Exam DP-IU

MORNING SESSION

Date: Thursday, October 30, 2008
Time: 8:30 a.m. – 11:45 a.m.

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This examination has a total of 120 points. It consists of a morning session (worth 60 points) and an afternoon session (worth 60 points).

   a) The morning session consists of 8 questions numbered 1 through 8.

   b) The afternoon session consists of 8 questions numbered 9 through 16.

   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.

1. *(4 points)* Your company uses a macro pricing approach in the product development process.

(a) Describe advantages of pricing using a project-based analysis versus a traditional pricing approach.

(b) You are given:

- P is price per unit
- $f(P) = \dfrac{40,000,000}{P^2}$
- Marginal expense per unit is 150
- Non-marginal expenses are 50,000

Calculate the following:

(i) Optimal price per unit
(ii) Sales volume
(iii) Total profit

Show all work.

2. *(6 points)* Company XYZ sells an Equity Indexed Annuity with the following characteristics:

Single Premium	1000
Index Period	10 Years
Index Growth Method	One Year Point-to-Point
Participation Rate	100%

You are given:

- Present Value of Expenses and Profit = 10% of initial premium
- Assumed Net Investment Earned Rate = 5%
- Standard Nonforfeiture Model Regulation approved by the NAIC in April 2003, with an accumulation rate of 3%

(a) *(1 point)* Calculate the budget available to hedge the index growth guarantee.

(b) *(3 points)* Describe the two major forms of hedging the index growth guarantee.

(c) *(2 points)* Recommend changes or additions to the product design to manage the risks of:

(i) Decreasing interest rates.
(ii) Increasing equity volatility.

3. *(12 points)* RKA Life Insurance Company markets Group Life and Universal Life Insurance products.

You are given:

	Group Life Insurance	Universal Life Insurance
Premium	60 million	40 million
Profit	0.75% of premium	1.50% of premium
Mortality Experience Study Basis	Aggregate	15 year select and ultimate
Underwriting Basis	Guaranteed Issue	Fully Underwritten with Preferred Classes

RKA Life plans to add an individual one-year term life insurance product with simplified underwriting. You are given the following pricing assumptions:

Premium Production Per Year	25,000,000
Average Premium Per Policy	400
Average Death Benefit Per Policy	1,000,000
Average Mortality Rate	0.00005
Acquisition Expense as % Premium	5%
Acquisition Expense Per Policy	40
Commission as % Premium	10%
Maintenance Expense Per Policy	10
Overhead Acquisition Expense as % Premium	2.5%
Overhead Acquisition Expense Per Policy	10
Overhead Maintenance Expense Per Policy	5
Cost of Capital	15%
Earnings Rate	7.5%

(a) *(4 points)* Explain why mortality experience data from the company's existing products may not be appropriate for setting the mortality assumption for this product.

(b) *(1 point)*
  (i) Describe two expense philosophies commonly used in pricing.
  (ii) Describe common problems and mistakes made with each.

(c) *(1 point)* Calculate the profit margin and premium margin for the term product, assuming premiums are paid annually. Ignore investment income, taxes and claim expenses. Show all work.

3. **(continued)**

(d)   *(4 points)* RKA Life considers its distribution channel to be a customer, and uses the following value matrix:

```
         0      10     20
       ┌──────┬──────┐ 300
 High  │  A   │  B   │
       │      │      │
Current Value ├──────┼──────┤ 150
       │      │      │
 Low   │  C   │  D   │
       └──────┴──────┘ 0
         Low    High
        Potential Value
```

(i)   Define current value and potential value based on the lifetime customer value.

(ii)   Explain the goal and strategy for each quadrant in the value matrix.

(iii)   Determine the appropriate quadrant for RKA Life's distribution channel. Show all work.

(e)   *(2 points)*

(i)   Define intensive growth strategies and diversified growth strategies.

(ii)   Determine the strategy used by RKA Life.

4. *(5 points)* You are pricing a term product with a conversion option available in policy years 5, 6, and 7.

(a) *(1 point)* Describe the three approaches to charging for policyowner options.

