ILA LP Model Solutions
Spring 2014

1. **Learning Objectives:**
  3. The candidate will understand the relationship between the product features, their inherent risks, and the selection of appropriate pricing assumptions, profit measures and modeling approaches.

  4. The candidate will understand actuarial requirements of product implementation and the monitoring of experience versus product assumptions.

Learning Outcomes:
  (3a) 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.

  (4b) 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:
Expected Mortality: Fully Underwritten Canadian Individual Life Insurance Policies, CIA Education Note, July 2002 (Exclude Appendices)

Does Preferred Wear Off? Product Matters, July 2004

Commentary on Question:
This question tested the candidate's knowledge on identifying and calculating proper credibility techniques and the impacts of mortality trends on different underwriting classes.

Solution:
  (a) List the criteria for a good credibility method.

1. Continued

Commentary on Question:
Only four of the five points listed below were required for full marks. Candidates were generally able to identify most of the criteria.

- The method is practical to apply / simple to use
- The sum of expected claims for the within-company sub-categories is equal to the total company expected claims.
- All of the relevant information is used.
- The results are reasonable in extreme or limiting cases.
- The sub-category A/E ratios are reasonable relative to company and industry data.

(b) Explain why the Greatest Accuracy Credibility Theory (GACT) is not commonly used in practice.

Commentary on Question:
Many candidates were able to identify the lack of industry data as the reason why GACT is not commonly used. However, in most cases the candidates did not provide the additional detail to receive full credit.

- The difficulty with GACT lies in the data currently available for the industry.
- While companies can track their own A/E ratios over time by sub-category, the problem of estimating the "between company" variation remains because no company has access to another's data.
- Many companies group mortality data for submission to experience studies, and grouped data is not sufficiently detailed to support the calculation of the parameter estimates.

(c) Under the Limited Fluctuation Credibility Theory (LFCT), the criterion for full credibility is $\Pr\{|X - m| \leq -r\lambda\} \geq p$, where *r* is the error margin and *p* is the confidence level.

(i) Identify when the expected aggregate amount of claims (X_E) is a good estimate of future expected mortality.

(ii) You are given:

1. Continued

Mortality Experience Data			
	Male	**Female**	**Total**
Industry Data			
A/E Mortality Ratios	74.0%	75.0%	74.5%
Company Data			
A/E Mortality Ratios	67.7%	61.9%	65.4%
Actual Number of Claims	158	93	251
Expected Number of Claims (assuming 100% industry mortality)	233	149	382

The number of deaths required for full credibility is 3,007.

Calculate the expected number of claims for females using the normalized method and an appropriate level of credibility.

(iii)   Describe a shortcoming of the LFCT method.

Commentary on Question:
Part (i): candidates were given partial credit for mentioning a specific distribution, or a distribution in general.
Part (ii): Common errors by candidates were
1. Calculating a credibility weighted number of claims instead of A/E ratios,
2. Using actual number of claims instead of expected in calculating the blended expected claims, and
3. Normalizing the expected claims using the inverse of the <step 2>/<step 3> ratio. Partial credit was given for listing the correct steps even if no calculations were performed.
Part (iii): Very few candidates were able to identify the shortcoming of the LFCT method.

(i) X_E is a good estimate of future expected mortality if the difference between X_E and its mean μ is small relative to μ with high probability.

(ii)   Formula for Credibility Factor: $= \min \{ \text{sqrt}(n / 3{,}007), 1 \}$
Step One: Calculate credibility factor total company and each segment
Male: $\min \{ \text{sqrt} (158/3{,}007), 1 \} = 0.2292$
Female: $\min \{ \text{sqrt} (93/3{,}007), 1 \} = 0.1759$
Total: $\min \{ \text{sqrt} (251/3{,}007), 1 \} = 0.2889$

1. **Continued**

> **Step Two: Calculate total company blended expected mortality ratio**
> = Z x (Company A/E Mortality Ratio) + (1 − Z) x (Industry A/E Mortality Ratio)
> = (0.2889) x (0.654) + (1-0.2889) x (.745) = .7187
>
> Calculation of Total Blended Expected Number of Claims
> = (Total Blended Expected Mortality Ratio) x (Total Company Expected Claims)
> = (0.7187) x (382) = 274.55
>
> **Step Three: Calculate the expected number of claims for the total company**
> Calculation of Blended Expected Mortality Ratio
> Male: (0.2292) x (0.677) + (1-0.2292) x (0.74) = 0.7256
> Female: (0.1759) x (0.619) + (1-0.1759) x (0.75) = 0.7270
>
> Formula for Company Male & Female Expected # of Claims
> = (Blended Expected Mortality Ratio) x (Company Expected # of Claims)
> Male: (0.7256) x (233) = 169.06
> Female: (0.7270) x (149) = 108.32
>
> Calculation of Company Total Blended Expected # of Claims
> = (Company Male Blended Expected Claims) + (Company Female Blended Expected Claims)
> = 169.06 + 108.32 = 277.37
>
> **Step Four: Normalize the A/E ratios from Step 3**
> Calculation of Company Female Normalized Expected Claims
> = (Company Female Blended Expected # of Claims) x (Total Blended Expected # of Claims Company) / (Total Blended Expected # of Claims Industry)
> = (108.32) x (274.55) / (277.37) = 107.21

    (iii)   There is no theoretical basis for determining the parameter values p and r used in the criterion.

(d)   The table below summarizes the mortality experience of the preferred versus non-preferred mortality cohorts.

1. Continued

Ratio of Preferred to Non-Preferred Mortality				
	Males		Females	
Years After Underwriting	Issue Ages 31 - 50	Issue Ages 51 - 70	Issue Ages 31 - 50	Issue Ages 51 - 70
1 - 5	52%	68%	43%	57%
6 - 10	50%	79%	47%	65%
11 - 15	55%	95%	42%	77%
16 - 20	57%	101%	48%	91%

(i) Interpret the mortality trends observed from this table.

(ii) Recommend modifications to the aggregate mortality assumption based on this information.

Commentary on Question:
Part (i): Most candidates were able to identify that the preferred mortality wore off over time for the older cohort but not the younger cohort. Many candidates failed to define "wearing off".
Part (ii): Partial credit was given if the candidate showed understanding that the preferred table should be increased to an aggregate population experience table but does not recommend a method or time period to be used. Credit is reduced if the candidate discusses select and ultimate periods.

(i) In earlier durations following policy issue, the preferred to non-preferred ratio is low, indicating better mortality experience for preferred risks.

For both males and females with lower issue ages (i.e. the 31 – 50 range), the low ratio of preferred to non-preferred persists into later durations as well.

This indicates that preferred does not wear off for the younger issue ages for both males and females.

For higher issue ages the ratio increases to close to 100% or even slightly over.

This indicates that the preferred status is "wearing off", and it is wearing off more quickly for males than females.

Preferred wearing off means the preferred and non-preferred risks would revert over time toward overall standard regular underwriting mortality rates.

1. Continued

(ii) For the females and males with issue ages 31-50, a preferred table is appropriate for all durations.

For males with older issue agues (i.e. ages 51-70), the preferred mortality rates should be applied for the first 10 years.

For females with older issue ages (i.e. ages 51-70), the preferred mortality rates should be applied for the first 15 years.

After the first 10 or 15 years for males or females, respectively, the non-preferred mortality rates should be used since the preferred status does not appear to apply anymore.

2. **Learning Objectives:**
3. The candidate will 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) 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.

