ILA LP Model Solutions
Spring 2016

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

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

Learning Outcomes:
(2c) Evaluate the feasibility of the recommended design.

(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:
ASOP #1 Non-guaranteed Charges or Benefits for Life Insurance Policies and Annuity Contracts

ASOP # 2 Non-guaranteed Charges or Benefits for Life Insurance Policies and Annuity Contracts

LP-107-07: Experience Assumptions for Individual Life Insurance and Annuities

Commentary on Question:
Commentary listed underneath question component.

Solution:
(a) With respect to ASOP 2:

(i) Describe the determination process for adjusting non-guaranteed charges or benefits.

(ii) Describe the criteria used in the grouping of policy classes for adjusting non-guaranteed charges or benefits.

Commentary on Question:
Most candidates did well on this part. For part (ii), some candidates listed a variety of underwriting factors (age, gender, smoking status, policy size, etc), instead of different types of criteria that could be used.

1. Continued

(i) consider size of policies, cost, practical difficulties and effects of changes to non-guaranteed benefits/charges
- consider sensitivity testing to understand impact where the deviations are expected to be material
- should include definition/description of the classes, or define appropriate criteria for grouping

(ii) grouping can be defined by:
- similarity of policy type
- structure of non-guaranteed benefits/charges
- similar expected experience factors
- time period for policies
- underwriting and marketing characteristics of the policy

(b)

(i) (*3 points*) Using the Balducci assumption, calculate the actual mortality rate for an age 50 MNS. Show all work.

(ii) (*1 point*) The expected mortality assumption for an age 50 MNS is 15 per 1,000. Determine whether a change to Cost of Insurance (COI) rates for age 50 MNS is warranted. Justify your answer.

Commentary on Question:
Part (i) was done well by most candidates. Common errors included: miscalculating deaths, arithmetic errors in counting numbers of months, and assuming lapses and deaths occurred mid-year even though exact dates were given.

For part (ii), most candidates did a simple calculation, either A/E or some sort of creditability calculation (Z or confidence interval). For full credit, candidates needed to comment on the fact that more years of data were needed, and that if the trend continues, COI charges should be increased.

(i) Using the balducci assumption, we convert the rows of the chart into exposures and deaths
-the 500 policies contribute 500 exposures and 0 deaths
-the 200 policies contribute 200*(3/4)=150 exposures and 0 deaths
-the 100 policies contribute 100*(2/3)=66.67 exposures and 0 deaths
-the 15 policies contribute 15 exposures and 15 deaths
-the 5 policies contribute 5*(5/6)=4.167 exposures and 5 deaths

1. **Continued**

Total Exposures = 500+150+66.667+15+4.167 = 735.834
Total Deaths = 15+5 = 20

q = (total deaths) / (total exposures) = 20/735.834 = 0.02718

(ii) Calculate the A/E ratio as 27.18/15 = 1.81
-only based on one year of data, so credibility is very low
-mortality studies typically use 5-10 years worth of data
-if this A/E ratio was based on years of data and was more credible, indicates a steep increase in mortality
-recommend increasing COIs to be in line with new mortality expectations

(c) Identify six disclosures that should be included in an actuarial communication justifying a change in COI rates.

Commentary on Question:
A common mistake on part (c) was to identify six disclosures specific to data and reliance on data, instead of those from ASOP 41 relating to changes to non-guaranteed benefits.

Actuarial communication should be in accordance with ASOP 41 and contain the following items:
- a description of the insurer's determination policy for the policies and policy classes involved
- any known areas in which the recommended nonguaranteed charges or benefits do not follow the insurer's determination policy
- any material change in the determination policy or in the assumptions the actuary has made about the determination policy since the previous determination
- the policy classes involved and any material changes in the assignment of policies to policy classes
- a description of the processes and methods used in the determination of nonguaranteed charges or benefits, including any significant modeling, averaging, or other approximation methods
- the nonguaranteed charges or benefits recommended for the forthcoming period

2. **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,   Chapters 2, 3

Marino and Grobe, Canadian Taxation of Life Insurance, Chapter 3

Commentary on Question:
Students received maximum points if they were able to break down each sentence and confirm if the statement was correct or not and provide the correct information if it was not correct.

In general, students did well on this question compared to the others on the exam. Candidates were most successful on paragraph (iii) and did reasonably well on paragraphs (i) and (ii)

Solution:
Critique each of the following statements. Justify your answer:

(i)   *In the U.S., the Cash Value Accumulation Test (CVAT) is used for Whole Life products, and the Guideline Premium Test (GPT) is applied to Universal Life products, since the tests are well suited for these respective products. One similarity between the two tests is in the area of policy administration. Some differences between the two tests include different interest rates and mortality rates. For example, if a product guarantees at any point in the contract a rate of 7% for 5 contract years, then 5.5% for 5 years, then 4% for 5 years, and then 3% thereafter, the interest rate used in the tax calculations for the CVAT is 4% for 15 years, and then 3% thereafter, and for the GPT is 7% for 5 years and then 6% thereafter.*

(ii)   *In Canada, an exempt policy is subject to income taxation, but not when there is an actual or deemed disposition of an interest in the policy. The policy gain of the disposition is the amount by which the adjusted cash surrender value exceeds the adjusted cost basis (ACB) to the policyholder. The key factors in determining the adjusted cost basis of an exempt life insurance policy are the cash surrender value and the net single premium. Relatively large premium deposits in comparison to the Net Cost of Pure Insurance (NCPI) will have the effect of dramatically reducing the ACB. The pattern of the ACB increases each policy year especially if the NCPI exceeds the premium deposit in a given year.*

2. Continued

(iii) *The two key components of a life insurance contract in the U.S. and Canada are savings and investment. As long as the relationship between savings and investment in the policy are within U.S. or Canadian guidelines, there is no tax payable on the inside build-up of cash values. On partial withdrawals in U.S. and Canada, amounts distributed are not taxable to the policyholder until they exceed the premiums paid.*

Commentary on Question:

(i) *In the U.S., the Cash Value Accumulation Test (CVAT) is used for Whole Life products, and the Guideline Premium Test (GPT) is applied to Universal Life products, since the tests are well suited for these respective products.*

Either test can be used. However, CVAT is typically used for WL and GPT is used for UL.

