend to the policyholder as least as large as last year's dividend. Substitution replaces the current dividend that would be paid with a previous scale, either the original or current scale. Substitution is usually more costly to the Company that either the Pegging or Experience Premium methods. This method needs to consider equity between blocks, like pegging. This method is best used only for recent issues and only for the first few dividends which are normally small. Also, it is used only for annual premium business since little or no early cash values exist. Experience premium method is a modified pegging method, which was used when interest rates were declining. It stopped dividends from declining in dollars, but carried the cost into future years.

(ii) Pegging can become costly, particularly if the dividend scale has declined over a long period of time. The additional cost of Substitution must be reasonable, like pegging. Since all these methods have a cost, they must be temporary (i.e., grade into current scale within a few years) and incur only a small cost. The improved persistency of Pegging and Substitution does offset part of the extra   cost. Other ways to help lower costs are to consider changing scales every few years if a large change is not needed, and also consider the shortest grading   period possible.

(iii) Proposed scale would be cheaper than what pegging would have paid. Pegging would have paid 11 in current year and probably 11 next year. Proposed scale may hurt persistency since dividend paid in current year is lower than previous year. Proposed scale is as equitable as current scale as both current and next year dividends total 19.

(b) Describe the U.S. tax treatment of policyholder dividends on participating insurance policies under:

(i)   The Deficit Reduction Act of 1984, and;

(ii)   Internal Revenue Code Sections 808, 7702 and 7702A.

Commentary on Question:
Many candidates did not know the answer for either (i) or (ii). A number of candidates responded with an answer for (ii) geared to the tax treatment of life insurance, and not specifically answering the question for policyholder dividends.

9. **Continued**

(i) The key point of this question is that DEFRA allowed 100% deductibility of dividends to all life insurers. Also, it eliminated immediate deductions for acquisition expenses by moving from net level reserves to modified CRVM reserves. This change increased dividends which could be credited. Also it increased after tax expense strain for new business. The Law contained a fresh start reserve calculation since the basis of tax reserve changed.

(ii) The key point is that Policyholder Dividends are not reflected in the computation of the 7702 and 7702A statutory definitional limits for tax treatment as life insurance. The traditional definition of policy is that dividend amounts are paid out of Company earnings by virtue of experience better than expected experience. In this view, dividends are earned first, then apportioned out of Company surplus as divisible surplus, then paid. In the law, the dividend is retrospective, as it is paid out of favorable experience.

(c) JPB is currently in the process of replacing the manual tax calculation methodology with tax software programs. Assess the hidden costs involved with this replacement.

Commentary on Question:
Most candidates knew the key hidden costs which were described in the Study Notes. However a number of candidates responded with any type of costs, not necessarily hidden, but this was not the response the question required.

There are people related costs, principally salaries and benefits which need to be considered. These costs are incurred when there is an expertise gap in making this move. The Company may need the services of a consultant to help, but they can be expensive. Opportunity costs need to be considered. Other projects will suffer as those projects will lose the resources devoted to this one. There are extra costs of manual workarounds, including the errors due to the manual process and slower processing speed. Errors are expensive to identify and fix. Errors have bad consequences, i.e., data reliability issues, customer service complaints, incorrect payments, etc. Training costs need to be considered to learn the new software. Communication of the change needs to be done to inform all needed parties. Implementation could mean delays in tax payments.

10. **Learning Objectives:**
3.   Understand the feasibility step of a new product and how it drives design.

Learning Outcomes:
(3f)   Describe non-forfeiture regulation and perform calculations to evaluate compliance.

Sources:
ILA-D800-07: Life Insurance and Annuity Non-forfeiture Practices

ILA-D801-07: NAIC Standard Non-forfeiture Law for Life Insurances: Sections 1 – 4, 5c, 6 - 9

Commentary on Question:
Commentary listed underneath question component.

Solution:
(a)   The "Unruh Report" states "non-forfeiture values of any kind should return to the terminating policyholder whatever equitable value may have been built up in a policy of life insurance."