(3c) 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:
ILA-D107-07: Experience Assumptions for individual Life Insurance and Annuities

ILA-D106-07: Gross Premiums for Disability Waiver Benefits

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

ILAD105-07: Life and Annuity Products and Features (LO#3)

Commentary on Question:
Overall candidates did well on this question. A differentiation in the candidates included the ability to correctly complete the calculations and go more in depth in the analysis connecting the relationship between a term product lapses and mortality.

Solution:
(a)
  (i) Describe the factors affecting the lapse rates for the above term product.

  (ii) A recent lapse study carried out on the whole in-force block of policies produced the following results:

2. Continued

Policy Year	Lapse rate (%)
1	20
2	10
3	5
4	4
5+	3

Recommend the expected lapse assumption to be used for the re-pricing of this term product.

Commentary on Question:
Candidates did well on listing factors affecting lapses; some struggled with connecting the renewability period and shock lapses.

(i)

- Policy Year: rates usually start high then decrease rapidly the first several years and level off after 5-10 years
- Policy Size: larger policy size generally has lower lapse rates
- Frequency and Method of Premium Payment: more frequent premium payments have higher lapses; automatic withdrawals will have lower lapses than directly billed
- Class variation: can vary by issue age, risk class, gender, tobacco
- Term products have higher lapses than Permanent Products
- Compensation: a level compensation pattern will promote persistency compared to a heaped structure that will have more higher earlier lapses
- A shock lapse rate at the end of the guaranteed renewablity period (20 years)
- Rate of Premium Increase: The larger the increase in premium the larger the higher the lapse rate
- Waiver of Premium Benefit will help decrease lapses

(ii) For policy years 1-20 the lapse rates from the lapse study seem appropriate. Term products have a high first year lapse then grades down to an ultimate lapse rate. After year 20 because of the renewal period a shock lapse is expected; the size of the shock lapse will be in proportion to the size of the premium increase. It can also be appropriate to split the lapse assumptions by gender, underwriting class, age or policy size.

2. Continued

(b)

   (i)   Evaluate, and recommend ways to improve if applicable, the credibility of best estimate mortality rate of 0.005/year for the term policy based on a 95% confidence level.

   (ii)   Recommend changes, if any, to the best estimate mortality rate of 0.007 per year for a permanent policy.

   (iii)   Calculate the charge to be included in the pricing of the term product to account for the conversion feature, assuming converted policies are not included in the mortality experience studies, and the Net Amount at Risk is equal to the Face Amount in all years

Commentary on Question:
Part i) most candidates were able to correctly calculate the confidence interval and recognize that because of the wide range it has low credibility.
Part ii) most candidates were able to connect that because of selective lapsation the best estimate mortality should increase. Many candidates had errors when calculating the actual mortality rate.
Part iii) wasn't well understood by many candidates and they weren't able to correctly calculate the conversion charge.

(i)

- For a 1000 policies => Expected claims = nq = 5/1000 * 1000 = 5
- Variance = npq = 1000 * (1-.005) * .005 = 4.975
- 95% Confidence level of the mortality rate = Expected claims +/- 1.96 (Var)^(1/2) = 5 +/- 1.96 * (4.975)^(1/2) = 5 +/- 4.37 = (.63, 9.37)

note: can either be per 1000 or claim amount
Poor credibility due to the high variance and small amount of data
To improve credibility:

- can combine company data with industry data or other internal data from a similar product
- can combine data with other internal data from a similar product
- Use more years of experience

(ii)   qdNorm = 9/1000
    qdSelect = 7/1000
    qwNorm = 3%
    qwExtra = .09 - 0.03 = 0.06
    SelectPct = 75%

    qwSelect = (0.09-0.03) * 75% = 0.045
    qwNon-select = 0.06-0.045 = 0.015

2. **Continued**

qdActual = {(1-qwNorm-qwNon-Select)qdNorm-qwSelect*qdSelect} / {1-qwNorm-qwExtra}
qdActual = {(1-0.03-0.015)*9/1000-0.045*7/1000} / {1-0.03-0.06} = 0.0091

Recommend to increase best estimate mortality due to selective lapsation.

(iii)   qdconvterm ([x]+t+s) = mortality rate for converted policies originally issued at age x, converted at duration t of the term policy, inforce at duration s of the permanent policy
qdperm ([x+t]+s) = mortality rate for permanent policies issued at age [x+t] and inforce at duration s.

NAR(s) = Net Amount At Risk at duration s for the permanent policy

The cost of extra anticipated mortality in year (s) after conversion =
NAR(s) * [qdconvterm([x]+t+s) - qdperm([x+t]+s)]

The charge included in the pricing is the pv of the cost of extra mortality =
NAR(s) * [qdconvterm([x]+t+s) - qdperm([x+t]+s)] * annuity factor =
 (.009 - .007) * 10 = .02 per $1000 of Face Amount (or NAR since they are equal)

3. **Learning Objectives:**
2. The candidate will understand the design and purpose of various product types, benefits and features.

3. The candidate will 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) Describe in detail product types, benefits and features.

(2c) Evaluate the feasibility of the recommended design.

(3a) 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.

(3b) 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) Expenses (fixed, variable, marginal)
(vii) Taxes (income and premium)
(viii) Investment strategy

(3c) 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

(3e) Describe when a stochastic model should be used, its advantages and disadvantages, how to build it and how to analyze its results

3. **Continued**

Sources:
ILA-D116-10: Variable Annuities, Kalberer and Ravindran, Chapter 10 Overview of Commonly Used Risk Management Strategies

Hardy, Investment Guarantees, Chapter 6 Modeling the Guarantee Liability

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

Stochastic Modeling: Theory and Reality from an Actuarial Perspective, IAA – Intro, various parts within Sections 1-4

Commentary on Question:
In general, candidates dumped the relevant lists on the page but failed to actually answer the question, i.e. the specific risks of the new Vampire product. Too much effort was spent on listing general hedging risks instead of the actual product risks. Most candidates did not demonstrate that they could apply what they learned in the source material to the actual question.

Solution:
(a) Describe risks of the new VA product. Recommend strategies to manage those risks.

> **Commentary on Question**: *This part of the question was answered poorly by most candidates. Many people wrote down long lists of general risks, often without any description of what they mean or how they relate back to the Vampire product. In order to receive full credit, candidates were expected to draw connections between the risks described in the source material and the product information given in the question.*

> The Vampire product exposes ECC to pricing risk – the risk of losses to the company if the GMDB and GWMB are priced too aggressively or if the risks are not managed appropriately.

> The large number of funds available, especially foreign funds which are riskier and more volatile, will increase the cost of the GMDB and GMWB, depending what fund allocation the policyholder chooses.

> The Vampire product also exposes ECC to policyholder behavior risk due the design features of the product. The GMWB feature allows policyholders to choose when and how much to withdraw. The reset feature is also an implied option that the policyholder can use once per year, further increasing the risk of the product. These policyholder behavior options are risky to ECC since a rational policyholder will optimize their own benefits in a given economic scenario to the detriment of ECC.

3.   **Continued**

ECC has the following options to manage the risks:
- Naked or no risk management
- Static or semi-static hedging
- Implement a dynamic hedging strategy
- Reinsurance

ECC can also manage risk through the product design. The following product design changes could be made to reduce risk:
- Reducing the amount or number of guarantees
- Setting a deferral period for the withdrawals
- Removing the reset feature or reducing the frequency of resets
- Limit the number of funds available or use index funds which are easier to hedge
- Set constraints on asset allocation

(b)

(i)   Describe modeling techniques for all policyholder behavior assumptions relevant to Vampire.

(ii)   Explain limitations surrounding the modeling techniques.

(iii)   Critique these assumptions and recommend appropriate changes.