One similarity between the two tests is in the area of policy administration.

This is false:
CVAT is much easier to administer than GPT.
CVAT is a prospective test and is based on future benefits.
GPT is a retrospective test that needs to keep history of policy transactions.
GPT requires recordkeeping and is more prone to administrative errors.

Some differences between the two tests include different interest rates and mortality rates.

Comparing mortality:
Rates are the same for both tests except GPT has an expense component.
Both use reasonable mortality assumptions without exceeding the mortality charges in the prevailing commissioner's standard table
GPT is the same but adds an expense component.

Comparing interest rates:
Interest rates are different for the two tests.
CVAT and GLP use maximum of (4%, guaranteed rate at issue).
GSP uses maximum of (6%, guaranteed rate at issue).
GSP uses expense charges in recognizing guideline premiums

For example, if a product guarantees at any point in the contract a rate of 7% for 5 contract years, then 5.5% for 5 years, then 4% for 5 years, and then 3% thereafter, the interest rate used in the tax calculations for the CVAT is 4% for 15 years, and then 3% thereafter, and for the GPT is 7% for 5 years and then 6% thereafter.

2. Continued

The most frequent misunderstanding happened on this section of the paragraph; some candidates confused the rate locked in at issue with the initial guarantee.

Interest rate for:
CVAT: 7% for 5 years, 5.5% for years, 4% thereafter
GLP: 7% for 5 years, 5.5% for years, 4% thereafter
GSP: 7% for 5 years, 6% thereafter

(ii)   *In Canada, an exempt policy is subject to income taxation, but not when there is an actual or deemed disposition of an interest in the policy.*

In Canada, an exempt policy is **not** subject to income taxation **unless** there is an actual or deemed disposition of an interest in the policy.

The policy gain of the disposition is the amount by which the adjusted cash surrender value exceeds the adjusted cost basis (ACB) to the policyholder.

The policy gain of the disposition is the amount by which the **proceeds of the distribution of the policyholder's interest** exceed the adjusted cost basis (ACB) to the policyholder.

The key factors in determining the adjusted cost basis of an exempt life insurance policy are the cash surrender value and the net single premium.

The key factors that determine the adjusted cost basis of an exempt life insurance policy are:
* Cumulative premiums - Net cost of premium insurance (NCPI)
* This assumes no dispositions made
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Relatively large premium deposits in comparison to the Net Cost of Pure Insurance (NCPI) will have the effect of dramatically reducing the ACB.

Relatively large premium deposits in comparison to the Net Cost of Pure Insurance (NCPI) will have the effect of dramatically **increasing** the ACB.

The pattern of the ACB increases each policy year especially if the NCPI exceeds the premium deposit in a given year.

The pattern of the ACB initially increases, reaches a maximum and then decreases.
If premium deposits > NCPI, ACB will increase
If premium deposits < NCPI, ACB will decrease

2. Continued

Candidates struggled with this last comment as well, with many candidates not complete in their answer explaining that in early years the ACB increases due to premium deposits exceeding the NCPI, then the ACB hits a maximum and that in later years the NCPI will continue to increase and therefore the pattern for the ACB will change and decrease

(iii)   *The two key components of a life insurance contract in the U.S. and Canada are savings and investment.*

This statement is only partially correct. The two key components are savings/investments and net amount of risk/cost of insurance

As long as the relationship between savings and investment in the policy are within U.S. or Canadian guidelines, there is no tax payable on the inside build-up of cash values.

This sentence is incomplete, inside buildup is tax deferred only if it remains inside the insurance contract.

On partial withdrawals in U.S. and Canada, amounts distributed are not taxable to the policyholder until they exceed the premiums paid.

This is true in US, unless there is a MEC.
In Canada, the gain is calculated as the amount withdrawn over the proportionate adjusted cost basis before the disposition.

3. **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 Text - Intro, Sections 1-4 (See VanDam email 2/3/13)

Commentary on Question:

This solution came from one study note, if the student understood the study note, they received many points. Sometimes they used curtate instead of continuous functions, then they still received points but not all. Also, some used the answer to part (a) for part (b), similar formulas but not the same. Overall, the student either knew many parts to the solution or not. Good question overall,

Solution:

(a) Describe the theory of interest rate parity.

Foreign exchange rate movements are determined by the risk free differentials between two economies.

$$X_{(t+1)} = X_t * e^{(rff-rfd)}$$
$where \ X_t =$ units of foreign currency per one unit of domestic currency
$rff = foreign \ nominal \ continuos \ risk - free \ rate \ and$
$rfd = domestic \ nominal \ continous \ risk - free \ rate$

(b)

    (i)   (*3 points*) Calculate the projected amount of ¥ that could be exchanged for 1 $U.S. at the end of year one for each scenario. Show all work.

    (ii)   (*6 points*) Calculate the GMAB liability at issue in $U.S. Show all work.

