
SOCIETY OF ACTUARIES
Individual Life & Annuities Canada – Design & Pricing

Exam DP-IC

AFTERNOON SESSION

Date: Thursday, May 2, 2013

Time: 1:30 p.m. – 4:45 p.m.

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This afternoon session consists of 6 questions numbered 7 through 12 for a total of 60 points. The points for each question are indicated at the beginning of the question.
2. Failure to stop writing after time is called will result in the disqualification of your answers or further disciplinary action.
3. While every attempt is made to avoid defective questions, sometimes they do occur. If you believe a question is defective, the supervisor or proctor cannot give you any guidance beyond the instructions on the exam booklet.

Written-Answer Instructions

1. Write your candidate number at the top of each sheet. Your name must not appear.
2. Write on only one side of a sheet. Start each question on a fresh sheet. On each sheet, write the number of the question that you are answering. Do not answer more than one question on a single sheet.
3. The answer should be confined to the question as set.
4. When you are asked to calculate, show all your work including any applicable formulas.
5. When you finish, insert all your written-answer sheets into the Essay Answer Envelope. Be sure to hand in all your answer sheets since they cannot be accepted later. Seal the envelope and write your candidate number in the space provided on the outside of the envelope. Check the appropriate box to indicate morning or afternoon session for Exam DP-IC.
6. Be sure your essay answer envelope is signed because if it is not, your examination will not be graded.

Tournez le cahier d'examen pour la version française.

****BEGINNING OF EXAMINATION****

**Afternoon Session
Beginning with Question 7**

7. (9 points) GTA Life is a small start-up U.S. life insurer developing a Universal Life (UL) product. GTA currently has operations in just one state, but hopes to eventually expand to the entire U.S. GTA believes its UL product will appeal to buyers of all ages, incomes, and attitudes, but the profitability of the product will be greatly influenced by the buyers' usage rate. GTA feels their small size gives them a superior customer service advantage that will cause buyers to become loyal customers who will purchase future products GTA develops.

(a) (3 points)

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

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

(b) (6 points) You are given:

| Basic Agent Compensation | | | | Additional New Agent Financing Plan | | | | |
|--------------------------|---------|-------|-------|-------------------------------------|-------------------------------|-------------------------|--------------------------|--------------------------|
| Policy year (t) | NVC_t | 0_t | P_t | Commissions Required $_t$ | New Agent Retention Rate $_t$ | Subsidy Percentage $_t$ | Unvested Recoveries $_t$ | First Year Premiums $_t$ |
| 1 | 0% | 0.00 | 1.00 | 10,000 | 1.00 | 150% | 0 | 20,000 |
| 2 | 5% | 0.05 | 0.80 | 10,000 | 0.75 | 100% | 1,500 | 16,000 |
| 3 | 2% | 0.20 | 0.60 | 10,000 | 0.50 | 50% | 2,000 | 12,000 |
| 4+ | 0% | - | - | - | - | 0% | - | - |

where NVC_t = Non-vested commissions as a percent of gross annual premium

0_t = Probability that premium on new business is written by agents who leave before business enters policy year t

P_t = Probability that the annual premium for the policy year t will be paid.

7. Continued

- Gross Annual Premium per policy = 300
- First year commission rate is 50% of premium
- Total fixed cost of issuing all new Universal Life product policies = 100,000
- The new agent financing plan is a subsidy program payable in addition to normal commissions.
- All agents selling this plan will be hired and financed based on the subsidy plan above.
- There are no marginal costs of issuing policies except for the cost of commission and the cost of financing new agents.
- Annual interest rate for discounting = 3.00%

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

8. (13 points) You are given the following for an Equity Indexed Annuity:

- Index Period: 4 Years
- Net Earned Rate: 4%
- Guaranteed Minimum Account Value (GMAV) = 95% of premium accumulated at 1% annually
- Commissions: 5% of premium
- No other expenses or charges
- PV of Profit: 3% of premium

(a) (2 points) Calculate the option budget. Show all work.

(b) (4 points) You are given:

- Single Premium = 10,000
- Index Growth Method: Point to Point
- Participation Rate: 100%
- Participation Rate Guarantee Period: 4 Years
- Ratchet: Annual
- Floor: 0%
- Risk-Free Rate: 2%
- Annual Cost of One Year Call Option: 3%
- Initial Index Level at policy issue is 1000.

| End of Policy Year | Expected Annual Index Levels |
|--------------------|------------------------------|
| 1 | 1020 |
| 2 | 975 |
| 3 | 1050 |
| 4 | 1100 |

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

8. Continued

- (c) (2 points) Explain the benefits of stochastic pricing.
- (d) (1 point) Senior management wants to buy one year options in hopes the option price will decrease for future years. Explain the risks with this approach.
- (e) (4 points) For a contract issued January 1, 2010, you are given the following information:

Single Premium: 70,000

| Date | Cash Surrender Value / MTAR |
|--------------|-----------------------------|
| Dec 31, 2010 | 75,000 |
| Dec 31, 2011 | 81,000 |
| July 1, 2012 | 90,000 |

Assume:

- The Maximum Tax Reserve (MTAR) equals the CSV.
- No withdrawals or payments have occurred prior to July 1, 2012.

