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

Exam DP-IC

AFTERNOON SESSION

Date: Thursday, April 26, 2012

Time: 1:30 p.m. – 4:45 p.m.

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This afternoon session consists of 8 questions numbered 7 through 14 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.** (3 points) You are considering the use of underwriting predictive models similar to the models discussed in Deloitte's paper titled "Predictive Modeling for Life Insurance."
- (a) (1 point) Describe the underwriting predictive modeling process.
- (b) (2 points) Explain how predictive modeling can help deliver a competitive advantage.

8. (6 points)

- (a) (2 points) You are developing new term products which feature a level initial premium for 10 years and then a higher ultimate premium for the remaining term of the products. You are presenting these new products to marketing and senior management.
- (i) Recommend appropriate sensitivity tests for lapse and mortality assumptions for these products.
- (ii) List the key areas on which agreement is needed to complete the reconciliation stage of the product development process.
- (b) (4 points) You are given:

Year	Product 1		Product 2		Combined Results	
	Pre-Tax Profits	Distributable Profits	Pre-Tax Profits	Distributable Profits	Pre-Tax Profits	Distributable Profits
1	-100	-65	-132	-86	-232	-151
2	150	98	72	47	222	145
3	50	33	66	43	116	76
4	25	5	55	36	80	41
5	-38	-25	46	30	8	5

- Assume a hurdle rate of 12%
- Assume an after-tax discount rate of 6%

You are considering three alternatives:

Alternative A: Sell only product 1

Alternative B: Sell only product 2

Alternative C: Sell both products 1 and 2

Recommend which alternative the company should choose, using embedded value as the criterion. Show all work.

9. (7 points) QMD Life sells term life insurance and plans to enter the variable annuity market. QMD Life hired a consultant to design and price the new annuity product since they have no expertise in this market.

You are given:

- The product includes a Guaranteed Minimum Death Benefit (GMDB)
 - The value of an annuity of 1 per month is 45.9
 - The option cost at time 0 is 1.18
 - Initial Guarantee and Fund Value are 100
 - The company's existing administrative system cannot support this annuity product.
 - QMD Life is not willing to change the design of the new product.
- (a) (2 points) Outline the costs and benefits of this new product.
- (b) (1 point) Calculate the annual margin offset required to cover a GMDB option.
- (c) (4 points)
- (i) Propose an effective risk management strategy for this product assuming reinsurance is not available. Justify your answer.
 - (ii) Recommend a pricing approach to support the proposed risk management strategy. Justify your answer.

- 10.** (10 points) You are evaluating the original pricing lapse assumptions for a long-term care (LTC) insurance product, based on the following experience:

Duration	Original Expected Lapse Rate by Monthly Benefit Amount	Monthly Benefit Amount Exposed (000)	Average Number Exposed (000)	Monthly Benefit Amount Lapsed (000)	Number Lapsed (000)	A/E Ratio by Monthly Benefit Amount	95% Confidence Interval for A/E by Amount
1	10%	975,000	195	65,000	13	66.67%	58% - 142%
2	8%	825,000	165	55,000	11	83.33%	48% - 152%
3	6%	725,000	145	45,000	9	103.45%	36% - 164%
4+ (Ultimate)	5%	625,000	125	5,000	1	-	-

Assume all policies are the same size.

- (a) (5 points)
- (i) Calculate the ultimate Actual to Expected (A/E) lapse rate by monthly benefit amount and the 95% confidence interval for the A/E ratio by amount for durations 4+.
 - (ii) Recommend adjustments to the lapse assumptions for pricing going forward. Justify your answer.