    (i)

$$X_{(t+1)} = X_t * e^{\left(rff-rfd-\frac{VOL^2}{2}\right)+VOL*Z}$$
$where \ VOL =$ volatility between ¥ and US$
Z is a random number from a normal distribution for Exchange Rates

3. **Continued**

Scenario 1: $X_{(t+1)} = 110 * e^{\left(.0111 - .0251 - \frac{.05^2}{2}\right) + .05 * .7556)} = 112.51$

Scenario 2: $X_{(t+1)} = 110 * e^{\left(.0091 - .0243 - \frac{.05^2}{2}\right) + .05 * (-1.2865)} = 101.46$

Scenario 3: $X_{(t+1)} = 110 * e^{\left(.0105 - .0265 - \frac{.05^2}{2}\right) + .05 * 1.5581)} = 116.88$

(ii)

$S_{(1)} = S_0 * e^{\left(rff - \frac{VOL^2}{2}\right) + VOL * Z)}$
where VOL = volatility of TPX
S is the scenario
Z is for Equity Returns

$GMAB\ value\ in\ ¥ = e^{(rff)} * \max(0, S_{(1)} - S_0)$
$GMAB\ value\ in\ \$ = GMAB\ value\ in\ ¥ / X_{(t+1)}$ (from (b)(i))
GMAB liability is average over the 3 scenarios

Scenario 1 $: S_{(1)} = 1,000,000 * e^{\left(.0111 - \frac{.2^2}{2}\right) + .2 * (-.5694)} = 884,458$
$GMAB\ value\ in\ ¥ = e^{(.0111)} * \max(0, 1,000,000 - 884,458) = 114,266$
$GMAB\ value\ in\ \$ = 114,266 / 112.51 = 1016$

Scenario 2 $: S_{(1)} = 1,000,000 * e^{\left(.0091 - \frac{.2^2}{2}\right) + .2 * (.3707)} = 1,065,282$
$GMAB\ value\ in\ ¥ = e^{(.0091)} * \max(0, 1,000,000 - 1.065,282) = 0$
$GMAB\ value\ in\ \$ = 0 / 101.46 = 0$

Scenario 3 $: S_{(1)} = 1,000,000 * e^{\left(.0105 - \frac{.2^2}{2}\right) + .2 * (-1.2066)} = 778,162$
$GMAB\ value\ in\ ¥ = e^{(.0105)} * \max(0, 1,000,000 - 778,162) = 219,520$
$GMAB\ value\ in\ \$ = 219,520 / 116.88 = 1878$

GMAB liability = (1016 + 0 + 1878)/3 = 965

4. **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:
(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

(3d) Analyze the capital requirements for a product and describe solutions that optimize capital usage.

(3e) 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 11 Profit Measurement and Analysis

LP-114-09: CIA Research Paper, Life Insurance Costing and Risk Analysis, June 2008
Stochastic Modeling Text - Intro, Sections 1-4 (See VanDam email 2/3/13)

LP-113-09: Swiss Re, Economics of Insurance: How Insurers Create Value for Shareholders

Commentary on Question:
Commentary listed underneath question component.

Solution:
(a) Identify the product with the highest profit margin that meets the hurdle rate. Show all work.

4. **Continued**

The hurdle rate is based on the weighted average cost of capital, set at 70% of equity return of 13% and 30% of bond return of 7%. Then the tax rate is applied, set at 40%. Hurdle rate = 10.36%.
To determine which products meet the hurdle rate, you must calculate the weighted ROE which is PV(Earnings)/PV(Equity)
A: 33/350 = 9.43%
B: 19/178 = 10.67%
C: 3/20 = 15%
B and C meet the hurdle rate

Profit Margin = PV (Profits)/PV(Premium)
B: 12/550 = 2.18%
C: 2/75 = 2.67%
Product C has the highest profit margin that meets the hurdle rate

(b)   Calculate the modified break-even year for each product. Show all work.

4. **Continued**

Full credit was given when a candidate was able to explain modified break even year and was able to calculate correctly.

Modified break even year is the year in which accumulated profits turn positive and stay positive. Modified BEY is calculated assuming that all policies would lapse at the end of the year. As a result, change in reserves and change in required capital is included.

Product A profits: -85, 22, 92, 117, 123
       Modified break even year is 2
Product B profits: -51, -15, 2, 15, 19
       Modified BEY is 3
Product C profits: 2,1,5,5,2
       Modified BEY is 1

(c)   Assume that the results above are for male non-smokers and have been prepared using a deterministic model.

      (i)   Identify risks involved with this pricing model.

      (ii)   Propose additional analysis to help manage the risks.

Commentary on Question:
This section was testing the candidates' knowledge of Learning Object 3b, identifying appropriate assumptions and methodology for these products. LO 3E is also tested, regarding stochastic modeling.

Most candidates were able to identify the shortcomings of the current assumptions. Most were also able to answer section ii, and propose additional analysis.

Using a deterministic method for a complex product has limitations and can be misleading. Sensitivity testing should be run on key assumptions, such as mortality, lapse, interest rate, credited rate, premium persistency and fund selection. Ranges or load factors can also be implemented. Further, Stochastic modeling can be used to better understand the secondary guarantees of this product, as well as illustrate the interaction of tail risk and how effective the assumptions capture this risk.

Looking at only one cell(M-NS) may not fully capture all the risks and costs of this product. Other relevant cells should be studied for profitability, such as female or smoker. Creating a future mix of business will help identify representative costs. Getting feedback from producers competitors will help set reasonable assumptions.

4. **Continued**

    (d)   XYZ's board of directors proposes to link the CEO's compensation to the annual ROE from the biggest closed block of business. Explain why this proposal may not be in the long-term best interest of the company.

