
SOCIETY OF ACTUARIES
Individual Life & Annuities United States – Design & Pricing

Exam DP-IU

AFTERNOON SESSION

Date: Thursday, November 4, 2010

Time: 1:30 p.m. – 4:45 p.m.

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This afternoon session consists of 7 questions numbered 9 through 15 for a total of 60 points. The points for each question are indicated at the beginning of the question. There are no questions that pertain to the Case Study in the afternoon session.
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-IU.
6. Be sure your essay answer envelope is signed because if it is not, your examination will not be graded.

****BEGINNING OF EXAMINATION****
AFTERNOON SESSION
Beginning with Question 9

9. (5 points) ABC Life Insurance Company writes a wide variety of insurance products and outsources policy administration to various third party vendors. Your team has recently received seriatim policy data from a vendor that supports your Term-to-100 (T100) product line as well as an early generation Universal Life (UL) product without secondary guarantees.

(a) (2 points) The following is an email you received from a member of your team:

“I have fully audited the T100 policy data from our third party vendor. Even though there are several instances where the data looks odd, I believe we should rely on the data and disclose our reliance. But since our UL line is so old, I would like to compare our UL data with recent data from our competitor XYZ Life. A friend of mine at XYZ can look over our data and document differences between our company’s experience. After that, regardless of any material defects, I believe we are ready to start our analysis.”

Critique this review of the data.

(b) (3 points) Your actuarial student has assembled the report below.

Expected vs. Assumed vs. Actual			
Product 1			
	Mortality (% of Tabular)	Lapses	Administration Expense
Expected	70%	5%	\$35
Assumed	50%	4%	\$40
Actual	55%	1%	\$375
Product 2			
	Mortality (% of Tabular)	Lapses	Administration Expense
Expected	60%	5%	\$25
Assumed	80%	10%	\$30
Actual	90%	5%	\$400

- (i) Determine which of the products should have been labeled as UL and T100. Justify your answer.
- (ii) For each product, calculate the deviation in mortality, lapse, and administration expenses and categorize the deviation as adverse or favorable. Show all work.

10. (11 points) Your company is developing an annuity product.

- (a) (2 points) Identify and describe the considerations that must be addressed during the feasibility stage of the product development process.
- (b) (3 points) Recommend the type of income annuity most suitable for the following clients. Justify your answer.
- (i) Client A is a married couple and both are retired, have no children, have paid off their house and prefer to exhaust their estate.
 - (ii) Client B is disabled, has 10 years of payments remaining from an insurance settlement and wants to maintain the level of payments for an additional 15 years to pay off his 25-year fixed-rate mortgage.
 - (iii) Client C, a widow, wishes to maintain her purchasing power for the rest of her life.
 - (iv) Client D wants to maximize his potential for future payment increases and is not concerned with downside risk.
- (c) (6 points) You are given the following information for a fixed 3-year joint and last survivor income annuity.
- Clients are a male age 62 and a female age 57.
 - The level income payment is paid annually at the end of the year with no payments after 3 years.
 - The annuity pays two-thirds of the original payment following the first death.
 - The original level income payment is 10,000.
 - The single premium is 29,496.

Mortality Rates			
Male		Female	
Attained Age (x)	q_x	Attained Age (y)	q_y
62	0.04	57	0.01
63	0.05	58	0.02
64	0.06	59	0.03

Deaths occur at the end of the year before the annuity payment is made.

10. Continued

Pricing Assumptions	
Commissions	0.50% of premium
Acquisition Expenses	250 per policy
Required Capital	4.50% of solvency reserves
Hurdle Rate	15.00%
Discount Rate	6.00%

Ignore reinsurance, investment income, taxes and maintenance expenses.

Solvency Reserves	
End Of Year	Reserve
1	19,120
2	9,620
3	0

- (i) Calculate the expected payments at the end of each of the first 3 years. Show all work.
- (ii) Calculate the Embedded Value profit measure, using distributable earnings as the basis for profits. Show all work.
- (iii) Calculate Profit as a Percent of Premium using distributable earnings as the basis for profits. Show all work.

11. (8 points) ABC Life prices using the Return on Equity (ROE) pricing metric with a deterministic model. ABC has just been acquired by XYZ, and the new management requires a Risk-Based (also called Market-Consistent) pricing environment and prefers the use of stochastic modeling.

