

# Exam CSP-IU

## MORNING SESSION

**Date:** Friday, May 9, 2008  
**Time:** 8:30 a.m. – 11:45 a.m.

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

**\*\*BEGINNING OF EXAMINATION\*\***  
**INDIVIDUAL LIFE & ANNUITIES UNITED STATES**  
**COMPANY SPONSOR PERSPECTIVE**  
**Morning Session**

- 1.**     *(6 points)*
- (a)     *(1 point)* Identify the two fundamental premises for asset-liability management.
  
  - (b)     *(2 points)* The fundamental premises are subject to four significant qualifications
    - (i)     Statutory and GAAP measures have economic value
    - (ii)    Risk is costly
    - (iii)   Managing interest rate exposure is not enough
    - (iv)    Asset liability management is not just asset management.
- Explain the significance of each qualification.
- (c)     *(3 points)*
    - (i)     Describe the key considerations when examining the economic value of any insurance company as it pertains to ‘Asset-Liability Management for a Going Concern’.
    - (ii)    Propose ways to protect the insurer’s shareholder value from interest rate risk.

2. (12 points) ABC, a US life insurance company is planning to introduce a new 3-year term insurance product, Executive Term.

Projections for Executive Term

	12/31/2008	12/31/2009	12/31/2010
Face amount	8000	6800	5500
Statutory reserves	1500	900	0
GAAP benefit reserve	600	200	0
Premiums	2000	1200	900
Commissions	600	350	200
Benefits paid	300	700	1100
Unamortized GAAP deferred acquisition costs	1200	550	400
GAAP earnings	170	220	70

Assume:

- Statutory required capital is equal to 10% of the statutory reserves
- Statutory required surplus is equal to statutory required capital
- Investment income on year end statutory reserves and required capital are both 8% annually
- Cost of capital is 12% annually
- No income tax

- (a) (2 points) Explain how capital budgeting techniques can be used in strategic planning and list the potential limitations of these techniques.
- (b) (6 points)
- (i) Calculate the actuarial appraisal value of Executive Term at 12/31/2008. Show all work.
  - (ii) Determine whether ABC should invest in the product. Show all work.

## 2. Continued

(c) (4 points) A reinsurer proposes the following YRT terms for ceding Executive Term:

- YRT using the pro rata method, retention rate is equal to 20% of the net amount at risk
- Initial terminal reserve is zero
- YRT reinsurance premium rate equal to 0.10 per 1000 of ceded amount
- First year reinsurance allowance is equal to 15% of first year ceded premium
- Unearned portion of a one year term insurance benefit is equal to 60% of the YRT reinsurance premium
- Ceded premium and reinsurance allowance are paid at the beginning of the year
- All other reinsurance transactions are at the end of the year

Compare the cash flow strain, before required capital consideration, at 1/1/2008 with and without the proposed YRT arrangement. Show all work.

**3.** (10 points) XYZ Life Insurance Company is building an Economic Capital model.

- (a) Describe the major uses of Economic Capital in the insurance industry.
- (b) Describe choices XYZ Life needs to consider with regard to the types of models, techniques and parameters pertaining to Economic Capital.
- (c) Compare the types of risks that should be considered in Economic Capital calculations for the following products:
  - (i) Ten-year Term Life
  - (ii) Equity Indexed Annuity
- (d) You are provided with the following scenario results:

Scenario	Present Value of Future Profits
1	1250
2	-45
3	120
4	1400
5	1350
6	-500
7	-600
8	1200
9	1300
10	1600

- (i) Calculate the Economic Capital using a Tail-Value at Risk approach with a risk tolerance of 20%. Show all work.
- (ii) Calculate the Economic Capital under a 10% confidence level using a Value at Risk approach. Show all work.

4. (8 points) You are given the following financial information for a two year term insurance product:

	Year 1	Year 2	Year 3
Premiums	2000	2250	0
Claims or Death Benefits	500	650	800
Operating Expenses	550	600	550
Policy Reserve at year end	1500	1600	0
Tax Reserve	1400	1525	0
DAC	200	250	0
Required GAAP Surplus	600	750	0
Risk Capital	1200	1125	0

Assume:

- risk-free annual rate 5.0%
- risk capital cost rate 2.5%
- spread due to default option and liquidity 0.5%
- tax rate 40%
- no investment income is earned

- (a) (5 points) Calculate the after-tax economic profit for Year 2.
- (b) (3 points) Determine the GAAP basis free cash-flow for Year 2.