            Commentary on Question:
This last section tests Sections 3C and 3D of the LO's. It tests the candidate's ability to identify appropriate profit measures to link to the overall capital management of a product and company. Most candidates were able to identify the limitations of this profit measure tied to CEO compensation. There were many reasons explaining why this may not be the best idea, and so many opportunities for candidates to achieve full credit.

            Managing a closed block of business may not be aligned with overall goal of the company, so the incentive may be misaligned. The CEO should be incented to make the best long term decisions for the firm. The ROE pattern may be high in early years and lower at tail end. The CEO may then work to front load profits and not invest in future business growth.

5.

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.

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

Sources:

LP-102-07: Equity Indexed Annuities: Product Design & Pricing Considerations

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a)   Calculate the Indexed Account Value at time 3 for a 100,000 policy issued at time 0. Show all work.

      Commentary on Question:

      This purpose of this question is to test the candidate's understanding of EIA products and specific features attached. In general, candidates did well on this question and were able to adequately calculate the IAV and GMAV.

5. **Continued**

The following formulas are used in the calculation:

$GMAV_t = Premium*SNFL\%*(1+SNFL\ Interest\ Rate)^t = 1000*87.5\%*1.03^t$

$Growth\ rate = Index\ Value_{t+1}/Index\ Value_t - 1$

$IAV_t = MAX(GMAV_t\ ;\ Premium * \prod (1 + Max(0, Index\ Based\ Interest))$

Note that this product includes an annual ratchet feature, therefore the annual return on the index is floored to zero.

Time	GMAV	Index	Growth Rate	Index Growth Rate	IAV
0		1000			100,000
1	90,125	1070	7%	7%	107,000
2	92,829	1284	20%	20%	128,400
3	95,610	963	-25%	0%	128,400

The IAV at time 3 is $128,400.

(b)   Propose changes to the product to mitigate the high volatility of the index.

Commentary on Question:
This question tests the candidate's comprehension of the various features of EIA products. To obtain full points, the candidate should describe the feature and explain why the recommended change would mitigate volatility. In general, most candidates did well on this part but some could improve by providing more rationale and description for each recommended feature.
Full marks were given for 3 options fully explained.

In order to mitigate the high volatility of the index, the following changes to the product can be made:

- Eliminate the annual ratchet feature: ratcheting locks in the return so poor index performance in the future cannot be countered by lowering crediting rate
- Introduce a margin: similar to a participation rate of less than 100%, the margin decreases the Index-Based interest relative to the index growth rate. The margin can be applied before or after the participation rate but can't reduce the credited rate to less than zero.
- Introduce a cap: has the potential to decrease the Index-Based interest relative to the growth rate.
- Reduce the participation rate: similar to the margin, but this may not be a good selling feature.
- Reduce the guarantee period to one year: insurers reduce the need to lock-in long term volatility for the index period.

5. **Continued**

- Change the crediting method to an average index growth method: An average index growth credits a smoother index growth rate by taking the average of each period's returns which reduces volatility. Also, average index growth method hedging costs are generally less expensive than point-to-point method.

(c)

    (i)   (*1 point*) List 4 factors that can affect the ability of the initial option budget to adequately fund the Index-Based Interest levels in future years.

    (ii)   (*3 points*) Recommend a cap level for the product assuming static hedging is used. Justify your answer.

Commentary on Question:
The first part of this question tests the understanding of EIA product design and features and associated risks. The second part tests the candidate's understanding of pricing considerations for EIA. The candidate is also tested on his ability to interpret the results by explaining why cap is best suited for this product given a specific option budget. The ideal response provide a comparison of the option budget to the two option prices that are available.

    (i)   Full marks were given if the candidate was able to provide 4 factors. There are several factors that can affect the ability of the initial option budget to fund the Index-Based interest levels:
1. Reinvestment rates that could increase or decrease the net earned rate
2. Actual Index-Based Interest credited affects the future level of the IAV.
3. High future equity volatility causes higher option costs
4. High future risk-free rates cause higher option costs
5. High option costs in any year during an Index Period can strain the option budget.

    (ii)   The most common EIA static hedge involves the purchase of a call spread option on the index. The call spread requires purchasing a plain vanilla call option and selling a call option with a strike equal to the cap rate. The first step is to determine the option budget. Then, we need to find the cap that falls within the option budget.

Option Budget = Net Earned Rate – Pricing Spread
Option Budget = 7.5% - 2.5% = 5%

We have 5% available to purchase a call spread. We are given two option costs, one with a strike price of 106 and one with a strike price of 108.

5. **Continued**

Option price with a cap of 6% = Call Price(100) – Call Price(106) = 9%- 5% = 4%

Option price with a cap of 8% = Call Price(100) – Call Price(108) = 9% - 3% = 6%

The option price with a cap of 8% is 6%, this is above our option budget. The option price with a cap of 6% is 4%, this is below our option budget. Therefore, based on the information available, a cap of 6% is recommended because it is within our option budget. Note that option prices are not linear, hence we can't linearly interpolate between the option price with a cap of 6% and 8% to solve for a cap that would meet our option budget of 5%

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

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

(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:
Life Insurance and Modified Endowments Under IRC 7702 and 7702A, Chapters 2, 3

Marino and Grobe, Canadian Taxation of Life Insurance, chapter 3

2008 Supplement to Life Insurance and Modified Endowments under IRC 7702 and 7702A

Ending the Mortality Table (Living to 100 Symposium)

Commentary on Question:
The question was testing how mortality and interest rates impact 7702 and 7702A testing and then more specifically how older age mortality, including changing the terminal age from 100 to 120 and different ways to end the mortality table, impact 7702(A) testing. Overall, candidates did slightly worse on this question compared to others on the exam.

