ILA LP Model Solutions
Spring 2015

1. 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

Marino and Grobe, Canadian Taxation of Life Insurance,

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

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Compare and contrast policyholder tax treatment of a full policy surrender versus a partial surrender on a whole life policy in both the US and Canada.

Commentary on Question:

This question is to test the different tax rules between exempt policies and non-exempt polices, in both the US and Canada. To receive maximum points, candidates needed to list the types of life policies (exempt/non-exempt) and explain the different tax treatment of each type of policy on both full surrender and partial withdrawal. Most candidates understood the question, although some candidates spent time explaining the details of the exemption test.

US TAX

Life Insurance

- Partial or full surrender are treated the same under Life Insurance
- Under section 72, withdrawal provisions, amounts distributed under a life insurance contract are not taxable to the policyholder until they exceed the premiums paid

1. Continued

- Section 72 stacking rules determine the taxable income resulting from a pre-death distribution of life insurance Cash Value (CV). Such a distribution is treated first as a recovery of the policyholder's investment in the contract and is not included in gross income except to the extent it exceeds the investment in the contract (i.e. First-in First Out (FIFO) Rule

Modified Endowment Contract (MEC) - Full surrender

- Under section 72 for a MEC, the amount received is includable in gross income, but only to the extent it exceeds investment in the contract, i.e. the FIFO rule
- This rule (FIFO) allows full basis recovery for MECs where there is a full surrender in the presence of a surrender charge
- Therefore in US, the taxable gain for a full surrender is the same for a life insurance contract and a MEC

MEC - Partial surrender

- In the US, the taxable gain for partial policy surrender is treated on a LIFO basis
- If a pre-death distribution (partial surrender) is made from a MEC, the amount included in gross income is the amount of CV just prior to distribution, unreduced by any surrender charge, minus the investment in the contract; this is the Last in First out or Income comes out first (LIFO)
- The investment is defined as the aggregate amount of premiums or other considerations paid for the contract less the aggregate amount previously received under the contract to the extent the amount was excludable from income
- For a contract with a surrender charge, the amount considered to be distributed is net of any surrender charge imposed

Canadian Tax

Exempt policy - Full surrender

- In Canada, a surrender is a disposition of an interest in the policy pursuant to the definition of "disposition"
- the policy gain is calculated as the excess of the proceeds of the disposition (cash surrender value less outstanding policy loans and unpaid premiums) over the adjusted cost basis (ACB) immediately before the disposition
- the key factors that determine the adjusted cost basis of an exempt life insurance policy are the cumulative premiums less the cumulative Net Cost of Pure Insurance (NCPI), assuming the original policy was issued to the current policyholder and that no dispositions have taken place
- the NCPI represents the pure mortality costs under the policy each year

1. Continued

Exempt policy - Partial surrender

- The ACB must be prorated between the amount of partial surrender and the remainder of the policy at the time of the partial surrender
- The ACB of the partial interest is the proportion of ACB of the policyholder's entire interest that the proceeds of the disposition are of the accumulating fund of the policy immediately before the withdrawal
- The accumulating fund is the greater of (1) the CSV (cash surrender value) of the policy and (2) insurer's maximum reserve for the policy. Generally for most products the accumulating fund equals the CSV of the policy
- For a partial surrender, the ACB is reduced by the proceeds of the disposition and is increased by the policy gain reported on the partial disposition

Non-Exempt policy

- Non-Exempt policies are subject to annual accrual taxation
- Non-Exempt policies are taxed on excess of accumulating fund over the ACB
- Accumulating fund generally defines the Maximum Tax Actuarial Reserves (MTAR)

(b) Calculate the tax payable for each partial policy surrender assuming a 40% tax rate and the policy is:

(i) A US policy treated as Life Insurance, according to IRC 7702/7702A, assuming the non-taxable portion at the end of year 19 is zero.

(ii) A US policy treated as a Modified Endowment, according to IRC 7702/7702A, assuming the non-taxable portion at the end of year 19 is zero.

(iii) An exempt Canadian policy, assuming the Adjusted Cost Base (ACB) at the end of year 19 is zero.

Commentary on Question:
As an extension of part(a), part(b) tests how to apply the tax rules in the tax calculation e.g., FIFO/LIFO rules in the US tax, full ACB and prorated ACB in Canadian tax. Most candidates did quite well on the first part (FIFO). However some candidates failed the second part because they did not understand the LIFO principle. In the third part of the question, most candidates were able to calculate the tax payable in the year 21 but some candidates had difficulties in the calculation of ACB(22).

1. Continued

Cash Surrender Value
CSV(t) = CSV (t-1) + increase in CSV - surrender (t-1)
CSV (19) =0
CSV (20) = 0 + 20,000 - 0 = 20,000
CSV (21) = 20,000 + 20,000 - 0 = 40,000
CSV (22) = 40,000 + 20,000 - 20,000= 40,000

(i) US Life Insurance (FIFO)
Non-Taxable Portion (NTP) (t) = NTP (t-1) – non-taxable portion of surrender (t-1) + Prem (t)
NTP(20) = 10,000
NTP(21) = 10,000+10,000 = 20,000
NTP(22) = 20,000-20,000+10,000 = 10,000

Taxable amount (21) = Surrender (21) -NPT(21) = 20,000 - 20,000 = 0
Taxable amount (22) = Surrender (22) - NPT(22) = 20,000

Tax Paid (21) = Taxable amount (21) * 40% = 0
Tax Paid (22) = Taxable amount (22) * 40% = 8,000

(ii) US MEC (LIFO)
Non-Taxable Portion (NTP) (t) = NTP (t-1) – non-taxable portion of surrender (t-1) + Prem (t)
NTP(20) = 10,000
NTP(21) = 10,000+10,000 = 20,000
NTP(22) = 20,000-0+10,000 = 30,000

Taxable amount (21) =min(CSV(21) - NTP(21), surrender(21)) = 20,000
Taxable amount (22) =min(CSV(22) - NTP(22), surrender(22)) = 10,000

Tax Paid (21) = Taxable amount (21) * 40% = 8,000
Tax Paid (22) = Taxable amount (22) * 40% = 4,000

