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

Exam DP-IC

AFTERNOON SESSION

Date: Thursday, November 1, 2012
Time: 1:30 p.m. – 4:45 p.m.

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This afternoon session consists of 7 questions numbered 8 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.

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BEGINNING OF EXAMINATION
Afternoon Session
Beginning with Question 8

8. (*12 points*) ECP Company currently offers a Point-to-Point Annual Reset Equity-Indexed Annuity (EIA) product with a participation rate of 70%. To increase sales, ECP plans to implement a new version with a higher participation rate.

(a) (*1 point*) List the stages of product development that are applicable to this implementation.

(b) (*3 points*) Propose EIA design features that could be used to increase the participation rate. Explain why each feature would raise the participation rate.

(c) (*3 points*) Define static and dynamic hedging and their respective disadvantages.

(d) (*1 point*) Define additional costs associated with dynamic hedging.

(e) (*4 points*) You are given the following:

Continuous annual risk-free rate	6%
Dividend rate	2%
Annual volatility	20%
Premium Amount	100
Maturity	1 year
Guaranteed Amount at Maturity	95% of premium accumulated at 3%
Decrements	None

$$d_1 = \frac{\log\left(\frac{\alpha P}{G - P(1-\alpha)}\right) + \left(r - d + \frac{\sigma^2}{2}\right)n}{\sigma\sqrt{n}}$$

$$d_2 = d_1 - \sigma\sqrt{n}$$

x	$N(x)$
0.22	0.5871
0.26	0.6026
0.30	0.6179
0.42	0.6628
0.46	0.6772
0.50	0.6915

Calculate the percentage increase in the one year hedging cost at issue if the participation rate is increased to 90%.

9. (8 *points*) Your company is developing a fixed deferred annuity with the following surrender charge schedule:

Policy Year	Surrender Charge
1	9%
2	8%
3	7%
4	6%
5	5%
6+	None

The guaranteed crediting rate is 3%.

(a) (*2 points*) Describe the interest rate risks you should be concerned about in developing this product in a low interest rate environment.

(b) (*1 point*) Describe a Market Value Adjustment (MVA) and how it benefits your company.

(c) (3 *points*) You are given:

- The interest rate guaranteed for 3 years for new deposits is 4%.
- The company imposes an additional margin of 0.25% in the MVA calculation.

Calculate the MVA at the end of year 2. Show all work.

(d) (2 *points*) Propose other methods of protecting the company versus using an MVA in the product.

10. (*10 points*) TLP Life currently has limited sales in fixed annuities and wants to increase sales to the retirement market by offering a new variable annuity with a Guaranteed Minimum Income Benefit (GMIB).

(a) (*1.5 points*) Explain the elements of a successful product strategy.

(b) (*1.5 points*) You are given the following information about TLP:

Operations	• Mainly term insurance • Limited fixed annuity sales
Policyowner Focus	Lower to middle income customers
Vision	Grow business and dominate target market
Strategy	Focus on sales to lower and middle income customers, offer a variety of products to those customers
Tactics	• Focus on providing a few low cost products sold through low cost distribution methods • Decrease unit costs • Pursue enhancements to improve underwriting expertise and mortality

Assess whether the new product would meet the company's product strategy. Justify your answer.

(c) (*2 points*) Describe how the new product could benefit clients in retirement.

(d) (*5 points*) Senior management has proposed using TLP's current Single Premium Deferred Annuity (SPDA) assumptions and payout factors for the new product. You are given the following:

- SPDA Lapse Rate:
  3% in surrender charge period;
  35% shock after surrender charge period;
  15% ultimate

- SPDA annuitization rate: 1% in all years

- Current SPDA payout rates based on recent company experience

Evaluate this proposal and recommend changes where appropriate. Justify your answer.

11. (*6 points*) A 100,000 par life insurance policy, with the Paid-up Addition (PUA) dividend option, is issued to Ana on January 1, 2012. Ana is a female non-smoker aged 63, and she will pay premiums of 6,000 per year. You are given the following information:

Exempt Test Policy Factors per 1000 of Death Benefit

	Issue Ages		
Duration	**63**	**64**	**65**
1	40	45	50
2	80	90	100
3	120	135	150
4	160	180	200

Policy Illustration Information (all values are end of year):

Policy Year	Death Benefit	Total Cash Surrender Value (CSV)	Maximum Tax Actuarial Reserve (MTAR)	NCPI*
1	108,000	4,000	3,000	1,650
2	118,800	8,000	7,500	1,950
3	128,304	13,000	15,000	2,350
4	138,568	19,000	23,000	2,750
5	149,654	25,000	30,000	3,300
6	161,626	32,000	36,000	3,900
7	174,556	40,000	42,000	4,550

* Net Cost of Pure Insurance (NCPI)

Other Assumptions:

- The Base and PUA were priced using the same interest and mortality assumptions
- The policy passes the exempt test for all durations beyond duration 4
- The 250% rule is satisfied for all durations
- No outstanding loans exist on this policy

(a) (*3 points*) Determine whether Ana's policy passes the exempt test for each of the first four policy years. Show your calculations.