Solution:
(a)   Evaluate the impact on the relevant section 7702 and 7702A tests for each of the following:

   (i)   Changing the statutory mortality table from 1980 CSO to 2001 CSO.

   (ii)   Increasing the statutory valuation interest rate from 4% to 5%.

6. Continued

Commentary on Question:
Candidates did well on part (a) and were typically able to draw the relationship between the mortality and interest rate change with the impact to 7702 and 7702A tests. Often, students would miss that since the policy is Whole Life the focus is on CVAT testing not GPT testing. Or candidates would fail to include impact on both 7702 AND 7702A tests.

(i) The 2001 CSO has improved mortality compared to the 1980 CSO as well as the terminal age extending to 121 instead of 100. Due to the improved mortality, the Net Single Premium (NSP), the 7-pay premium and well as the cash values will decrease. Because this is a whole life product the CVAT tests should be the focus.

(ii) Increasing the statutory interest rate has a similar impact as using an improved mortality table. The NSP and the cash values will decrease. The impact on the 7-pay premium will vary based on the changes in the numerator and denominator. The one exception is if the policy guaranteed rate is higher than 5% there will be no impact because the tests will use the higher policy guaranteed rate.

b) Describe how Canadian Net Cost of Pure Insurance mortality rates are determined before and after the terminal age of the prescribed tax mortality table.

Commentary on Question:
Very few candidates were able to the correctly say how mortality rates are determined after the terminal age. Many candidates were able to say that before the terminal age there is a standard prescribed mortality table and that there is a difference in the mortality before and after the terminal age.

In Canada, mortality for taxation is calculated using the Net Cost of Pure Insurance (NCPI). The NCPI is based on the CIA 1969-1975 Mortality Table, which ends at age 70. After age 70 the actuary must extrapolate using consistent accepted actuarial principles.

(c) Describe the policyholder taxation problem that occurs with U.S. policies that mature beyond age 100.

Commentary on Question:
Most candidates knew testing ended at age 100 and several were able to say that cash values may extend past age 100 - there is little guidance on how to handle testing past age 100.

6. Continued

The CVAT test requires the policy to endow between age 95 and 100, so for tax purposes the testing ends at age 100. This worked with the 1980 CSO table which has a terminal age of 100. However, with the change to the 2001 CSO the terminal age is extended to age 121 and now cash values may go to age 121. The tax authorities have given little guidance how companies should handle testing after age 100.

(d)   Tax authorities in the U.S. are considering changing the method used to end the 2001 CSO mortality table for tax purposes. Currently, it is assumed that the 2001 CSO mortality tables end using the blended method starting from age 95. Explain how the following methods impact the tax free build-up of cash values for a whole life product for the relevant section 7702 and/or 7702A test using the:

(i)   Blended method, blending from age 95 to age 100

(ii)   Forced method, with ultimate age 100

(iii)   Forced method, with ultimate age 121

Commentary on Question:
Many candidates compared the three methods to each other instead of independently comparing each method in part i,ii, & iii to the method given in the question. If candidates were able to correctly identify the impact to mortality, usually they were able to correctly describe the impact to the 7702 and 7702A tests.

(i)   Using the blended method, blending from age 95 to 100 (instead of 121) will result in higher mortality since the rates will blend to 1 earlier. $Qx = 1$ at 100 instead of 121. The higher mortality will result in a higher NSP under CVAT and the policyholder paying less taxes. The higher mortality will also impact the 7-pay premium; the impact will vary based on the changes in the numerator and denominator.

(ii)   The forced method with ultimate age of 100 will result in higher mortality because $qx = 1$ at 100 instead of 121. The higher mortality will result in a higher NSP under CVAT and the policyholder paying less taxes. The higher mortality will also impact the 7-pay premium; the impact will vary based on the changes in the numerator and denominator.

6.   **Continued**

(iii)   The forced method with ultimate age of 121 will result in lower mortality because qx will jump to 1 at age 121 instead of blending to 1 at age 121. The lower mortality will result in a lower NSP under CVAT and the policyholder paying more taxes. The lower mortality will also impact the 7-pay premium; the impact will vary based on the changes in the numerator and denominator.

7.

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.

Sources:

CIA 2014 - Lapse Experience Study for 10-year Term Insurance, Jan 2014, pp 6-32

Term Conversions - A Reinsurers Perspective, Zajac - Product Matters, June 2012, pp. 1, 5 - 6

Life Insurance Underwriting in the United States, Ch. 1, 2, 4, 5, 6, Klein

SOA Research 2010 - Automated Life Underwriting, Phase 2, Deloitte

SOA Research 2014 - Report on the Lapse and Mortality Experience of Post-Level Premium Period Term Plans

Commentary on Question:

In general, most candidates did well on part (a) as they logically followed through the financial evaluation. Part (e) was also completed well because most candidates understand how lapses vary with various parameters. Parts (b) and (c) are asking about evaluating a business proposal and many candidates found this challenging. Successful candidates compared each of the approaches and considered pros and cons - what are the tradeoffs of a more simplified approach vs variations of more complete underwriting.

Solution:

(a)   Calculate the present value of total underwriting and implementation costs of Approach 2 over the next 3 years using an annual discount rate of 5%. Show your work.

7. Continued

Commentary on Question:
Most candidates did well on this part receiving full marks. Those candidates applying the 10% increase in apps in all years still received nearly full marks.

