DP-IC Model Solutions
Fall 2012

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

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

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

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

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

Designing & Pricing LTCI Combination Insurance Products

Commentary on Question:
Part (a), (b)(i) and (b)(ii) were mostly retrieval questions with some analysis. Most candidates did well on this questions and received full marks, if they knew the lists.
Part (b)(iii) was a knowledge utilization question. No marks were given if the candidate provided only a definition of the segmentation method or if the example contradicted LLL's current market strategy given in the question.
Part (c) was a comprehension question. A lot of candidates had trouble with this question because they provided key pricing considerations that were not specific to LTC product and no explanation was provided. Partial marks were given for a list of pricing assumptions.

1. Continued

Solution:

(a) Live Long Life (LLL) is considering the addition of a new Long-Term Care (LTC) Accelerated Death Benefit Rider to its universal life products. The rider will be offered to new and existing policyholders.

List the top ten pricing mistakes made by the insurance industry as described in PD-5 Pricing Best Practices.

List needed to be from specified note (i.e. PD-5)

- Companies base their prices on their costs, not their customers' perception of value.
- Companies base their prices on the market place.
- Companies attempt to achieve the same profit margin across different product lines.
- Companies fail to segment their customers.
- Companies hold prices at the same level for too long, ignoring changes in costs, competitive environment and in customers' preferences.
- Companies often incentivize their salespeople on units sold or revenue generated, rather than on profits.
- Companies change prices without forecasting competitors' reactions.
- Companies spend insufficient resources managing their pricing practices.
- Companies fail to establish internal procedures to optimize prices.
- Companies spend most of their time serving their least profitable customers.
- Companies rely on producers for perceptions of the company.

(b) LLL wishes to target the new LTC rider to policyholders aged 50-80 and decided not to target prospective policyholders with low and high incomes. The rationale is that low income individuals cannot afford the product and high income individuals can afford to pay for long term care out of their current income.

   (i) Identify and describe this consumer market segmentation category.

   The market segmentation category is demographic. This segmentation is based on the personal characteristics of people in the market such as age, income, life cycle stage, gender, marital status, household composition, and education. Demographic variables are closely associated with consumers' product needs and purchase behaviors.

   (ii) Question: List the advantages and disadvantages of the primary categories of consumer market segmentation.

1. Continued

Geographic Segmentation
Advantages
- Relatively inexpensive
- Easy to perform
- Easy for local sales force to relate to customers in their same geographic area

Disadvantages
- Geographic differences do not greatly influence customer needs and desires
- May not adequately subdivide the market to allow marketer to target viable potential customers

Demographic Segmentation
Advantages
- Relatively easy to identify and measure
- Information about many demographics are easy to obtain from government and private sources

Disadvantages
- May not adequately segment the market
- May not capture the differing needs of market members

Geodemographic Segmentation
Advantages
- Segments can be very well defined

Disadvantages
- Cost is high
- Takes more time to develop segments than other segmentation types
- Company must commit to review this approach as people's lives change and they fit into different segments

Psychographic Segmentation
Advantages
- Gives a much deeper understanding of consumers than demographic or geographic segmentation information

Disadvantages
- More difficult to measure psychographic factors than geographic factors or demographic factors

1. Continued

Behavioristic Segmentation
Advantages
- For existing customers, company already has some information such as preferred purchase method, usage rate, risk tolerance, etc.
- Past behavior is often a good predictor of future behavior
- General information about behavior patterns of customer groups is available from a variety of commercial sources

Disadvantages
- Higher cost than other segmentation methods
- Hard to accurately predict customer behavior
- Difficult to collect info for insurance products

(iii) Provide an example of how each primary category of consumer market segmentation can be used to determine the most appropriate market segment for LLL to pursue.

Commentary on Question:
Candidates needed to provide specific examples relating to each segmentation method, not just providing a definition, relating to LLL's situation.

Below is an example of a solution that would receive full marks:

Geographic:
LLL could target the state of Florida where retired people live and there might be a high interest in LTC insurance.

Demographic:
LLL could stick with their target market plan by targeting individuals ages 50-80 with middle incomes.

Geodemographic:
LLL could combine segmentation to middle income retired people in a specific state such as Florida.

Psychographic:
LLL could target those that have a lifestyle that fits in with being middle income and retired such as golf but may be not a member of a country club.

Behavioristic:
LLL could target those individuals that have inquired about LTC insurance in the past or have a lapsed LTC policy.

1. **Continued**

(c) Explain the key considerations in designing and pricing the LTC rider.

Determine the benefit structure
- Payments based on original death benefit, or death benefit at time or acceleration
- How do riders like inflation protection affect the benefit
- COI charges level or attained age

Mortality concerns such as
- Less anti-selection on accelerated versus stand-alone
- Not all accelerated claims end in death - some recover
- Assume higher mortality for those who use acceleration

Reserve issues
- May need separate LTC minimum reserve
- Disabled life reserve if receiving benefit
- Reduce death benefit to account for accelerated payment

Tax Issues
- If have level premium qualifies as life insurance reserve

Guaranteed Minimum Death Benefits
- If policy offers GMDB consider using stochastic modeling

2. **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:
(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

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

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

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

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

Marketing for Actuaries, 2000 Edition, All Chapters

Commentary on Question:
The goal of the question was to have the student demonstrate an understanding of distribution channels and structure, and how commission structures drive product design. Also, the student needed to demonstrate how to calculate specific profit measures.

The cognitive level of the question was a combination of Retrieval, Comprehension, and Knowledge Utilization.

Solution:

(a)   Describe the types of new agent financing plans available for ABC.

  Commentary on Question:
  In general, the students responded well to this part.

2. Continued

Advances
Loans in anticipation of future earnings
Usually a debit balance at end of financing period

Subsidy
Payments in addition to earned commissions

Salary
Payments in lieu of earned commissions

(b) Calculate the highest renewal commission that meets the profit objective. Show all work.

Commentary on Question:
A number of students received full credit, but the majority either made mistakes in the formulas, and/or were not able to apply the formula to the question asked. The student needed to show the formula and work for calculating the After-tax stockholder earnings, and how to apply the formula to a specific problem to get full credit. One important point for the student to remember is to always show the formulas for all parts, and then to show the work. A number of students only showed the work, and did not get full credit if they had numerical mistakes. Also, some candidates incorrectly used formulas for alternative profit measures, e.g., distributable earnings (which includes required capital).

Formulas:
After-tax stockholder earnings as percent of premium = PV (after-tax stockholder earnings) / PV (Premium)
AT Stockholder earnings = Pre-Tax Stockholder Earnings - Tax - TaxInvIncRC - DefTaxProv
Pre-Tax Stockholder Earnings = ProductCashFlow + InvInc - BenResInc - DACAmort + InvIncRC
ProductCashFlow = Prem - Benefits - Expenses

ProductCashFlow = 1,000 + 15,000 - 9,000 - 1,000 - 1,000 - 2,000
= 3,000
Pre-Tax Stockholder Earnings = 3,000 + 1,000 - 500 - 750 + 500
=3,250
AT Stockholder Earnings = 3,250 - 500 - 200 - 1,000
= 1,550
AT Stockholder Earnings as percent of premium = 1,550 / 16,000 = 9.69%
Need to calculate additional commission expense such that earnings as percent of premium are no less than 6%.

2. **Continued**

Calculate change in ATStockEarn such that Earnings as % of premium are no less than 6%.
(Guess and check) Additional affordable expense is $590 ((1,550 - 590) / 16,000 = 6%.

Now need to calculate annual commission such that PV of additional expense is $590.

