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

# Exam DP-IC

## MORNING SESSION

**Date:** Thursday, November 4, 2010
**Time:** 8:30 a.m. – 11:45 a.m.

### INSTRUCTIONS TO CANDIDATES

**General Instructions**

1. This examination has a total of 120 points. It consists of a morning session (worth 60 points) and an afternoon session (worth 60 points).

   a) The morning session consists of 8 questions numbered 1 through 8.

   b) The afternoon session consists of 7 questions numbered 9 through 15.

   The points for each question are indicated at the beginning of the question. Questions 1-3 and 8 pertain to the Case Study, which is enclosed inside the front cover of this exam booklet.

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.


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Exam DP-IC Front Cover

## CASE STUDY INSTRUCTIONS

**The case study will be used as a basis for some examination questions. Be sure to answer the question asked by referring to the case study. For example, when asked for advantages of a particular plan design to a company referenced in the case study, your response should be limited to that company. Other advantages should not be listed, as they are extraneous to the question and will result in no additional credit. Further, if they conflict with the applicable advantages, no credit will be given.**

****BEGINNING OF EXAMINATION****
**MORNING SESSION**

***Question 1 pertains to the Case Study.***
***Each question should be answered independently.***

**1.** (*6 points*) You are given the following information with respect to product initiatives for three life insurance companies:

Company A wants to grow rapidly and has decided to enter the term market. The company plans to set premiums 10% lower than any of its competitors in order to build market share.

Company B believes it can sell more products by increasing term life sales and then cross selling other core products to a newly acquired customer base. The company plans to reduce the premiums of its term life product in order to increase total company sales.

Company C has been a leader in the whole life insurance market for many years. The company plans to reprice premiums on its core whole life products to be in line with the competition and use its exceptional customer service and reputation to generate sales. The premium charged will cover all costs associated with selling and administering the product.

(a) (*2 points*) Explain the pricing objective of each company.

(b) (*2.5 points*) Explain the pricing strategy used by each company for its product initiative.

(c) (*1.5 points*) Determine which pricing objective and pricing strategy best fit the profile of the company described in the case study. Justify your answer.

***Question 2 pertains to the Case Study.***
***Each question should be answered independently.***

**2.** (*12 points*) ABC Life launched a new whole life insurance product on January 1, 2008. ABC has a Moody's financial strength rating of Aa2 and faces the issues and challenges described in the case study.

(a) (*1 point*) Define the three types of credit events encompassed by Moody's definition of default.

(b) (*8 points*) You are given the following:

| | | |
|---|---|---|
| Actual Sales 2008 | 100 Policies | |
| Projected Sales 2009 | Moody's Rating | Projected Sales |
| | Aa2<br>Ba2 | 75 policies<br>15 policies |
| Annual Premium Rate | 6.50 per 1000 of death benefit | |
| Cash Value per 1000 of Death Benefit | Policy Year | Cash Value |
| | 1<br>2<br>3 | 4<br>10<br>16 |
| Commissions | 70% of first year premium<br>0% of renewal premiums | |
| Maintenance Expenses | 40 per policy per year | |
| Mortality Rate | $q_{[40]}$<br>$q_{[40]+1}$<br>$q_{[40]+2}$<br>$q_{[40]+3}$ | 0.001<br>0.002<br>0.003<br>0.004 |
| Lapse Rate | Moody's Rating | Lapse Rate |
| | Aa2<br>Ba2 | 4% per year<br>8% per year |
| Interest Rate | 6% | |
| Tax Rate | 0% | |
| Solvency Reserve | None | |
| Required Capital | None | |

## 2. Continued

Assume:

- All sales are on January 1 and premiums are paid annually.
- All sales are to males age 40 with a 100,000 Death Benefit.
- Deaths occur at the end of the year, prior to lapses.
- Lapses occur at the end of the year, after deaths.

Calculate the change in 2009 distributable earnings if Moody's downgrades ABC in 2008 to a financial strength rating of Ba2. Show all work.