11. Continued

(b) (*3 points*) At the end of policy year five, Ana plans to advance 20,000 for two years. She is considering the following three options:

Option 1: Bank Loan using policy as collateral	• Loan interest rate of 6% • Requires interest payment every year • Principal repaid at the end of two years
Option 2: Policy loan	• Loan interest rate of 3% • Requires interest payment every year • Principal repaid at the end of two years
Option 3: Partial Surrender	• Reduce coverage to generate a 20,000 withdrawal

Assume a marginal tax rate of 40%.

Determine which option will minimize Ana's out-of-pocket cost (interest and taxes).

12. (*9 points*) An annuity company wants to start selling a Whole Life-Long Term Care (LTC) acceleration product through its existing annuity sales channel. The company's pricing framework mandates the following:

- Minimal to no subsidization among the products
- Full cost/expense pricing

(a) (*7 points*) You are given the following proposed assumptions for the new product:

(i) The Whole Life mortality assumption will be based on an Industry Life mortality table which will be adjusted to account for the company's credible annuity experience.

(ii) LTC Mortality: The acceleration benefit is similar to an annuity. For this reason we will use our current annuity experience.

(iii) Although the base product is Whole Life, Industry Whole Life lapse experience will be ignored in favor of LTC industry lapse experience.

(iv) A portfolio interest assumption based on their annuity block will be used.

(v) Use industry pricing that is equivalent to full cost pricing after 5 years.

(vi) Claims expenses are the same as LTC experience.

(vii) Assume claims experience to be 50% of industry experience. This is consistent with company annuity experience being 50% of the industry, due to the company's superior claims efficiency in the annuity business.

(viii) LTC incidence/termination rates will be based on industry experience.

Critique the proposed assumptions and recommend changes where appropriate. Justify your answer.

(b) (*2 points*) Explain the benefits of scenario testing in pricing this product.

13. (*6 points*) You have been asked to price the Guaranteed Minimum Income Benefit (GMIB) to be attached to a 10-year Variable Annuity contract. An economic scenario generator has been used to generate 1000 scenarios and the resulting fund values have been ranked in increasing order, with the first six results shown below:

Scenario	FV_{10}
389	540
589	654
900	780
1	890
18	1200
456	1278

You are given:

- GMIB base is 1000
- Guaranteed annuity factor is 10
- Current annuity factor is 8
- The risk-free rate is 1.5%, and
- ${}_{10}p_x$ is 0.96.

(a) (*1 point*) Explain the shortfall risks associated with a GMIB

(b) (*3 points*)

(i) Calculate the value of the GMIB option

(ii) Calculate the 95% Conditional Tail Expectation

(c) (*2 points*) Explain the factors that could affect GMIB utilization.

14. (*9 points*) You are the Pricing Actuary for ARN Life, which specializes in Term, Universal Life, and Par products.

(a) (*1 point*) Describe the following expense philosophies:

(i) Full cost pricing

(ii) Marginal expense pricing

(b) (*3 points*) You are given the following information:

Underwriting Requirements		Face Amount		
		0-249	250-999	1M +
Age Range	20-39	Saliva Test	Urine Test	Urine Test Blood Test
	40-59	Urine Test	Urine Test	Urine Test Blood Test
	60+	Urine Test Blood Test	Urine Test Blood Test	Urine Test Blood Test Medical exam

	Cost
Saliva Test	50
Urine Test	85
Blood Test	125
Medical Exam	300
Policy Issue	50
Junior Underwriter	150/hour
Senior Underwriter	250/hour

- Policies over one million face require a senior underwriter. Other policies only require a junior underwriter.

- Policies for ages 60+ require 2.5 hours of underwriters' work. Other policies require one hour of underwriters' work.

Create an underwriting and issue unit cost grid. Show all your work.

14. Continued

(c) (*3 points*) You are given the following information:

An excerpt from the prior year's expense report:

Acquisition Expenses	
Underwriting - Term	150,000
Underwriting – UL	400,000
Underwriting – Perm	350,000
Commissions	340,000
Other	10% of premium
Maintenance Expenses	
Admin expenses	90,000
Overhead expenses	200,000

An excerpt from the current sales report:

	Current Year (Actuals)	
Product	**Premium (000's)**	**Applications Received**
Term	150,000	2,000
Universal Life	420,000	2,800
Par	300,000	1,600

You are also given:

- Expected inflation for next year is 2%.
- Assume product-level commissions are weighted by premium dollars.
- The acceptance rate is 75%.
- A fully allocated expense philosophy is used.
- Assume sales remain level for next year.

Construct refreshed per policy and percent of premium expense assumptions to use in the pricing for next year for each product line. Show all your work.

(d) (*1 point*) Assume the premium margin is 75% and that 150,000 of term premium produces 18,000 of profit. If term prices decrease by 3%, calculate the breakeven sales change.

(e) (*1 point*) Recommend expenditures that can be undertaken to improve customer service and retention.

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

USE THIS PAGE FOR YOUR SCRATCH WORK

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