Justify your answer.

Commentary on Question:
This part of the question was answered poorly overall. Most candidates recognized that lapse rates should be modeled dynamically, but few people discussed the other policyholder behavior assumptions. Some candidates also confused economic assumptions with policy holder behavior assumptions. Candidates generally understood that term assumptions were not appropriate for Vampire product and did a good job recognizing the differences.

(i)   Policyholder behavior varies with the perceived value or in-the-moneyness (ITM) of the guarantees.
- ITM for GMDB = Guarantee Value / Account Value
- ITM for GMWB = PV benefits / Account Value

The following policy holder behavior assumptions need to be modeled dynamically:

3. **Continued**

Lapses

Lapse rates vary by ITM of the guarantees and, therefore, require dynamic modeling. Lapse rates should decrease when ITM increases, and lapse rates should increase when ITM decreases. Start with a base lapse rate and apply a dynamic lapse adjustment factor.

Dynamic lapse = base lapse * λ

where λ = min [cap , max { floor, 1 - sensitivity * (GV / AV - trigger point) }]

The dynamic lapse adjustment factor can be one sided or two sided
- One sided is capped at 1 (i.e. Only serves to decrease base lapse rate)
- Two sided can increase lapse rate beyond base lapse (considered less conservative)

Withdrawal Amount

Withdrawal amount can be modeled with 2 methods (or a combination of both):
- Dynamic modeling
  - Withdrawal is based on ITM, age, qualified / non-qualified status, distribution channel and product incentives
  - A single dynamic formula is usually not sufficient
- Cohort modeling
  - Policies are split into different cohorts
  - Withdrawal behavior varies by cohort, e.g. Cohort A withdraws 0%, B withdraws 100% and C withdraws 80%

Withdrawal Timing

Withdrawal timing can be modeled in one of 2 ways:
- Can assume that the policyholder withdraws right away or when first available (if there is a waiting period)
- Can model using cohorts similar to cohort modeling described for withdrawal amount (i.e. each cohort has a different withdrawal schedule)

Asset Allocation

Assume a static asset allocation as it would be too complicated to model transfers across 200 different funds.

Reset Usage

Resets can be modeled in one of 3 ways:
- an optimal reset usage, i.e. reset at the best possible time (conservative assumption)
- reset on a fixed schedule, e.g. reset on policy anniversary

3. Continued

- reset whenever reset is available, i.e. whenever AV > 1.05 GV and reset has not been utilized for the year

(ii)
- Dynamic formulas may break down due to unforeseen policyholder reactions and irrational behavior
- Lack of credible data (dynamic models have not been validated)
- Experience studies need to be done on a regular basis
- Life events will play a role regardless of market performance, e.g. a lapse / withdrawal may be driven by need instead of ITM of the guarantee
- Dynamic modeling relies on adequate stochastic models
  - ITM drives dynamic formulas and ITM depend on economic scenarios
  - It is important to choose a good interest / equity model
  - Simplifications such as cell grouping may distort dynamic models

(iii) Mortality Tables
- Vampire will not require underwriting
- T10 policyholders will have different mortality rates due to different underwriting criteria
- T10 mortality tables will be split into different categories: M/F, premium bands, smoker / non-smoker etc
- It is not adequate to use T10 mortality tables, adjustments have to be made.
Renewal Expense
- VAs have higher administrative expenses than Term products due to
  - Daily calculation of unit values
  - Infrastructure required for timely processing of all transaction
  - Service cost e.g. customer service centre, frequent updates on account balance, etc
- Using the same unit expense as Term 10 is not adequate
- It is not adequate to use T10 renewal expenses. Need to increase the T10 expenses reflect the higher administrative expenses of VAs.
Inflation Rate
- Inflation will determine future increases in renewal expenses. It is adequate to use the same inflation rate since this is not a product specific assumption.

3. Continued

10% Annual Return
- Stochastic modeling is required since ITM of the guarantees varies by economic scenario.
- An Economic Scenario Generator (ESG) should be used to forecast returns
- The ESG may involve the joint simulation of many variable combinations such as:
  - multiple equity indices,
  - several points on the yield curve
  - currency exchange rates
  - inflation rates
  - yield curves in multiple countries
  - historical and implied volatilities

(c) With respect to projecting underlying stock returns:

(i) Evaluate the use of both lognormal and Wilkie models.

(ii) Recommend a more appropriate model. Justify your recommendation.

(iii) Describe other steps for implementing a stochastic modeling process.

Commentary on Question:
This part of the questions was generally answered well. Many candidates were able to list the pros and cons of both the lognormal and Wilkie models. To receive full credit, the candidate needed to relate the pros and cons back to the Vampire product described in the question, and most candidates failed to do this. The majority of candidates received full credit for recommending the RSLN model as a more appropriate model, and for listing the steps required for implementing a stochastic modeling process.

(i) The lognormal model is simple and tractable. It provides reasonable approximations over short time intervals, but is less appealing for longer-term applications. Vampire's GMDB and GMWB features are long term in nature, making the lognormal model inappropriate.

Also, empirical studies indicate that the lognormal model fails to capture extreme price movements and that a distribution with fatter tails should be used. The model also fails to capture volatility bunching and doesn't allow for autocorrelation of the data.

3. Continued

Therefore, it would not be appropriate for ECC to use a lognormal model to project stock returns underlying the Vampire product.

The Wilkie model is a multi-variate model and was developed for long-term applications. The problem with this model is that it was designed and fitted as an annual model and is an unsatisfactory approximation for contracts with monthly cash flows. This is important for the Vampire VA since there are reset opportunities for the policyholder to increase the guarantee any time during the year. Also, annual models are too infrequent to use for dynamic hedging strategies.

Therefore, it would also not be appropriate for ECC to use a Wilkie model to project stock returns underlying the Vampire product.

(ii) Recommend the Regime-Switching Lognormal Model (RSLN).
- This model maintains the attractive simplicity of the lognormal model such as mathematical tractability, but more accurately captures the more extreme observed behavior.
- It is also one of the simplest ways to introduce stochastic volatility and allow you to reflect the fact that the market may switch between stable, low-volatility periods and more unstable high-volatility periods.
- The RSLN model also provides a good fit to the data relevant to equity-linked insurance.

(iii)
- Describe the goals and all of the intended uses of the model.
- Decide if stochastic modeling is necessary or if an alternative approach will yield equally useful results.
- Determine which of the projection techniques should be used, if a stochastic model is deemed appropriate.
- Decide on the risk metrics (VaR, CTE, etc.) to use.
- Establish which risk factors need to be modeled stochastically.
- Determine the approach for modeling these risk factors in terms of which distributions or models should be used, and how to parameterize or fit the distributions.
- Determine the number of scenarios necessary to reach the point at which additional iterations provide no additional information about the shape of distribution.
- Calibrate the model.

3. **Continued**

- Run the model.
- Validate the model and review output.
- Conduct a peer review.
- Communicate results.

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Learning Outcomes:
(2a)	Describe in detail product types, benefits and features.

(3a)	Identify and explain the setting of an appropriate assumption for product characteristics such as the following:
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(vi)	Secondary guarantees
(vii)	Payout annuity benefits
(viii)	Crediting methodology
(ix)	Other non-guaranteed elements.

(3e)	Describe when a stochastic model should be used, its advantages and disadvantages, how to build it and how to analyze its results.

Sources:
Stochastic Modeling: Theory and Reality from an Actuarial Perspective, IAA – Intro, various parts within Sections 1-4

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

ILA-D102-07: Equity Indexed Annuities: Product Design and Pricing Consideration (LO#3)

Commentary on Question:
Commentary listed underneath question component.