(c) (*3 points*) Explain adverse effects of a financial strength rating downgrade on ABC's overall operations.

***Question 3 pertains to the Case Study.***
***Each question should be answered independently.***

**3.** (*8 points*) You are the new pricing actuary for the company described in the case study. The development of a new Universal Life (UL) product is underway. The product has the following features:

- The cost of insurance will be level and guaranteed for the first 10 policy years and will increase by 15% in policy year 11 with lower annual increases thereafter.
- The surrender charge grades to zero over 7 years.
- The minimum face amount is 10,000.
- The average face amount is expected to be 50,000.

(a) (0.*5 point*) Determine whether the product fits the needs of the company's existing target market.

(b) (*1 point*) Critique the lapse assumption originally set for the product as shown in the following table.

| Policy Year | Male | Female |
|---|---|---|
| 1 | 6% | 7% |
| 2 | 7% | 8% |
| 3-7 | 5% | 6% |
| 8 | 10% | 12% |
| 9+ | 1% | 2% |

(c) (*3 points*) The company currently uses the portfolio method to determine the interest credited on its UL policies.

(i) Contrast the portfolio method with the segmentation method.

(ii) Recommend a method to determine the credited interest rate for the new product in light of the 2008 financial turmoil described in the case study and its impact on sales. Justify your answer.

## 3. Continued

(d) (*3.5 points*) You are given the following information:

- The policyholder always pays the maximum premium allowed each year to maintain exempt status under the Canadian Income Tax Act.
- The death benefit is the face amount plus the policy's account value.
- The credited interest rate equals 5%.
- Cost of Insurance and expenses are deducted annually at the beginning of the policy year.
- The policy's accumulating fund is equal to the account value.

| Policy Year | Net Cost of Pure Insurance (NCPI) | Exempt Test Policy Accumulating Fund (ETP AF) | Cost of Insurance (COI) | Expenses |
|---|---|---|---|---|
| 1 | 104.0 | 270 | 200 | 720 |
| 2 | 123.0 | 540 | 200 | 300 |
| 3 | 145.2 | 810 | 200 | 300 |

(i) Define Exempt Policy according to the Canadian Income Tax Act.

(ii) Calculate the Adjusted Cost Basis (ACB) for each of the first 3 years. Show all work.

(iii) Calculate the taxable income and the ACB at the end of year 3 assuming a partial surrender of $500 occurs at the end of year 3. Show all work.

**4.** (*5 points*) XYZ Insurance Company is a market leader in Individual Term Life Insurance products and would like to enter the health market by offering a Critical Illness (CI) product. However, the distribution area is concerned that customers may feel it is too expensive.

(a) (*0.5 points*) Prepare talking points for your distribution partners in response to the criticism that CI is too expensive.

(b) (*3 points*) The following product features have been proposed:

- Stand-alone T100 product
- Enhanced conditions coverage
- Guaranteed premiums for life
- Return of Premium on Surrender and Death

Recommend actions you could take to lower the price of the product. Justify your answer.

(c) (*1.5 points*) XYZ plans to offer two CI products: T10 and T100. It expects 75% of the sales from T10 and 25% from T100.

You are given the following Return on Investment (ROI) results for the CI products:

| **T10 ROI Results** | | |
|---|---|---|
| **Price Point** | **With Reinsurance** | **Without Reinsurance** |
| Below Market Prices | 6.75% | 8.0% |
| At Market Prices | 7.50% | 9.0% |
| Above Market Prices | 23.50% | 25.0% |

| **T100 ROI Results** | | |
|---|---|---|
| **Price Point** | **With Reinsurance** | **Without Reinsurance** |
| Below Market Prices | 8.0% | 10.0% |
| At Market Prices | 13.0% | 15.0% |
| Above Market Prices | 20.0% | 22.0% |

Recommend a price point and decision on reinsurance for each product that satisfies a minimum 10% ROI. Justify your answer.