Define "equitable" from the perspective of each of the following parties:

Commentary on Question:
Overall People answered all parts of question very well. The occasional person talked more about the philosophical meaning of the word "equitable."

(i)   The company is able to recover its costs and make a reasonable profit for assuming risk.

(ii)   The policyholder
A terminating policyholder should receive the return of premiums with interest less a reasonable protection charge. A persisting policyholder should not have their cost of insurance increased due to a terminating policyholder.

(iii)   The agent should retain a reasonable reward for sales.

(iv)   The regulators have conflicting pressures. They want to maximize the return for terminating policyholders, protect the interest of persisting policyholders, and ensure the solvency of the company.

10. Continued

(b)

    (i)   Describe the prospective method of determining non-forfeiture values.

        The non-forfeiture value is the present value of future benefits plus the present value of future expenses and profit, less the present value of gross premiums. Those present values reflect mortality, morbidity, and interest yields. Assumptions may be based on government regulations. Changes in the assumptions after issue change the non-forfeiture value.

    (ii)   List the advantages and disadvantages of using the prospective method for both the company and the policyholder.

        The prospective method is more difficult to understand than others. For flexible premium plans, an assumption for future premiums amounts must be made. Deterioration in experience will lead to changes in non-forfeiture values for existing customers.

(c)   You are given the following excerpts from a draft of JLL's policy:

- "Upon surrender of this policy within 60 days after the due date of any premium payment in default after premiums have been paid for at least four full years , we will pay, in lieu of a paid-up non-forfeiture benefit, a cash surrender value of such amount as described in this contract."

- "This paid-up non-forfeiture benefit shall become effective unless you elect another available option not later than 30 days after the due date of the premium in default."

- "We reserve the right to defer the payment of any cash surrender value for a period of nine months after a request for surrender of the policy."

- "Cash surrender values will never be less than those required under Federal law."

Critique this contract language.

Commentary on Question:
Overall people answered part (c) very well. Where people did struggle it was with paying non-forfeiture for three policy years instead of four and that cash surrender requirements are at a state level, not federal.

10.   Continued

Must pay non-forfeiture after three policy years instead of four
Have 60 days to choose surrender option instead of 30
Can only reserve right to defer payment for 6 months, not 9.
Cash surrender requirements are at a state level, not federal.

(d)   Calculate the present value of adjusted premiums at issue using the net level premium method in accordance with the NAIC Standard Non-forfeiture Law.

Commentary on Question:
Overall people answered part (d) very well. Some people didn't calculate the net premium as $100. Some did not show all work

Present value of adjusted net premiums =
    Present value of future guaranteed benefits
    plus 1% of the amount of insurance
    plus 125% of the non-forfeiture net premium
Non-forfeiture net premium =
Present value of future guaranteed benefits
divided by present value of annuity due
 =800/8 = 100
Present value of adjusted net premiums = 800 + .01 x 10,000 + 1.25 x 100
    = 1025

11. **Learning Objectives:**

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

Learning Outcomes:

(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:

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

Report on the Lapse and Mortality Experience of Post-Level Premium Period Term Plans
http://www.soa.org/files/pdf/research-shock-lapse-report.pdf

Commentary on Question:

The goal to this question is by beginning with the list of relevant factors related to lapse rates, then *applying* the factors specifically to the product design. The objective is to be able to use experience data, but appropriately set lapse rates based on different product features that may not present in the data.

Solution:

(a) Describe the factors by which life and Critical Illness insurance lapse rate assumptions may vary and the impacts associated with each.

Commentary on Question:
Generally a list question, with a description for each. There are some product-specific items.