PV Commission Factor = (sum t from 2 to 5) Aggregate Policyholder Persistency (t) x (1 - Aggregate Agent Attrition (t)) / (1 + DiscRt) ^t
= .95 x .99 / 1.06 + .9 x .98 / 1.06^2 + .85 x .97 / 1.06^3 + .8 x .96 / 1.06^4
= 2.97

Affordable annual commission = PV Additional Expense / PV Commission Factor
= 590 / 2.97
= $198.46
As percent of premium: $198.46 / $1,000 = 19.85%

(c)

    (i)   Evaluate the appropriateness of the current distribution method through home-service agents.

        Commentary on Question:
        The students generally knew some details about the Home Service agent and the PPGA's, but did not go into specifics about either.

        Home Service Agent is not a good distribution channel
        Typically sell low-face-amount whole life insurance with monthly premium
        Reason: middle-high income market usually buy higher face amount policies
        Reason: ABC is selling single life whole life insurance employee of the insurer
        Reason: more expensive, sell to low-middle income market
        Reason: ABC is targeting middle-high income market, collect premiums door-to-door
        Reason: sophisticated high-income market might not like it

        Home Service Agent is good distribution channel
        In most cases home service agents have an exclusive relationship with the insurance company
        Reason: agents focus on one product / only sell ABC company product
        Can be good depending on the geographical area depends on the area of the market

2.   Continued

Reason: if specific rural then good, more specialized approach and vice versa (negative), all business is assigned to service agent
Reason: no "orphaned" business problem, commissions are not generally vested to the writing agent
Reason: company saves money

(ii)   Evaluate the appropriateness of changing to a PPGA distribution system.

PPGA
Advantages
Target a more upscale market than home-service agents
Engages primarily in personal production, so will sell more new policies
Experienced salesperson, so will be better fit for new products
They spend most of their time selling insurance rather than building agency
PPGA are less expensive because they have minimal office expenses and are not co employees
Could hire fulltime subagents to sell even more policies
Company is allowed to set minimum production requirement that PPGA must meet to maintain their contracts
Disadvantages
Hold contract with several insurance companies
If company does not set min prod reqs or enfore prod reqs, no guar will sell co products
May need to price product more competitively or pay more commission to entice ppga to offer
Company product over other comparable prod offered by PPGA from other companies
May receive technical assistance in the form of computer and advanced sales support
Commissions usually vested

(d)   Critique the terms of the agency contract and identify any contract terms that should be added. Justify your answer.

Commentary on Question:
Similar to Part (c), the students knew a few of the key points concerning items which should be included in all contracts, but did not know the majority of them.

The following are not addressed in the contract and should be:
Changing premiums, on the company's behalf is prohibited.
Altering contracts on the company's behalf is prohibited.
Incurring debts on the company's behalf is prohibited.

2. Continued

Having the right to revise the commission schedule or to reduce commission rates on policies that replace existing insurance coverage with the same insurer.
Reimbursement of expenses is not addressed.
Haven't said what the commission scale is a percent of (for example, percent of premium).
Haven't discussed if first year commission are annualized.
Also doesn't discuss expense allowances and security benefits and Salary compensation.
Haven't discussed if commissions are vested.
If annualized, commissions on the unpaid premium are charged to the agent in the event of a lapse in the first policy year needs to be addressed.
Does not specify the obligations of each party, such as confidentiality and nondisclosure requirements and the agent's obligation to return company equipment and records, including customer files.
Information on bonuses is not provided if there are any, what they are based on.
Does not discuss termination for cause.
This is where the company can terminate the contractor without advance notice and may be relived of various contractual obligations, such as the obligation to pay renewal commissions. Usually there is a list of specific circumstances that allow the insurer to terminate the contract for cause. For example, an insurer usually may terminate a contract for cause if an agent violates specific terms of the agency contract or other company policies, has a license suspended or revoked or is convicted of a crime.

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

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

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
    (v) Implementing and Monitoring the Product

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

Sources:
ILA-D110-07: Policyholder Dividends

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

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

Commentary on Question:
Candidates could not identify actual rather than pricing assumptions when doing calculations.
Candidates mixed up the profit margin formulas from other parts of the study materials.
Very few candidates are able to provide appropriate considerations and recommendations in the cognitive part of the question.

Solution:
(a)
    (i) Calculate the actual mortality rate.

$$\text{Actual Mortality Rate} = \frac{2}{1000} = 0.002$$

3. **Continued**

    (ii)   Evaluate its credibility using a 95% confidence interval (where $z = 1.96$).

$$\text{Variance of Estimated Mortality Rate} = npq$$
$$= 1000 \times (1 - 0.002) \times 0.002$$
$$= 1.996$$

$$\text{95\% Confidence Interval} = q \pm 1.96 \times \frac{\sqrt{\text{Variance}}}{n}$$
$$= 0.002 \pm 1.96 \times \frac{\sqrt{1.996}}{1000}$$
$$= 0.002 \pm 0.00277$$
$$= (-0.00077, 0.00477)$$

    Since confidence interval is plus or minus 100% to 200% of the estimate of the mortality rate, the estimates are not very credible.

  (b)   Calculate the total profit margin from mortality and investment experience.

$$\text{Mortality Margin} = \text{Mortality Charges} - \text{Actual Mortality}$$
$$= 100000 \times (1000 \times 0.0012) - (100000 \times 2)$$
$$= 80000$$

$$\text{Investment Income} = \text{Ending Balance} - \text{Premiums} + \text{Death Benefits}$$
$$= 30620000 - (30000 \times 1000) + 100000 \times 2$$
$$= 820000$$

$$\text{Investment Margin} = \text{Investment Earnings} - \text{Interest Credited}$$
$$= 820000 - 30000 \times 1000 \times 1.5\%$$
$$= 370000$$

$$\text{Total Profit Margin} = \text{Mortality Margin} + \text{Investment Margin}$$
$$= -80000 + 370000$$
$$= 290000$$

  (c)

    (i)   Describe considerations you should make in setting a dividend scale.

    Set aggregate amount of dividends to be distributed.
    Establish a formula in an equitable manner in proportion to major sources of past and current earnings.
    Annual dividends should not vary widely from year to year.
    Smoothing of past results should be done.
    Change dividend scales periodically when changes in experience are material.

3. Continued

Pegging – pay each policy owner a dividend at least as large as previous year.
Substitution – replaces current formula dividend that would be paid with a previous formula scale.

(ii) Recommend a dividend scale to be paid on December 31, 2011. Justify your recommendation.

$$\text{Total Dividends} = \text{Total Profit Margin} \times 0.5$$
$$= 290000 \times 0.5$$
$$= 145000$$

Dividend scale should vary in proportion to how major sources earnings vary, should allow company to retain sufficient earnings so that it can meet future obligations and grow the company. It should pay out most of earnings that are not needed to ensure future ability to meet guaranteed obligations, and retain small amount of earnings as permanent retained surplus.

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:
(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

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

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

Report on the Lapse and Mortality Experience of Post-Level Premium Period Term Plans, (pages 14-31 and 40-51 only)

Product Matters, 10/2011 Level Term Lapse Rates - Lessons Learned Here and in Canada

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

Commentary on Question:
Question was testing the students know on what factors affect lapses rate, how lapses rates differ between different term periods and what changes could done to increase persistency on a product.

4.   **Continued**

Solution:

(a)   Describe the factors that affect lapse rates for term insurance products, including industry trends that have impacted term lapse rate over the last 20 years

Commentary on Question:
Student needed to not only identify the factors but explain how they affected either increase or decrease lapses.

- Shock lapse will happened at the end of the level premium period. Year 21 for T20 and year 11 for T10
- Lapse rate during level premium period decreases as term period increases.
- The higher the jump ratio, the higher the lapse rate.
- Product designs have gone from ART to level premium for a period of years.
- Underwriting enhancements have added preferred risk classes which generally have better lapse rates during the term period but higher shock lapses.
- Brokerage business is more likely to lapse than agent sold business.
- Using Needs based selling has better persistency.
- Levelized commissions have more incentive for agents to encourage insureds to persist.
- Heaped commissions encourage lapsation of policies in later years.
- Smaller polices have higher earlier lapse rates while larger policies have higher later duration lapse rates.
- Conservation programs generally improve persistency at end of premium period
- In a more competitive environment, need to assume a higher lapse rate.
- Older age have lower lapses during level term period but higher shock rates
- Females have better persistency.