10. Continued

You are given the following for a projection of issues on the LTC product:

Target Profit Margin as a Percent of Premium	13%
PV of Premiums	10,000,000
PV of Benefits (Using Best Estimate Assumptions)	6,000,000
PV of Expenses (Using Best Estimate Assumptions)	1,500,000
PV of Investment Income on Reserve and Cash Flow	475,000
PV of Increase in Statutory Reserves	1,000,000
PV of Increase in Tax Reserves	900,000
PV of Investment Income on Required Surplus (RS)	35,000
PV of Increase in Required Surplus	500,000
PV of Taxes (Excludes Tax on Investment Income on RS)	200,000
MVM – Morbidity (Shock & Contagion)	750,000
MVM – Lapse (Shock & Contagion)	1,250,000
MVM – Investment Income Mismatch	375,000
MVM – Operational Risk	250,000
Transfer Tax on Liabilities	-50,000
Value of Tax Liability Timing Difference	25,000

Note: MVM is the Market Value Margin reflecting the effect of diversification.

All present values are discounted at a constant risk-free interest rate.

- (b) (5 points)
- (i) Calculate the Present Value of Profit as a Percent of Premium using the traditional pricing approach.
 - (ii) Calculate the Market Consistent Value of New Business.
 - (iii) Recommend whether or not to continue selling the current LTC product as priced, based on the results above.

- 11.** (8 points) Company ABC, a company successful in selling term insurance, wants to offer a new product in order to increase sales. The captive field agency wants a stand-alone Critical Illness (CI) product to offer to their clients.
- (a) (3 points) Recommend the consumer market segment(s) that would be most appropriate for a CI product. Justify your recommendation(s).
 - (b) (3 points) Explain key assumptions and features affecting the price of a critical illness product and how they differ from term insurance.
 - (c) (2 points) Outline ABC's considerations in determining whether to enter the critical illness market and provide a recommendation.

12. (8 points) RNC Life Insurance Company has the following profile:

Goal:	Continue to grow and remain as the major competitor in the target market which provides best long-term value for customers
Main Products:	Individual Universal Life and Annuities
Target Market:	Upper-middle and high net-worth customers
Sales Force:	Captive Agents

- (a) (2 points) Describe key elements of a product strategy that RNC should implement to achieve its goal and outline possible tactics RNC can use.
- (b) (6 points) You are given the following information on the assets backing the Deferred Annuity policyholder account:

Asset Class	Gross Yield	Annual Default Cost	Investment Expenses	Term to Maturity
Government Bonds	5.0%	0.00%	0.02%	10
Corporate Bonds	6.5%	0.01%	0.04%	15
Junk Bonds	10.0%	1.00%	0.10%	7

In addition, the investment strategy has:

- A limit of 20% on the amount of junk bonds
 - Average term to maturity of 10 years for fixed income assets
 - Annuity crediting rate strategy: Net Yield – 1.25%
- (i) Calculate the annuity account’s crediting rate.
- (ii) Discuss the purpose of the interest rate spread (i.e. 1.25%) in the crediting rate strategy.
- (iii) Critique the crediting rate strategy methodology in a rising interest rate environment.

- 13.** (11 points) You are an actuary working on illustrations for a Canadian insurer. You have asked your actuarial student to prepare a point-of-sale illustration that will be used by an agent to sell a 10-Pay Universal Life (UL) policy with guaranteed mortality and expense charges, and a minimum credited rate of 3%.

You are given the following partial illustration based on a reasonable range of interest rate scenarios:

XYZ Life Insurance Company					
Date Prepared: September 1, 2011					
Client Name: Mr. X					
Gross Rate:		5%	Face Amount:		250,000
Net Rate:		4%	Death Benefit Option:		Level
Mortality Charges:		YRT	Premium Frequency:		Annual
Expense Charges:		5% of Premium	First Payment:		10,000
Year	Age	Annual Premiums	Cash Surrender Value*	Death Benefit	
1	70	10,000	7,950	250,000	
2	71	10,000	17,142	250,000	
3	72	10,000	26,153	250,000	
4	73	10,000	34,956	250,000	
5	74	10,000	43,519	250,000	
6	75	10,000	51,806	250,000	
7	76	10,000	59,776	250,000	
8	77	10,000	67,381	250,000	
9	78	10,000	74,567	250,000	
10	79	10,000	81,271	250,000	
11	80	0	78,421	250,000	
12	81	0	73,533	250,000	
13	82	0	67,912	250,000	
14	83	0	61,448	250,000	
15	84	0	54,014	250,000	
16	85	0	104,000	250,000	
* Net of applicable surrender charges					
The interest rate is not guaranteed and can have a significant effect on the cash surrender value of the policy provided in this illustration. The rate used reflects a reasonable expectation of the long-term performance of the underlying investment. Actual rates may be higher or lower than the rate provided in the illustration.					
The potential customer should be advised that:					
The illustration is based on an interpretation of current tax law.					
The illustration does not constitute current legal or tax advice for a specific individual.					
Differences in an individual's circumstances may have an impact on the effect of the tax treatment being shown.					
This illustration does not contain the associated policy information summary and thus this illustration is incomplete without it. The prospective customer is advised to consult the policy document itself for additional information regarding the policy.					