Common to both:
- Issue Age – higher lapses at older ages when premium jumps occur
- Frequency of Premium Payment Pattern – higher lapses for annual payments are more prevalent at premium jumps
- Policy Size/Face Amount
- Distribution Channel – brokerage tend to have higher lapses than career agents. Quality of agents also plays a role.
- Gender – generally not much variance, but males tend to have slightly higher lapses
- Risk Class – preferreds tend to have higher lapses at premium jumps

11. Continued

Life Insurance:
Plan type (term / universal life) and Product Design
- First year lapses tend to be higher
- For Term, lapses tend to vary based on when premium jumps occur (the shock lapses). Also take into consideration jumps for Conversions and ROP. Could reflect lapse skewness around premium jumps.
- For UL, lapses tend to be higher after surrender charges have expired. First year when CSVs become available would see a lapse increase. Low ultimate lapse rates

Critical Illness:
Product Design
- Shock lapses every 10 years to reflect premium increases
- Could reflect lapse skewness where lapses are concentrated in later months of before premium jump, and earlier months after premium jump.
- ROP option should create 2 sets of lapse assumptions because this is an optional rider - one set with ROP, one set without ROP
- Jump in lapses to reflect the star of the conversion option.
- There should be a higher jump in lapses to reflect the last year the conversion option is available

(b)

(i) Critique Marketing's recommendation, based on the different features and characteristics of each product.

(ii) Recommend appropriate lapse rate assumptions to use in the pricing of each product.

Commentary on Question:
Candidates must remember that when the question asks to critique about Marketing's recommendation, they MUST make an explicit statement to say whether or not it is good or bad. Many candidates just listed reasons. Also, this question only referred to the life products. Some candidates talked about impacts to CI, which got no points. Although relevant in real world analysis, discussion on profitability was not relevant to this question. This question focused on Marketing's recommendation of "averaging lapse rates."

11. Continued

For part (ii), the key is not about actual numbers, but the relative differences between the various points. This is about applying what was written in part (i), and to some degree part (a). Graphs were acceptable, as long as there was clear indication on key points. Some candidates simply stated 'use experience studies or industry studies,' but it does not necessarily incorporate all product features of the product going forward.

(i)
Marketing's recommendation is not a good one
- For Term, the combination does not fully capture the jump in premium at year 10 (i.e. lapse rate wouldn't be big enough). Lapse for conversion privilege that starts at year 5 may not be big enough. Does not capture the ROP beginning in year 15.
- For UL, should reflect expiry of surrender charge after 5 years. Does not reflect a low ultimate lapse rate due to no-lapse guarantee. Spike in year 10 is not appropriate for UL.

(ii)
Term
- Lapses in the first couple of years could be slightly elevated
- Should have a spike in lapses at year 10 or year 10/11 to reflect increased premiums
- Should have a small spike in lapses at year 5 to reflect conversions
- Should have a small spike in lapses at year 15 to reflect ROP, but only in the ROP tables
- In the later years, lapse should level off to a low level, but not close to 0% (like UL)

UL
- Lapses in the first couple of years could be slightly elevated
- Should have a small spike in lapses at year 6 to reflect expiry of surrender charges (NOTE: if lapse in year 5, there would still be a surrender charge)
- Ultimate lapse rate should be very low (close to 0%) to reflect no-lapse guarantee. Although this may dampen the above point, you should still incorporate a spike at year 6 in the lapse tables.

(c) Construct a set of CI lapse rates for a male aged 43 and a male aged 63, clearly labeling points where lapses would change:

    (i)   Assuming annual premium pay with no ROP benefits

    (ii)   Assuming monthly premium pay with no ROP benefits

    (iii)   Assuming monthly premium pay with the inclusion of a ROP rider

11. Continued

Commentary on Question:
The key to this part is not about actual numbers, but the relative differences between the various points. The candidate should have relied on knowledge written down in the prior parts, and applied them here. Graphs were acceptable as long as the points were clearly marked. Candidates MUST distinguish between age 43 and 63, because there were subtle differences. It is important for the candidate to distinguish between persistency and lapse as some candidates labeled persistency graphs as 'lapse rates' on the y-axis.