(b) *(1 point)* Explain pricing factors needed to price a conversion option.

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

- Number of policies sold = 1,500
- Average face amount = 100,000

Policy year (*t*)	5	6	7
Reserve credit at time *t* (per thousand of face amount converted)	5	7	9
Number of conversions in policy year *t*	20	30	30
Percent of face amount converted	75%	75%	75%
Option expense	150	153	157
Option charge (per thousand of face amount converted)	2	4	6

Calculate the cost of the conversion option, per unit of insurance at issue, in policy year 7 using option pricing mathematics. Show all work.

5. *(10 points)*

    (a)   *(3 points)* Describe the impact the following would have on your choice of discount rates in measuring profitability:

        (i)   Whether the company is stock or mutual
        (ii)   Current interest rate levels
        (iii)   Tax rate
        (iv)   Product design
        (v)   Negative profits after the first year

    (b)   *(5 points)* With respect to the following profit metrics as defined in *Atkinson and Dallas*:

- Return on Investment (ROI)
- Weighted-Average Return on Equity (ROE)
- Profit as a Percentage of Premium
- Breakeven Year
- Embedded Value
- New Business Strain

        Describe each metric and how it is impacted by the discount rate.

    (c)   *(2 points)* Company DGL uses Embedded Value as its primary profit measure and requires profit to be at least 6% of premium.

        You are given the following:

t	Premium	Profit Stream A	Profit Stream B
1	400	(1000)	(600)
2	400	300	300
3	400	300	300
4	400	700	200

        Hurdle rate = 15%
        Discount rate = 7.5%

        Identify the optimal profit stream for the company. Show all work.

6. *(9 points)*

(a)   LNZ Life is planning to change to a principles-based approach for statutory reserving and capital purposes.

      (i)   Explain the differences in the pricing process between using a principles-based approach and a formula-based approach for projecting reserves.

      (ii)   Explain the interdependencies between the valuation actuary and pricing actuary in developing assumptions for product pricing under a principles-based approach.

(b)   LNZ Life is introducing a Universal Life product with a persistency bonus. The bonus credits an additional 1.5% of interest retroactively over the first 10 policy years if the policy persists to the end of the 10th policy year.

      (i)   It has been proposed that the system changes to administer the persistency bonus will be completed post-implementation. Assess this proposal.

      (ii)   Evaluate the bonus in light of potential persistency risk and policyholder equity issues.

7. *(8 points)*

    (a)   *(5 points)* List the distribution systems available for marketing life insurance products and describe their advantages and disadvantages.

    (b)   *(3 points)* You are given the following information for a 5-year level premium term life insurance product, priced to achieve a 15% return on investment.

Year	Comm%(t)	Agent-$p(t)$	Premium-$p(t)$
1	40%	1.000	1.000
2	10%	0.900	0.850
3	5%	0.850	0.750
4	3%	0.700	0.700
5	2%	0.650	0.600

Discount rate = 3%

Where:

- Comm%(t) = commission paid as a percentage of gross premium to agent in policy year t
- Agent-$p(t)$ = probability (measured from policy issue) that premium on new business is written by agents who do not leave before business enters policy year t
- Premium-$p(t)$ = probability (measured from policy issue) that the annual premium required to keep the policy in force for policy year t will be paid

    (i)   Calculate the present value of commissions paid as a percentage of the gross annual premium, assuming commissions are:

- vested
- not vested

Show all work.

    (ii)   Describe the impact on profitability of using a levelized commission structure that is equivalent to the non-level structure with a discount rate of 3%.

8. *(6 points)* Senior management has suggested adding a secondary guarantee to universal life (UL) and variable universal life (VUL) products to increase sales.

(a) *(1 point)* List questions that need to be answered for senior management to assess the feasibility of the proposed product initiative.

(b) *(3 points)* With respect to the key features of secondary guarantees for UL and VUL:

(i) Explain their impact on the cost of the guarantee.
(ii) Recommend options to reduce the cost of the guarantee.

(c) *(2 points)* Design a high level plan for stochastically pricing a secondary guarantee.