(b)   Your Company currently sells a 20-year Level Term Product through brokers. Annual Renewal Term (ART) premiums follow the initial level term period. The brokers would like you to add a 10 year Level Term product to target older individuals.

Commentary on Question:
For (b)(i) the student needed to distinguish between during term period and end of term period. For (b)(ii), the students did well in thinking about solutions to reduce lapses.

(i)   Describe now the lapse assumptions used for the 10-year term product should differ from those used for the 20-year term product.

- 10-year term will have higher lapse rates during the level term period than the 20-year term.

4. **Continued**

- Typically the shorter term periods will have lower shock lapse rates.
- Target market of older insureds will reduce lapses during the level term but increase the shock lapse rate.

(ii) Describe changes which could be made to the 10-year term product or actions which could be taken to improve lapse rates.

- Make sure the Premium Jump Ratio is as low as possible when setting initial period rates and ART rates.
- Add a second 10-year level premium period may improve lapse rates.
- Add a conservation program to encourage customers to stay for another 10-year term or persistency bonus.
- Change commission structure to be more levelized or add persistency bonus.

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

Commentary on Question:
Question was aimed at the Comprehension level.

Solution:
(a) Describe the impact the following would have on your choice of discount rates used in measuring the profitability of an insurance company:
(i) Whether the company is stock or mutual
(ii) Current interest rate levels
(iii) Tax rate
(iv) Product design
(v) Negative profits after the first year

Commentary on Question:
In (i), every paper mentioned stock companies; a few papers lumped stock and mutual companies together, making the same comment for both. Very few papers even mentioned mutual companies. Recommendation: Reread the question before answering.

In (iv) not many papers discussed the risk level of the product.

(i) Stock companies base discount rate on the cost of capital or opportunity cost.
Cost of capital is the rate at which your stockholders expect to earn.
Mutual companies - cost of capital is hard to determine so use targeted rate of return.

(ii) The companies cost of capital is directly related to the current level of interest rates as well as cost of debt, equity market and net cost of capital through reinsurance.

5. **Continued**

        (iii)   Discounting at a before-tax interest rate has no theoretical basis.
                Most companies use only one discount rate for both investment returns
                and discounting for simplicity.
                After-tax rate used to discount negative profits (approximating a
                borrowing rate).

        (iv)   The level of risk associated with the product line and design should be
                reflected in the profit level and discount rates chosen.

        (v)   For most profit measures do the following:
                $i(t)$= discount rate to be applied to year t when present value of future
                profits is positive - normal discount rate
                $j(t)$= discount rate to be applied to year t when the present value of future
                profits is negative

                To calculate the present value of future profits at time zero, start with the
                last policy year and work backwards using the following procedure:

                if PVFP(t)>0 then PVFP(t-1) = PVFP(t)/[1+i(t)] + Profit(t-1)
                else PVFP(t-1) = PVFP(t)/(1+j(t) + Profit(t-1)

(b)   Explain the impact of lowering the discount rate on the following profit measures:
        (i)   Value of New Business (VNB)
        (ii)   Internal Rate of Return (IRR)
        (iii)   Profit Margin (PM)

Commentary on Question:
Overall this question was answered reasonably well. For VNB, some papers said
it would increase and decrease the profits. The majority of papers did say there
would be no impact on IRR, but some papers said there would be an impact. For
profit margin, some people said either increase or decrease, not both.

It's doesn't hurt to give an explanation for your answer.

        (ii)   VNB: Lowering the discount rate would increase the profits on VNB

        (iii)   IRR: No impact on IRR

        (iv)   PM: Lowering the discount rate could increase or decrease the Profit
                Margin depending the incidence of earns and the premium flow

5. **Continued**

(c)   Explain what could cause two life products with identical VNB's to have different PM's

Commentary on Question:
Most papers did discuss the Incidence of profits and the different premium streams. Not many papers discussed discount rate.

Discount Rate - Profit Margin uses pre-tax or after-tax interest rate earned on assets. Products may invest in different assets thus earning a different interest rate which produces a different PV.

Incidence of Profits - Different earning streams can produce the same VNB but have different value where using a discount rate different than the hurdle rate.

Premiums - The two products have different premium stream which make the denominator different or one product may have less premium paid which would affect the denominator in PM but not affect VNB.

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

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:
(1a)   Describe the steps in the iterative control cycle process within the context of product development;
     (v)   Idea Generation
     (vi)   Feasibility
     (vii)   Planning the Design
     (viii) Actuarial Development
- Assumptions
- Profitability Regulatory Issues
- Choice of Model

     (v)   Implementing and Monitoring the Product

(2b)   Analyze how the following drive product design
- Company strengths and weaknesses
- Economic forces
- Marketplace demographics
- Consumer behavior
- Distribution channel behavior
- Competition

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

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

Sources:
Atkinson & Dallas, Life Insurance Products and Finance, Chapter 10 Required Capital

ILA-D118-11: Traditional versus Market Consistent Product Pricing, Senjeeb Kumar

Product Matters, February 2010, Conditional Stochastic Pricing, Sun

6. **Continued**

Commentary on Question:
I think the question was quite good in that it was not ordinary and required the candidate to analyze something that they would see in their day to day work. It also avoided a list type question and those candidates that tried to regurgitate a list without thinking about the actual question were penalized (which is good).
The main problem encountered was that many students (on the US side) recognized the question as an ASOP 42 question and began to list the requirements for actuarial documents. I asked the DP chair about this and we decided that it wasn't an official actuarial statement and so should not need to adhere to those requirements. Unfortunately, this meant that many candidates lost the entire question. I don't think this was overly unfair as the ones that lost all the points did not even attempt to analyze the actual results which is clearly a poor interpretation of the question.

Solution:
Critique the specialist's memo.

To hold the required capital at 450% might be too high as most of the competitors in the market are only holding 300%. Holding extra required capital as compared to the industry may make the product uncompetitive.

Assets backing required capital should be invested more conservatively than common stocks which have a high default risk factor for determining required capital. Consider bonds or other low risk assets.

The average asset default factor is inappropriate. Should identify the default factor for each assets and apply them individually.

Distributable earnings formula is wrong. DE(t) = After tax profit (t) – Increase in RC + Investment income on RC – Tax on investment income on RC. The formula in the memo seems to add tax on the increase in RC.

Required capital is required once the product is sold—they should not wait until the end of the year to inject the capital.

Unless the impact of hedging or ALM strategies are insignificant in the calculation of required capital, they should be taken into consideration. They cannot ignore its impact.

Economic required capital is normally more stringent than the regulatory required capital. Economic capital takes into consideration 1-in-200 years events and is meant to set aside enough capital to withstand the worst scenarios. Economic capital normally also takes into account diversification benefit as compared to the regulatory covariance adjustment. So even if the economic capital is higher than the regulatory capital requirement, economic capital should still be considered as it may be what is really needed to cover the risks.

6. **Continued**

Conditional stochastic pricing ensures solvency is achieved first before considering future profits. It is a powerful alternative to regular stochastic pricing which ignores the possibility of ruin. This method favors companies that are well-capitalized.

7.   **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.

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

Sources:
Atkinson & Dallas, Life Insurance Products and Finance, Chapter 10 Required Capital

ILA-D118-11: Traditional versus Market Consistent Product Pricing

Commentary on Question:
Commentary listed underneath question component.

Solution:
(a)   For the UL and VA products:

(i)   Identify the relevant risk components common to required capital frameworks.

