November 2001- Course 8ILA
Society of Actuaries

**** BEGINNING OF EXAMINATION ****
MORNING SESSION

1. *(4 points)* You are the Chief Marketing Officer of a large life insurance company with a career agent distribution system. You have been asked to implement a financing plan for new agents. The President wants to keep financing costs at a minimum and to retain a high percentage of good producers.

(a) Describe factors that impact the degree of financing needed.

(b) Describe the types of financing plans commonly used by life insurance companies today and assess how each plan meets the President's criteria.

Questions 2 – 4 pertain to the case study.
Each question should be answered independently.

2. *(17 points)* You are applying value-based financial measurement to a block of identical term-to-100 policies sold by Saturn Life, using seriatim stochastic methods for assessing mortality and lapse risk. The following table summarizes the expected mortality and lapse assumptions for each policy year beyond the valuation date, and also gives the results of a randomly generated number, $S(0 <= S <= 1)$, for both mortality and lapse for each policy in the block.

	Year 1		Year 2		Year 3	
	Death	Lapse	Death	Lapse	Death	Lapse
Pricing Expected Rate "q"	0.25	0.07	0.65	0.07	1	- -
Random Number "S"						
- Policy 1	0.7566	0.0287	0.6811	0.7509	0.9847	- -
- Policy 2	0.8135	0.1860	0.9852	0.2320	0.0006	- -
- Policy 3	0.8226	0.4234	0.6708	0.0555	0.3046	- -
- Policy 4	0.5431	0.3565	0.3367	0.0621	0.5718	- -
- Policy 5	0.9731	0.8522	0.0004	0.6089	0.9629	- -

Other pertinent information:

- Face amount for each policy: $100,000
- Annual level premium for each policy: $300
- Net earned rate on cash flows & reserves: 12%
- Net earned rate on surplus: 6%
- Inflation: 2.4%
- Hurdle Rate: 15%
- Corporate income tax rate: 0%
- Statutory reserves and required surplus for each policy, net of reinsurance, per $1000 of insurance in force:

	Statutory Reserve	Required Surplus
Beginning of Year 1	63.00	5.50
End of Year 1	72.00	6.50
End of Year 2	84.00	8.00
End of Year 3	100.00	10.50

- The anniversary for all policies falls on the valuation date and each has been in force for at least ten years.
- There is currently no free surplus allocated to the block.
- Deaths and lapses occur at the end of the year.
- Other pricing assumptions, including reinsurance details, are as described in the case study.

2. Continued

(a) (1 point) Describe the outcomes of the stochastic simulation for each of the five policies above.

You are given two additional policies.

- Policy A survives to year 3 and then dies
- Policy B survives to year 2 and then lapses

(b) (6 points) Calculate the value-based earnings in year one for policies A and B using pricing assumptions.

(c) (2 points) Explain approaches to reduce the gap between value-based earnings calculated using pricing expenses and those calculated using the current unit expenses experienced by Saturn Life.

(d) (2 points) Assuming the block contains only policies A and B, demonstrate the impact to the return on value in year 1, given that Saturn's current unit expenses are $50 per policy.

(e) (6 points) Evaluate the pricing assumptions for lapse and interest rates, given the nature of term-to-100 products and Saturn Life's company profile.

Questions 2 – 4 pertain to the case study.
Each question should be answered independently.

3. *(11 points)* Mercury Life is conducting its annual review of the Par Whole Life block. Management is considering the following changes to improve sales and persistency:

- Modification of the dividend scale to reflect policy loans in aggregate rather than on a policy-by-policy basis (direct recognition method).
- The addition of a new dividend option that allows the policyholder to purchase 1 year term coverage. The policyholder is underwritten for the additional coverage at the time the option is elected. The term purchase option is available only on newly issued policies.

For the par whole life block, all premiums are paid on a monthly basis.

(a) The current dividend interest rate for the non-loaned portion is equal to the UL credited rate, and the variable loan rate is the five-year risk-free return plus 2%.

Explain the possible impacts on the dividend scale of changing the policy loan recognition methodology.

(b) Assess the appropriateness of using the current Par Whole Life mortality and lapse experience assumptions for pricing the new dividend option.

(c) Assuming Mercury Life is a Canadian based company,

(i) Describe considerations for setting experience assumptions for income-based reserves for the Par Whole Life block, and

(ii) Assess the impact of the proposed changes on the assumption for income based reserves.

Questions 2 - 4 pertain to the case study
Each question should be answered independently.

4. *(6 points)* As chief actuary of Mercury Life, you are reviewing the assumptions used in pricing Mercury's Waiver of Premium Rider for its par whole life portfolio. The following pricing assumptions have been used for this rider:

Coverage period	To insured's age 75
Premiums used in benefit calculation	Male non-smoker gross premiums for Mercury's Ordinary Life Payable to 65 (OLP 65), for a $50,000 average size
Interest	10%
Active life mortality	85% of mortality assumed for OLP 65
Withdrawals	None
Morbidity rates	Intercompany male non-smoker
Termination rates	Intercompany annual termination rates with a 60 day waiting period
Recovery at retirement	20% recovery from disabled status at retirement (the retirement age set to be 65).
Substandard cases	Waiver premium for the standard business times the substandard multiple

(a) (5 points) Evaluate these pricing assumptions.

(b) (1 point) Explain considerations for pricing a Waiver of Premium Rider on Universal Life products.