Calculate the taxable amount for the following events on July 1, 2012:

- (i) Withdrawal of 10,000
- (ii) Full surrender
- (iii) Policy loan of 10,000
- (iv) Lump sum paid to beneficiary at death of owner
- (v) Transfer of ownership to non-spouse
- (vi) Transfer of ownership to spouse

9. (8 points) JPB Mutual markets participating life insurance products. JPB currently pays annual policy dividends, but is considering its first change in the dividend scale.

(a) (4 points)

- (i) Compare and contrast the various methods to transition to new dividend scales.
- (ii) Evaluate how these methods impact the overall cost.
- (iii) You are given:

| | Previous Year | Current Year | Next Year | Following Year |
|--------------------------------------|---------------|--------------|-----------|----------------|
| Prior Dividend Scale | 11 | 12 | 15 | 18 |
| Current Dividend Scale | 11 | 8 | 11 | 13 |
| Proposed Transitional Dividend Scale | 11 | 9 | 10 | 13 |

Evaluate the proposed scale.

- (b) (3 points) Describe the Canadian tax treatment of policy dividends on participating insurance policies.
- (c) (1 point) JPB is currently in the process of replacing the manual tax calculation methodology with tax software programs. Assess the hidden costs involved with this replacement.

10. (6 points)

- (a) (2 points) Define the Adjusted Cost Basis for policyholder taxation purposes.
- (b) (4 points) You are reviewing a new Universal Life policy, with annual premiums of 3,000 and a level death benefit of 100,000. A partial withdrawal of 3,000 occurs at the beginning of year 6. You are given the following policy information for the first six policy years:

| Policy | Net Cost of Pure Insurance | Cash Value (End of Year) |
|--------|----------------------------|--------------------------|
| 1 | 600 | 2,000 |
| 2 | 720 | 4,100 |
| 3 | 830 | 6,700 |
| 4 | 960 | 9,400 |
| 5 | 1,110 | 12,000 |
| 6 | 1,285 | 10,000 |

- Tax rate = 40%

Determine the after-tax proceeds of a full surrender at the end of:

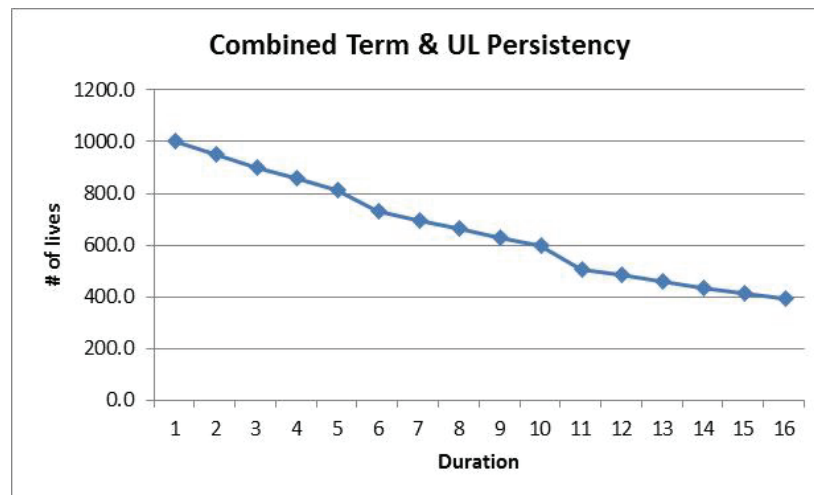
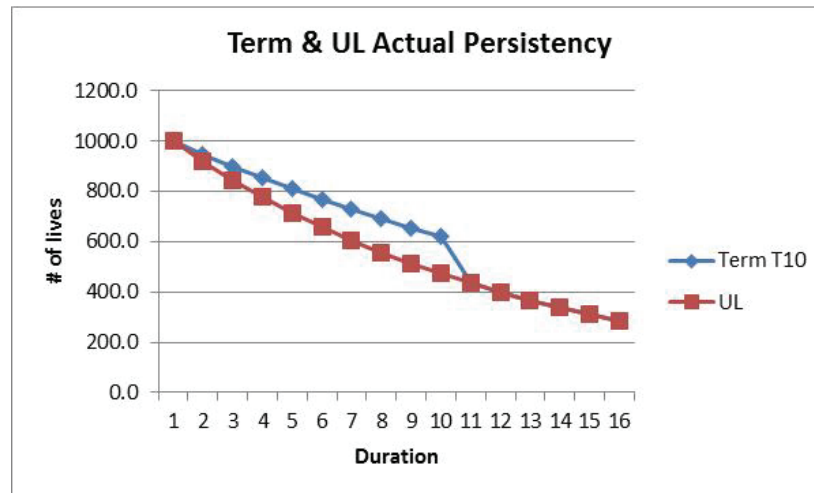
- (i) Year 3
- (ii) Year 6