Commentary on Question:
This question asked candidates to identify the relevant risk components common to required capital frameworks for <u>UL and VA products</u>.
The purpose was to test whether candidates knew the risks (by name and a brief description/definition) and to show that they could apply the risks to a particular product.
Some candidates described the risk components but didn't apply their knowledge to the UL/VA products.

Asset Default Risk – risk an asset permanently loses value
•   Significant risk for both UL and VA

Insurance Risk – risk that mortality/morbidity experience exceeds assumed
•   Mortality Risk – significant for UL; small/moderate for VA (if candidate assumed GMDB in base contract), otherwise not for VA
•   Longevity Risk – significant risk for VA (due to GMWB)
•   Morbidity Risk – not applicable to UL/VA (unless there were additional riders)

7. Continued

- May also consider expenses and persistency (or include in Other Risk)

Interest Rate Risk – made up of:
- Disintermediation Risk – risk of loss from selling assets at depressed prices
  - Moderate for UL (secondary guarantee makes it less significant than otherwise), not significant for VA (unless fixed sub accounts)
- Guarantee Risk – risk of not earning the return on future cash flows required to support the guarantee
  - Significant for UL (secondary guarantee) and VA (GMAB/GMWB guarantees)
- Liquidity Risk – risk of not being able to raise cash to meet obligations on time
  - Significant for UL; small for VA (due to separate account assets)

Interest Spread Risk – risk of insufficient spreads due to investment/pricing decisions
- Moderate for UL (secondary guarantee makes it less significant than otherwise), not significant for VA (unless fixed sub accounts)

Other Risks – such as mispricing, legal, regulatory, etc.
- Applies to both UL and VA

(ii) Outline the various risks DVD may face due to changing interest rates.

Commentary on Question:
Successful candidates applied their knowledge regarding interest rate risks from (i), specifically to DVD.
Many candidates only considered the risks of interest rates going up or down but didn't consider both scenarios.

If interest rates rise:
- UL policyholders can earn higher interest rates elsewhere and because money is likely invested long-term, DVD will not be able to match new money rates. As a result, policyholders may surrender and create large outflows that need to be funded by selling assets. DVD will have to sell these assets for a loss and could trigger a downgrade/loss of confidence and more surrenders, creating a ripple effect. (Disintermediation Risk)
- This chain of events will put a strain of DVD's cash resources and make it more difficult to get fair prices on assets when trying to sell quickly (Liquidity Risk).

7. **Continued**

If interest rates decline:
- The ability to earn the return needed to support the ULSG and VA GMAB/GMWB is at risk (Guarantee Risk).
- It will be difficult for DVD to earn the spread it priced for due to a decline in portfolio yield (Interest Spread Risk).

(b) Determine which of these two required capital formulas produces the higher diversification benefit. Show all work.

Commentary on Question:
Some students applied the cost of capital rate (12%) when calculating the economic capital; however, this is not necessary when determining the capital. Some students were confused how to apply the new RBC formula, as this question was written prior to the publishing of the new (extended) formula. Students who were aware of the new formula but had trouble applying it were still given appropriate credit.

Start by calculating the economic capital using the supplied information.

Mortality Component (pre diversification)
= (PV Charges less PV Benefits & Expenses under Best Estimate) - (PV Charges less PV Benefits & Expenses under 30% Mortality Shock)
= (1,000,000 – 1,500,000) – (975,000 – 1,590,000)
= -500,000 – (-615,000)
= 115,000

Lapse Component (pre diversification)
= (PV Charges less PV Benefits & Expenses under Best Estimate) - (PV Charges less PV Benefits & Expenses under 50% Lapse Shock)
= (1,000,000 – 1,500,000) – (1,025,000 – 1,550,000)
= -500,000 – (-525,000)
= 25,000

Investment Mismatch Component (pre diversification)
= (PV Charges less PV Benefits & Expenses under Best Estimate) * Investment Mismatch Charge
= (1,000,000 – 1,500,000) * 5%
= 25,000 *(absolute value)*

Operational Risk Component (pre diversification)
= Fund Value * Operational Risk Charge
= 500,000 * 2%
= 10,000

7.   Continued

Commentary on Question:
A UL product is generally considered a unit-linked plan.
If the candidate considered this product to be a traditional plan, they would have
used the PV Benefits & Expenses to calculate the Operational Risk Component
rather than the Fund Value (as described in the ILA-D118-11 study note).

Total Economic Capital (pre diversification)
= 115,000 + 25,000 + 25,000 + 10,000
= 175,000

Total Economic Capital (with diversification factors)
= 115,000 * 0.80 + 25,000 * 0.90 + 25,000 * 0.25 + 10,000 * 0.75
= 128,250

Diversification Benefit
= 1 – 128,250 / 175,000
= 26.7%

Commentary on Question:
It is most appropriate to compare the diversification benefit between Economic
Capital and U.S. Risk Based Capital on a percentage basis because of the
difference in the size of the absolute quantities.
However, the question did not explicitly state this and credit was given to students
who compared the diversification benefit on a dollar basis, as well.

Next, we calculate the U.S. Risk Based Capital the economic capital using the
supplied information.

U.S. RBC (without diversification/covariance benefit)
= C1 + C2 + C3 + C4
= 3,000 + 5,000 + 1,000 + 500
= 9,500

U.S. RBC (with diversification/covariance benefit)
= sqrt(C2^2 + (C1 + C3)^2)) + C4
= sqrt(5000^2 + (1000+3000)^2) + 500
= 6,903

Diversification Benefit
= 1 – 6,903 / 9,500
= 27.3%

Therefore, the U.S RBC provides a higher diversification benefit in percentage
terms.

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

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

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

Learning Outcomes:
(1a) Describe the iterative steps in the control cycle process within the context of product development;
   (i) Idea Generation
   (ii) Feasibility
   (iii) Planning the Design
   (iv) Actuarial Development
      - Assumptions
      - Profitability
      - Regulatory Issues
      - Choice of Model
   (v) Implementing and monitoring the product

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

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

ILA-D102-07: Equity Indexed Annuities: Product Design and Pricing Consideration (LO#4)

Hardy, Investment Guarantees, Chap. 13 Equity Indexed Annuities

8. **Continued**

Hardy, Investment Guarantees, Chap. 8   Dynamic Hedging for Separate Accounts

Commentary on Question:
Commentary listed underneath question component.

Solution:
(a)   List the stages of product development that are applicable to this implementation.

Commentary on Question:
Candidates were able to this question fairly easily. Some papers gave full descriptions of each but not additional points were given for the descriptions.

Idea Generation or Product idea or discovery
Feasibility
Comprehensive business analysis
Product design or pricing/ Reconciliation and testing
New product implementation
Product evaluation (monitor), post launch

(b)   Propose EIA design features that could be used to increase the participation rate. Explain why each feature would raise the participation rate.

Commentary on Question:
Candidates were able to identify at least some EIA options that would lower participation rate but less likely to explain them properly.

- Averaging Index Growth
  - This method is less expensive than point to point method
  - Daily averaging has tendency to tame volatility of index levels
  - This method will produce 55-60% of an unaveraged calculation

- Margin
  - Introduce or increase the margin
  - Will stunt the growth of the index allowing purchase of less expensive options

- Cap
  - Introduce or decrease the cap
  - Will stunt the growth of the index allowing purchase of less expensive options
- Guaranteed Minimum Account Value (GMAV)
  - Lower the GMAV
  - Allows more money for option budget therefore higher participation rate

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8. **Continued**

- Index Choice
  - Indexes can have different volatility thus different participation rates can be offered

(c) Define static and dynamic hedging and their respective disadvantages.

Commentary on Question:
Candidates were able to identify at least some EIA options that would lower participation rate but less likely to explain them properly.