(iii) Exempt Canadian Policy
ACB (t) = ACB(t-1) + Prem (t) - NCPI(t) - Dispositions (t-1) + Policy gains (t-1)
ACB(20) = 0 + 10,000 - 1000 = 9,000
ACB (21) = 9,000 + 10,000 - 1000 = 18,000

Prorated ACB (21) = Surrender(21) / CSV (21) * ACB(21) = 9,000
Taxable Gain (21) = Surrender(21) - Prorated ACB (21) = 11,000
Tax Paid (21) - 11,000 * 40% = 4,400

1. Continued

ACB (22) = 18,000 + 10,000 - 1000 - 20,000 + 11,000 = 18,000
Prorated ACB (22) = Surrender(22) / CSV (22) * ACB(22) = 13,500
Taxable Gain (22) = Surrender(22) - Prorated ACB (22) = 16,500
Tax Paid (22) = 16,500 * 40% = 6,600

(c)

(i) Describe the tax advantages of marketing a Prescribed Annuity Contract in Canada.

(ii) For a specific prescribed life annuity in Canada, you are given:

- Annual annuity payment: 25,000
- Adjusted purchase price: 150,000
- Interest rate: 5%
- Annuitant age: 61
- Expected lifetime of annuitant: 15 years

Calculate the taxable amount of each annuity payment.

Commentary on Question:
To get full marks, candidates needed to show an understanding of the tax benefit of PAC and how to calculate the capital deductible and taxable portion of annual annuity payment.

(i)

- In general, for post 1989 contracts, annuities which qualify as prescribed annuity contracts (PACs) are taxable as payments received.
- For PACs, the taxable portion of each annuity payment equals the annual payment minus the capital portion. Each payment is considered to be a blended payment of capital and income in a ratio that does not change for the life of the contract.
- This is more favorable than taxation on an accrual basis since it averages out the amount subject to tax and includes an element of tax deferral
- For the latter years of the contract, the income that was not taxed in the early years of the contract must be brought into income

(ii) Total payments = annual payments * the number of years expected to be paid
= 25,000 * 15 = 375,000

1. Continued

The capital element deductible
= (adjusted purchase price / total payments) * annuity payment received
= (150,000 / 375,000) * 25,000 = 10,000

Taxable portion = 25,000 - 10,000 = 15,000

2. 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.

Learning Outcomes:

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

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

Sources:

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

Commentary on Question:

Most candidates understood LTC rider offers some tax advantage; however, many failed to realize such tax advantage exists whether the base policy is MEC/Life or qualified/non-qualified annuity.

Solution:

(a) Describe the US tax impact for benefits paid and premiums received when adding a Long Term Care (LTC) rider to a whole life policy.

(i) Assuming the whole life policy is treated as Life Insurance, according to IRC 7702/7702A

(ii) Assuming the whole life policy is treated as a Modified Endowment, according to IRC 7702/7702A

Commentary on Question:

The main goal is to realize premium and benefit tax advantage of the LTC rider for both Life Insurance and Modified Endowment.

(i) The Pension Protection Act of 2006 excludes from gross income the charges to fund LTC if they provide qualified LTC insurance. These LTC charges reduce the investment/basis in the contract and are tax free.

Section 7702 provides that the portion of a life insurance contract that provides LTC coverage through a rider on or as part of the contract is treated as a separate contract for tax purposes, whether the LTC overage is qualified or not. The separate contract means that the QLTCI can provide tax free benefits. Both the CSV and Net Amount at Risk could be paid out as a tax free QLTCI benefits after onset of the insured's chronic illness.

2. Continued

(ii) Modified Endowment has the same treatment as Life Insurance.

(b) Describe the US tax impact on benefits paid and premiums received when adding an LTC rider to an immediate annuity:

(i) Assuming the immediate annuity is qualified

(ii) Assuming the immediate annuity is non-qualified

Commentary on Question:
The main goal is to realize premium and benefit tax advantage of the LTC rider for both qualified and non-qualified immediate annuity.

(i) LTC rider is treated as a separate contract from the base annuity. The QLTCI portion of the annuity-LTC combination product provides tax free benefits and premiums.

(ii) A non-qualified annuity has the same treatment as a qualified annuity.

(c) Recommend a product structure that minimizes the LTC tax impact on:

(i) A whole life policy

(ii) An immediate annuity

(i) Considering LTC tax purposes, recommend the Qualified LTC coverage as a combination whole life/LTC product, whether the base policy is a MEC or life insurance.

(ii) Considering LTC tax purposes, recommend the Qualified LTC coverage as a combination immediate annuity/LTC product, whether the base policy is a qualified or non-qualified annuity. In addition, a coinsurance design is recommended since Private letter rule states that coinsurance provides meaningful risk and thus has favorable tax treatment.

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:

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

(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

Sources:

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

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

Marketing for Actuaries, 2000 Edition, Chapter 6 Marketing and Pricing

LP-105-07: Life and Annuity Products and Features

3. Continued

Commentary on Question:
Overall candidates did fairly well on this question. Most papers discussed the anti-selection effect on mortality when 10 year term renews and most papers also discussed the large lapse rate at renewal for T-10 that doesn't exist for WL. However, not many candidates discussed the impact that conversions would have on mortality or the impact that a surrender charge schedule would have on lapses. Approximately half the papers discussed the difference in needs for the 2 products.

Solution:

(a) Assess the implications of combining experience for 10-year term and whole life business for the following assumptions:

(i) Mortality

(ii) Lapses

(i) Mortality:
10-yr term would have worse mortality from anti-selection in later years and after 10-yr level period
If you had conversions in your WL study, now the extra mortality from the conversions will be in your term and WL mortality assumption
Different levels of underwriting could bring about difficulties
if product structure differs (i.e. preferred vs. non-preferred) between products, mortality could vary
Consider the exposure base and the credibility resulting from combining the data.

(ii) Lapses:
By combining the Term and WL experience, the lapse rates at renewal will be dampened for the term 10 product
The lapses influenced by surrender charge schedule for the WL product would be included in the blended experience. This could cause an increase in lapses where it would not be justified for the term product
The need for the insurance for term and WL policyholders may be different, which would impact the blended lapses.