Show all work.

**5.** (4 points)

- (a) Compare and contrast various methods of determining modeled credited interest rates and any implications on policyholder behavior.
- (b) XYZ Life Insurance Company stochastically models interest rates using the successive ratios method for an asset liability model. The yield curve is defined by the 90-day and 15-year rates.

You are given:

- 90-day rate 4.50%
- 15-year rate 6.00%
- degree of correlation of changes between 90-day and 15-year rate 60%
- volatility factor 20%
- the following normally distributed, randomly generated numbers with means of zero and standard deviations of one:

Time	Z1	Z2
1	0.482	1.829
2	-0.709	0.902

Calculate the 90-day and 15-year rates for the next two time periods. Show all work.

**6.** (4 points)

- (a) Describe the common tests of claim reserve adequacy.
- (b) You are given:

Cash Claims Paid by Year of Incurral

Total Cash Paid by End of Calendar Year	2003	2004	2005	2006	2007
2003	10				
2004	12	7			
2005	6	10	5		
2006	3	5	10	6	
2007	2	4	6	10	5

Calculate the minimum level of claim reserves which needed to be held in the table below to ensure claim reserve adequacy.

Calendar Year	2004	2005	2006	2007
2004	?			
2005	?	?		
2006	?	?	?	
2007	?	?	?	?

Show all work.



**7.** (10 points)

(a) (3 points) Compare the advantages and disadvantages to ABC Life Insurance Company of the following forms of reinsurance:

- (i) YRT
- (ii) Modified Coinsurance

(b) (7 points) You are given the following for a Whole Life policy from ABC Life issued in 2009:

Face Amount	500,000
Premium Rate per 1000	10
Commission Rate	20% of premium
Maintenance Expenses	50 per policy
Reserve at December 31, 2009	3000
Reserve at December 31, 2010	3400

ABC Life enters a modified coinsurance reinsurance arrangement with XYZ Re starting January 1, 2009.

You are given:

Quota Share	60%
Expense Allowance	10% of reinsurance premium
XYZ Re's Maintenance Expenses	25 per cession
Net Investment Income Rate (for both companies)	10% per annum
ABC Life's Surplus at December 31, 2009	500
XYZ Re's Surplus at December 31, 2009	1000
Mod-co interest rate	10% per annum

Assume:

- Policy and reinsurance premiums are paid annually in advance
- Policy fees, claims, surrenders, dividends and taxes are 0 in all years
- Expenses are incurred on policy anniversaries
- Investment Income is earned on beginning of year assets only
- No embedded derivative reporting issues

Construct the 2010 income statement and balance sheet for both ABC Life and XYZ Re. Show all work.

**8.** (6 points)

- (a) (2 points) A US life insurer's target surplus goal is 3 times the minimum Risk Based Capital (RBC) amount and current surplus has fallen to 1.25 times the minimum RBC amount.

Recommend actions to improve the life insurer's surplus position.

- (b) (1 point) You are given the following C-3 factors:

Low Risk	0.77%
Medium Risk	1.54%
High Risk	3.08%

A life insurer's product mix includes two annuity products:

Products	Surrender Charge	Considerations in 000's	Reserves in 000's
LeveragedSelect	0%	10,000	9,800
CorpSelect	10%	5,000	4,800

Both products allow withdrawals at book value.

Determine the risk classification and calculate the C-3 component of the RBC for each product. Show all work.

- (c) (3 points) Compare the RBC C-3 Phase I approach to the C-3 Phase II approach.