- Static Hedging is a buy and hold strategy and often involves the purchase of Over the Counter options
  - Disadvantages
    - (a) If funding ratio is $< 100\%$, need to sell option if lapses higher than expected
    - (b) Volume – if low, may pay higher price
    - (c) Complex options might be hard to find and option dealers might charge higher costs
- Dynamic Hedging - involves monitoring the delta (and other Greeks) of the liability portfolio and purchasing instruments that track the index and rebalancing when necessary
  - Disadvantages
    - (a) Cost is a function of volatility and total cost unknown until end of hedging period
    - (b) Does not provide downside protection

(d) Define additional costs associated with dynamic hedging

Commentary on Question:
Candidates received very little points in this section since it was a mix from two sources. If some received credit, it was for the terms and no definitions were given. Overall, very little points were given for this section.

- Discrete Hedging Error
  - Error since trading can't occur continuously over time
- Model Error
  - Real world measure assumes stochastic volatility versus constant volatility assumption
- Transaction costs
  - Are proportional to the absolute change in the value of the stock part of the hedge

8. **Continued**

(e) Calculate the percentage increase in the one year hedging cost at issue if the participation rate is increased to 90%

Commentary on Question:
Many candidates could not get the correct formula for the Hedge cost, they were close but not exact. Many received points for applying the correct numbers in the d1 and d2 formulas (it was disappointing when they didn't apply it correctly!). This section had many grading points and overall many candidates received points in this section.

Hedge Cost = aPe-dn x Norm(d1) - (G - (P(1-a))e-rn x Norm(d2)

Where   G = (Percentage) x P x (1 + accum rt) ^ n
= .95 x 100 x (1.03)^1 = 97.85

Using 70%

d1 = (log(.7 x 100 / (97.85 - 100 x .3))) + (.06 - .02 + .2^2/2)) / (.2)
=(log(1.032) + 0.06) / .2 = .456

d2 = d1 - .2 = .256

Hedge Cost = .7 x 100 x e-.02 x Norm(d1) - (97.85 - 100 x .3) x e-.06 x Norm(d2)
= 70 x e-.02 x .6772 - 67.85 x e-.06 x .6026 = 7.96

Now need to recalculate at 90%

d1 = (log(.9 x 100 / (97.85 - 100 x .1))) + (.06 - .02 + .2^2/2)) / (.2)
=(log(1.024) + 0.06) / .2 = .421

d2 = d1 - .2 = .221

Hedge Cost = .9 x 100 x e-.02 x Norm(d1) - (97.85 - 100 x .1) x e-.06 x Norm(d2)
= 90 x e-.02 x .6628 - 87.85 x e-.06 x .5871 = 9.90

Increase in hedge cost = 9.90 / 7.96 – 1
= 24.3%

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

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

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

Learning Outcomes:
(1a)   Describe the iterative steps in the control cycle process within the context of product development;
     (vi)   Idea Generation
     (vii)   Feasibility
     (viii) Planning the Design
     (ix)   Actuarial Development
          • Assumptions
          • Profitability
          • Regulatory Issues
          • Choice of Model
     (x)   Implementing and monitoring the product

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

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

Sources:
Atkinson & Dallas, Life Insurance Products and Finance, Chapter 10 Required Capital

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

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

Commentary on Question:
Most candidates did well on part (a). US candidates struggled more on part (c) compared to Canadian tracks and were confused with what the fixed annuity product's guaranteed crediting interest rate is. Many candidates did not do well in part (d) as they misunderstood the intent of the questions which is to propose ways to protect the company other than changing the product features. It might be worthwhile to review question wording to avoid similar confusion going forward.

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9.   Continued

Solution:

(a)   Describe the interest rate risks you should be concerned about in developing this product in a low interest rate environment.

The interest rate risks of concerns are as the following:
- Disintermediation Risk: When interest rates increase, lapse is expected to increase as policyholders would look for higher rates elsewhere but the value of fixed income assets such as bonds backing the fixed deferred annuity products would decrease. The company would be exposed to the risk of having to sell assets at a loss to cover liability outflow at the time when interest rate increases.
- Guarantee Risk: The risk that the company might not be able to earn enough investment income to cover the interest guaranteed by the product
- Liquidity Risk: When interest rates increase, lapse is expected to increase as policyholders would look for higher rates elsewhere. The company might be at risk of not being able to raise cash to meet its obligations on time.
- Interest Spread Risk: Total investment return = interest spread + guaranteed crediting rate. In a low interest rate environment, the company might not be able to earn enough return to support the pricing spread leading to spread compression or even no spread.

(b)   Describe a Market Value Adjustment (MVA) and how it benefits your company.

An MVA protects the company from changes in asset market values and also rewards owners if market value increases. Since market values drop when interest rates rise, an MVA would adjust down the cash surrender value and discourage owners from surrendering. This significantly reduces a company's disintermediation risk. Liquidity, credit rating, and market conditions can also impact market values and the company can try to mitigate these by setting the margin at an appropriate level.
MVA is usually expressed as the formula below:
MVA = $[(1+i)/(1+j+k)]^s$, where i=interest rate currently guaranteed, j interest rate guaranteed for new deposits, k=small margin, s= number of years remaining

(c)   Determine the limit on the maximum allowable MVA that can be applied at the beginning of each of the first five years. Assume no premium tax. Show all work.

   (DP- IC)

   MVA = $((1+i)/(1+j+k))^s$
   i=interest rate guaranteed
   j=interest rate guaranteed for new deposits with guaranteed period of s

9. **Continued**

s= number of years remaining for the current interest rate guarantee
k=small additional margin to provide additional protection for the insurance company
MVA =[(1+.03)/(1+.04+0.0025)]^3
MVA=(1.03/1.0425)^3
MVA ='0.988009592^3
MVA = .964458363

(DP-IU)

SNFL = (87.5% of Premiums - withdrawals - contract charge of $50 - premium tax - loans) accumulated at nonforfeiture rate
Minimum nonforfeiture rate = lessor of 3% and 5 year constant maturity treasury rate reduced by 1.25% but not less than 1%
Given the 5 year treasury is equal to 1.36%, the NF rate is 1% which also equals to the guaranteed crediting rate
The $50 charge could be used but as the contract size increases, it will become immaterial and therefore ignored in the following calculation

There are two ways of expressing MVA and credits are given for either answer:

Method 1: Since SNFL = 87.5% premium accumulated at 1% and the account value= 100% premium accumulated at 1%. Therefore the maximum that could be deducted is 12.5% in all years before surrender charges.
This produces a maximum benefit of yr 1 = 3.5% (12.5% - 9% surrender charges), yr 2= 4.5%, yr 3 = 5.5%, yr 4 = 6.5%, yr 5 = 7.5%

Method 2: Maximum MVA @ time t * (1- Surrender charges @ time t) * AV @time t = SNFL @ time t.
At time 1: Max MVA = (87.5% * (1+1%) * premium)/ ((1-9%)* premium *(1+1%)) = 96.15%
At time 2 Max MVA = (87.5% * (1+1%)^2 * premium)/ ((1-8%)* premium *(1+1%)^2) = 95.11%
At time 3 Max MVA = (87.5% * (1+1%)^3 * premium)/ ((1-8%)* premium *(1+1%)^3) = 94.09%
At time 4 Max MVA = (87.5% * (1+1%)^4 * premium)/ ((1-8%)* premium *(1+1%)^4) = 93.09%
At time 5 Max MVA = (87.5% * (1+1%)^5 * premium)/ ((1-8%)* premium *(1+1%)^5) = 92.11%

9. **Continued**

The logistic of calculating MVA is the same in both methods and the only difference is that: MVA in method 1 is added to surrender charge % before applying to AV while in Method 2 MVA is multiplied by (AV – Surrender charges). So at time 1, Max MVA _Method_2 $=$ 96.15% $=$ 1 - Max MVA_Method_1 / (1- Surrender Charge at time 1) $= 1 - 3.5\% / 0.91$ and so on.

(d) Propose other methods of protecting the company versus using an MVA in the product.