(i)
Lapse rates for Male Age 43, Annual Premium, without ROP option
- Spikes in lapse rates at renewal points, every 10 years (age 53, 63, 73, 83)
- Small spike at year 5 when conversion starts (age 48)
- Bigger spike at year 25 when conversion ends (age 68)

Lapse rates for Male Age 63, Annual Premium, without ROP option
- Spikes in lapse rates at renewal points, every 10 years (age 73, 83). Spikes could be relatively higher than age 43's spikes
- Small spike at year 5 when conversion starts (age 68)
- Bigger spike at age 80 when conversion ends (year 17)

(ii)
For each age, similar to part (i) with lapse rates for monthly premiums should be relatively lower at the spikes. Can apply lapse skewness where a higher concentration of lapses occur at the later months of year 10, and the beginning months of year 11.

(iii)
For each age, similar to part (ii) with spike at year 15 to reflect the beginning of the ROP being payable. ROP does make the product lapse supported, but only BEFORE the ROP benefit is payable, so would be lower than part (ii) before year 15. The product is not lapse supported after year 15, so would have the same lapse rates as the above.

12. Learning Objectives:

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

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

Learning Outcomes:

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

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

Sources:

Hardy, Investment Guarantees
- Chapter 2, Modeling Long-Term Stock Returns
- Chapter 6, Modeling the Guarantee Liability
- Chapter 9, Risk Measures

Commentary on Question:

Candidates were expected to show (1) understanding of how a Variable Annuity product works and applying knowledge to a new product feature (2) computing risk tolerance metric and (3) describing alternative models for stock price simulation.

Solution:

(a) Calculate the net present value of future combined GMMB and GMCB liabilities for Scenario 1. Show your work.

Commentary on Question:
In general, candidates did poorly in part (a) when attempting to compute the value for the GMCB. Many candidates forgot to deduct fund value for both the GMMB and GMCB and confused management charge with margin offset. However, marks were awarded when candidates showed understanding of the product.

$S(t+1) = S(t) * \exp(\mu + \sigma*\varepsilon)$

$F(t) = \{ F(t-1) - GMCB(t-1) \} * (1-m) * S(t)/S(t-1)$
    where m is the management charge = 0.7%

$M(t) = F(t) * mc * tpx$
    where mc is the margin offset = 0.3%
    and M(t) is calculated at the beginning of the year

12. Continued

GMMB cost = Max(Deposits * 100% - GMCB paid - F(t),0) * tPx,
> This formula is only applied at the maturity date (i.e. year 3)

GMCB cost = Max(60% * Max{ Deposits , F(t) } - F(t),0) * tPx ,
> This formula is only applied in the years prior to maturity (i.e. years 1 & 2)

Net CF = (GMMB cost + GMCB cost) - Margin Offset Income

L(0) = NPV (Net CF)

