Exam DP-IC

AFTERNOON SESSION

Date: Thursday, November 3, 2011
Time: 1:30 p.m. – 4:45 p.m.

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This afternoon session consists of 7 questions <u>numbered 9 through 15</u> for a total of 60 points. The points for each question are indicated at the beginning of the question. Question 9 pertains 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.

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.

> ***Question 9 pertains to the Case Study.***

---

9. (*7 points*) With respect to the case study company's Life & Protection Solution Products and Retirement and Wealth Strategies Products (pages 6 & 7 of the Case Study):

(a)   (*1 point*) Identify the variable features of these products and their inherent risks.

(b)   (*4 points*)

    (i)   (*2 points*) Propose product design measures the case study company may use to enhance risk management of its variable annuity products. Justify your answer.

    (ii)   (*2 points*) Propose non-product-related measures the case study company may take to manage the risk associated with its variable annuity products. Justify your answer.

(c)   (*2 points*) The case study company has a hedging strategy for the guarantees on their variable annuities.

    Define the following risks that are associated with such a hedging strategy:

    (i)   Long-term volatility risk

    (ii)   Gamma risk

    (iii)   Basis risk

    (iv)   Fund choice risk

10. (*11 points*) You are given the following information for a variable annuity policy with a GMAB (Guaranteed Minimum Accumulation Benefit) rider issued to a 45 year-old:

- Invested in a large cap mutual fund.
- Single Premium is 10,000.
- GMAB maturity period is 3 years.
- GMAB amount is 90% of premium.
- Annual Charge is 0.60% of fund value.
- $_3 p_{45} = 0.995$

A stochastic valuation of the GMAB rider is performed using a lognormal model with 100 scenarios. The lognormal model is:

$$\frac{S_{t+1}}{S_t} \sim LN(\mu, \sigma)$$

Parameter μ for real world returns is 8%

Parameter μ for risk free rate is 1.50%

Parameter σ for historical volatility is 18%

Parameter σ for implied volatility is 25%

Real world discount rate is 4%

Only 3 of the 100 scenarios are "in-the-money" at maturity for both real world and risk neutral scenarios. The first of these scenarios had the following random numbers from a standard normal distribution:

Year	1	2	3
Scenario 1	-0.483	-1.516	-1.087

The other two "in-the-money" scenarios had the following option values:

Option Values:

	Real World	Risk Neutral
Scenario 2	122	2490
Scenario 3	850	3259

(a) (*1 point*) Define types of minimum guarantee variable annuity riders.

(b) (*1 point*) Compare real world and risk neutral scenarios

10. Continued

(c) (*1 point*) Compare the 95% quantile and CTE95.

(d) (*4 points*) Calculate each of the following under both real world and risk neutral valuation:

(i) The fund values at maturity for each of the "in-the-money" scenarios.

(ii) The GMAB payoffs at maturity for each of the "in-the-money" scenarios.

(iii) The GMAB option value.

(iv) The 95% quantile for the GMAB value.

(v) The CTE95 for the GMAB value.

(e) (*2 points*) Explain the considerations in setting the lapse assumption for a stochastic valuation.

(f) (*2 points*) Explain the shortfalls of a lognormal model.

Recommend a better model. Justify your answer.

11. (*10 points*) ABC Life is launching a new enhanced version of its 20-year non-renewable term life insurance product for its existing target market. This new product offers a built-in Return of Premium (ROP) feature which returns the total premium paid by the policyholder at maturity.

(a) (*1 point*) List the anticipated benefits of the ROP feature from both the policyholder perspective and the company perspective.

(b) (*1 point*) List the pricing considerations when adding ROP to a term life product.

(c) (*3 points*) You are given the following information for existing policies with attained age 40 for calendar year 2010:

- New sales and decrements are uniformly distributed throughout the calendar year.
- Case Count at Beginning of 2010: 10,000.
- Number of Deaths: 50.
- Number of Lapses: 800.
- Number of New Issues: 2,500.
- 80% of the lapses are anti-selective.
- Mortality rates of the anti-selective lapses are assumed to be 25% lower than the regular mortality rates.

Calculate the mortality and lapse rate for age 40. Show all work.

(d) (*5 points*) The Pricing Actuary is using the experience of the existing term product to set the mortality assumption for the new enhanced product.

    (i) (*2 points*) Evaluate the mortality assumption of the new product and recommend changes, if any.

    (ii) (*3 points*) Calculate the mortality rate for age 40 based on your recommendation in (i). Show all work.

12. (*10 points*) Your company is planning to enter the living benefit market by offering a Critical Illness insurance product.

    (a)   (*1 point*) Describe the benefits of offering Critical Illness insurance product on acceleration basis versus standalone basis.