13. Continued

In addition to the figures from the illustration above, you are given the following tax information regarding the product.

Year	Age	Cumulative Deposits	Net Cost of Pure Insurance (NCPI)	Cumulative NCPI
10	79	100,000	3,696	21,329
11	80	100,000	4,250	25,579
12	81	100,000	4,888	30,467

- The insurer's maximum reserve is less than or equal to the Cash Surrender Value provided in the illustration above in all years.
 - Tax Rate = 40%
- (a) (4 points) Recommend modifications needed to make this illustration compliant with Canadian Life and Health Insurance Association Inc. (CLHIA) Guideline G6.
- (b) (3 points) Explain the purpose of the exempt test and the steps that must be taken to ensure the UL policy qualifies as an exempt policy.
- (c) (4 points)
- (i) Calculate the after-tax value of a partial withdrawal of 15,000 in year 11. Show all work.
 - (ii) Explain the advantages of taking a policy loan instead of a partial withdrawal in year 11.
 - (iii) Calculate the amount of the policy loan to generate the same after-tax value in year 11 as the partial withdrawal of 15,000.

14. (7 points)

- (a) (3 points) IRM Life’s current Variable Annuity (VA) design has the following features:

Investment Options	Fund A Fund B Fixed interest account earning 2%
Expense load	8% of deposit amount
Surrender charges	15% of the account value in year one and decreasing by 1% at the beginning of each year to 0% in year 16 and thereafter
Transfer fee	0.05% of amount transferred

You are given the following information regarding a policy purchased on January 1, 2010:

Date	Transaction	Investment Option	Unit Values	
			Fund A	Fund B
January 1, 2010	1,000 deposit	100% in the fixed interest account	8.00	20.00
January 1, 2011	1,000 deposit	50% in Fund A 50% in Fund B	9.00	21.00
January 1, 2012	200 withdrawal	100% from Fund A	10.00	21.25
January 1, 2013	None		8.50	23.00
January 1, 2014	Transfer	100% of the fixed interest account value to Fund B	9.25	20.00

Calculate the annuity account value as of January 1, 2014 after the transfer. Show all work.

14. Continued

(b) (4 points) IRM Life is considering adding either a Guaranteed Minimum Income Benefit (GMIB) or Guaranteed Annuity Option (GAO) to this VA product. You are given:

- The contract holder pays a single premium.
- Issue age is 55.
- In the absence of a GMIB or GAO the contract can be annuitized with annual annuity payments of 1,000 at age 65.
- The assumed interest rate at annuitization is 3%.
- Actuarial Values:

$$\ddot{a}_{65} @ 2\% = 15$$

$$\ddot{a}_{65} @ 3\% = 12$$

$$\ddot{a}_{65} @ 4\% = 9$$

- The GAO provides a guaranteed annual annuity of 90 per 1000 of maturity lump sum at age 65.
- The GMIB is calculated assuming the fund grows at 5% per year during the 10-year accumulation period.
- The GMIB uses 3% to calculate the guaranteed annuity payment at age 65.

- (i) Outline GMIB pricing and modeling considerations.
- (ii) Recommend a design for this contract that minimizes the cost of the guarantee to the company.

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

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