**\*\*END OF EXAMINATION\*\***  
**MORNING SESSION**

# Exam CSP-IU

## AFTERNOON SESSION

**Date:** Friday, May 9, 2008

**Time:** 1:30 p.m. – 4:45 p.m.

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- 9.** (6 points) Five years ago ABC Life Insurance Company started marketing variable annuities with living and death benefit guarantees. Even though the annuities are profitable, management is concerned about the high variability in cash flows and whether the reserve assumptions used are appropriate.
- a) (4 points) Describe key valuation assumptions of guaranteed benefits related to policyholder behavior and explain how policyholder behavior can affect them.
- b) (2 points) Describe potential costs to the company associated with highly variable cash flows.

**10.** (8 points)

(a) You are given the following information for a block of variable annuities with guaranteed minimum income benefits (GMIB):

- the block has no deferred acquisition cost
- accumulation and discount rate is 6%
- all benefit payments, expenses and assessments are assumed to be at the end of year

	Total Revenue	GMIB Benefits
Present value at beginning of policy year $t$	30,000	9,750
Accumulated value at beginning of policy year $t$	60,000	3,800

Assume the following results for policy year  $t$ :

- Expected Total Revenue: 8000
- Expected Expenses: 250
- Expected GMIB Benefits: 950
- Actual GMIB Benefits: 1800
- Expected future experience remains unchanged.

Under Standard of Practice 03-1:

- (i) Calculate the expected gross profit for policy year  $t$ . Show all work.
- (ii) Calculate the actual gross profit for policy year  $t$ . Show all work.

(b) Under SFAS 157:

- (i) Define the components of a fair value measurement.
- (ii) Describe the three different valuation techniques for fair value measurement.
- (iii) Recommend for the GMIB which fair value hierarchy applies. Justify your reasoning.

**11.** (8 points)

(a) (5 points) Contrast the U.S. GAAP reporting requirements for Flexible Premium Universal Life with the requirements for non-participating term, with respect to:

- (i) Accounting standards
- (ii) Assumptions used
- (iii) Revenue and expense recognition
- (iv) Deferred acquisition cost (DAC) calculation

(b) (3 points)

- (i) List the qualifications and procedures required to become an appointed actuary.
- (ii) Explain the requirements of the statement of actuarial opinion prepared annually by an appointed actuary.
- (iii) Describe the information that must be included in the liability section of the actuarial memorandum.

- 12.** (6 points) An insurer utilizes U.S. GAAP for its management accounting basis and is proposing to develop a dividend paying participating Universal Life (par UL) product. Cost of insurance rates, expense loads, and the interest crediting rate are fixed and guaranteed by terms of the contract.

For the first year you are given the following par UL policy projections:

	(000's)
Premium	100,000
Investment Income	2,625
Death Benefits	30,000
Commissions	50,000
Fixed Expenses	3,200
Benefit Reserve	40,312
Initial DAC	50,000
Interest Credited in First Year	2,500
Dividend	0

You are given:

DAC Amortization Factor	50%
DAC Interest Rate	5% annual
Cost of Insurance	45% of premium
Surrender Charge	2.5% of premium
Expense Loads	3.5% of premium
Initial Death Benefit	750,000 per policy
Number of Policies	75,000
Annual Lapse Rate	4%

Assume:

- No taxes
- Deaths occur prior to lapse
- Lapses occur at end of policy year
- Policies are all of equal size
- No actual dividends paid in year 1

- (a) (1 point) Describe the appropriate SFAS accounting treatment of this product.
- (b) (5 points) Calculate the end of first year Deferred Acquisition Cost (DAC) balance and construct the first year income statement. Show all work.

**13.** (7 points) ABC Life is a small life insurance company domiciled in State XY in the United States.

(a) (3 points) Recently, one of the 15 states in which ABC Life writes business decided to start imposing premium tax on annuity considerations received from residents of that State, while State XY does not.

(i) Describe the types of insurance products and premiums that are and are not subject to state premium taxation.

(ii) Discuss ABC Life's concerns with imposing premium tax on annuity considerations.

(b) (4 points) You are preparing the tax returns for 2007 and have been provided the following details:

	2005	2006	2007
Premiums	500	550	400
General Operating Expenses	125	137	250
Death Benefits	84	53	167
Policyholder Dividends	12	15	17
Increase in Statutory Reserves	146	156	187
Increase in Tax Reserves	129	145	166

This small life insurance company had no taxable income for 2004.