    (b)   (*3 points*) Compare the key differences between traditional pricing and market consistent pricing methodology for this product.

    (c)   (*6 points*) Your company decided to issue the product to sub-standard lives. You are given the following assumptions:

	Standard Policies		Sub-standard policies
Incidence (by issue age)	Female	Male	
25	0.30	0.35	200% of Male Standard
35	0.40	0.50	Incidence (total) for all
45	0.50	0.60	policies
55	0.60	0.80	
Lapse Rates			
All durations	10%		10%
Acquisition Expenses			
Per policy	100		150
% of 1st year premium	15%		15%
Commission	100% first year premium		120% first year premium
Maintenance Expenses			
Percent of claim	10%		10%
Per policy	50 per policy		50 per policy
Present Value Factors			
A_{45}	0.28		0.36
$\ddot{a}_{45}$	5		3

    Assume premiums are payable in all years.

    (i)   (*2 points*) Calculate the extra gross premium charge for a substandard policy with an average size of 25,000 for a 45-year old policyholder assuming level premiums payable in all years.

    (ii)   (*3 points*) Evaluate the appropriateness of the assumptions above for substandard lives relative to standard lives.

    (iii)   (*1 point*) Due to time constraints, the actuary suggests that the policies with substandard risk will not be modeled. Critique the actuary's suggestion.

13. (*7 points*) ABC Life, a Canadian Life insurance company, has been quite successful with Level Cost of Insurance (COI) Universal Life sales but the product has become quite complex. The pricing actuary feels that a simplified, Term-To-100 (T100) product would meet many client needs, particularly with the aging market.

(a)   (*3 points*) Explain some of the concerns with launching a T100 product and how reinsurance could help address these concerns.

(b)   (*4 points*) ABC Life is deciding whether to reinsure 20% or 40% on a first dollar basis.
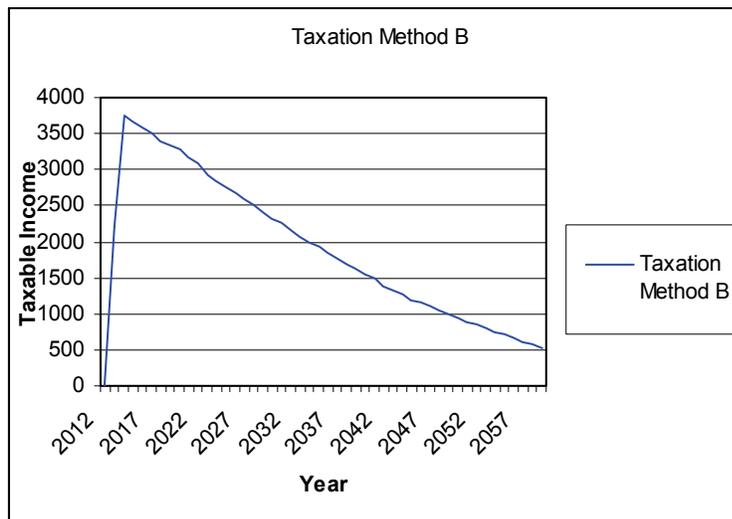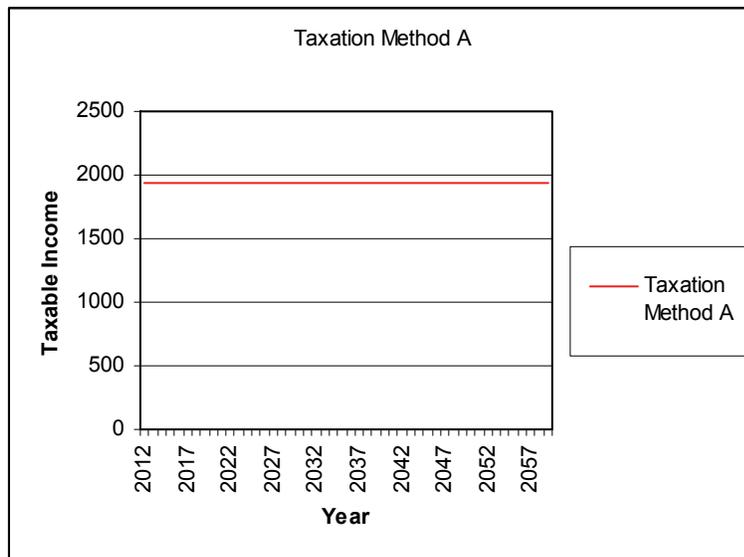
You are given:

First Year Values	
Gross Face Amount	12,000,000
Gross Premiums	1,000,000
Reinsurance Premium	0.50 / 1,000 of NAAR
Commissions	1,125,000
Without Reinsurance	
Required Capital	2,500
Solvency Reserve	75,000
With Reinsurance – 20% First Dollar	
Expense Allowance	100% of first-year premium
Required Capital	1,000
Solvency Reserve	48,000
With Reinsurance – 40% First Dollar	
Expense Allowance	120% of first-year premium
Required Capital	800
Solvency Reserve	36,000

Recommend whether reinsurance should be used on this new product considering New Business Strain as the profit measure and ignoring any decrements in the first year.

