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

Exam DP-IU

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 <u>numbered 9 through 17</u> 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-IU.

6. Be sure your essay answer envelope is signed because if it is not, your examination will not be graded.

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. *(8 points)* Your company offers a Return of Premium (ROP) rider with your 20-Year Term product.

(a) *(1 points)* Explain how the pricing assumptions and expected profitability for your term product might be affected by the addition of the ROP rider.

(b) *(2 points)* Describe the regulatory requirements that must be considered before offering a ROP rider.

(c) *(5 points)* You are given:

- Male age 50
- Face amount of 100,000
- Annual premium of 800
- Cash value accumulation test is used
- Return of Premium benefit is a percentage of the sum of premiums paid, as shown below, payable on surrender:

Duration	16	17	18	19	20
ROP	70%	80%	90%	100%	0%

Age	Dx	Mx	Nx	Age	Dx	Mx	Nx
50	13,334,189	4,540,213	228,643,368	61	8,104,364	3,881,951	109,782,728
51	12,777,102	4,495,979	215,309,180	62	7,710,601	3,799,895	101,678,364
52	12,239,358	4,449,662	202,532,078	63	7,326,406	3,712,261	93,967,763
53	11,719,656	4,400,705	190,292,720	64	6,951,420	3,619,060	86,641,358
54	11,216,950	4,348,755	178,573,065	65	6,585,802	3,520,805	79,689,937
55	10,729,660	4,292,886	167,356,115	66	6,229,726	3,418,028	73,104,135
56	10,256,936	4,232,841	156,626,455	67	5,883,617	3,311,524	66,874,409
57	9,798,530	4,168,933	146,369,519	68	5,547,572	3,201,772	60,990,792
58	9,354,581	4,101,851	136,570,989	69	5,221,598	3,089,167	55,443,221
59	8,924,990	4,032,051	127,216,408	70	4,905,139	2,973,539	50,221,622
60	8,508,690	3,959,021	118,291,419	71	4,597,295	2,854,353	45,316,483

(i) Determine whether the contract qualifies as life insurance. Show all work.

(ii) Determine whether the contract will become a Modified Endowment Contract (MEC). Show all work.

(iii) Propose changes to the 20-Year Term product and the ROP rider design to ensure the contract does not become a MEC. Show all work.

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 90th 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 behavior related to adding a GMWB.

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

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

15. *(6 points)* Your company markets a term life insurance product through a career agency force. You plan to expand distribution by marketing the same product on the internet.

(a) *(4 points)* Explain potential channel conflict this may cause and propose ways to manage the conflict.

(b) *(2 points)* Describe the following, in the product development process:

    (i) Concurrent engineering.

    (ii) "Fuzzy front end."

    (iii) "Fuzzy after launch."

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 No-Lapse Guarantee to age 100 and an interest bonus at the end of year 10.

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

    (b)   *(1 point)* Predict how the design will affect the lapse rate assumption.

END OF EXAMINATION
AFTERNOON SESSION