Solution:
(a)	Calculate the percentage growth in the Index Account Value at the end of three years.

Commentary on Question:
Most candidates understood the calculations. Some candidates did not calculate the GMAV, so full marks were not given as they failed to demonstrate the need to compare GMAV and IAV.

4. **Continued**

GMAV0 = 90% (by definition)
GMAV1 = GMAV0 x 1.03 = 92.70%
GMAV2 = GMAV1 x 1.03 = 95.48%
GMAV3 = GMAV2 x 1.03 = 98.35%

Index Based Interest1 = Greater of 0% and Min({[(S&P1/S&P0) x Participation Rate] - Margin }, Cap) = 5.75%
Index Based Interest2 = Greater of 0% and Min({[(S&P2/S&P1) x Participation Rate] - Margin }, Cap) = 8.00%
Index Based Interest3 = Greater of 0% and Min({[(S&P3/S&P2) x Participation Rate] - Margin }, Cap) = 0.00%

IAV0 = 100.00%
IAV1 = IAV0 x (1 + Index Based Interest1) = 105.75%
IAV2 = IAV1 x (1 + Index Based Interest2) = 114.21%
IAV3 = IAV2 x (1 + Index Based Interest3) = 114.21%

The percentage growth in IAV at the end of three years is 14.21%

(b) Describe the criteria that must be met to use a book value valuation method on a block of EIA business in the U.S.

Commentary on Question:
Not many candidates answered this part correctly. Some knew "Hedged as Required" must be met, but failed to explain/describe the concept correctly.

To use book value valuation (Type I Method, Enhanced Discounted Intrinsic Method):
"Hedged as Required" criteria must be met.
* Must provide ensurances that no matter how the market value of the options or liabilities behave, the Index-Based Interest is actually being hedged by the options.
* the market value of the options being held as hedges should also move in the same direction and at the same magnitude as the market value of the liabilities
* The appointed actuary has to be able to show that any Index-Based Interest is accounted for in some sort of hedging instrument & that no matter what the Index Returns are, the Index Account Value is funded adequately.

(c) Describe the practical considerations an actuary should consider when using stochastic deflators.

4. Continued

Commentary on Question:
Unfortunately, due to a discrepancy between the original and final published syllabus, the published syllabus did not cover the content of this section of the question.

Practical considerations of deflators:
- Deflators tend to be numerically unstable as the growth rate and risk-free rate are simulated simultaneously
- Deflators tend to require more simulations for convergence than risk-neutral valuation.
- Deflators tend to require more sophistication within the Economic Scenario Generators
- Deflators tend to be less transparent than risk-free rates.

(d)   Calculate the stochastic deflator for the given scenario.

Commentary on Question:
Similar to the comment in part c), the published syllabus did not cover the content of this section of the question.

$t = 10$ (10 Years)
$q_i = 0.25$ (Risk-neutral scenario probability)
$p_i = 0.30$ (Real-world scenario probability)
$r = 0.03$ (Risk-free interest rate)

Deflator = $(q_i / p_i) * (1 + r)^{(-t)}$
Deflator = $(0.25 / 0.30) * (1.03)^{(-10)}$
Deflator = 0.62

(e)   Describe the key differences between risk-neutral and real-world scenarios, and recommend which should be used by GJ. Justify your recommendation.

Commentary on Question:
Most candidates knew the discount rate differences and the difference in investor risk preferences between the two types of scenarios. Cash flow difference was missed by most candidates. The question specifically asked for a recommendation with justification, yet many candidates did not make any recommendations.

Cash Flow differences:
- Real-world cash flows are expected cash flows.
- Risk-neutral cash flows are risk-adjusted cash flows.

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4.   Continued

Discount Rate differences:
- The real-world discount rate reflects the risk associated with the cash flows.
- The risk-neutral discount rate is the risk-free discount rate.

Risk-neutral scenarios use an unrealistic assumption about risk premiums for purposes of calculating derivative prices under the no-arbitrage assumption. Real-world scenarios take into account investor risk preferences.

The goal of real-world scenarios is to produce a realistic pattern of underlying market prices or parameters that will ultimately be used to generate realistic distributions of outcomes

Candidate should recommend REAL WORLD scenarios
- Best for "What-If" type questions / What outcome might we expect if market prices behave as we might realistically expect?"
- Because the company is interested in hedging capital risk, Real World is best.

5. **Learning Objectives:**
4.   The candidate will understand actuarial requirements of product implementation and the monitoring of experience versus product assumptions.

Learning Outcomes:
(4a)   Describe and evaluate compliance with illustration regulation and other policy form regulations
(4b)   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-D804-09: NAIC Life Insurance Illustrations Model Regulation

LP- 128-13 : Guideline G6 - Illustrations

Commentary on Question:
Commentary listed underneath question component.

Solution:
(a)   Compare and contrast Guideline G6 Policy Illustrations in Canada and the NAIC Life Insurance Illustrations Model Regulation with respect to the content and structure of illustrations.

Commentary on Question:
Some candidates did not receive maximum points as a result of not answering the question in the manner requested. The question asked for "compare and contrast." Some candidates did not receive maximum points if their response was a list of features of the Guideline G6 and a separate list of features of the NAIC Regulation with no additional analysis or insight provided regarding similarities and differences.

Similarities
- The purpose of both is to provide guidelines for the format and the content of the illustration in order to educate and not mislead the client.
- Both require the illustration date, Page X of Y, and insured information (age, gender and underwriting class).
- Both require the illustration to clearly disclose what is guaranteed and what is non-guaranteed.
- Both require the illustration to contain the name of the product and generic name, brief description of the product.
- Both require the name of the preparer, producer and the name of the insurer.
- Both provide the rules for New Business, Supplementary and In-Force illustrations.
- Both forbid the use of an illustration that does not comply with the G6 or NAIC Model Reg.

5.   Continued

- Both G6 and NAIC Model Reg do not apply to Individual and Group annuity contracts.

Differences

- When presenting non-guaranteed elements, G6 requires at least two scenarios, the second one having to be less favorable than primary. Can have more scenarios that clearly indicate the assumptions (these could be more favorable.) The NAIC Model Reg does not allow scenarios that are more favorable than the illustrated scale.
- The NAIC Model Reg requires a narrative summary, a numeric summary, tabular details and statements signed by the producer and by the person for who the illustration is produced.
- The NAIC Model Reg forbids the use of an illustration that is not self-supported or that is lapse supported (unless can't develop nonforfeiture values).
- The NAIC Model Reg requires a statement that the results may be less favorable.
- The NAIC Model Reg forbids the use of the words "vanishing premium."
- The NAIC Model Reg states that guaranteed elements should be presented before non- guaranteed elements.
- The NAIC Model Reg states that the illustration cannot be presented as something other than life insurance.
- The interest rate for G6 in primary should reflect a reasonable assumption as to the long term performance of the market while the NAIC Model Reg requires that interest rate is equal or lower than the earned interest rate underlying the disciplined current scale.
- If there are tax consequences, G6 requires a disclosure that it is based on the current interpretation of the tax law.
- The NAIC Model Reg requires that commissioner is informed for all policy forms if policy will be sold with or without an illustration.
- G6 allows incomplete illustration as long as it is indicated that it is incomplete (and can indicate where to find more information). The NAIC Model Reg does not allow for incomplete illustration.
- G6 requires that if the policy will fail the exempt test, that it is indicated on the illustration. The NAIC Model Reg does not require anything for PH taxation
- The NAIC Model Reg forbids leading to think that something non-guaranteed is guaranteed.
- The NAIC Model Reg requires that account value and surrender value be shown in close proximity.
- The NAIC Model Reg requires annual certification by the illustration actuary. The illustration actuary is appoint by the board of directors and has qualification standards.