3. Continued

(b)

(i) Calculate the deteriorated mortality of the remaining group assuming preservation of total deaths. Show all work.

(ii) Using the additional information below:

- 10% of total lapses at end of year 10 are assumed to be conversions
- Conversion mortality is assumed to be 110% of normal mortality

Recalculate the deteriorated mortality of the remaining group assuming preservation of total deaths. Show all work.

Commentary on Question:
Most candidates did well on the b i) part of the question. The most common mistake was using the incorrect qd Norm. Part marks were given.
For part b ii), there were some more common mistakes. The qd Norm and the qw Select and Nonsel were often miscalculated. A number of papers used the same values from part b i). Some papers did not use the conversion information in their calculations. Part marks were given.

(i) qdNorm = 3.7 per 1,000
qdSelect = 1.1 per 1,000
qwNorm = 5%
qwExtra = 50%
SelectPct = 50%
qwSelect = qwExtra x SelectPct = (50%) 50% = 25%
qwNonSel = qwExtra – qwSelect = 50% - 25% = 25%
qdActual = [(1 – qwNorm – qwNonSel) qdNorm – (qwSelect) qdSelect] / [1- qwNorm – qwExtra]
qdActual = [(1 – 0.05 – 0.25) x 3.7 per 1,000 – (0.25) x 1.1 per 1,000] / [1 – 0.05 – 0.50] = (2.590 - 0.275) / 0.45 = 5.144 per 1,000

(ii) qdNorm = 3.7 per 1,000
qdSelect = 1.1 per 1,000
qwNorm = 5%
qwExtra = 50%
SelectPct = 50%
qwConv = 10%
qwSelect = (qwExtra - qwConv) x SelectPct = (40%) 50% = 20%
qwNonSel = qwExtra – qwSelect - qwConv = 50% - 20% - 10% = 20%
qdConv = qdNorm x 1.10 = 3.7 x 1.10 = 4.07 per 1,000
qdActual = [(1 – qwNorm – qwNonSel) qdNorm – (qwSelect) qdSelect - (qwConv) qdConv] / [1- qwNorm – qwExtra]

3. Continued

qdActual = [(1 – 5% – 20%) 3.7 per 1,000 – (20%) 1.1 per 1,000 - (10%) 4.07 per 1,000] / [1- 5% – 50%]
qdActual = 4.77 per 1,000

4. **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.

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

Learning Outcomes:

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

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

(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.

(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

(4c) Describe how to ensure the quality of data.

Sources:

Annuity/LTCI Combinations , Product Matters, Oct, 2009

Quantification of the Natural Hedge Characteristics of Combination Life or Annuity Products Linked to Long-Term Care Insurance, Mar 212

ASOP #2 Nonguaranteed Charges and Benefits for Life Insurance Policies and Annuity Contracts

4. Continued

SOA Product Development Section, The Interstate Compact, Product Matters, Feb 2013, pp. 8 - 11

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

Commentary on Question:
Commentary listed underneath question component.

Solution:
(a) Describe the three annuity/LTC combination designs.

Commentary on Question:
Almost all candidates did well on this part. Candidates were able to list out all three designs and describe them.

Tail Design
Benefits are paid first as accelerated benefits until the maximum accelerate benefit has been exhausted, followed by a benefit extension provision.

Coinsurance Design
Accelerated and independent benefits are paid concurrently in fixed proportions until the LTCI benefit limit is exhausted.

Pool Design
Benefit payments are based on a maximum LTCI pool amount defined at issue.

Benefit payments reduce the remaining maximum LTCI pool and account value on a dollar for dollar basis until the account value is depleted. Then benefits payable so long as LTCI benefits triggers are met and the maixum LTCI pool has not been paid out.

(b) Compare and contrast these three designs.

Commentary on Question:
Few candidates received credit on this part. Most candidates could not list the key aspects and compare each design. Very few candidates touched on inflation protection.

Tax Treatment
Coinsurance - receive favorable tax treatment because it implies a meaningful amout at risk for the insurance company
Tail Design- The optimal tax positioning because it would continue payments until the account value
Pool design - Unclear on tax treatment

4. Continued

Cost / Risk to company
Tail design - cheapest and least amount of risk
Pool and Coinsurance - More expensive and risky than Tail design

Tail Design - Lowest risk to company (because client pays LTC benefits first then company)

Appeal to customer / producers
Tail Design: Greatest appeal among agents, Least costly, simplest to explain.
Pool Design: Difficult to understand or explain

Inflation Protection
"Pool design" inherently does not provide inflation protection. This is because under "pool design" the maximum LTCI benefit is set at issue

Tail design provides inherent inflation protection since benefit grows as AV grows

(c) Describe from ABC's stand point:

(i) The benefits of an annuity/LTC combination product over a stand-alone LTC product

(ii) The target market for the annuity/LTC combination product

(iii) The distribution channels to consider for an annuity/LTC combination product

Commentary on Question:
Most candidates were able to list out and describe all key items.

Company benefits of combo product.
- Reduction in risk due to same cross funding that benefits client
- Risk of under pricing LTC benefit is diluted
- Combo product creates an internal hedging effect of risks (e.g. higher mortality increases cost of annuity but lowers cost of LTC)
- Increase sales by targeting a broader market (e.g attracting customers that could not afford standalone LTCI or was not qualified)
- Higher premium and PV of after-tax profits on combo products vs LTCI

4. Continued

Target Market
Customers close to retirement
Age group: 50-80. 80 is usually a cap due to underwriting concerns

Affluent customers since it is a single premium product. Need customers with accumulated wealth
Customers with interest in LTCI but ineligible due to UW or cost

Distribution Channels
Generally in the distribution phase of retirement planning

LTCI producers. Natural fit since producers know the LTCI need

Financial planners
Annuity Producers: if combo product is simple to explain

(d) Recommend changes to ABC's current annuity pricing assumptions to be used with a single premium annuity/LTC combination product. Justify your answer.

Commentary on Question:
Most candidates were able to state all assumptions and list out changes, but only about a quarter of the candidates were able to comment on the right changes.