**5.** (*7 points*) You have been asked to assist in the design and pricing of a Variable Annuity product with a Guaranteed Minimum Death Benefit (GMDB) and a Guaranteed Minimum Maturity Benefit (GMMB). The product offers a range of fund options with varying levels of investment risk.

You are given the following:

| | |
|---|---|
| Maturity | 3 months |
| Deposit Amount | 100 |
| Guarantee Level | 100 |
| Management Expense Ratio | 3%/12<br>Deducted at the beginning of each month |
| Margin Offset | 1%/12<br>Collected monthly in advance |
| Risk-Free Force of Interest | 4% |

The stock returns for the underlying funds were randomly generated for 10 scenarios using a Regime-Switching Lognormal model with the following liability present values under each of the first 9 scenarios.

| Scenario | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| $L_0$ | -0.36 | 2.15 | -0.98 | -1.11 | 0.56 | 0.08 | -0.22 | 3.09 | -4.45 |

The simulated values of the stock return process for the 10th scenario were:

| $t$ (month) | 0 | 1 | 2 | 3 |
|---|---|---|---|---|
| $S_t$ | 1.00 | 0.98 | 0.99 | 0.94 |

(a) (*1 point*) Explain why stochastic pricing is better suited than traditional pricing techniques for the pricing of equity-based guarantees.

(b) (*3 points*) Estimate the CTE(80) present value of liability using the simulations above, assuming no deaths or withdrawals. Show all work.

(c) (*3 points*) Recommend changes to the product design to reduce risk to the company. Justify your answer.

**6.** (*7 points*) You are the pricing actuary for a mutual life company that offers participating single life policies. There is demand for a joint life last survivor product since sales are being lost to competitors. The field is pressing for a quick release of the product to stop the decline in sales.

(a) (*2 points*) Contrast the pricing considerations for a single life vs. a joint last survivor product.

(b) (*1 point*) Explain the following methods to price a last survivor product:

(i) exact age;

(ii) joint equivalent age; and

(iii) equivalent single age.

(c) (*4 points*) A suggestion has been made to set dividends using the Equivalent Single Age approach rather than the Exact Age approach.

Analyze the appropriateness of this suggestion in the context of policyholder equity.

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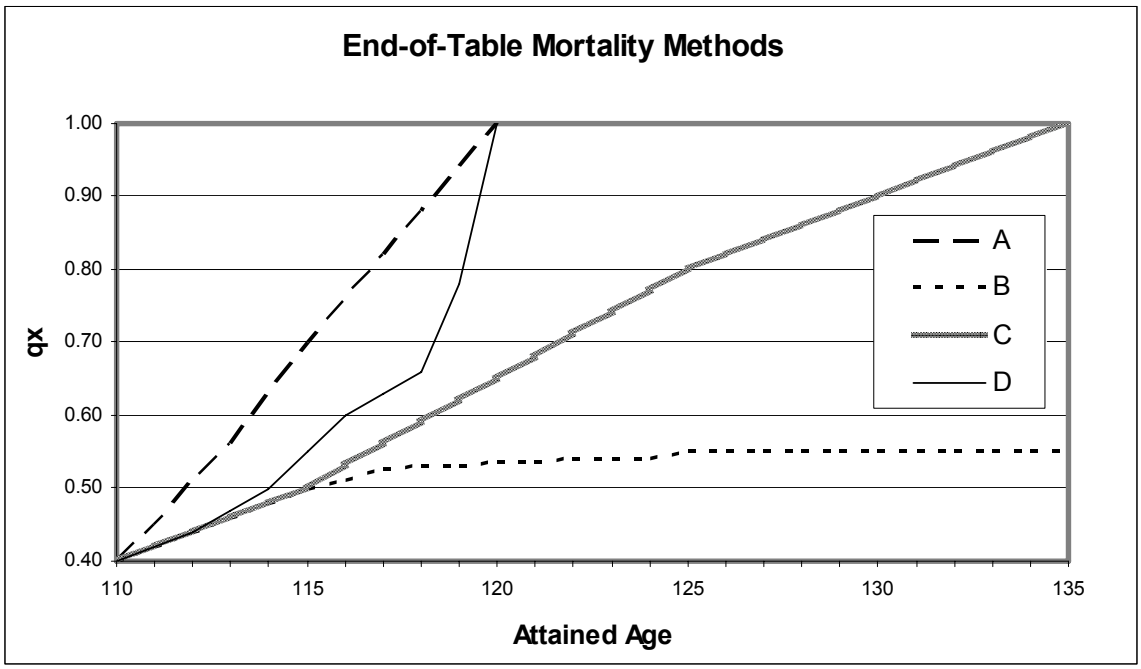
**7.** (*8 points*)