The total apps with Approach 2 is 500 x 1.10 =550
Total apps decided by AUS = 550 x .70 = 385
Total apps decided by UW = 550 - 385 = 165

The total annual cost of Approach 2 =
AUS apps x AUS cost + UW apps x UW cost + implementation cost

The year 1 cost = 385 x 250 + 165 x 500 + 2,000,000 = 2,178,750

The year 2 & 3 costs = 385 x 250 + 165 x 500 = 178,750

3 year PV at 5% = 2,511,119

(b) Rank each of the AUS underwriting approaches in order of expected mortality change from current fully medically underwritten mortality. Justify your answer.

Commentary on Question:
Full credit was given if candidates correctly identified that Approach 1 should have better mortality than the current approach. If no comparison to the current approach was mentioned, or if they incorrectly ranked Approach 1 and the current method, than only partial credit was awarded. Only partial credit was given if candidates did not justify their answers.

Approach 1 < current approach < Approach 2 < Approach 3

Approach 1: Fully underwritten with AUS, out of risk factors flagged for underwriter The expected mortality is slightly lower than under the full underwriting mortality approach; it is felt that the AUS would produce more consistent decision making and thus better mortality experience. In addition, the level of exceptions/errors made by underwriters would be reduced. In general, it is expected that fewer underrated risks would hit the books.

Approach 2: For non-medical underwriting; the full application is completed; however, no medical exam is completed and no fluid specimen (blood or urine) is completed. Higher than full underwriting mortality is expected.
Because fewer underwriting tools are used (i.e. no fluids), there is less known about the applicant.

7. Continued

Approach 3: Simplified Issue with AUS. The expected mortality is higher than non-medical underwriting because the full medical questionnaire is no longer asked. Therefore, because there are fewer underwriting tools used (# of questions): less is known about the applicant and applicants that were excluded through the application questions no longer being asked, will now be introduced into the risk pool.

(c)

(i) Describe two additional criteria to evaluate the AUS underwriting approaches.

(ii) Identify additional data you would need to evaluate each approach.

Commentary on Question:
There are several possible answers that could get full credit for this question. Candidates who received full credit provided a reasonable and practical approach and provided comments on how to evaluate the options.

(i) Ideas for comparing the approaches:
- One example is to consider a cost/benefit analysis to compare the 3 approaches. The estimated increase in mortality for mis-classifications of each approach should be included in the costs, along with training, development, impact on distribution, underwriting savings etc.
- A second example is to consider the time saved for each approach in placing the applications from start to finish

(ii) Additional data needed to evaluate each approach:
- Expenses, Claims, Loss Ratio
- Resources/training
- Sales count
- Premium

(d) JDB wishes to add a conversion option to Term 10 that would allow conversions to its more profitable permanent insurance products.

(i) Describe the two ways of incorporating the additional cost of anti-selective mortality due to term conversions in pricing.

(ii) Recommend two ways to charge for the cost of a term conversion option.

Commentary on Question:
For part (i), only partial credit was given if the 2 ways were listed rather than described.

7. **Continued**

      (i)   Two ways to incorporate the additional cost of anti-selective mortality:

           1. Include excess mortality in permanent product pricing: This choice is popular because level-period term is very price sensitive, and places the antiselective mortality into the product that is directly affected by the actual increased claims.
           2. Include excess mortality in the term pricing as part of a cost of conversion: This has the advantage of aligning the cost of the conversion option the term product that created the option.

      (ii)   Two ways to charge for the cost of the conversion option:

           1. Could have two term products with different premiums. The higher priced one would offer the conversion benefit (or an extended conversion benefit) and the lower cost one would be more restrictive.

           2. The cost can be managed by reducing the richness of the benefit: e.g. limiting the number of years in which you can convert or only allowing it for certain ages.

(e)   Describe, with reference to the CIA 2014 Lapse Experience Study, how lapse rates for Term 10 would vary by:

      (i)   Issue age for the level period

      (ii)   Issue age for duration 10

      (iii)   Rating class

      (iv)   Gender

      (v)   Payment frequency and mode

Commentary on Question:
If the candidate did not show an understanding of each point, then only partial credit was given. An example of full credit is shown below.

      (i)   Issue age for the level period: Limited variation by issue age as experience shows that rates for younger issue ages are only slightly higher than average and rates for ages over 60 are slightly higher when measured by amount.

      (ii)   Issue age for duration 10: Duration 10 lapses increase by age because the premium jump is larger, resulting in more of a shock lapse.

7. **Continued**

      (iii)   Rating class: The Best Preferred class has lower than average lapse rates, Residual/Standard Preferred is close to expected and Standard underwriting class is slightly above expected.

      (iv)   Gender: Lapse rates for males are higher than for females, whether measured by count or by amount.

      (v)   Payment frequency and mode: Policies paid less frequently than monthly show higher lapse rates because the shock of the premium amount. Compared to standardized lapse rates on policies not paid by preauthorized cheque or similar arrangements (PAC) are approximately twice those of PAC policies.

(f)   In order to improve profitability on Term 10, JDB is considering an increase to the post-level premium rates from a "3 times" jump from level period rates to a "10 times" jump. The rationale is that the level premium that is used for competitive purposes will not change and the income in durations 11 and greater will improve.

      (i)   Describe the effect of this premium increase on other assumptions.

      (ii)   Propose three alternative methods that could be used to increase profitability.

Commentary on Question:
On part (i) only partial credit was given if the effect of the premium increase on only mortality and lapse was mentioned and they did not explain the impact these premiums would have on the performance of the product due to those who persist (i.e. much higher claims).

      (i)   Lapse rates increase as the premium jump increases because healthy individuals will leave to be re-underwritten and get lower rates elsewhere. Mortality multipliers increase as the premium jump increases due to the anti-selection. Therefore while income would increase by the higher premiums, it could be partially or fully offset by the lower amount of policies that are around due to higher lapses, and the higher claims paid due to a significant increase in mortality.