Mortality: continue to use Annuity mortality
Add morbidity assumption (e.g based on 2009 Milliman LTC Guidelines) to account for LTC

Lower Lapse: combo product lapse rates should be lower than annuity lapses;
- around half of base annuity lapses and shock lapse rate in 10 - 15% range
- Due to surrender charge pattern, recommended lapse rate should not be flat

Expenses: keep current annuity expenses plus
- add underwriting expense (e.g $100 to $200 that varies by age)
- increase annual maintenance expense (e.g 0.05% of account value)
- add LTC rider claim expenses (e.g 5% of LTC insured claim)

Commissions:
- increase first year commission (e.g 1%)
- increase trail commissions (e.g 10bp)

4. Continued

(e) Explain the benefits of using the Interstate Compact for this product.

Commentary on Question:
Most of the candidates did fair on this question. Candidates were able to list out the two key benefits, but not many where able to state and explain the "other" benefit.

There are two key benefits:

- Improved speed to market; as a result of a single filing, 40+ state approvals are received; enough state approvals to consider a product launch are received all at once; compact committed to quickly addressing filings (e.g. 60 days) vs more than a year in some states
- Better consistency across markets since the same form is used in all states, eliminating state alternate versions of forms which reduces marketing and administering challenges

Other:

- Deal with fewer examiners - more efficient use of time
- Filing requirements are better document by the compact than by individual states; Compact has uniform standards and best practices checklist

(f) ABC also recently bought a block of inforce annuity/LTC combination contracts. Senior management wants to increase the LTC charge by 40%. Describe what you need to do to in order to comply with the recommended practices of ASOP No. 2 Nonguaranteed Charges or Benefits for Life Insurance Policies and Annuity Contracts.

Commentary on Question:
Candidates did poorly on this part. Most candidates were not able to list out the key items.

You will need to determine your company's determination policy. Since this is a recently acquired block of business the company may not have one yet.

You should provide advice on policy that is consistent with marketing, financial and other objectives.

You should also consider relevant policy provisions and applicable law.

You should inquire about the insurer's intentions for the determination on nonguaranteed charges or benefits

You should have the senior management confirm those intentions as the determination policy

4. Continued

You will need to use modeling, averaging, grouping of policy classes, or other methods to calculate the specific nonguaranteed charge.

You should consider practical constraints in the determination process (e.g. size, costs, difficulties, etc)

You should consider conducting sensitivity tests of the impact of likely deviations from the anticipated experience

You will need to establish policy classes considering similarity of policy types, structure of the policy factor (i.e. max fee), similarity of anticipated experience factors, time period over when the policies where issued, and UW and marketing characteristics

You will need to determine nonguaranteed charges or benefits to be used in illustrations not subject to ASOP 24

You will need to prepare sufficient documentation to comply with the disclosure requirements.

(g) Recommend how you would stochastically determine the cost of an LTC rider with a design that ties the LTC benefit amounts to account values.

Commentary on Question:
Candidates did well on this question. Most candidates were able to state using stochastic scenarios to project AV and using CTE to calculate fee and claim.

Calibration of account value growth scenarios
The cost is determined by using stochastic modeling that estimates the account value under account value (AV) growth scenarios.

For each scenario, the account value is projected over a long term period (e.g 30-year horizon)

When the account value falls to zero within the 30 years, the LTC claim is calculated as the present value of the remaining payments.

The claims are then discounted to the present for each scenario and averaged

The cost is generally expressed as basis points

The number of scenarios depends on a trade-off between accuracy and run time.

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:

(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:

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

Ending the Mortality Table (Living to 100 Symposium)

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

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

Lapse Experience Under Lapse Supported Products, Product Matters, December (63) 2005

Commentary on Question:

This question tests the student understanding of the pricing for both Term Life and Whole Life. 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.

5. Continued

Solution:

(a) List reasons that mortality experience varies from country to country.

Commentary on Question:
Most of the students answer this question correctly. Some candidates put down personal factor such as age and gender as the reason, although these factors result in different mortality experience, it is not a reason that vary from country to country.

List out any 4 of the 8 reasons below will earn the full credit.

- Environmental Risk Factors: Air or water pollution
- Location Risk Factors: High exposure to ultraviolet light or infectious diseases
- Healthcare: Accessibility, quality, cost, preventive measures
- Cultural difference: fraud, violence, suicide rates
- Natural disasters
- Wars
- Food/Water availability
- Population living standard

(b) Recommend steps to construct a mortality table for MyLife, a new whole life product.

Commentary on Question:
Candidates have mixed performance on this question. Some candidates only outlines very general step to construct mortality table without referencing specific information of MyLife provided in the question.

- Start with the 80-duration mortality table XYZ built based on historical mortality data for the general population
- Extend the mortality table (required since table is for a whole life product). Use any of the methods: Forced Method, Blended Method, Pattern Method or less-than-one method
- Determine credibility of the data
- If data is not credible either (1) apply factors based on company's experience or (2) find other sources of data
- Adjust mortality rates by underwriting class i.e. Preferred class
- Create select and ultimate rates i.e. Wear off the effect of selection due to fully underwritten
- Further refine mortality table as adequate (Male / Female, Smoker / Non-Smoker)
- Ensure that data is still credible after all the adjustments
- Future mortality improvement can be included

5. Continued

(c) Critique the design of the proposed products.

Commentary on Question:
Many candidates simply put down that guaranteed issue is risky. In order to receive full mark, it should be clearly stated that the risk is high mortality rate. For MyLife, many candidates suggests to include a CSV to increase marketability, without commenting that it is required for Whole Life product to come with a CSV.

FastFive
- Guaranteed issue will lead to anti-selection at issue, causing very high mortality rates
- FastFive's pricing strategy will not allow XYZ to charge a fair price to compensate the high mortality rates
- Should at least have SM/NS class due to mortality differential
- The conversion option is another opportunity for anti-selection
- Should establish a maximum face amount limit unknown risk exposure for guaranteed issue product

MyLife
- Whole Life product should come with a CSV (Else, would have been called a T100 product).

(d) Critique the appropriateness of these assumptions for the proposed products.

Commentary on Question:
Most of the candidates correctly captured the effect of different underwriting on mortality and expense assumption. Only a few candidates noted that lapse should cut off at during 5 for FastFive since there are no renewable.