Possible ways to protect the company vs using an MVA in the product:
- Invest in assets with cash flow that closely match its liability cash flows
- Limit exposure to this product, e.g. reinsurance and limit sales volume
- Adopt investment strategy that is fairly short term allowing the company to adjust more quickly to changes in interest rates
- ncrease the surrender charges and remove MVA (**DP-IC**)/ Increase the surrender chargers to the maximum allowed by law and remove MVA (**DP-IU**)

10.

Learning Objectives:

1.   Describe the product development process.

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

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

Learning Outcomes:

(1a)   Describe the iterative steps in the control cycle process within the context of product development;
- (xi)   Idea Generation
- (xii)   Feasibility
- (xiii)   Planning the Design
- (xiv)   Actuarial Development
  - Assumptions
  - Profitability
  - Regulatory Issues
  - Choice of Model
- (xv)   Implementing and monitoring the product

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

(5a)   Identify and explain the setting of an appropriate assumption for product characteristics such as the following:
- (x)   Riders
- (xi)   Policyholder Dividends
- (xii)   Equity Linked
- (xiii)   Embedded Options
- (xiv)   Return of Premium
- (xv)   Secondary Guarantees
- (xvi)   Payout Annuity Benefits
- (xvii)   Crediting Methodology
- (xviii) Other Non-Guaranteed Elements

10. Continued

    (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:
Atkinson & Dallas, Life Insurance Products and Finance, Chapters 2 and 13

ILA-D115-10: Variable Annuities, Kalberer and Ravindran, Chapters 5, 9, 10, and 11

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

Commentary on Question:
Commentary listed underneath question component.

Solution:
(a)   Explain the elements of a successful product strategy.

    Commentary on Question:
    In general, candidates did fairly well on this section. Many candidates mentioned target markets but did not elaborate.

- Need alignment between mission, vision, strategy, culture, core competencies, and target market.
- Company should define one or more target markets:
  - Needs to be well defined.
  - Needs clear method of reaching the target market.
  - Needs to be sufficiently large to make it worth targeting.
  - Members of target market have similar buying habits, insurance needs, or other characteristics.
- Risks of product should fit company's goals for stability and financial results.
- Successful companies build on strengths and stick to what they know best.
- Some new products may not fit strategy. But if minimum investment, could lead to important new markets/products.

10. Continued

(b)   Question: Assess whether the new product would meet the company's product strategy. Justify your answer.

Commentary on Question:
In general, candidates did well on this section. Some candidates gave rational but did not make a definitive statement on whether or not it met the company's product strategy.

- Annuities sold to clients who have accumulated some wealth.
- Low/middle income market may not be the best fit for GMIB.
- Avoid developing products out of sync with needs and desires of target market.
- New product does not fit with strategy to focus on lowering unit costs.
    o   Administration of variable annuities with GMIB is complex.
    o   Unit value calculations, regulatory requirements, commissions, and issue expenses lead to high administrative expenses.
    o   Expensive to develop and set up new products.
- Variable Annuity with GMIB is complex and may need agent which does not align with low cost distribution methods.
- Overall, new products do not appear to meet product strategy.

(c)   Question: Describe how the new product could benefit clients in retirement.
Solution:

Commentary on Question:
In general, responses were too brief in this section. Many candidates struggled to describe how a Variable Annuity with a GMIB rider will help clients with their retirement income needs.

- Income annuities provide a predictable income stream.
- Income annuities provide income for as long as the annuitant lives.
- GMIB guarantees a minimum income amount at a future date, regardless of investment performance.
- GMIB has an investment performance guarantee and a guaranteed price for income annuity.
- GMIB payment is based on a benefit base (not contract value) which could be increased each year at an annual rate.
- Variable annuity products can protect against inflation.
- Contract holders may be willing to take greater risks in hopes of achieving higher returns.
- Supplemental income sources are needed to provide for a more comfortable retirement.

10. Continued

(d)   Question: Evaluate this proposal and recommend changes where appropriate. Justify your answer.

Commentary on Question:
In general, responses on this section were too brief. The number of points assigned to this part should have led to longer, more detailed answers. Strong candidates recommended adding various dynamic assumptions. Several candidates discussed the issues with the SPDA assumptions but did not make strong enough recommendations on what needed to be different. Many candidates did not understand payout rates/factors (e.g. thought it was same as utilization rate) and therefore their recommendations did not make sense (e.g. make it a dynamic assumption).

- Recommend adding policyholder behavior assumptions. Value/cost of the guarantee depends on it.
  - o Need stochastic modeling. Policyholder behavior, options, and asymmetric dependency on capital markets make it challenging to model.
  - o Behavior depends on perceived value or In-The-Moneyness (ITMness) of guarantee.
  - o Guarantees are relatively new and contain waiting periods so there is insufficient credible industry data.
- Recommend adding dynamic lapse formula that varies based on ITMness of guarantee.
  - o Lapse assumptions are one of most important policyholder behaviors that drive guarantee cost.
  - o Appropriate to use current experience as starting point since lack of industry studies and need to use company specific factors (design, commissions, and distribution).
  - o Dynamic formula can be one sided (only lowers lapses) or two sided (can increase rate if deeply OTM).
  - o Recommend using one sided since more conservative and this is the company's first GMIB so no experience.
- Recommend adding dynamic assumption on GMIB utilization depending on ITMness, age of annuitant, and duration of contract compared to waiting period.
  - o Without guarantee, annuitization is not common so usually include low or no base annuitization assumption.
  - o Presence of GMIB could alter how policyholder views value of annuitization feature.
  - o Biggest unknown is utilization rate.
  - o Expect spike in utilization right after waiting period, subject to ITMness and age.

10. Continued

- Recommend different payout factors that include conservatism and mortality improvements.
    - o Payout rates could prove costly years later if mortality improves and interest rates decline.
- Recommend adding an assumption for asset allocation.
    - o Most guarantees require policyholder to elect an asset allocation model, or restrict underlying funds to select or limit allocation percentages.

11.

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

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

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

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

Sources:
Marino and Grobe, Canadian Taxation of Life Insurance, 5th Edition
*   Chapter 1 History of Policy Tax
*   Chapter 3 Taxation of Life Insurance Policies
*   Chapter 4 Leveraged Life insurance

Commentary on Question:
The goal of this question is to demonstrate the consideration of Canadian tax regulation rule when designing a product.

Candidate needs to
*   Demonstrate an understanding of the 8% rule and 250% rule as it relates to policyholder taxation.
*   Demonstrate an understanding of exempt testing with application of the 8% test.
*   Demonstrate an understanding of the calculations of the ACB and Accumulating Fund.

Solution:
(a)   Determine whether Ana's policy pass the exempt test for each of the first four years. Show your calculation

   Commentary on Question:
   Overall, most candidates received partial credit for calculating AF and writing down formula for Exempt Test. However, to receive full credit, candidate must go beyond retrieval and show comprehensive knowledge by providing detailed calculation and appropriate conclusion.

   Accumulating Fund (AF) = max (CSV, Maximum Reserve)
   Age 63: AF = max (CSV at 63, Maximum Reserve at 63) = max (4,000, 3,000) = 4,000
   Age 64: AF = max (CSV at 64, Maximum Reserve at 64) = max (8,000, 7,500) = 8,000
   Age 65: AF = max (CSV at 65, Maximum Reserve at 65) = max (13,000, 15,000) = 15,000

11. Continued

Age 66: AF = max (CSV at 66, Maximum Reserve at 66) = max (19,000, 23,000)
= 23,000

Exempt Test Policy (ETP) = Death Benefit (DB) X ETP Factor

Checking for 8% test:
DB does not exceed 8% growth from the prior policy year's DB

Age 63: $108,000 / $100,000 = 8% growth, OK
Age 64: $118,800 / $108,000 = 10% growth, fail.