THIS PAGE INTENTIONALLY LEFT BLANK

14. (*7 points*) ABC sells 5-year guaranteed Single Premium Immediate Annuity:

    (a)   (*2 points*) The graphs below illustrate two main taxation methods for post-1989 annuity contracts.

Taxation Method A

Taxation Method B

Identify and describe the two taxation methods that correspond to each of the graphs.

14. Continued

(b)   (*5 points*) You are given the following information:

- 5-year guaranteed Single Premium Immediate Annuity
- Single Premium equals $100,000
- Annuity purchased on Jan 1, 2011
- First annuity payment occurs one year after policy issue
- Annual annuity payment is $2,000
- Annuitant tax rate is 40%
- Interest rate is 4%
- Life expectancy at issue is 57 years
- Mortality Gain in year 2 equals 40
- Present Value of Future Non Guaranteed Payments in 2012 is 89,000
- Present Value of Future Non Guaranteed Payments in 2013 is 88,000

Determine the lower present value of taxes paid from a policyholder perspective for years 2012 and 2013 for each type of taxation. Show all work.

15. (*8 points*) You are a product development actuary working for a life insurance company with the following characteristics:
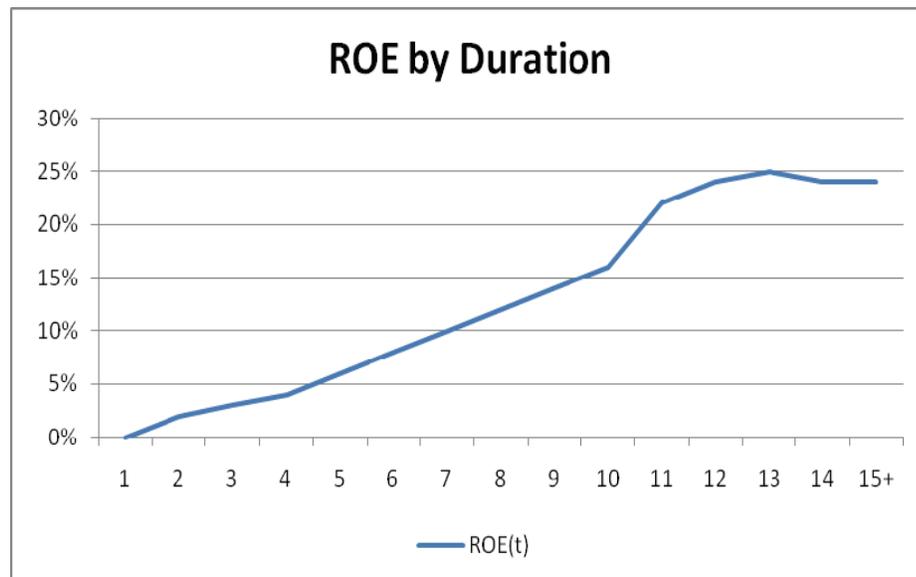
- Low level of capital

- Current major product line includes a 10-Year Level-Premium Term insurance product that guarantees a low level premium for the first 10 years, followed by higher and annually increasing YRT premiums to age 100

- The product is distributed through direct mail marketing

In order to increase sales and expand the company's target markets, the marketing department suggests developing a high return/high cash value Universal Life product to target high net worth individuals.

(a)   (*1 point*) Explain the pros and cons of using the company's current distribution channel for its new UL product.

(b)   (*5 points*) With respect to the mortality and lapse assumptions:

    (i)   Outline the various considerations that should be addressed when analyzing experience for these assumptions.

    (ii)   Propose adjustments that need to be made to the term pricing assumptions in order to appropriately price this new UL product.

15. Continued

(c)   (*2 points*) The following chart represents the expected ROE pattern for the new UL product using your current best estimate assumptions. The product is priced to meet the ROI objective of 12% and the company's shareholders require an ROE of 15%.

ROE by Duration

(i)   Analyze the ROE pattern.

(ii) Recommend approaches the company can take to improve or achieve the ROE objective.

END OF EXAMINATION
AFTERNOON SESSION

USE THIS PAGE FOR YOUR SCRATCH WORK

USE THIS PAGE FOR YOUR SCRATCH WORK