5. **Continued**

(b)   Criticize the illustration based on the general rules and format from the NAIC Life Insurance Illustrations Model Regulation.

Commentary on Question:
Candidates generally scored well on this part of the question. Some candidates mistakenly thought the risk class, age, issue date, death benefit and premium shown above were part of the illustration. This information was not part of the illustration.

The following are issues with the illustration:
- The name and business address of the producer are missing.
- The age and gender of the insured are missing.
- The underwriting classification is missing.
- The initial death benefit is missing.
- The application of non-guaranteed element is missing.
- The illustration should be labeled with the date on which it was prepared.
- The illustration should have each page numbered and show the relationship to total number of pages.
- The assumed dates of payment receipt and benefit payout need to be clearly identified.
- The guaranteed death benefits and values upon surrender need to be shown and clearly labeled guaranteed.
- The guaranteed elements need to be shown before corresponding non-guaranteed elements
- The illustration of non-guaranteed elements needs to be accompanied by statement indicating benefits and values are not guaranteed, assumptions subject to change by insurer, and actual results may be more or less favorable.
- The illustration is missing values for every fifth year after policy year 10 and ending at age 100, policy maturity or final expiration.

6. **Learning Objectives:**

2. The candidate will understand the design and purpose of various product types, benefits and features.

3. The candidate will 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) Describe in detail product types, benefits and features.

(3a) Identify and explain the setting of an appropriate assumption for product characteristics such as the following:
(i) Riders
(ii) Policyholder dividends
(iii) Equity linked
(iv) Embedded options
(v) Return of premium
(vi) Secondary guarantees
(vii) Payout annuity benefits
(viii) Crediting methodology
(ix) Other non-guaranteed elements.

Sources:

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

Marketing for Actuaries, 2000 Edition, Chapter 4 Traditional Distribution Systems

Commentary on Question:

In general this question is testing the candidate's ability to evaluate the design and purpose of various product benefits and features. The candidate will understand the relationship between the product features, their inherent risks, and the selection of appropriate pricing assumptions, profit measures and modeling approaches.

Solution:

(a) SEM attributes the success of this product to the use of an effective distribution channel, simplified underwriting and special product design on premium and commission. Critique the validity of this statement.

Commentary on Question:
In general candidates did well in this section. Most candidates were able to identify that the product is essentially a decreasing term product and that SEM was likely attracting substandard mortality and high lapse rates.

6. Continued

Effective distribution channel
ABC distributed this product through mortgage brokers, which are the independent agency distribution channel
Have direct access to the target customers. The best point of sales with this product is when the mortgage was originated.
Low cost - do not need to finance, train or house agents who represent them.
These agencies may represent several companies and therefore not as effective as dedicated sales force.

Simplified underwriting
Help to keep underwriting cost low and increase competitiveness of the product.
Since Bank and mortgage brokers are not professionally trained in selling insurance, simplified underwriting makes selling through these channel possible. Simple health questionaire and no medical test will lead to high insurance application acceptance rate and fast approval process. This facilitates the rapid growth of the volume.
Simplified underwriting is not effective in sceening out substantial mortality, which in turn could lead to higher overall mortality risk for the company.

Premium design
Guaranteed premium is appealing to customers because premium is guaranteed not to increase regardless of experience.
Level premium is easy to adminster therefore help to keep system and adminstrative cost low.
On the other hand level premium is not well suit for decreasing term insurance since rate per 1000 will increase as outstanding mortgage balance decrease overtime.

Commission
Large heap first year commission provide high insentive agents to generate new business, good strategy to grow market share.
But with no renewal commission, agents are not motivate to provide service after the insurance is issued.

(b) List the drawbacks of using guaranteed level premiums and heaped first year commissions for this mortgage insurance product.

Commentary on Question:
Candidates generally did well identifying that the mismatch of premium to benefit over time would be a big drawback. Fewer candidates identified the risk to the company in not being able to adjust for experience.
Most candidates recognized that high first year commissions and new renewal commissions would cause high lapse rates. Few candidates explained why high lapse rates would be problematic.

6. Continued

Guaranteed premium rates mean the company cannot adjust the premiums if product is mispriced or experience was worse than pricing expectation.

The level premium will become very high in relationship to death benefit in later policy years, leading to little motivation for the insured to keep the policy in force.
Level premium design increases sensitive to presistency. For decreasing coverage product, the coverage amounts are higher in the initial years. A mismatch premium pattern (level premium) leads to lower profitablity in the initial years and higher in later years.

Heap commission and no renewal commission may induce higher lapse rates, since agent encourage to sell but not to provide after sales services.

Heap commission leads to higher acquisition cost and reduce competitive edge.

If lapse rate is higher than expected, ABC may have DAC deficiency and have to write off DAC.

(c) Describe the advantages and disadvantages of each of the above proposed premium structures.

Commentary on Question:
Candidates generally did well in explaining the pros/ cons for limited level and decreasing premium payments. Many candidates were confused by annually increasing premiums and did not recognize that it was not a strictly increasing premium pattern with decreasing benefit.

Limited level payments
Pros:
- Easy and cost efficient to administer
- Combat the high lapse probability towards the end of mortgage periods when the outstanding mortgage balance becomes very small. The policy will be paid up before that point.
Cons:
- the limited paid premium amount will be higher than life paid premium, therefore less attractive to customers
- may require to provide cash surrender values under nonforteiture laws
- If the policy holder decided to extend the mortgage term or delay paying of the principal, then ABC could be exposed to higher than expected risk without additional compensation, i.e. the amount of premiums collected are limited but the coverage term is longer and benefit amount is higher

6. Continued

Decreasing premium payments
Pros:
- Since premiums are predetermined, easy and cost efficient to administrate.
- give the perception of matching the decreasing benefit with decreasing premium payment but avoid the costly administrative expense of tracking the outstanding mortgage balance. Increase perceived relative value of the policy in later durations.

Cons:
- results in higher premiums in first few years, therefore less attractive than lower level premiums
- same problem with limted paid premiums. If mortgage is extended, ABC will have higher risk but not higher premium.

Annually increasing premium approach
Pros:
- matching insurance cost to benefit amount. Eliminate the problem of unmatched cost and benefit that leads to potential high lapse rate

Cons:
- difficult and expensive to administer, need to keep track of outstanding mortgage amounts
- it can result in an erratic schedule of payments, especially if the one year term rates increase more slowly or less slowly than the mortgage balance decreases

(d)

    (i)   Compare the benefits and costs of each of these distribution channels.

    (ii)   Evaluate whether each distribution channel is appropriate for this product.

Commentary on Question:
To receive full credit the recommendation given for each distribution channel needed to be supported with reasonable justifications. Recommending either way was acceptable for the channels as long as appropriate support was given.

Agency - build its own sales force of career agents
Benefits:
- dedicated and exclusive sales force
- can provide more services, strengthen client relationship, lower lapse rates
- higher underwriting standards and better risk screening

6. Continued

Costs:
- the most expensive distribution channel to maintain since ABC is expected to recruit, train and house the agents. Compensation will have to include base salary as well as commission.

Recommendation: Not recommend to use this channel due to the high cost and relatively long period of time need to set up this channel

Other independent agents - such as insurance brokerage
Benefits:
- have established client basis and assess to insurance market which could be use to sell this product.
- leverage on the brokers' underwriting experience

Costs:
- cheaper than career agents since only paid commissions

Recommendation: This is a suitable channel to gain immediate access to the target market but will have to be careful if the brokers are already selling other competitors' products.