END OF EXAMINATION
Morning Session

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

Exam DP-IU

AFTERNOON SESSION

Date: Thursday, October 30, 2008
Time: 1:30 p.m. – 4:45 p.m.

INSTRUCTIONS TO CANDIDATES

General Instructions

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9. *(5 points)*

    (a)   Describe pricing assumptions specific to disability waiver of premium benefits.

    (b)   Describe alternative life insurance policy riders that could be beneficial to those who become disabled.

10. *(5 points)*

    (a)   You are given the following components of U.S. Risk-Based Capital:

	Product A	Product B
Interest Rate Risk	45	60
Asset Default Risk	25	45
Insurance Risk	60	25
Other Risk	10	10

        (i)   Determine which product will require the least amount of U.S. Risk-Based Capital. Show all work.

        (ii)   Compare the Canadian Minimum Continuing Capital and Surplus Requirement to the U.S. Risk-Based Capital requirement.

    (b)   Your company is considering using reinsurance to manage its capital position. You are given the following information about a product line before reinsurance:

Capital needed to fund new business strain	600
Required capital	300
Pre-tax earnings excluding interest on required capital	120
Tax rate	30%
After-tax rate of return on capital	12%

        Assume:
- Reinsurance reduces required capital and pre-tax earnings in the same proportion.
- Reinsurance reduces the capital needed to fund new business strain by 115% of the required capital reduction.
- The proposed reinsurance will apply to both existing and new business.

        Determine the proportion of business to reinsure in order to increase the after-tax return on capital to 16%. Show all work.

11. *(10 points)* ABC Life is developing an Equity-Indexed Annuity (EIA) product. You are given the following additional information:

- ABC Life has a large, exclusive agency field force.
- ABC Life prices aggressively in the SPIA market, an important segment for them.
- As an emerging high-risk product, the target profit margin for the EIA is high.
- ABC Life is financially stable with a high surplus ratio, but with little experience using derivatives.
- ABC Life expects to rely heavily on reinsurers for risk management and pricing expertise.

(a) *(5 points)* With respect to the following pricing strategies:
- Cost-driven
- Competition-driven
- Customer-driven

      (i) Describe each strategy.
      (ii) Assess the viability of each.
      (iii) Identify the appropriate strategy for ABC Life.

(b) *(4 points)* Describe product design and pricing issues specific to EIA products.

(c) *(1 point)* Describe the major differences between EIAs and Variable Annuities.

12. *(8 points)*
(a) *(6 points)* Describe considerations in setting lapse assumptions for the following product types:

      (i) Universal life with secondary guarantees
      (ii) Term insurance
      (iii) Variable annuities with guaranteed living benefits and guaranteed death benefits

(b) *(2 points)* Explain the impact the following may have on persistency:

      (i) Buyers
      (ii) Producers
      (iii) Product design
      (iv) Sales process
      (v) Outside environment

13. *(9 points)* ABC Life is expanding their income annuity offerings by adding an underwritten income annuity. All prospective annuitants will be underwritten and placed in a standard or substandard risk class. The mortality assumptions for the new product will be derived from ABC Life's existing income annuity products.

(a) Describe the key principles that should be applied in using mortality experience from an existing product to set assumptions for a new product.

(b) Describe the methods by which ABC Life's standard mortality assumption may be modified to reflect the substandard risk class, including advantages and disadvantages of each.

(c) You are given the following for a prospective annuitant:

Issue Age	85
Risk Class	Substandard
Benefit Amount	10,000 / year, payable at the end of each year
Payout Option	Life Only
Premium Tax	0%
Initial Expense	200
Annual Expenses	None
Commission	4% up front (applies to benefits as well as expense load)

You are also given:

Age	standard q_x
85	0.09
86	0.10
87	0.11
88	0.12
89	0.13
90	1.00 (for all classes)

Year	Spot Interest Rate
1	3.0%
2	3.3%
3	3.6%
4	4.0%
5	4.4%

ABC Life has set the mortality assumption for the substandard risk class at 120% of standard mortality.