      (ii)   Other methods (examples) to increase profitability:
          1. Lower expenses (overhead, distribution, claims, maintenance)
          2. Seek out reinsurance to the product (new or improved agreements)
          3. Enhance portfolio yields/investment performance

8.

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:

(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.

Sources:

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

Digital Distribution in Insurance: A Quiet Revolution, Swiss Re, 2014

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Outline the advantages of an extension of benefits provision for UL / LTC combination products.

   Commentary on Question:
   Candidates did poorly on this part of the question. Many candidates missed the key point of this question which is that the extension of benefit (EOB) structure provides benefits even after depletion of face amount(FA). Candidates were given full points if they answered the key point and any other three benefits from the list below.

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8. Continued

- EOB structure provides benefits even after depletion of FA
- EOB designs can help assure that a wide range of consumer needs are met by combination plans
- Without EOB structure, the funds are diverted from the UL beneficiary, when in fact the need for insurance may actually be increased in the event that LTCI services are required.
- Without EOB structure, UL face may not provide enough coverage needed for LTCI.
- EOB rider can allow LTCI lifetime amount in excess of face amount.
- EOB may sufficiently address the LTCI need over a 24-month period, while an independent benefit that begins once the accelerated benefit provision ends will round out the coverage for an extended period.
- Under an EOB, benefit payments reduce the maximum LTCI pool amount on a dollar-for-dollar basis.

(b)

    (i)   Predict the effect on the PV of Profits for the Combo product for each scenario. Justify your answer.

    (ii)   Compare the effect on the PV of Profits for the Combo product for each scenario relative to the stand-alone UL and LTC products. Justify your answer.

Commentary on Question:
Candidates did well on this part of the question. Overall, Scenarios 1 and 2 were better answered than Scenario 3. Part (ii) comparison to stand-alone products was also better answered than part (i). The following answer would earn full grading points.

Scenario 1 - Lower LTC Incidence:
- Lower LTC incidence increases PV profits for the Combo products
- Higher increase than just stand-alone UL since UL is not affected by LTC incidence
- Stand-alone LTC would have higher increase in PV Profits than Combo product

Scenario 2 - Lower Active Life Mortality:
- Increases PV profit on Combo product
- Decreases PV profit on stand-alone LTC due to increased long-term LTCI costs
- Increases PV profit more on stand-alone UL than on Combo product since the increase on Combo product is dragged down by the LTC component

8. **Continued**

Scenario 3 - Lapse Rates Increase:
- Effect on Combo product dependent on age. In general may help PV profits at younger issue ages but hurt at higher issue ages
- Stand-alone LTC is highly lapse supported so increase in lapse rates will help PV profits more than Combo product
- UL generally slightly persistency supported, so higher lapse rates will hurt PV profits more than Combo product

(c) Evaluate ASD's plan to sell the Combo product online. Justify your answer.

Commentary on Question:
Candidates did well on this part of the question. Candidate that received full marks indicated selling online is not a good idea, and provided some rationale to support such statement. Candidates were given full points when they answered that selling online is not a good idea with the support of at least 4 arguments taken from the list below.

Selling online is not a good idea because:
- In the US, a significant shift by consumers to online insurance purchases has not materialized.
- Customers have a high preference for personal interaction and expert assistance.
- Mainly simple products currently sold online - commercial auto and professional liability.
- Younger customers typically more comfortable with online purchases but prime target for Combo products is > 55.
- Customers need intermediaries since voluminous amount of info on internet can hinder decision making.
- Significant upfront costs to establish online presence required.
- There is still a demand for face to face sales for complex products such as Combo product.

9.

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

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:
(1a)   Explain considerations for successful product development.

(1c)   Identify gaps between product design and the operations of the company, its procedures and systems.

(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

(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:
Predictive Modeling for Life Insurance by Deloite http://www.soa.org/files/pdf/research-pred-mod-life-batty.pdf

Expected Mortality: Fully Underwritten Canadian Individual Life Insurance Policies, CIA Education Note, July 2002 (Exclude Appendices) www.actuaries.ca/members/publications/2002/202037e.pdf

Atkinson & Dallas, Life Ins. Products and Finance Chapter 2 Product Development

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

Commentary on Question:
This question tests the candidate's understanding and practical implementation of predictive modelling. The candidate is expected to be able to determine what the challenges/benefits are of predictive modelling in different applications and to evaluate whether a predictive model makes financial sense to implement.

9. **Continued**

Solution:
(a)   Explain the challenges a life insurance company has with using predictive
       modeling to estimate mortality as the target variable.

       Commentary on Question:
       *In this section, the candidate is expected to provide the two main challenges with
       using predictive modelling: the long term nature of insurance and low frequency
       of claims. Full credit is given if the candidate identified and provided a brief
       explanation for these two challenges. Most candidates identified at least one of
       the two challenges.*

       1. Long coverage period (eg. 10, 20 or more years)
           - Risk factors to mortality may change over time
           - Premiums may be guaranteed from outset

       2. Low frequency of life insurance claims
           - More experience needed to model sufficient mortality
           - Accessing usable data is a significant challenge

(b)   Recommend whether the predictive model should be implemented. Justify your
       answer.