A new ETP "layer" is required when performing the exempt test
The new "layer" is the amount that exceeds 8% growth. 8% growth would have
given a DB of $108,000 X 1.08 = $116,640. Therefore, new "layer" is $118,800 -
$116,640 = $2,160
Age 65: $128,304 / $118,800 = 8% growth, so OK
Age 66: $138,568 / $128,304 = 8% growth, so OK
Age 63: ETP = DB at duration 1 X ETP Factor for issue age 63, duration 1 = 108
X 40 = 4,320

For ages 64-66: Total ETP = [(DB - 'new layer') X ETP Factor for issue age 63 at
proper duration] + ['new layer' X ETP Factor for issue Age 65 at proper duration]

Age 64: Total ETP = [(118.8 - 2.16) X 80] + [2.16 X 50] = 9,439.2
Age 65: Total ETP = [(128.304 - 2.16) X 120] + [2.16 X 100] = 15,353.28
Age 66: Total ETP = [(138.568 - 2.16) X 160] + [2.16 X 150] = 22,149.28

Exempt Test: Fail if AF > ETP; otherwise, pass. Fail = non-exempt; Pass=exempt
Policy passes exempt test if it passes current policy year, and every policy year in
the future

Perform Exempt Test at each age
Age 61: AF < ETP, so pass
Age 62: AF < ETP, so pass
Age 63: AF < ETP, so pass
Age 64: AF > ETP, so fail

Since the exempt test failed at one duration, the policy fails and is considered
non-exempt

(b)   Determine which option minimize out-of-pocket cost.

11. Continued

Commentary on Question:
Overall, candidates did not do well on this question. Most candidates received some credit for calculating interest payment and comparing the lowest costs among three options. But few of them are able to show comprehensive understanding for three options, their pros /cons and give appropriate conclusion.

Option 1: Collateral Loan cost

Check that the bank would actually loan out $20,000 at policy year 5 if Ana uses the policy to secure it. Since the CSV at policy year 5 is more than $20,000, there is no problem

Total Cost = Total Interest payable = [20,000 X 6%] X 2 = $2,400

Adjusted cost basis (ACB) for PY 5

ACB = Prior ACB + (Premium + Policy Dividend buying PUAs + Interest on policy loans + policy gains + policy loan repayments) - (Proceeds of dispositions + NCPI charges), where each component is for a policy year

For par, dividends are proceeds of dispositions, but the PUAs they buy are additions to the ACB (i.e. They cancel each other out in the ACB formula). Since the par policy has the paid-up addition (PUA) dividend option, they can essentially be ignored

ACB at policy year 5 = cumulative premiums - cumulative NCPI = 30,000 - 12,000 = 18,000
Proceeds of Disposition is the amount of the partial withdrawal/policy loan = 20,000

Option 2: Policy Loan cost

Check that the bank would actually loan out $20,000 at policy year 5 if June uses the policy to secure it. Since the CSV at policy year 5 is more than $20,000, there is no problem

Policy Gain = Proceeds of Disposition – ACB
Policy Gain for Policy Loan = 20,000 - 18,000 = 2,000
Taxes payable = Policy Gain X Marginal Tax Rate = 2,000 X 40% = 800
Total Interest payable = [20,000 X 3%] X 2 = $1,200

Total Cost = Total Taxes payable + Total Interest payable = 800 + 1200 = 2,000

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11. Continued

Calculate the ACB at the end of policy year 6 under the policy loan option, and the partial surrender option

ACB at policy year 6 = Prior ACB + (Premium + Interest on policy loans) - (NCPI charges) = 0 + (5,000 + 600) - 3,900 = 1,700
ACB at policy year 7 = Prior ACB + (Premium + Interest on policy loans + policy loan repayments) - (NCPI charges) = 1,700 + (5,000 + 600 + 20,000) - 4,500 = 22,800

Option 3: Partial Surrender cost

ACB must be prorated by the ratio of the (partial surrender over the accumulating fund)

Accumulating Fund (AF) = max (CSV, Maximum Reserve)
AF for PY 5 = max (25,000, 30,000) = 30,000
Prorate ACB at PY 5= partial surrender / AF X ACB at policy year 5 = 20,000 / 30,000 X 18,000 = 12,000
Policy Gain = Proceeds of Disposition - prorated ACB
Policy Gain for Partial Surrender = 20,000 - 12,000 = 8,000
Total Cost = Taxes payable = Policy Gain X Marginal Tax Rate = 8,000 X 40% = 3,200

Looking at the 3 options, the Policy Loan option is the lowest cost, so June should take the policy loan

Additional pros /cons of the three options:

1) Collateral loan option:

The policy continues to grow on a tax-deferred basis
Some institutions may offer more flexible options (e.g. Principal paid upon death)

2) Policy Loan option,

Lose tax-free growth within the policy
May be able to have deductions from your income tax

3) Partial surrender option

With the partial surrender option, you outright lose a portion of the policy and hence lower death benefit. This in turn like the policy loan makes you lose tax-free growth potential in the policy

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12.

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:

(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:

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

Designing & Pricing LTCI Combination Insurance Products

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

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

Commentary on Question:

This question was trying to test the candidates' ability to not just produce a "list" of comments, but to customize the "list" into comments that were applicable and not applicable to the situation presented.

Candidates receiving full marks for this question were rare. The amount of information written was not consistent with the expectation of a 9 mark question.

Solution:

(a)   Critique the proposed assumptions and recommend changes where appropriate. Justify your answer.

12. Continued

(i):
- Disagree with this recommendation. The use of industry tables is a reasonable approach, except annuity experience is different from life experience, and should not be used. Life insurance is typically underwritten while annuities are not.
- Life mortality can vary widely from company to company based on target markets and underwriting obtained to issue the policy.
- The company should try to analyze factors applicable to their business that will affect mortality.
- Mortality improvements are normally used with income annuities. Caution should be used in setting mortality improvement factors for Life Insurance.

(ii):
- Disagree with this recommendation.
- To understand the cost of acceleration benefits, you need to identify separate mortality rates for those who have triggered LTCI benefits versus those who have not.
- Recommend developing the incidence and termination rates from first principles.

(iii):
- Disagree with this recommendation as it would not be appropriate to use standalone LTC product lapses for a life product with an LTC acceleration benefit.
- As the base policy is a Whole Life policy, it would be appropriate to look at industry experience, but need to consider the impact of the product design on the ultimate lapse rates used.

(iv):
- Disagree with this recommendation as the annuity portfolio would not be appropriate for the new product line.
- A separate asset segment would be appropriate based on a target asset mix.

(v):
- Disagree with this recommendation as projecting unit costs is not consistent with the company's pricing framework of full cost/expense pricing.
- OR: Recommend considering deviating from the company's pricing framework and utilizing relevant cost pricing to establish expenses for the new profit line because full-cost pricing could result in the new product being unprofitable/unsellable.

12. Continued

(vi):
- Disagree with this recommendation as the company's pricing framework requires full cost/expense pricing. The claims expenses will be a combination of Whole Life experience and LTC experience.
- Would be appropriate to consider industry benchmarks for both.

(vii):
- Disagree with this recommendation as it would not be reasonable to assume for a new line that claim costs will be substantially better than industry experience.
- Internal claims efficiency in the annuity line of business will not necessarily translate into better than industry experience for life business.

(viii):
- Agree with the recommendation of using LTC industry incidence & termination rates as a starting point.

(b) Explain the benefits of scenario testing in pricing this product.

- Scenario testing looks at a plausible set of assumptions.
- Due to the uncertainty in all assumptions, it is useful to test variations through sensitivity testing.
- Sensitivity/Scenario testing should be done for incidence, severity, persistency, and interest rates.
- Sensitivity analysis helps you understand the relative sensitivity of individual assumptions.
- In establishing assumptions, it is important to understand the financial impact of likely deviations from experience.
- Allows you to better understand the product's risks and establish mechanisms to monitor and manage those risks in the future.
- Results of the scenario testing can lead to:
  a) Changes in the product design
  b) Changes to the assumptions used in the pricing
  c) Cancellation of the product

13.