Evaluate the appropriateness of offering an annuity at age 86 to this prospective annuitant. Show all work.

14. *(7 points)* KG Financial is developing a Flexible Premium Deferred Annuity (FPDA) with a Market Value Adjustment (MVA).

(a) *(1 point)* Explain the advantages of a MVA feature on a FPDA from the perspective of the:

    (i)   Consumer
    (ii)   Company

(b) *(3 points)* Describe key pricing considerations for a MVA feature on a FPDA.

(c) *(3 points)* Assume:

- A 10,000 deposit at the beginning of year 1 with a 5 year guarantee period and 5% guaranteed interest rate.
- A 10,000 deposit at the beginning of year 2 with a 6 year guarantee period and a 6% guaranteed interest rate.
- The MVA formula includes an additional margin of 0.5%.
- Credited interest is compounded annually.

You are given:

Policy Year	1	2	3	4	5	6
Surrender charge (% of Account Value)	10%	9%	8%	7%	5%	3%
New deposit interest rate						
2 year guarantee period	3.50%	3.75%	5.00%	4.00%	5.50%	5.75%
3 year guarantee period	3.60%	3.85%	5.25%	4.75%	5.60%	5.85%
4 year guarantee period	3.80%	4.50%	6.00%	7.00%	5.80%	5.95%

Calculate the cash surrender value at the beginning of:

    (i)   Policy year 4.
    (ii)   Policy year 6.

Show all work.

15. *(5 points)* You are given the following for a guaranteed minimum maturity benefit (GMMB):

- Maturity period is 5 years
- Annual resets
- No decrements
- 1% margin offset based on end of year fund values
- No margin offset in year 5
- 5% risk free rate
- No dynamic hedging

End of year fund values (before margin offset)					
	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Issue	100	100	100	100	100
Year 1	90	105	105	110	105
Year 2	95	110	100	95	110
Year 3	100	105	110	90	110
Year 4	105	110	115	95	120
Year 5	110	100	110	90	125

(a)   *(4 points)* Calculate the 60% CTE of the cost of the GMMB. Show all work.

(b)   *(1 point)* Explain advantages of the CTE measure over the Quantile measure.

16. *(11 points)* XYZ Life Insurance Company has a Flexible Premium Universal Life Product. The following information represents a typical policy at the end of the 10th policy year:

Issue age	35
Death benefit	50,000 level face amount
Single premium at issue	7,500
Account value year 10	17,000
Surrender value year 10	14,500
Premium load	7%
Guaranteed interest rate	4%
Guaranteed cost of insurance charges	1980 CSO Male Aggregate, Age Nearest Birthday

- No other expense charges or loads
- No policy changes or partial withdrawals in the first 10 years

You are given the following:

	at 4%	**at 6%**
A_{35}	0.24682	0.13951
A_{45}	0.34071	0.21861
$\ddot{a}_{35}$	19.58258	15.20206
$\ddot{a}_{45}$	17.14145	13.80451

- Section 7702(d) cash value corridor factor at age 35 is 250%
- Section 7702(d) cash value corridor factor at age 45 is 215%

(a)   Describe the two actuarial tests used to determine if a contract meets the definition of life insurance under IRC section 7702.

(b)   Determine whether the contract meets the definition of life insurance under IRC section 7702, both at issue and at the end of policy year 10, under:

   (i)   The Cash Value Accumulation Test
   (ii)   The Guideline Premium / Cash Value Corridor Test

   Show all work.

(c)   Describe the choice of tests for this product, including the advantages and disadvantages.

16. (continued)

(d)   You are given:
- Partial withdrawal in year 10 is 3,000.
- Partial withdrawals do not decrease the death benefit.
- Tax rate is 30%.

Assuming:
- The contract is a Modified Endowment Contract under IRC Section 7702A.
- The contract continues to qualify as life insurance under IRC Section 7702.

Calculate the following:

(i)   Taxable Income
(ii)   Remaining Account Value
(iii)   Remaining Premiums Paid
(iv)   Remaining Gain
(v)   Total Tax

Show all work.

END OF EXAMINATION
Afternoon Session