Direct sales - internet or mailing list
Benefits:
- can reach a wide market economically

Costs:
- lowest cost, once the initial program was set up, the maintenance cost is minimal
- since no sales staff were involved, no commission is required.

Recommendation: (For) Suitable channel for a product with simplified underwriting requirements. Cost effective and could be used to compliment other distribution channels.

(Against) If ABC believed that the high lapse rates and high benefits were due to no after sales services and insufficient underwriting, then this is not a suitable channel.

7. Learning Objectives:

1. The candidate will understand feasibility step of new product and how it drives design.

2. The candidate will understand the design and purpose of various product types, benefits and features.

3. The candidate will understand the relationship between the product features, their inherent risks, and the selection of appropriate pricing assumptions, profit measures and modeling approaches.

4. The candidate will understand actuarial requirements of product implementation and the monitoring of experience versus product assumptions

Learning Outcomes:

(1e) Recommend ways to close the gaps between design and the internal/external constraints.

(1f) Describe non-forfeiture regulation and perform calculations to evaluate compliance

(2c) Evaluate the feasibility of the recommended design.

(3a) 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.

(3c) 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

(3e) Describe when a stochastic model should be used, its advantages and disadvantages, how to build it and how to analyze its results

(4a) Describe and evaluate compliance with illustration regulation and other policy form regulations

7. **Continued**

Sources:
Lapse Experience Under Lapse Supported Products, Product Matters, December (63) 2005 http://www.soa.org/library/newsletters/product-development

Quantification of the Natural Hedge Characteristics of Combination Life or Annuity Products Linked to Long-Term Care Insurance, March 2012

ILA-D614-11 CLHIA – Guideline Illustrations

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

ILA-D804-09: NAIC Life Insurance Illustrations Model Regulation

Product Matters, 10/2011 Level Term Lapse Rates – Lessons Learned Here and in Canada http://www.soa.org/library/newsletters/product-development

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

ILA-D120-11: Session PD-5: Pricing Best Practices

Commentary on Question:
The Question tested the candidate's knowledge of the important pricing assumptions of the T to100 Insurance Product (T-100) and the Long Term Care Standalone product (LTC). The candidate needed to understand the key points of each assumption, and how they impacted profitability. The candidate also needed to understand the pricing changes which were put into place since the products were first marketed, and why those changes were made.

Solution:
(a)   Compare and contrast the key pricing assumption risks

   Commentary on Question:
   In Part (a) of the question, almost all the candidates knew some of the key pricing assumptions for the T-100 and LTC products. However, a number of candidates did not know the key points of each assumption and the impact on profitability. For example, for the lapse assumption, the candidate needed to know that both products were lapse supported and also needed to know the meaning of a lapse supported product. Also, in regards to LTC, many candidates did not know all of the specific assumptions which impacted LTC and not T-100, e.g., disabled lives, recoveries, inflation, etc.

   Key pricing assumptions are lapse rates, investment yield rates and mortality rates
   - low lapse rates reduce profits

7. Continued

For LTC Standalone product, the key pricing risks are persistency, investment returns and morbidity rates
LTC is a lapse supported product, similar to T100
-LIMRA and SOA 2004 lapse study showed ultimate lapse rates of 3% to 4%
LTC has level premium that contrast with a claim cost curve that increases dramatically with advancing age
Excess of premium over claim costs in early durations, coupled with investment income on those amounts, accumulates over time to cover the cost of LTCI in later durations that exceeds the annual premium
Higher persistency than expected reduces profits because more insureds retain their coverage into later durations where the annual premium is insufficient to cover the claim costs.
This sensitivity to lapses is increased since virtually all LTCI has no nonforfeiture for the insured
This is partly mitigated by longer period to amortize acquisition expenses, but not to enough to offset lapse factor
Most adverse scenarios are higher than expected lapsation in very early durations and lower than expected lapses in intermediate to later durations
Increased investment returns add significantly to the profit of LTCI, as is true for T100
LTCI morbidity risks include the incidence rates for LTC and related insurance requirements to be triggered;
Claim terminations occur as a result of 3 scenarios:death, recovery from claim, and maxed-out of benefits
Disabled life mortality rates are like a lapse as they end the policy
  Higher the disabled life mortality the higher the profits
Recoveries are beneficial in terms of claim payments leave open the possibility for future LTCI claims and persistency into later durations (where premium is insufficient to cover expected annual claim costs)
Risk of an increase in cost of LTC care itself is minor consideration in LTCI risks
-Most coverage limits LTCI benefits at a monthly or daily level, and do not increase unless inflation coverage is purchased
If inflation coverage is bought, the increase in coverage is well-defined, usually at 5% annual compound increase
This is a major distinction from risks from general medical inflation trends and their impact on rates

(b)   Assess the key changes to the pricing assumptions which companies have made to the products since their introduction into the marketplace. Justify your assessments.

7. Continued

Commentary on Question:
Many candidates did not know the key changes to the pricing assumptions, and their impact on premium rates and profitability. More candidates knew the changes to the T-100 than the LTC product.

By end of 1990s, many companies had introduced T100 products that turned out to be underpriced

This was due to actual lapse rates lower than pricing of 6% with ultimate rates below 2% (some <1%)

Also due to rapidly declining interest rates, and both of these led to higher prices on new plans

Price increases on some new plans were in excess of 50% and sharp decline in sales quickly followed

The original expectation was that T100 lapse rates would fall somewhere between lapse rates for traditional permanent products and those for long duration term products.

In actuality T100 lapse rates turned out to be lower than lapse rates for traditional permanent products

T100 is one product like LTCI which is lapse supported

  Lapse supported products depend on lapses at some point during life of product to maintain adequate profit

  If lapses are lower than anticipated, profitability will be eroded

Lapses are explicitly recognized in the calculation of reserves in Canada, unlike the US

Interest rates are no longer prescribed in Canada as they are in the US

Therefore T100 reserves are sensitive to the assumed level of investment return and assumed level of lapses

Canadian insurers were hit hard early on as reserves under Canadian GAAP are principles based

They are required to be adjusted as actual experience emerges & was a big hit on reserves & reduced net income

  Canadian valuation requirements led to these designs

From a historical perspective, risks of new LTCI policies are significantly lower than the risks on older In-force LTCI business

The pricing of newer LTCI business has been done with lapse assumptions that are much lower than assumptions used on most prior generation products

Interest rates are much lower as well

Both of these imply much more conservatism in pricing of products currently offered in standalone LTCI market

For T100, there has been no change in price in last 10-15 years, even though interest rates are lower

  This means insurance companies are taking more risk to support the price with less profit

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8.   **Learning Objectives:**
3.   The candidate will 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)   Describe when a stochastic model should be used, its advantages and disadvantages, how to build it and how to analyze its results

Sources:
Stochastic Modeling: Theory and Reality from an Actuarial Perspective, IAA – Intro, various parts within Sections 1-4

Commentary on Question:
This question tested the candidate's knowledge of stochastic modeling – specifically, the advantages/disadvantages of using various distributions to model bond rates and equity rates. Candidates generally did poorly on this question. Many candidates failed to critique the technical content of the memo and instead focused on the non-technical content (e.g., scope, style, compliance with ASOP 41, ways that stochastic results will help with regulatory reporting requirements, etc.). Overall, candidates performed well in critiquing the choice of risk measure, but struggled with evaluating the appropriateness of the models used for bond and equity rates.

Solution:
Critique the technical content of the memo. Justify any recommended changes.