(a) (*2 points*) You are given:




For each of the end-of-table mortality methods illustrated in the above chart:

(i) Identify each method and indicate the associated line on the chart (A-D).

(ii) Describe each method and its underlying theory, identifying any advantages or disadvantages.

(b) (*6 points*) An actuarial student performed a mortality study for a preferred term life insurance product. The student used the company's original pricing mortality table as the expected basis (15 year select and ultimate, using the same table for preferred and residual). The actual-to-expected (A/E) ratios from the study are as follows:

| A/E Mortality Ratios by Duration - Issue Age 45 | | | | | | |
|---|---|---|---|---|---|---|
| | **1-5** | **6** | **7** | **8** | **9** | **10** |
| Preferred | 44% | 60% | 65% | 76% | 81% | 84% |
| Residual | 64% | 75% | 80% | 85% | 85% | 86% |
| Aggregate | 58% | 71% | 76% | 82% | 84% | 85% |

## 7. Continued

| A/E Mortality Ratios by Duration - Issue Age 65 | | | | | | |
|---|---|---|---|---|---|---|
| | **1-5** | **6** | **7** | **8** | **9** | **10** |
| Preferred | 61% | 72% | 80% | 93% | 95% | 98% |
| Residual | 85% | 94% | 105% | 122% | 126% | 127% |
| Aggregate | 81% | 91% | 101% | 118% | 121% | 123% |

The actuarial student has made the following conclusions based on the study.

1. Mortality experience has been very near expectations for issue age 65.

2. Mortality experience has been favorable relative to expectations for issue age 45.

3. The 'effect of preferred' appears to have worn off by duration 10 for issue age 65 because the A/E ratios seem to converge toward 100%, but not for issue age 45.

Justify your agreement or disagreement with the student's conclusions.

***Question 8 pertains to the Case Study.***
***Each question should be answered independently.***

**8.** (*7 points*) ABC Life Insurance Company sells only variable annuities with Guaranteed Minimum Death Benefit (GMDB) riders in the affluent market. ABC would like to expand its product offerings by introducing a term life insurance product that will be offered to existing customers. ABC hired a consulting actuary to assess the new direction.

(a) (*2 points*) Identify key questions and issues that should be addressed by the consulting actuary in reviewing the feasibility of this new direction.

(b) (*3 points*) Pricing assumptions for the new term life insurance product are based on ABC's current experience for:

- Mortality
- Persistency
- Expenses

(i) Compare each of the above pricing assumptions for variable annuities and term insurance.

(ii) Recommend appropriate changes to the pricing assumption for the term insurance product. Justify your answer.

(c) (*2 points*) ABC has decided to offer a Term-to-100 insurance product.

Assume:
- Premiums set slightly below a key competitor.
- The ultimate lapse rate is 5%.
- The pricing interest rate is 10% (based on ABC's current portfolio of assets).

Anticipate issues with this approach in reference to:

(i) The economic environment outlined in the case study; and

(ii) Lapse supported products

****END OF EXAMINATION****
**MORNING SESSION**

**USE THIS PAGE FOR YOUR SCRATCH WORK**

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