S(0) = F(0) = 50000

S(1) = 50000 * exp(0.05 + 0.15*0.483) = 56513.13

S(2) = 56513.13 * exp(0.05 + 0.15*-2.516) = 40734.4

S(3) = 40734.4 * exp(0.05 + 0.15*0.5) = 46158.13

Case 1 – Cancer in year 1

Prob (Cancer in year 1) = 1%

Assume GMCB is paid at the end of year 1

M(0) = 0.003 * 50000 * 1 = 150

F(1) = 50000 * (1-.007) * 56513.13/50000 = 56117.54

GMCB cost = Max {60% * Max (50000 ,56117.54) – 56117.54 ,0} * 0.9 = 0

M(1) = 0.003 * (56117.54 – 33670.52) * 0.9 * 0.8 = 48.49

F(2) = (56117.54 - 33670.52) * (1-0.007) * 40734.4/56513.13 = 16066.45

M(2) = 0.003 * 16066.45 * (0.9 * 0.8) * (0.8 * 0.8) = 22.21

F(3) = 16066.45 * (1-0.007) * 46158.13/40734.4 = 18078.23

GMMB cost = Max (50000 * 100% - 33670.52 - 18078.23,0) * 0.258 = 0

L(0) = + 0/(1.05) + 0/(1.05)^3 - 150 - 48.49/(1.05) - 22.21/(1.05)^2 = -216.32

Case 2 – Cancer in year 2

Prob (Cancer in year 2) = (1 – 1%) * 1% = 0.99%

Assume GMCB is paid at the end of year 2

M(0) = 0.003 * 50000 * 1 = 150

F(1) = 50000 * (1-.007) * 56513.13/50000 = 56117.54

M(1) = 0.003 * 56117.54 * 0.9 = 151.52

F(2) = 56117.54 * (1-.007) * 40734.4/56513.13 = 40166.12

GMCB cost = Max {60% * Max (50000,40166.12) – 40166.12,0} * 0.9 * 0.8= 0

12. Continued

M(2) = 0.003 * (40166.12 – 30000) * 0.9 * (0.8 * 0.8) = 17.57

F(3) = (40166.12 - 30000) * (1-0.007) * 46158.13/40734.4 = 11439.08
GMMB cost = Max (50000 * 100% - 30000 - 11439.08,0) * 0.3226 = 2761.41

L(0) = 0/(1.05)^2 + 2761.41/(1.05)^3 - 150 - 151.52/(1.05) - 17.57/(1.05)^2 = 2075.17

Case 3 – No cancer in years 1 or 2

Prob (No cancer in years 1 or 2) = 1 – 1% - 0.99% =98.01%

M(0) = 0.003 * 50000 * 1 = 150

F(1) = 50000 * (1-.007) * 56513.13/50000 = 56117.54
M(1) = 0.003 * 56117.54 * 0.9 = 151.52

F(2) = 56117.54 * (1-.007) * 40734.4/56513.13 = 40166.12
M(2) = 0.003 * 40166.12 * 0.9 * 0.8 = 86.76

F(3) = 40166.12 * (1-.007) * 46158.13/40734.4 = 45195.57
GMMB cost = Max (50000 * 100% - 45195.57,0) * 0.9 * 0.8 * 0.7 = 2421.43

L(0) = 2421.43/(1.05)^3 - 150/(1.05)^0 - 151.52/(1.05) - 86.76/(1.05)^2 = 1718.13

Final L(0) = 1% * -216.32 + 0.99% * 2075.17 + 98.01% * 1718.13 = 1702.91

(b)   Calculate the 95% quantile, and the CTE95. Show your work.

Commentary on Question:
The most common mistake was candidates using the 5th worst scenario instead of 6th for the quantile value.

95th quantile = 95th scenario i.e. 6th worst scenario
CTE 95 is the average of the worst 5 scenarios

Order scenarios in descending order:
scenario 6 = 5834
scenario 44 = 4956
scenario 23 = 3095
scenario 67 = 2094

12. Continued

scenario 17 = 1703
scenario 29 = 1295

95th quantile = 1295
CTE95 = (5834 + 4956 +3095 + 2094 + 1703) / 5 = 3536

(c)   Describe three alternative models to the lognormal model.

Commentary on Question:
Overall, candidates did well on this part.

Multiple models could have been used: AR(1), ARCH(1), GARCH(1,1), RSLN, Empirical, Stable Distribution Family, Wilkie or Vector Autoregression

Autoregressive Models - Autoregressive AR(1) model
- Model where deviation from the long-term mean influences distribution of subsequent values
- Process that moves towards the mean
- Captures autocorrelation in the data in a simple way
- It does not capture the extreme values or the volatility bunching

RSLN model - Regime-Switching Lognormal
- Assumes a discrete process switches between k regimes randomly
- Each regime is characterized by a different parameter set
- More accurately captures the more extreme observed behavior
- Can switch from a low volatility to a high volatility regime
- Provides a very good fit to the stock index data relevant to equity-linked insurance
- Generally found that two to three regimes is sufficient to model data

Wilkie Model
- A multivariate model (several related economic series are projected together)
- Useful to use to project stock process, inflation rates and fixed interest yields
- Designed for long-term applications
- Model is designed to be applied to annual data
- Commonly used for actuarial applications where liabilities may depend on stock prices