Commentary on Question:
An important aspect of answering this question was that the candidate take a stance on the choice of models. Candidates who gave alternatives other than listed below received credit if they were able to justify their recommendations. Candidates who simply stated a choice was good/bad without justification did not receive credit.

In evaluating the number of years of data used to calibrate the equity model, many candidates recommended using fewer years of data to only capture more recent experience. ULSG is a long-duration product and the model should be calibrated using more years of data than the liability.

Choice of Model for Bond Rates
The lognormal model is a poor choice for modeling bond rates because it produces very high interest rates with a higher frequency than is realistic. The normal model is preferred because of its annual tractability, natural skew, and the high degree of normality in rate changes. Since a normal distribution produces negative rates, a cap and floor should be applied to the generated interest rates.

8. **Continued**

Evaluation of Linear Interpolation
Using linear interpolation to determine rates in between the points generated by the model is not appropriate because the yield curve is not linear. Instead, rates should be converted to a continuous curve using bootstrapping.

Choice of Model for Equity Rates
The most common model for equity returns is geometric Brownian motion (GBM) with the Wiener process.

Calibration Using MLEs
The model should be calibrated using more than the past 30 years of stock market data. The duration of the calibration period should be long enough to capture outlier events and should also be longer than the duration of the liability.

Using maximum likelihood estimators to calibrate the model is a good choice. When a large number of observations is used, the MLE is asymptotically unbiased, asymptotically efficient, and asymptotically normal.

Choice of Risk Measure
Since the ULSG product has significant tail risk due to mainly to the secondary guarantee, Value at Risk (VAR) is not the best choice of risk measure. VAR has the following shortcomings:
- VAR does not accurately capture tail risk
- VAR cannot capture risks that occur with low frequency and high severity
- VAR is not a coherent risk measure
- VAR lacks subadditivity

Conditional Tail Expectation is a better choice of risk measure since it will capture the total risk of the tail (average of losses above the chosen confidence level), not just a single point on the distribution. CTE will also produce more conservative reserves than VAR.

9.   **Learning Objectives:**
2.   The candidate will understand the design and purpose of various product types, benefits and features.

3.   The candidate will 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)   Describe in detail product types, benefits and features.

(3a)   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:
"Term Mortality and Lapses", Product Matters, August (62) 2005,

ILA-D105-07: Life and Annuity Products and Features (LO#3)

Commentary on Question:
Commentary listed underneath question component.

Solution:
(a)   Explain the implications to BRL of the difference between expected and actual lapse rates.

   Commentary on Question:
   Part a) tests candidates on the implications of the difference between expected and actual lapse rates. Most candidates were able to list "hurt profitability", "mis-priced product","anti-selection" and "mortality deterioration"; some were able to list "recovery of acquisition" and "maintenance expenses"; very few were able to list "inadequate reserve".

   Candidates tend to write explanations on why there's difference between expected and actual lapse, which was not worth any points for this part.

9. Continued

The actual lapses being higher than expected will affect mortality, lapse and expense experience of the term business and this will affect the profitability of the business.

- Recovery of acquisition expenses will not be as expected.
- Coverage of overhead/maintenance expenses will not be realized no matter which allocation basis was assumed.
- Higher renewal lapses could be a sign of anti-selective lapses.
- Anti-selective lapses will result in worsening mortality for those policyholders that remain.
- The in-force business may not be adequately reserved if the emerging experience is significantly worse than originally expected.
- Higher renewal lapse rates than assumed in pricing will hurt profitability

(b)

    (i)   Provide plausible reasons why BRL's lapse experience in durations 10 and 11 differs from the SOA study.

    (ii)   Compare the impact of both proposals on BRL.

Commentary on Question:
Part b) (i) tests an explanation on why BRL's lapse experience differs from the SOA study. Most candidates mention the different "distribution channel", "different business mix" or "target market". Some of them get partial credit for mentioning "low commission rates" for agents, agents' "attitude towards selling". Very few were able to point out that "BRL's ratio is at the higher end of the SOA range, which could increase the expected results to the next category".

Part b) (ii), candidates did not do very well in general. Most of them were able to point out that changing the premium ratio to 200% or 800% impacts the lapse rates and mortality deterioration.

    (i)   The inforce business could have a higher proportion of sales to individuals or brokers that focus solely on price.
           The brokers selling BRL products are more actively managing their books of business.
           The SOA study is an industry study that aggregates experience across different distributions channels, sales mix, etc. Career channels may have different results based on different activity focus.
           BRL may have a different mix of business. Larger term policies often have higher lapses than smaller policies.
           BRL's renewal premium ratio is 400% to 500% which is at the higher end of the range (250% - 500%) which would increase the expected lapse results into the next category.

9. **Continued**

(ii) Lower renewal premium ratio to 200% would appear to align the expected lapses in pricing with the SOA study.

The lapses on inforce business could be expected to reduce and might help achieve the original pricing assumptions for expense, mortality and lapses.

Lowering renewal premiums could be received positively by the policyholder.

New business would be able to charge a more appropriate rate for those that are not lapsing at renewal.

BRL would need to expect even higher renewal lapses that would put pressure on the expense and mortality assumptions in pricing a profitable product.

The initial rates would need to be very competitive to balance the high renewal premiums in comparison against the competition. Combined with the pressure on pricing assumption the profitability will be a real challenge.

Expect mortality deterioration as unhealthy lives much more likely to accept 800% increase.

Should put very little weight in the value of renewal periods in profit measurement.

10. **Learning Objectives:**

1. The candidate will understand feasibility step of new product and how it drives design.

Learning Outcomes:

(1b) Describe tax regulation and perform calculations to evaluate compliance.

Sources:

Life Insurance and Modified Endowments Under IRC §7702 and §7702A, Chapter 2 The Requirements for Qualification

Commentary on Question:

This question unintentionally asked for the "minimum premium" instead of asking for the "maximum premium." Most candidates pointed this out in their paper, and solved the question as it was supposed to be asked. Proper points were also awarded when candidates answered the question as it was given, solving for the minimum premium.

Solution:

(a) Determine the **minimum** premium that can be paid in each of the first three years and still pass the Guideline Premium Test and not be a Modified Endowment Contract (MEC). Show your work.

Commentary on Question:

Some candidates didn't fully understand how the expense load should come into play. Some had trouble in getting correct interest rate to apply.

1. Guideline premium limit is the greater of the Guideline Single Premium (GSP) and sum of Guideline Level Premium (GLP) to that point.
    *   GSP calculation -- Use greater of 6% and guaranteed interest rate (=3% in this case)
        *   GSP = [(Face Value * $A_{x,.06}$) + (12 months * 10 administrative fee * $\ddot{a}_{x,.06}$)] + GSP*0.05 expense premium
        *   GSP = [(Face Value * $A_{x,.06}$) + (12 months * 10 administrative fee * $\ddot{a}_{x,.06}$)] / (1.00 - 5% expense premium)
        *   GSP = [(100,000 * 0.19) + (12 * 10 * 13.000)] / 0.95=21,642.11
    *   GLP calculation -- Use greater of 4% and guaranteed interest rate (=3% in this case)
        *   GLP = [(Face Value * $A_{x,.04}$ / $\ddot{a}_{x,.04}$) + (12 months * 10 administrative fee)] + GLP*0.05 expense premium
        *   GLP = [(Face Value * $A_{x,.04}$ / $\ddot{a}_{x,.04}$) + (12 months * 10 administrative fee)] / (1.00 - 5% expense premium)
        *   GLP = [(100,000 * 0.30000 / 15.000) + (12 * 10)] / 0.95=2,231.58