(a) (3.5 points) For its two flagship life products, you are given a financial summary for the current year:

Item	Term 10 Renewable	UL Plus
Pre-Tax Stock Earnings	56	188
Pre-Tax Solvency Earnings	45	260
Investment Income on Required Capital	15	75
Deferred Tax Liability (Beginning of Year)	85	110
Deferred Tax Liability (End of Year)	85	140
Stock Assets (Beginning of Year)	600	850
Stock Liabilities (Beginning of Year)	400	600

Demonstrate that the single-year ROE for each product is the same, assuming the income tax rate is 30%.

(b) (4.5 points) The UL product has the following features:

- Yearly renewable term costs of insurance
- Several domestic and foreign equity options
- A fixed-income option with a 5% minimum guarantee
- A secondary guarantee with a shadow account
- Death benefit is the face amount plus the greater of the account value and 75% of premiums paid.

ABC's pricing actuary has concluded:

“After analyzing each feature of the UL Plus, my deterministic pricing model yielded a positive Value of New Business. I therefore see no reason for the product to be re-priced.”

- (i) Analyze the appropriateness of the pricing actuary's model with respect to each product feature.
- (ii) XYZ's management team has determined that the UL Plus product does not meet its Risk-Based pricing target.

Suggest changes to the UL Plus product to improve its Risk-Based pricing results. Justify your answer.

- 12.** (11 points) You have been asked to determine the feasibility of introducing an Annuity/LTCI and Life/LTCI Combination product for XYZ Life, a US Company. XYZ's Marketing Officer explained that sales of these products have typically been poor due to the perceived lack of need for LTCI coverage and the high cost of the product.
- (a) (2 points) According to LOMA, list and describe the steps of the product development cycle.
- (b) (2 points) Criticize the Marketing Officer's comments.
- (c) (2 points) Explain the impact of the Pension Protection Act of 2006 on the product's marketability and product design for the Annuity/LTCI Combination product.
- (d) (5 points) The following plan features and market strategies are being considered:
- Daily indemnity benefit of 300, with a 2 year benefit period and 5% compound inflation protection option.
 - Target market is over age 50.
 - Tail design benefit payout structure.
 - Accelerated death benefit rider with payments based on current death benefit amount.
 - Broker-dealer distribution.

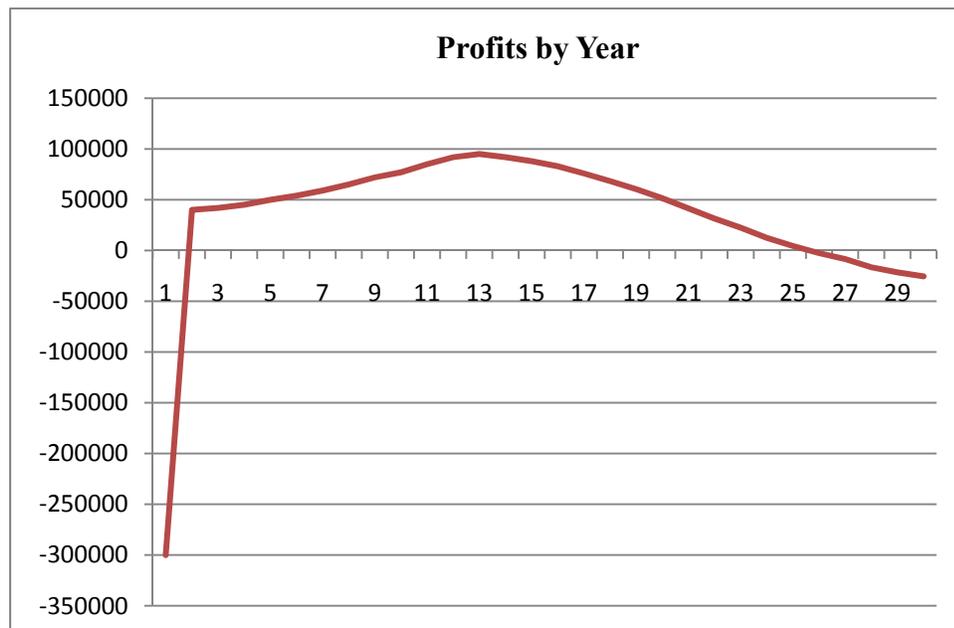
Assess the appropriateness of each item and identify suitable alternatives.