- 11.** (12 points) AEY Life sells Term and Universal Life (UL) products and is currently developing a new Critical Illness (CI) product. Their target market is young professionals and they distribute their products through both a brokerage and a career agency. You are given:

| | Term | UL | CI |
|----------|--|--|--|
| Premiums | <ul style="list-style-type: none"> • Years 1-10: Level • Year 11: Three times the initial rate • Years 12+: Annually increasing • Paid monthly or annually | <ul style="list-style-type: none"> • Level for life • Paid monthly or annually | <ul style="list-style-type: none"> • Level premiums increasing every 10 years • Paid monthly or annually |
| Other | <ul style="list-style-type: none"> • Conversion privileges begin in year 5 • Optional Return of Premium (ROP) rider, with benefits beginning in year 15 | <ul style="list-style-type: none"> • Surrender charges for the first 5 years • Lifetime secondary guarantee (no-lapse guarantee) | <ul style="list-style-type: none"> • Optional Return of Premium (ROP) rider exists beginning in year 15 • A conversion privilege to a Long Term Care Insurance product starting at year 5, ending at year 25 or age 80, whichever occurs first |

- (a) (4 points) Describe the factors by which life and Critical Illness lapse rate assumptions may vary and the impacts associated with each.
- (b) (4 points) You are setting lapse assumptions for both the Term and UL products. The Marketing area is recommending we use the average lapse rates from both Term and UL for all durations, stating: “Term will have increased profitability which will allow us to reduce premiums and beat the competition!” Below are the persistency graphs of actual UL and Term lapse experience, as well as the combined lapse experience.

11. Continued



- (i) Critique Marketing's recommendation, based on the different features and characteristics of each product.
- (ii) Recommend appropriate lapse rate assumptions to use in the pricing of each product.
- (c) (4 points) Construct a set of CI lapse rates for a male age 43 and a male age 63, clearly labeling points where lapses would change:
 - (i) Assuming annual premium pay with no ROP benefits
 - (ii) Assuming monthly premium pay with no ROP benefits
 - (iii) Assuming monthly premium pay with the inclusion of a ROP rider

- 12.** (12 points) XYZ Company sells Variable Annuity products, which include a Guaranteed Minimum Maturity Benefit (GMMB) rider and a “Guaranteed Minimum Cancer Benefit” (GMCB) rider which pays out a partial benefit acceleration upon diagnosis of cancer.

Consider a contract offered to a person aged 50, with the following details:

- Single Deposit = 50,000
- Maturity period = 3 years
- GMMB = 60% of total deposits, less any GMCB benefits paid
- GMCB = 60% \times max[Fund Value, 100% of total deposits] at the time of cancer diagnosis.
- Management Charge Rate (m) = 0.70% of the Fund Value
- Total Margin Offset (m_c) = 0.30% of the Fund Value
- Fund Value follows a lognormal model with $\mu = 5\%$ and $\sigma = 15\%$

You are given the following mortality assumptions:

- ${}_1p_{50} = 0.9$
- ${}_1p_{51} = 0.8$
- ${}_1p_{52} = 0.7$

You are given the following with respect to cancer morbidity assumptions:

- ${}_1q_x = 0.01$, for all ages
- ${}_t p'_x = 80\%$ of the ${}_t p_x$ given above for mortality

You are given the following from 100 scenarios generated from a standard normal distribution:

| | | | |
|------------|-------|--------|-------|
| Year | 1 | 2 | 3 |
| Scenario 1 | 0.483 | -2.516 | 0.500 |

| Scenario | NPV (future liabilities) -includes all “in-the-money” scenarios |
|----------|--|
| 6 | 5834 |
| 17 | 1295 |
| 23 | 3095 |
| 29 | 789 |
| 44 | 4956 |
| 67 | 2094 |
| 95 | 567 |

12. Continued

- (a) (6 points) Calculate the net present value of future combined GMMB and GMCB liabilities for Scenario 1. Show your work.
- (b) (2 points) Calculate the 95% quantile, and the CTE95. Show your work.
- (c) (4 points) Describe three alternative models to the lognormal model.

****END OF EXAMINATION****
Afternoon Session

USE THIS PAGE FOR YOUR SCRATCH WORK