Mortality
- FastFive has no underwriting whereas MyLife policyholders undergo full underwriting. Select and Ultimate rates would not be present
- Higher mortality rates for FastFive to capture effect of anti-selection at issue
- At duration 6+, mortality rates for MyLife should capture the anti-selective conversions from FastFive

Lapse
- FastFive lapse should cut off at duration 5 since non-renewable
- Lapse rates for MyLife should vary by issue age, underwriting class and face amount band
- MyLife should see decreasing lapse rate through duration
- MyLife should see very low ultimate lapse rate (1~2%)

5. Continued

Expense

- FastFive has no underwriting. Issue cost should be much lower

6. **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:

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

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

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

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

(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

6. Continued

Sources:
LP-126-13: Pricing Critical Illness Insurance in Canada, Mooney

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

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

LP-127-13: Product Design of Critical Illness Insurance in Canada

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

Lapse Experience Under Lapse Supported Products, Product Matters, December (63) 2005 http://www.soa.org/library/newsletters/product-development-news/2005/december/pdn-2005-iss63-lebel.pdf

Product Matters, 10/2011 Level Term Lapse Rates – Lessons Learned Here and in Canada http://www.soa.org/library/newsletters/product-development-news/2011/october/pro-2011-iss81.aspx

Marino and Grobe, Canadian Taxation of Life Insurance, 5th Edition, Chapter 1 The History of Life Insurance Policy Taxation

Commentary on Question:
Commentary listed underneath question component.

Solution:
(a) Explain the differences between CI and life insurance in terms of:

(i) Payout trigger

(ii) Policyholder benefits

(iii) Underwriting

Commentary on Question:
Part (a) tested the candidate's understanding of the difference between life insurance and CI. The candidate would be required to know the characteristics of the two products. Overall, the candidates did a good job in answering this part of the question since skill level on this part was mostly retrieval. Some candidates did not get full marks in part (ii) because they focused more on the benefit design vs. the purpose of the benefits.

6. Continued

(i) Payout trigger
- Life pays face amount upon death
- CI pays face amount if policyholder is diagnosed with a covered condition (eg. heart attack, cancer, etc) stated in the contract, condition is not excluded by any other provision, and policyholder lives pass the survival period

(ii) Policyholder benefits
- Life benefits provide financial resources for beneficiaries eg. lost income, final expenses, paying off mortgages
- CI benefits provide financial resources to help pay for additional personal, family or business expenses that often accompany a critical illness or condition to support patients before, during and after treatment eg. taking out new mortgage.

(iii) Underwriting
- Life underwriting would require more financial and avocation information if higher face amounts
- CI underwriting is similar to preferred life underwriting in terms of health and family history assessment.

(b) Describe issues DEF should consider for the CI product regarding:

(i) Product Design

(ii) Implementation

(iii) Canadian Regulatory / Tax Implications

Commentary on Question:
Part (b) tested the candidate's understanding of the considerations in introducing a CI product. The candidate would needed to apply the general considerations of product design, implementation, and regulatory/tax implications to the specifics of the CI product. Overall, the candidates did well in answering this part of the question since this was mostly retrieval with some comprehension.

(i) Product Design
- Conditions – number covered and definitions
- Define survival period
- Will premiums be fully guaranteed?
- Will there be other riders available eg. ROPS, ROPD, etc?

6. Continued

(ii) Implementation
- Will it require new administration systems, processes, or software?
- Training for agents, underwriters and claims administration
- How will the product marketed and distributed?
- How will the product fit the company and impact its existing products?

(iii) Canadian Regulatory/Tax Implications
- Consider if this will be treated like a life insurance policy due to the living benefit component.
- CI does not fall under the definition of life insurance since a person may or may not contract a critical illness and there is no "fixed or determinable future time" at which the insurer must pay benefits.
- What are the reserving or capital requirements?
- Will you need regulatory approval ie. licensing?

(c) DEF is considering the following four product designs for the CI product:

(i) 10-year renewable term to age 75 (Term 10).

(ii) Level term to age 75 (Term to 75).

(iii) Level term to age 100 (Term to 100).

(iv) Level term to age 100 with 100% Return of Premium on Surrender available in the 15th policy year.

Describe the pattern of annual lapse rates for each product design. Justify your answer.

Commentary on Question:
Part (c) tested the candidate's knowledge of the lapse rate pattern based on the product design. The candidate needed to understand the policyholder's behavior during the lifetime of the policy ie. during the early durations, at premium renewal, ROP payment, etc. The skill level on this part was higher then the previous parts since it required some comprehensive and analysis. Overall, many candidate did well in answering this part of the question.

(i) Term 10
- Higher lapses in early years because of buyer's remorse
- Expect a high spike in lapses at the renewal points eg. durations 10 & 11 and 20 & 21, etc.
- Large % of policyholders will lapse at renewal because the premiums increase significantly

6. Continued

(ii) Term to 75
- Higher lapses in early years because of buyer's remorse.
- Decrease to low lapse rates (~2-3%) in the ultimate
- Low lapses because the policyholder is overfunding in the early years, as there is no CSV. This policy is lapse supported.

(iii) Term to 100
- Higher lapses in early years because of buyer's remorse.
- Decrease to very low lapse rates (~1-2%) in the ultimate
- Low lapses because the policyholder is overfunding in the early years, as there is no CSV. This policy is lapse supported.

(iv) Term to 100 with ROP
- Higher lapses in early years because of buyer's remorse.
- Expect spike in lapses at duration 15 as policyholder's will surrender their policy for ROP, then lapses will slowly decrease.
- Expected very low lapses (0-1%) in few years leading up to eligibility of ROPS.
- Steeper decrease after ~duration 25+ as policyholders are not likely to exercise ROPS.

(d) DEF is considering varying its pricing lapse assumption for the Term 10 product by premium payment mode. Propose monthly lapse skewness patterns at durations 9, 10 and 11 for monthly premium payment and annual premium payment. Justify your proposal.

Commentary on Question:
Part (d) tested the candidate's understanding of the lapse skewness pattern before, during, and after the renewal period. The candidate was required to use this knowledge to propose a lapse skewness patterns under the different premium payment modes and justify the proposal. Similar to part (c), the skill level was higher since it required comprehension and analysis. Overall, many candidates did not do very well in this part because many cannot differentiate between lapse rate vs. lapse skewness pattern ie. some candidates provided lapse rates rather then proportion of lapses during the duration.