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

(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, Chap. 6   Modeling the Guarantee Liability

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

Commentary on Question:

The question wanted to know if the candidate fully understood the GMIB option rider product; for example, could the candidate explain how the rider worked, when it was "in the money." The candidate also needed to know the risks inherent in this option rider, and what factors would influence the value of this option and how and when it could be optioned.

The Cognitive Levels required would be Retrieval, Comprehension and Analysis

The candidate needed to understand this option guarantee and when it would provide a payoff, "in the money." They also need to fully understand the risks and risk factors that would contribute to potential losses to the issuer.

13. Continued

Candidates had trouble with part (b), they either read it too fast or did not fully understand the payout scenarios under the Monte Carlo simulations' values that were provided. Only 6 values were provided in descending order in the question, but that is all that was needed to calculate the option value/price, since all other values would have resulted in a zero. Candidates thought all 1,000 Monte Carlo values should have been provided or at least the top 50 for the CTE 95%, so many candidates thought the question was in error.

Solution:

(a)   Explain the risks inherent in a GMIB rider

Shortfall Risk – when assets are not sufficient to pay the guaranteed benefits
There are two components of this:
-assets performance: assets perform worse than expected
-biometric risk: risk caused by excessive longevity

Combined risk of asset performance and biometric risks.

For GMIB, excessive longevity will cause greater number of payees than expected, this will increase shortfall risk.
Poor asset performance will also lower the fund value.

(b)   Given the Monte Carlo simulation values provided, calculate the price of this GMIB rider and also calculate the value of the CTE 95%.

Commentary on Question:
This is where candidates got confused, they did not think they were provided all the necessary information; also, the grading outline had a small oversight, the first scenario value (line 10) was discounted for interest and survivorship, but the next two values were not (lines 11-12). We gave full credit to those that discount the values correctly and partial credit if they had the option value correct for that scenario, but just did not discount

Payoff = $\max(\text{GMIB}/a_x^{\text{Guar}} * a_x^{\text{Curr}} - Fn, 0)$

Scenario	Payoff
389	260
589	146
900	20
1	0
18	0
456	0

13. Continued

Since the scenarios are ordered, the other 994 values are worth 0. Hence
The GMIB option value = $(260 + 146 + 20) / 1{,}000 * e^{-0.015 * 10} = 0.3667 * 0.96 = 0.352$

The CTE 95% is the average of the (1-0.95)% or 5% of 1,000, the average of 50 worst scenarios.

(c)   List the factors that would contribute to individuals exercising this option

- "In the moneyness"; this can be calculated with formula:
- -ITM = $GMIB(a^c_x / a^g_x) / AV$
- -If the guarantee is in the money, the ITM formula is > 1, so the GMIB will be exercised more often, and vice versa
- Tax considerations might affect the GMIB and whether the benefits will be taxed and at what rate
- Age of customer - If customer is young he/she might want to earn more money with the VA
- The income needs of the annuitant will affect the option utilization rate
- The length of the waiting period and whether there is an annuitization bonus or withdrawal penalties will affect the GMIB

14.

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 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:

Atkinson and Dallas, Life Insurance Products and Finance - Chapter 3

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Describe the following expense philosophies:

Commentary on Question:

Candidates were to distinguish between the two approaches of developing expense assumptions in pricing. Generally written moderately well - those candidates who did poorly, gave incomplete or vague explanations of the approaches.

(i) Full Cost Pricing

- Also known as Fully Allocated Expenses
- Allocates all company expenses in pricing - when the proper rates are multiplied
- By the associated units the entire company expenses are reproduced
- This makes it difficult to produce a competitive product
- Actual price customers will pay is not taken into account - some companies price
- Using expense goals rather than actual expenses

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14. Continued

        (ii)   Marginal Expense Pricing

- Also known as Relevant Cost Pricing
- Allocate only those expenses that are affected by changes in sales levels
  - Incremental and avoidable costs
- Incremental costs are those associated with changes in pricing or sales levels
- Avoidable costs are those that have not occurred yet or are reversible
- They could be "avoided" depending on the pricing decision
- Common mistakes: treating as incremental expenses that are more step in nature
  - Overlooking opportunity costs
  - Averaging total variable costs to get a single unit cost

(b)   Create an underwriting and issue unit cost grid. Show all your work.

Commentary on Question:
Candidates were to use data on various costs to produce unit issue costs. For the most part this section was well written. A number of candidates lost marks for only showing a grid of numbers without any identifying information.

Unit cost = cost of medical tests + underwriting time + policy issue cost
Sample calculations
Age 20-39 Face amount 0 to 250,000
Cost = 50 (Saliva Test) + 150 (junior underwriter) + 50 (policy issue) = 250
Age 40-59 Face Amount 250,000 to 999,999
Cost = 85 (urine test) + 150 (junior underwriter) + 50 (policy issue) = 285
Age 40-59 Face Amount 1M+
Cost = 85 (urine test) + 125 (blood test) +250 (senior underwriter) + 50 = 510
Age 60+ Face Amount 1M+
Cost = 85 (urine test) +125 (blood test) + 300 (medical exam)
+ 625 (2.5 hrs of senior underwriter) + 50 (policy issue) = 1185

Total Cost Grid			
			Face Amount
Age	0 – 249	250 – 999	1M+
20 – 39	250	285	510
40 – 59	285	285	510
60+	635	635	1185

14. Continued

(c) Construct refreshed per policy and percent of premium expense assumptions to use in the pricing for next year for each product line. Show all your work

Commentary on Question:
Candidates were to adapt current year data in formulating usable expense assumptions for pricing for next year's business. A large portion of the candidates scored poorly on this section. Many omitted it and some others were clearly unfamiliar with the material. A common mistake among those who did comparatively better was to try and make all expenses a percentage of premium rather than employ both per policy and percentage of premium rates.

-apply acceptance rate to applications received
  Term 2000 x .75 = 1500
  UL   2800 x .75 = 2100
  Par   1600 x .75 = 1200
              Total   4800

-apply inflation to underwriting costs
  Term 150,000 x 1.02 = 153,000
  UL   400,000 x 1.02 = 408,000
  Par   350,000 x 1.02 = 357,000
-per policy cost of underwriting
  Term 153,000/1500 = 102.00
  UL   408,000/2100 = 194.29
  Par   357,000/1200 = 297.50
-apply inflation to admin and overhead expense
  (90,000+200,000) x 1.02 = 295,800
-per policy cost of admin and overhead = 295,800/4800 = 61.63
Total per policy cost
  Term 102.00 + 61.63 = 163.63
  UL   194.29 + 61.63 = 255.92
  Par   297.50 + 61.63 = 359.13
Commission rates (all products) = 340,000/870,000 = 39.1%
Add other % (all product)   = 10%
Percentage of premium expense = 49.1%

(d) Assume the premium margin is 75% and that 150,000 of term premium produces 18,000 of profit. If term prices decrease by 3% calculate the breakeven sales rate.

14. Continued

Commentary on Question:
Candidates were to demonstrate knowledge of profit measures. There are different approaches that will come up with the proper answer. The one shown is the simplest but anyone coming up with the correct answer received all or most of the grading points. Some candidates lost marks by not identifying the numbers used in the calculation.

Profit Margin = Profit/Premium = 18,000/150,000 = 12%

If y is the required breakeven sales increase and z is the premium decrease
y = (Profit Margin)/ (Profit Margin + z x Premium Margin) - 1
   = .12/(.12-.03*.75) - 1 = 23.08%

(e)   Question: Recommend expenditures that can be undertaken to improve customer service and retention.

- Institute a 1-800 number
- Expand the hours of the call center
- Enhance website so customers can access policy information online
- Enhance the underwriting function to improve turnaround times