10. Continued

2. Modified endowment contract (MEC) is a contract qualifies as a life insurance contract but fails to meet the 7-pay test.
   - 7-pay calculation -- Use greater of 4% and guaranteed interest rate (=3% in this case), no expense load
     - 7-pay = (Face Value * $A_{x,.04}$ / $\ddot{a}_{7:.04}$)
     - 7-pay = (100,000 * 0.30000 / 6.0) = 5,000

3. Premium comparison

Year	GSP	GLP	7 pay	Sum of GLP	GP Limit = max(GSP, sum of GLP)	7 pay limit	Premium Paid	Sum of Premiums Paid	Pass GP Limit	Pass MEC Limit
1	21,642.11	2,231.58	5,000.00	2,231.58	21,642.11	5,000.00	1,000.00	1,000.00	TRUE	TRUE
2		2,231.58	5,000.00	4,463.16	21,642.11	10,000.00	9,000.00	10,000.00	TRUE	TRUE
3		2,231.58	5,000.00	6,694.74	21,642.11	15,000.00	6,000.00	16,000.00	TRUE	FALSE

   - GP limit is the total sum of paid premiums can't exceed 21,642.11 for each of the first three years. The sums of paid premiums are 1,000, 10,000, and 16,000 respectively, so pass GP test in the first three years.
   - 7 pay limit is the sum of paid premiums can't exceed 5,000, 10,000, and 15,000 in each first three years. However the sum of paid premiums in year three 16,000 exceeds the 7 pay limit of 15,000 by 1,000. Contract becomes MEC in year three. Need to decrease the third year premium by 1,000 in order not to be a MEC contract.

   The **minimum** premium that can be paid in each of the first three years and still pass the Guideline Premium Test and not be a Modified Endowment Contract (MEC) is the minimum to keep the contract inforce (COI + expense). While the **maximum** premium can be paid is the 7 pay limit – 5,000, 10,000, and 15,000.

(b) Explain how the classification as a MEC might affect pricing assumptions for:
   (i) Partial withdrawals
   (ii) Policy loans

Commentary on Question:
Only a few candidates didn't get the loan part correct. Failed to identify loan distribution is also need to be taxed if MEC.

Also a few failed to mention the pricing utilization assumption needs be to be decreased due to MEC situation.

- MEC contract follows LIFO (Last-In First Out, or Income Comes Out First) tax rule for pre-death distributions. Gain is withdrawn first, then premium.
- Additional 10% penalty tax if under age 59 ½

10. Continued

- MECs should generally assume lower partial withdrawals than assumed for non-MECs.
- Policy loans from MECs are treated as taxable income to the extent that the cash value before the loan exceeds the investment in the contract.
- Taxed loan amount is converted from gain to basis.
- MECs should generally assume lower policy loan utilization rates than assumed for non MECs.

11.

Learning Objectives:
1. The candidate will understand feasibility step of new product and how it drives design.

2. The candidate will understand the design and purpose of various product types, benefits and features.

3. The candidate will 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) Explain considerations for prudent and practical decision making.

(1c) Describe how investment policy and policy loans can impact design.

(2a) Describe in detail product types, benefits and features.

(2b) Construct and recommend a design that is consistent with the market needs identified in the idea generation.

(3c) 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 Ins. Products and Finance Chapter 2 Product Development

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

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

Atkinson & Dallas, Life Insurance Products and Finance, Chapter 11 Profit Measurement and Analysis

Commentary on Question:
Commentary listed underneath question component.

Solution:
(a) Outline the key areas to be considered when developing a product strategy

   Commentary on Question:
   Most candidates understood what was being asked of this question, and got a majority of the items correct. Most, however did not mention doing a consumer analysis.

11. Continued

In addition while most candidates mentioned the attributes of a target market, they did not suggest that we need to learn all the needs of the target market.

1. Product should align with the company's mission and vision
2. Product should align with the needs of target market
3. Need to learn all the needs of the target market (eg, buying habits, insurance needs and attitudes)
4. Product should align with the company's strength and core competencies
5. Consideration should be given to what competencies cannot be fulfilled by the company and look to outsource these (eg, admin, use consultants or utilize reinsurers)
6. The product's risk profile should be aligned with the company's risk appetite
7. Limited experimentation into new markets can make the company more robust, but must be cautious

(b) Critique the product design, and recommend appropriate improvements.

Commentary on Question:
Candidates understood and was able to identify the major issues (waiting period, survival period, including heart attack, etc.). In addition points were given if candidates could recommend current industry standards (e., 30 day survival period, 90 days waiting period for cancer and 15-20 enhanced coverage). Not many candidates clearly recommended offering both basic and enhanced versions or communicated the relative cost vs marketability of offering both. To get full credits, the candidate only needed to list a majority of the items.

1. Waiting period: Include a waiting period for cancer to help avoid ant selection at issue; otherwise someone that suspects cancer will purchase a critical illness policy. Typically, the period for the exclusion of coverage for any type of cancer is 90 days.

2. Survival Period: The survival period is relatively short. A short survival period will result in increased claims and CI is intended to offset the financial consequences associated surviving the critical illness, not the financial consequence of dying. Typical, the survival period is 30 days.

3. Include heart attach to improve the competitiveness, since it is considered one of the big 3 core coverage included in basic CI policies.

11. Continued

    4. Could also off both basic and enhanced versions with the enhanced version covering an additional 15-20 conditions. It will be a little more costly than the basic version, but could increase the marketability significantly.

    5. Premiums: Fully guaranteed premium is risky. Consider a version where the premium is allowed to be reset periodically.

    6. Face Amount: Could consider increasing face amount for inflation protection. In addition, partial benefits could be considered

    7. Could consider offering other types of riders (ROPX and/or ROPS) which have a strong appeal to many financial advisors and clients

    8. Could consider offering Acceleration CI which offers protection for both critical illness and death since STM is a term life company

    9. Could consider using reinsure to provide expertise

(c) Calculate the following profit measures using distributable earnings on the basis for profits:

    (i)   Embedded value
    (ii)   Return on investment
    (iii)   Percentage of premium (assume a discount rate of 5%)

Show all work.

Commentary on Question:
Section C was the easiest. Most candidates understood the definition of Embedded value, ROI and Profit percent. Candidates did not get full marks if they did not clearly demonstrate that they knew how to calculate distributable earnings. Alternately, once candidates demonstrated the understanding of the definitions above, they would get most of the marks.

    (i)   Embedded Value
           = Present Value of profits using a discount rate equal to the company's hurdle rate
           = Present Value of [After-Tax Solvency Earnings - Increase in Required Capital + After- Tax Investment Income on assets backing Required Capital]

           = 31.5 - 9.5 - 14.9 + 1.4 = 8.5 million   , using a hurdle rate of 10%.

11. Continued

    (ii)   Return on Investment (ROI) is the discount rate that produces a present value of profits to equal zero
At a discount rate of 5%:   PV of Distributable Earnings = 43.6 - 13.1 - 9.7 + 1.8 = 22.6 million
At a discount rate of 10%: PV of Distributable Earnings = 8.5 million (from part i)

At a discount rate of 15%: PV of Distributable Earnings = 23.3 - 7.0 - 17.5 + 1.2 = 0

Therefore ROI = 15%, since PV of Distributable Earnings = 0 using a 15% rate.

    (iii)   Profit as a percentage of premium = PV of Profits / PV of Premiums
Use Discount rate of 5% as supplied in the question
= PV of Distributable Earnings @ 5% / PV of Premiums @ 5%
= 22.6 / 480.4 = 4.7%