Monthly premium payment mode
- Duration 9 - lapses should be distributed equally throughout the year because the monthly premium is the same
- Duration 10 - lapses should be heavily skewed towards the end of the policy year. (>50% in month 12)
- Duration 11 - lapses should be skewed towards the beginning of the policy year (50% in first 3 months)

6. Continued

Annual premium payment mode

- Duration 9 - lapses should be heavily skewed towards end of policy year because annual policy was already paid
- Duration 10 - lapses should be heavily skewed towards end of policy year because annual policy was already paid.
- Duration 11 - lapses should be skewed towards the beginning of the policy year and the end of the policy year.

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:

(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.

Sources:

Sigma Study on Securitization in insurance - New opportunities for insurers and investors, Swiss Re, July 2006, pp. 1- 16, 24 - 26, 29 - 36

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

Commentary on Question:

This question tests the candidate's understanding of life insurance securitizations as a capital solution for new business strain. It first tests the candidate's broad knowledge of how securitization can benefit the company, the investors, as well as the insurance industry. Then it tests for why the existing offshore reinsurance with LoC solution to reserves and capital is not viable. It then asks the candidate recommend a type of securitization for a particular situation and to explain what is the main benefit/purpose of the securitization. Next, the candidate is expected to demonstrate the reduction in new business strain by showing the measure with and without XXX securitization. Finally, the candidate is challenged to propose a way to reduce structuring costs.

Solution:

(a) The CFO seeks to understand insurance-linked securitization (ILS) to help finance the statutory reserve and capital requirements of term insurance required by US regulation. He is not particularly concerned with extreme catastrophic events, such as earthquakes.

(i) List the three most relevant benefits ILS could potentially bring to your company.

(ii) List two reasons why fixed income investors may find these life bonds attractive.

(iii) List two reasons why securitization benefits the insurance industry.

7. Continued

Commentary on Question:
Most candidates did not give the last reason in their answer (Help develop the (re)insurance industry by making the market more complete and efficient).

(i)

1. Due to guideline XXX, term products require a great amount of XXX reserves. ILS can provide financing to the term business to free up capital. ILS can therefor expand the business or create new business using the capital saved.
2. ILS improves the capital efficiency and ROE for the company. Because of the XXX securitization, the required capital is reduced.
3. The company also can benefit from monetizing the intangible asset by issuing the embedded value security. The proceeds from ILS can be used for expanding the business or funding new business.

(ii)

1. Life bonds have different inherent risk and life bonds will make their portfolios more diversified.
2. High quality bonds available in market may be limited. Life bonds may be a good alternative to them.

(iii)

1. Provides access to the capital markets, which allows the company to grow their business and expand offerings.
2. Provides relief from capital/redundant reserve requirements, which allows insurers to return a better yield to shareholders.

(b) List three disadvantages to using a letter of credit with an offshore reinsurer to get capital relief.

Commentary on Question:
Most candidates were able to give 1 correct answer and received partial credit but to receive full credit more than one disadvantage was required.

1. Offshore reinsurers have limited capacity
2. Prices are typically only guaranteed for one year which exposes the company to rising costs
3. LOC costs are rising due to increased usage.

(c) The CFO is considering XXX securitization.

(i) Outline how this approach would work.

(ii) List reasons for using this approach.

7. Continued

Commentary on Question:
For (c) (ii), Credit was given alternative answers.

(i) In a XXX securitization, the redundant reserve, which is the XXX reserve minus the best estimate reserve, is securitized and issued as a bond to the financial markets. The insurer will provide an interest payment to the bondholder each year, stemming from the profits of the term business. At the end of the term of the bond, the principle is returned. Losses on the block of business will first come out of the retained tranche (i.e. the company's economic reserve). Losses in excess of the retained tranche will reduce interest and principle payments for investors. Bonds are often issued by a special purpose vehicle (SPV).

(ii) Reasons to use this approach:
- Free up capital so can use capital for new business
- A method to bypass severely conservative regulation requirements (must hold XXX reserves)
- Improve ROE and can promise benefits to investors at lower margin than originally priced for
- Full tax reserve deduction

(d) Calculate the new business strain at time zero with and without using XXX securitization.

Commentary on Question:
Very few candidates received full credit for (d). Some of the errors included forgetting to divide the final NB strain numbers by the premium, using premium instead of product cash flow in the distributable earnings calculations, and incorrectly calculating the reserves.

New business strain = PV (distributable earnings) / PV (premium)

Distributable earnings = Prod. Cash Flows – Stat Reserve – Required Capital

Without XXX securitization:
- Solvency Reserve = 100
- Distributable earnings = 20 – 100- 100 (25%) = -105
- New Business Strain = -105 / 30 = -3.5 or -3.50%

With XXX securitization:
- Economic Reserve = Solvency Reserve – Redundant Reserve = 100 – 60 = 40
- Distributable earnings = 20 – 40 – 100 (25%) = -45
- New Business Strain = -45 /30 = -1.5 or -150%

7. Continued

(e) Describe a way of lowering the structuring cost of a securitization.

Commentary on Question:
Most candidates gave alternative answers such as use in-house resources; multiple securitizations will lower per unit cost, and adding credit enhancements. Credit was given for these alternative answers.

Shelf registrations can significantly lower the structuring cost. A shelf registration is when a large ILS is priced at one time (typically hundreds of millions). This allows all the legal, tax, operational, etc. fees to be more efficiently spread out. The final ILS can then be sold in portions over time without the need for a full pricing each time.

8. Learning Objectives:

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

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.

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

Sources:

LP-110-07: Policyholder Dividends

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

Commentary on Question:

Candidates must understand how participating policies work, differences between participating and non-participating policies, special considerations that mutual companies must understand when acquiring non-participating products and a specific example of how it ties to a potential VUL product.

Solution:

(a) Describe the characteristics of a participating policy that differentiate it from a non-participating policy.

Commentary on Question:

Candidates that did well on this question provided a broad list of distinct characteristics of participating policies. Candidates that did do well did not provide an adequate number of unique characteristics.