13. (8 points) An independent review of your company's UL product with Secondary Guarantees (ULSG) was performed and the following assumptions and conclusions were offered in the reviewer's report:

- A one year mortality study of 10,000 policies exhibited 42 deaths compared to an expected of 30. Assuming a 95% confidence interval, no mortality adjustment is necessary.
- Given a one year lapse study with 10,000 policies and 950 actual lapses, assuming a 95% confidence interval, a lapse rate of 10% per year is appropriate.
- Investment income was determined using the formula:

$$\text{Investment Income} = \frac{(\text{Assets at } BOY + \text{Assets at } EOY) \times \text{Average Net Interest Rate}}{2 + \text{Average Net Interest Rate}}$$

- Expenses were assumed to be paid at the beginning of the year and per unit expense assumptions were developed by dividing expenses for a calendar year by the number of policies in force at the beginning of the year.
- Based upon the scenario illustrated below, the IRR is 11% with a Value of New Business greater than zero using a discount rate of 10% in all years.



13. Continued

- (a) (5 points) With respect to the independent review that was performed:
 - (i) Critique each of the assumptions and conclusions made by the reviewer; and
 - (ii) Recommend changes to the reviewer's report including any improvements needed in their analysis. Justify your answer.

- (b) (3 points) With respect to valuing embedded options:
 - (i) Define the embedded option being valued for a ULSG product.
 - (ii) Explain the approach typically used to value the embedded option for a ULSG product, including the key considerations.
 - (iii) Describe how attribution analysis may be helpful in analyzing embedded options.

- 14.** (9 points) ABC Life currently offers a variable annuity product with a Guaranteed Minimum Death Benefit (GMDB) and wide variety of company managed equity investment options.

ABC uses a dynamic hedging strategy to manage the risks of their GMDB product. Since the product was introduced 3 years ago, the economic environment has shifted towards lower interest rates and higher market volatility.

Recently, ABC became aware of several instances in which a policyholder who was in poor health sold their policy to XYZ Settlement Group. XYZ became the new owner of the policy, but the original policyholder remained the measuring life for the GMDB.

- (a) (2 points) Explain life settlement transactions and why they would be attractive to policyholders and XYZ.
- (b) (4 points)
- (i) Identify and explain the hedging risks for variable annuity guarantees that are most relevant in this situation.
 - (ii) Predict how actual policyholder behavior on policies settled by XYZ may differ from what ABC assumed at the time the GMDB was priced.
 - (iii) Analyze the impact of XYZ's actions on ABC's hedging strategy.
- (c) (3 points) ABC is contemplating adding one of the following benefit types to complement the existing GMDB.
- Guaranteed Minimum Maturity Benefit
 - Guaranteed Minimum Income Benefit

Describe each benefit and assess how each might impact the future actions of companies like XYZ.

- 15.** (8 points) XYZ Life has been a major player in the U.S. term insurance market for over 20 years predominantly using its captive agency field force. The majority of XYZ's competitors have introduced preferred term products, but XYZ's failure to do so has resulted in a recent loss of market share.

XYZ may introduce a new preferred term product to complement its existing non-preferred product in order to support its existing brokerage distribution channel. XYZ will employ a unique debit/credit underwriting approach for its preferred term product. No other companies in the industry underwrite using a debit/credit approach.

- (a) (1 point) State the considerations in setting the mortality assumption for a preferred term product.
- (b) (2 points) You are given the following industry and company mortality experience:

Mortality Rates per 1000 - Issue Age 50		
Duration	Industry	XYZ
1	1.53	12.17
2	1.59	12.55
3	1.68	12.92
4	1.78	13.30
5	1.90	13.61

Calculate the blended duration 5 mortality rate assuming a 75% / 25% mix of industry and XYZ experience. Show all work.

- (c) (3 points) Assess the appropriateness of blending the mortality rates of XYZ with industry experience in setting the mortality assumption for the preferred term product.
- (d) (2 points) Predict the effect on XYZ's sales and its current block of term policies if:
- (i) XYZ decides not to introduce a preferred term product.
- (ii) XYZ decides to introduce a preferred term product.

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

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