SOCIETY OF ACTUARIES

Individual Life & Annuities Canada – Design & Pricing

Exam DP-IC

AFTERNOON SESSION

Date: Thursday, November 1, 2007
Time: 1:30 p.m. – 4:45 p.m.

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This afternoon session consists of 9 questions numbered 9 through 17 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.

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****BEGINNING OF EXAMINATION****
INDIVIDUAL LIFE & ANNUITIES CANADA – DESIGN & PRICING
Afternoon Session

9. *(4 points)* Your company wants to offer a deferred annuity product with at least one of the following product features:

- interest rate bailout
- medical bailout
- penalty-free partial withdrawals
- return-of-principal guarantee

Describe these features and explain the financial risks inherent in each.

10. *(5 points)* You are developing a 20-Year Level-Premium Term product that guarantees a low level premium for the first 20 years, followed by annually increasing YRT premiums to age 95.

(a) *(4 points)* Compare the three basic types of commission scales and their intended purpose.

(b) *(1 point)* Recommend a commission scale for this product. Justify your answer.

11. *(7 points)* You are given the following summary for a Flexible Premium Universal Life policy that has been in force for 3 years:

- Male Age 45
- Death Benefit of 500,000 plus Account Value
- Level Cost of Insurance option
- Policy loans are permitted but none have been taken.

Year	Premium	NCPI	Account Value	Cash Value	Death Benefit
1	17,000	527	13,573	6,525	513,573
2	17,000	632	36,571	22,876	536,571
3	17,000	745	72,574	58,879	572,574

(a) The policy has failed the exempt test at the third policy anniversary as a result of high investment returns.

Describe the exempt test process and actions that could be taken to restore the policy's exempt status.

(b) List the factors that are included in the calculation of the Adjusted Cost Basis (ACB) of a life insurance policy for this product.

(c) The policyholder has requested a 30,000 partial withdrawal at the third anniversary.

Calculate:

(i) The taxable gain.
(ii) The ACB after the withdrawal.

Show all work.

(d) The company is concerned about meeting its profit targets on the product because of policyholder behaviour changes due to the strong investment performance.

Recommend actions to ensure profit margins remain at target levels.

12. *(7 points)* You are pricing an Inflation-Indexed Income Annuity.

(a) Describe income annuity designs that may provide increasing payments, and assess the ability of each to match inflation.

(b) Describe the two hedged investment strategies commonly used for Inflation-Indexed Income Annuities, including the advantages and disadvantages of each.

(c) Your current pricing mortality table for annuities ends at age 100. You are concerned that annuitant life expectancies are increasing.

(i) Describe theories regarding the shape of the mortality table at the oldest ages.

(ii) Explain the appropriate method for extending the existing table for each theory.

(iii) Assess the financial significance on reserves of using the different methods for a large group of annuitants.

13. *(11 points)* You are pricing a variable annuity with a Guaranteed Minimum Maturity Benefit (GMMB) equal to 105% of the premium after 5 years. You are given:

- Stock returns follow a lognormal process with a monthly mean return of 1% and a monthly standard deviation of 5%.
- The monthly management charge is 0.15%.
- The risk-free rate is 4% per annum.
- Values from a cumulative normal distribution table:

Z	$N(Z)$
1.04	0.851
1.19	0.883
1.28	0.900
1.67	0.953

(a) Describe:

(i) Quantile risk measure.

(ii) Conditional tail expectation risk measure.

(b) Calculate the probability that the cost of the GMMB is zero. Show all work.

(c) Calculate the quantile risk and the conditional tail expectation at the 90^{th} percentile per unit of initial fund value. Show all work.

(d) Explain why a lognormal assumption may not be appropriate when analyzing the GMMB.

(e) Explain weaknesses of using deterministic methods to evaluate the GMMB.

(f) Recommend a model for long-term stock returns that could be used to evaluate the GMMB stochastically. Justify your answer.

14. *(8 points)* Your company offers a variable annuity product and is considering adding a Guaranteed Minimum Withdrawal Benefit (GMWB).

You are given the following information for the existing variable annuity:

- Annual Mortality and Expense Fee is 1.50%.
- Contract Charge is 30 per year.
- Surrender Charge is 8% in year one, decreasing 1% per year.

The following pricing assumptions are currently used:

- Lapse rates are 3% for 8 years, 10% in years 9 and later.
- Withdrawals of 10% per year by 5% of contracts in force.
- Investment return is 10% per year.

(a) *(2 points)* Describe additional costs resulting from the complexity of a GMWB.

(b) *(4 points)*

(i) Explain the impact on the pricing assumptions of changes in policyholder behaviour related to adding a GMWB.

(ii) Recommend changes to the pricing assumptions to reflect changes in policyholder behaviour. Justify your answer.

(c) *(2 points)* Propose ways to reduce GMWB risks. Justify your answer.

15. (*7 points)* You work for a small Canadian life insurance company currently selling term insurance that is profitable. The company is considering adding a Preferred Term product.

(a) Explain considerations in setting pricing assumptions for this product.

(b) Describe trends and major results presented in the 2003 Munich Survey on Preferred Term Insurance.

(c) Assess whether your company should add this product to your portfolio. Justify your answer.

16. *(6 points)*

(a) *(1 point)* List the primary purposes of Asset/Liability Modeling with regard to fixed deferred annuities.

(b) *(3 points)* Describe immunization methods, and outline the practical considerations associated with each.

(c) *(2 points)* You are given a 3-year bond with an 8% annual coupon. The current interest rate is 7%.

Calculate:

(i) Macaulay Duration.
(ii) Modified Duration.

Show all work.

17. *(5 points)* You are pricing a Flexible Premium Universal Life product with a Level Cost of Insurance scale and an interest bonus at the end of year 10.

(a) *(4 points)* Describe the steps necessary to develop pricing assumptions for this product.

(b) *(1 point)* Predict how the demographic mix of sales of this product will affect the lapse rate assumption.

****END OF EXAMINATION****
AFTERNOON SESSION