Listing four of the following statements would earn the candidate full marks for this question

- A participating policyowner is the actual owner of the mutual insurance company
- Par policies are part of dividend class that has high probability of being self-supporting
- Par policies pay dividends, non par do not
- Participating, but not expected to pay any dividends, are policies that adjust non-guaranteed elements other than dividends based on future expectations, not past experience
- Par policy typically gets paid dividends based on block experience

8. Continued

Listing any of the following statements would help earn partial marks if less than four of the above were provided

- Par policyowners should get surplus if mutual company ceases to do business
- Mutual and stock companies can issue par policies
- Par policyowner contributes to entity surplus by the company "charging" in the dividend scale for long-term growth

(b) Explain the benefits and drawbacks of the two methods for changing dividend scales: pegging and substitution.

Commentary on Question:
Candidates did well on this question. Candidates that received full marks provided multiple examples of benefits and drawbacks for both scales. Candidates that did not do as well only provided the definition of pegging and substitution

Listing four of the following statements would earn the candidate full marks for this question

- Pegging pays same amount as last year, so policyowner will not see a decrease
- Substitution is best for more recent issues, so decreases would not be as. problematic due to the small amount of dividends in early years
- Both will slightly improve persistency over merely reducing dividends
- Improved persistency may offset part of extra cost of higher dividends
- Both will come at a cost to the company; must maintain equity between blocks of business

Listing any of the following statements would help earn partial marks if less than four of the above were provided

- Administrative costs can be high.
- Both are used when reducing the dividend scale, which reflects the material changes in experience.

(c) Describe considerations that LNO Life will have regarding the post-acquisition dividend scale if they move forward with the acquisition.

Commentary on Question:
Candidates did not do very well on this question. Most did not explain how the experience of the blocks would be merged over time, including how it would affect individual assumptions

8. Continued

Listing the four following statements would earn the candidate full marks for this question

- If two blocks of business are merged, experience must be combined over time so as to maintain equity for the policyowners of either company
- Expense experience, which should be a reduction, would need to be reflected to all policyowners.
- Mortality expectations will have to be combined; different underwriting standards
- Investment experience and overhead costs will eventually have to be combined

Listing any of the following statements would help earn partial marks if less than four of the above were provided

- Expenses for the merger must be charged against future savings
- Separate items that are unique to the blocks.
- Administrative issues
- Consider customer expectations - may need to communicate how future dividends to be affected

(d) Outline the considerations that LNO Life should have in expanding into the new line of VUL business.

Commentary on Question:
Candidates did well on this question. Candidates who received full marks provided many examples with adequate detail.

Listing four of the following statements would earn the candidate full marks for this question

- Administrative issues -- must track market data more frequently and update policies daily
- Could draw current customers into lapsing WL and buying new VUL
- Hedging guarantees -- guarantees on VUL contracts may require different investments
- SEC filings required for variable business
- Equity market risk in VUL

Listing any of the following statements would help earn partial marks if less than four of the above were provided

- Experience with current business may not be applicable to new business
- Distribution concerns
- Misalignment with company's mission and vision can cause failure, may not be within target markets

8. Continued

- Different regulations -- new reserving methods, potential for new reserving systems
- Underwriting differences
- Use of capital that par policyowners have paid into
- Policyholder behavior differences

(e) Define "Adaptive Pricing" and discuss whether it is an appropriate pricing strategy for the new VUL product.

Commentary on Question:
Candidates did not do well on this question. Candidates who did well, defined Adaptive Pricing well and provided a through argument as to why it is appropriate for the current company.

"Adaptive Pricing" definition
Listing three of the following statements would earn the candidate full marks for the definition portion of the question

- Set prices higher than price leaders
- Extra profit margin gained by charging a higher price outweighs any loss in sales
- Instead of competing mainly on price, companies using adaptive pricing try to compete based on image, quality, and service
- Their theory is that, as long as their prices and commissions are reasonable in relation to the price leaders, they will not lose many sales

Applying to LNO
Listing the following statements would earn the candidate full marks for the knowledge utilization portion of the question:

- Adaptive pricing is an appropriate strategy given the company is new to the market and is not yet a strong competitor
- Company has strengths in other areas (service, reputation given in the problem description - as well as underwriting and distribution channel hypothetically) that it can leverage to make up for higher prices

The candidate received partial credit if only applied definition without referencing LNO's situation. For example,

- Per definition, as long as the prices and commissions are reasonable compared to competitors, they should be able to meet reasonable sales expectations

9. 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

Sources:

Report on Pricing Using Market Consistent Embedded Value (MCEV) (Page 5, 6, 9, 12, 15, 20, &22)

Product Matters! (Page 5-6)

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Describe the differences between the RW and RN approaches for discount rate and swap curve setting.

Commentary on Question:

Most candidates outlined the use of risk-free discounting in the risk-neutral and risk-free plus a risk-premium in real-world but few candidates provided additional details.

Risk Neutral

This discount rate is typically the risk-free rate, however swap rates or another reference rate could be used. Cash flows are value consistently with the prices or similarly traded cash flows in the capital markets.

If the underlying cash flows are illiquid a liquidity premium should be added to the discount rate.

9. Continued

Real World
The pre-tax earned rate is often use as a discount rate. This rate is the weighted-average net investment earnings rate on the assets supporting the liabilities. Alternatively the company's weighted average cost of capital (WACC) is commonly used as the discount rate.
The discount rate can be viewed as a risk-free rate plus a risk premium.

(b)

(i) You are given the PVFP (stochastic) for Product B under RN is −1.2% of the present value of premium. Calculate the following:

- TVOG for Product B under RN
- FC for Product A under RN
- FC for Product B under RN

Show all work.

(ii) Determine which product is the EIA. Justify your answer.

Commentary on Question:
The costs in the question were shown with a negative sign consistent with the example in the source material. Several candidates failed to realize this and subtracted the negative number as the cost (i.e. implying the cost would increase the MCVNB, which is not correct). Candidates generally answered this question well.