Calculate ABC Life's revised taxable income for 2006. Show all work.



**14.** (4 points) ABC Life Insurance Company is offering the following replacement options for its current variable annuity with Guaranteed Minimum Withdrawal Benefit (GMWB) rider to its policyholders:

- (i) Variable annuity containing a GMWB for Life rider.
- (ii) Equity Indexed Annuity.
- (iii) Fund-of-funds variable annuity containing a GMWB rider.

ABC Life is evaluating these options with respect to SOP 05-1.

- (a) Define internal replacement under SOP 05-1.
- (b) Describe the two most important criteria that must be satisfied in order for a contract modification to leave the underlying contract 'substantially unchanged'.
- (c) For each internal replacement option above, determine whether the contract is considered 'substantially unchanged' by the replacement contract. Explain your reasoning.

**15.** (14 points) ABC Life Insurance Company is evaluating a proposal to acquire all of the stock of XYZ Life Insurance Company. You are given the following information:

- An actuarial appraisal has been prepared on XYZ Life, and the embedded value of the inforce business has been calculated using a range of discount rates.
- XYZ Life issues primarily basic term products and backs the liabilities with well-matched high grade corporate bonds.

(a) (6 points) Explain the potential shortcomings of value creations from the financial economics perspective for:

- (i) An actuarial appraisal of the value of XYZ Life's inforce business.
- (ii) Use of the Capital Asset Pricing Model (CAPM) to determine an appropriate discount rate for the actuarial appraisal.

(b) (8 points) You are given the following:

- The investment to launch a new product is 112 million
  - The present value of the net cash flows at the time of the product launch is estimated to be either 180 million or 60 million
  - A "twin security" has been identified whose price is 20 and whose value is estimated to be either 36 or 12
  - The risk-free rate is 8%
- (i) Explain the advantages of using Contingent Claims Analysis (CCA) over traditional Discounted Cash Flow techniques.
  - (ii) Explain the benefits of using CCA in evaluating a new product launch.
  - (iii) Calculate the option value assigned to launching this new product using CCA. Show all work.

**16.** (7 points)

- (a) (4 points) The following steps outline a procedure to determine minimum Universal Life (UL) reserves at time  $t$ :

Step	Procedure
1	Calculate a Guaranteed Maturity Premium (GMP) as the level premium that provides an endowment at the latest maturity date under the contract, calculated from the valuation date using valuation assumptions.
2	Calculate a set of Guaranteed Maturity Funds (GMF's) as of the valuation date using valuation basis assumptions, and assuming that gross premiums are paid.
3	Produce a set of "guaranteed death benefits" and a "guaranteed maturity benefit" by projecting forward from the valuation date $t$ , using valuation assumptions, the $GMF_t$ and assuming gross premiums are paid. Calculate the present value of these future benefits at time $t$ ( $PVFB_t$ ) using valuation assumptions.
4	Calculate a net level premium ( $P^{NL}$ ) based on the plan of insurance at issue, using valuation assumptions, and assuming gross premiums are paid.
5	Calculate the net level reserve at time $t$ as ${}_tV^{NL} = PVFB_t - P^{NL}$
6	Calculate the CRVM expense allowance ( $EA^{CRVM}$ ) for the plan of insurance generated at issue using valuation assumptions and assuming that $P^{NL}$ is paid.
7	Calculate the CRVM reserve at time $t$ as ${}_tV^{CRVM} = {}_tV^{NL} - EA^{CRVM}$

Revise, add or delete information to make each step compliant with the NAIC UL Model Regulation.

- (b) (1 point) Outline the criteria used to determine the maximum valuation interest rate assumption for a Survivor UL product.

**16. Continued**

(c) (2 points) You are given:

- Monthly average over a twelve month period of the composite yield on seasoned corporate bonds, as published by Moody's Investors Service:  
 $y_1 = 7.0\%$
- Monthly average over a thirty-six month period of the composite yield on seasoned corporate bonds, as published by Moody's Investors Service:  $y_2 = 8.0\%$
- Weighting factors:  $w_1 = 0.50$  and  $w_2 = 0.50$

Calculate the maximum valuation interest rate based on this information. Show all work.

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