       Commentary on Question:
       To earn full credit, a candidate is expected to do three things:
       - *Compare the original and revised present values of the product CFs including
         the costs of the model's input data.*
       - *Realize that the mortaliy gains from the predictive model are not being fully
         reflected in the premiums passed to the insured.*
       - *Provide a recommendation based on the PV of product cashflow differences*
       Partial marks are given for completing sub-steps and providing formulas.
       *Common mistakes made by candidates included calculating the cost of analytics
       for only the extra 100,000 lives instead of the total 200,000 lives, and calculating
       the new present value but not comparing it to the original present value.*

       Present Value = PV(Premium) - PV(Benefits) - (Costs)
       Original Present Value = (100*100,000) - 8M - 0 = 2M

       From conservation of deaths, 100% = 30% * pref Gold + 70% * pref Silver
       So pref Gold mortality = (100% - 0.70 * 125.71%) / 30% = 40% of preferred

9. Continued

New PV(Benefits) = 8M (from the original 100,000) + PV(Benefits from new 100,000 pref gold)

PV(Benefits from new 100,000 pref gold) = 40% PV(Benefits) = 40% * 8M = $3.2M

New PV(Benefits) = 8 + 3.2 = 11.2M

New PV(Premium) = PV(Gold and Silver Premium)

Pref Silver Premium = 70,000 * 100 = 7M

Pref Gold Premium = 130,000 * 80 = 10.4M

Total New Premium = 7M + 10.4M = 17.4M

Costs = 25 * 200,000 + 500,000 + 1 * 200,000 = 5.7M

New Present Value = 17.4M -11.2M -5.7M = 0.5M

Since New PV = 0.5 < Original PV = 2, it does not make sense to implement the predictive model.

(c)

(i)   Describe each strategy.

(ii)   Evaluate how each strategy could benefit from predictive modeling.

Commentary on Question:
Part (i) is retrieval and candidates must come up with one out of the two points under each strategy to receive full credit. The majority of candidates received most or full credit. Part (ii) requires application of the concept to the business strategy. Candidates had difficulty identifying predictive modelling variables relevant to the pricing strategies.

(i)   **Co-operative**
- few companies dominate the market, prices move in parallel, not necessarily the same

Adaptive
- companies review other companies' prices and set their prices relative to the market
- try to compete based on factors other than price (image, quality, service)

9. **Continued**

Opportunistic
- efficient companies use price as a competitive weapon to gain market share
- survival of the fittest, need to be committed to improving productivity and efficiency

Predatory
- setting price below cost of product to drive out competitors, then increase price to recoup losses

(ii) **Co-operative**
- can be used to analyze how high profit margins can be before other companies enter
- can be used to predict when barriers to entry are becoming ineffective

Adaptive
- can be used to improve target marketing to focus marketing efforts on customers who value service and quality over price
- can be used to speed up underwriting process to improve turn-around times, thereby increasing service satisfaction

Opportunistic
- can be used to segment the market to focus marketing efforts, increasing efficiency
- can be used to streamline underwriting and decrease underwriting costs, increasing efficiency

Predatory
- can be used to predict when/where/how much competitors will have price changes

10. **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:
LP-110-07: Policyholder Dividends

LP-125-13: NAIC Life Insurance Illustrations Model Regulation

Commentary on Question:
The question is to test the candidate's knowledge about the rules of a participating life insurance illustration and regulation on illustrated dividend scale. It also tests the candidate's ability to think about various adjustments that are needed in special circumstances.

Solution:
Propose changes to JTM Life Insurance Company's dividend illustration below to ensure it is compliant with the NAIC Life Insurance Illustrations Model Regulations for policies sold in the U.S.

Commentary on Question:
In general, candidates did not do well. Many candidates listed some reasons why the illustration was incompliant according to the general rules and standards. Very few candidates were able to comment on the incompletion/incompliance of the current illustration form, missing illustration on age 70/duration 20 and three different bases with one setting at 50% of dividends contained in the illustrated scale.

(i)   This illustration is both incomplete and incompliant.

(ii)   An illustration is required to contain the basic information, which is not contained in this form as per Section 6.A

- Name of insurer
- Name and business address of the producer or insurer's authorized representative, if any
- Name, gender and age of proposed insured
- Underwriting or rating classification

10. Continued

(iii)   This illustration doesn't conform the following requirements as per Section 7.A
  * The illustration should be labeled with the date on which it was prepared.
  * Assumed dates of payment receipt and benefit pay-out must be clearly identified.
  * Assumed payments must be identified as premium outlay or contract premium
  * Non-guaranteed elements must be clearly labelled as non-guaranteed

The illustration of non-guaranteed elements shall be accompanied by a statement indicating that they are not guaranteed, the assumptions on which they are based are subject to change, actual results can be better or worse.

(iv)   This illustration would require the following modifications with Section 7.B on Narrative Summary
  * Inclusion of a description for premium outlay
  * Inclusion of a brief description of the product being illustrated
  * Inclusion of a brief description of column headings and key terms

(v)   Proposed changes on Numeric Summary as per Section 7.C
  * Numeric Summary must illustrate the results for Age 70 and duration 20.
  * Illustration must provide three different bases with one setting dividends at 50% of dividends contained in the illustrated scale.
  * Illustration must show premium outlay.

(vi)   Proposed changes on Statements as per Section 7.D
  * Illustration must include be signed and dated.
  * Illustration must include verbiage stating they have received a copy of the illustration and understand any non-guaranteed elements illustrated.
  * Illustration must include verbiage whereby the insurer or representative certifies the illustration has been presented to the applicant and that they have explained the non-guaranteed elements illustrated which are subject to change.

(vii)   Standards on Tabular Detail requires a basic illustration to include the following for at least each policy year from 1 to 10, every 5th policy year thereafter ending at age 100
  * Contract premium
  * Guaranteed death benefit
  * Guaranteed values available upon surrender

Non-guaranteed elements (e.g. terminal dividends) must be shown at the same durations as guaranteed elements