(i) Product B TVOG
TVOG = PVFP(CEQ) – PVFP(Stoch)
= 1.6% - (-1.2%)
= 2.8%

Product A FC under RN
MCVNB = PVFP - TVOG - FC - CNHR
FC = PVFP - TVOG - CNHR – MCVNB
FC = 12.0% - (-0.4%) – 8.0% - 3.5%
FC = 0.9%

Product B FC under RN
MCVNB = PVFP - TVOG - FC - CNHR
FC = PVFP - TVOG - CNHR – MCVNB
FC = 1.6% - 2.8% - (-1.6%) – 0.2%
FC = 0.2%

9. Continued

(ii) Product B is the EIA.
The CNHR is particularly large for products involving significant lapse or mortality guarantees. EIA offers less of these guarantees than Term and has the ability to pass experience to policyholders therefore the CNHR should be small for the EIA (product B).

(c) The projected cash flows were discounted using a swap curve adjusted by a liquidity premium of 50 basis points. Determine the credit spread. Show your work.

Commentary on Question:
Most candidates did not answer this question correctly.

Liquidity Premium = max[0, 50% x (Credit Spread – 40bps)]
50bps = 50% x (Credit Spread – 40bps)
Credit Spread = 50/0.5 + 40
Credit Spread = 140bps

(d) With regard to a market-consistent framework:

(i) (*2 points*) Describe the product features that will improve performance.

(ii) (*1 point*) Evaluate how Payout Annuity and UL/VUL products perform.

(iii) (*1 point*) List considerations for replacing a traditional pricing framework with a risk-based pricing approach.

Commentary on Question:
Most candidates answered parts i) and iii) adequately. For part ii), the reasons given often contradicted the conclusion given.

(i) Products with fewer guarantees such as minimum interest rate guarantees or variable annuity guarantees will improve performance under a market-consistent framework.
Products that have lower asset risk borne by the insurer (i.e higher credit quality of assets) will perform better under the market-consistent framework.
If management discretion is allowed to mitigate adverse experience (i.e. can adjust future premiums, credited rates or dividends) this can improve performance in the market-consistent framework.

In general, products with fewer/lower guarantees, less asset risk and more management discretion are less risky and would show an improvement in profit margins when moving to a market consistent framework.

9. Continued

(ii) Payout annuities have high guarantees (mortality/longevity) and significant asset risk borne by the insurer while having little flexibility in mitigating adverse experience. They would perform worse in the market-consistent framework.

UL/VULs performance in the market-consistent framework will depend on the orientation of the product (accumulation vs protection), the cost of insurance structure, investment options and the level of guarantees. The performance could be better or worse in the market-consistent framework depending on the combination of the features in the product.

(iii) Risk-based pricing addresses the shortcomings of traditional pricing methods by providing a framework that is consistent across products for assessing the tradeoffs between shareholder risk and rewards.

While risk-based pricing should be an important part of product design, it should not be the only measure used. Other approaches (e.g. statutory IRR) can provide useful insights into the future profitability of the product(s).

An investment in technology, training as well as educating individuals on risk-based pricing would be needed in moving to a risk-based approach.

10. Learning Objectives:

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

Learning Outcomes:

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

Sources:

Hardy, Investment Guarantees, Chapter 7

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

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Calculate the missing put option prices based on the Black-Scholes formula using your initial estimate of implied volatility.

Commentary on Question:

Most students did well on this question. Partial credit was given to calculation errors.

BSP = K exp(-rT) N(-d2) - S N(-d1)
Put Option Price of 1 year 2400 strike =
2400 * exp(-.02 * 1) * .876 - 2000 * .843 = 374.77

Put Option Price of 5 year 2000 strike =
2000 * exp(-.02 * 5) * .448 - 2000 * .321 = 168.73

(b) Assess the reasonableness of the results in part (a) by explaining the differences between the theoretical prices from Black-Scholes you just calculated and the market prices from Bloomberg.

Commentary on Question:

Students did not receive full points if they did not correctly assess the results and did not explain the role of the implied volatility in the differences. Many students only listed general differences between Black-Scholes and real market prices and did not assess the specific results in the question. Only partial credit was given in that case. Most students did not identify that low strike options have higher volatility than high strike options.

10. Continued

Theoretical prices calculated from Black-Scholes and real market price can be different due to the following reasons:

- Transaction costs (Black-Scholes assumes none)
- Frictional costs (Black-Scholes assumes none)
- Observed vs. Implied constant volatility
- Arbitrage (Black-Scholes assumes none)

The theoretical price of 1 year at the money put option matches the market price. This suggests the initial estimate of implied volatility is derived from the 1 year at the money put option. The difference between the 1 year low strike BS price compared to the market price is higher than the difference between the 1 year high strike BS price and the market price. This makes sense because low strike options should have higher implied volatility than high strike options.

The 5 year BS price is lower than market price because longer maturity options should have higher implied volatility than shorter maturity options. Thus it is reasonable the 5 year price is higher.

(c) Describe methodologies to improve the estimates of implied volatility.

Commentary on Question:
Some students only listed various models that could be used to model volatility and did not describe methodologies to improve the estimates. Only partial credit was given to lists without descriptions.

Create an implied volatility surface, which is a 2-D representation of prices via implied volatility, ultimately creating a 3-D surface of time, maturity, and strike.

The BS model has a shortcoming in that it cannot match option prices over a spectrum of maturities and strikes, and it does not take into account volatility clustering or persistency. The volatility surface has volatility skew, and volatility term structure.

Volatility term structure can be handled with an extension to BS. Volatility skew cannot be handled with an extension to BS, so apply different volatility to different in-the-moneyness.

Additionally, stochastic volatility models can be used to improve volatility estimates. Allowing σ to be stochastic allows for dynamics closer to what is observed in historical market data. You can generalize σ to be a separate stochastic process with separate dynamics.

10. Continued

(d) Describe two approaches to model calibration.

Commentary on Question:
The 2 approaches listed below were the most common answers given. Credit was given for other correct approaches that were described completely.

1. Calibration to historical experience
   - Typically used for generating real world scenarios
   - Consider the incidence of the extreme events over long periods
   - The length of the historical period is an important consideration

2. Calibration to current market conditions
   - Typically used for assessing risk neutral scenarios
   - Produces market consistent assumptions
   - Useful in the analysis of different scenarios for equity market return