5. *(12 points)* Your consulting firm has been requested to develop a deferred acquisition cost (DAC) amortization model for Star Life's variable annuity block. You have also been asked to calculate the end of the year balances for inclusion in the audited financial statements prepared in accordance with U.S. GAAP. Star desires that the model be stochastically based and would determine DAC balances according to the following methodology:

- Future equity returns for the funds would be randomly generated using an equity model reflecting historic patterns appropriate to the variable annuity's equity funds.
- Future variable fund balances would be generated based on these random returns.
- Estimated gross profits would then be calculated based on best estimate spread assumptions.
- Each random scenario generates an associated DAC amortization schedule based on actual historical results and future results projected in the scenario.
- A distribution of DAC balances as of the end of the year is constructed.
- A corridor is defined between two predetermined percentiles of the distribution. If the current DAC balance falls within the corridor, no "catch-up" adjustment is required. If the current DAC balance falls outside the corridor, the "catch-up" adjustment equals the amount needed to bring the DAC balance to the nearest corridor boundary.

(a) Explain reasons Star Life might be interested in this methodology.

(b) Describe the DAC capitalization process applicable to Star Life for this product.

(c) List the significant assumptions and relationships that should be reflected in the model when the "Probabilistic Approach" is used for projecting future equity returns.

(d) Star Life has provided you with historical data on fund returns, withdrawals, recurring premiums and annuitization rates for the variable annuity block for use in setting model assumptions.

Describe considerations with respect to Actuarial Standards of Practice (ASP) 23 on data quality.

(e) Describe your responsibility to Star Life's auditors with respect to ASP 21.

(f) Propose how the model might be modified to calculate embedded value for the variable annuity block.

6. *(5 points)* A company offers a variable annuity with two investment options. It has a 5% premium load and a surrender charge that is 10% of the annuity account value in the first policy year, decreasing 1% at the beginning of each policy year. There are no other charges.

Unit value history for the company's investment options is as follows:

	Unit Values	
Date	Fund A	Fund B
January 1, 1995	5.00	15.00
January 1, 1996	5.50	17.50
January 1, 1997	7.00	16.50
January 1, 1998	8.00	12.50
January 1, 1999	7.50	12.50
January 1, 2000	9.25	15.00
January 1, 2001	11.00	16.50

(a) You are given the following information regarding Policy ABC:

- The policy was purchased on January 1, 1996
- Annual premium payments of $1,000 were made on January 1 of 1996, 1997, and 1998
- 75% of premiums were applied to Fund A and 25% to Fund B
- The policyholder received a net withdrawal of $500 on January 1, 2000. The withdrawal was deducted in equal amounts from each fund.

Calculate the annuity account value as of January 1, 2001. Show all work.

(b) You are given the following information regarding Policy XYZ:

- The policy was converted to the payout phase on January 1, 1997
- The policy has 10,000 units of Fund A and 1,000 units of Fund B
- The assumed investment return is 3%
- Payments are made annually, with the initial payout per $1,000 of value equal to $50.00
- There is no lag in timing between crediting units to the account and investment in the fund

Calculate the payment stream for policy years beginning January 1, 1997 through January 1, 1999. Show all work.

7. *(5 points)*

(a) Explain how reinsurance, debt, and surplus notes can be used to enhance a life insurance company's capital position.

(b) For a stock life insurance company, you are given:

- A SPDA block is priced to provide an ROI of 13% with an initial contribution of $385 million.
- The 2001 after-tax earnings for the company are $600 million.
- ROE for the company is 18%.
- The current capital mix for the company is 60% equity and 40% debt.
- The after-tax cost of long-term debt financing is 5.50%.

(i) A reinsurance group offers to contribute capital of $128 million in return for 26% of the annual SPDA earnings. Demonstrate the impact of this offer on ROE.

(ii) An investment group offers to underwrite a bond issue for $1,152 million. Demonstrate the impact of this offer on ROE.

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

**** BEGINNING OF EXAMINATION ****
AFTERNOON SESSION

Questions 8 – 10 pertain to the Case Study.
Each question should be answered independently.

8. *(14 points)*

(a) *(1 point)* Briefly describe the four major segmentation variables for consumer markets.

(b) *(2 points)* Explain the advantages and disadvantages of the segmentation variable that Mercury Life has chosen.

(c) *(3 points)* Evaluate the appropriateness of expanding the Mercury Life annuity portfolio to include:

(i) A SPDA with a bailout feature,
(ii) A Single Premium Market Value Adjusted Annuity and
(iii) An Equity Indexed Annuity.

(d) *(6 points)* You are given the following proposed product designs.

Single Premium Deferred Annuity	• 10-year surrender charge period, grading from 11% of account value in year 1, to 2% over 10 years, and 0% thereafter. • 10% free partial withdrawal annually • Bailout provision if interest rates are decreased below initial credited rate. • Guaranteed minimum interest rate of 4%. • Initial interest rate guaranteed for one year. • 5% commission on initial premium.
Single Premium Market Value Adjusted Annuity	• 7-year surrender charge period, grading from 8% of initial premium in year 1, to 2% over 7 years, then 0% thereafter. • 10% free partial withdrawal annually. • 5-year market value adjustment period. • Guaranteed interest rate period of 7 years. • Guaranteed minimum interest rate of 3%. • 10% commission on initial premium. • MVA formula $= \left[(1+a)/(1+b+c)\right]^{\wedge}(n-t)$ Where: • a = interest rate currently guaranteed by the contract, • b = current rate for new policies with the same initial guarantee period, • c = 0.02, • n = current interest rate guarantee period,

	• t = number of years remaining in the interest rate guarantee period.
Equity Indexed Annuity	• Indexed to NASDAQ • 3 year Index Period • Participation rate guaranteed for index period • Index return based on the highest index value on each anniversary during the index period over index value at beginning of period • Guaranteed minimum account value is 90% of initial premium • Guaranteed Minimum Interest rate is 3% • Commission = 7% of initial premium plus trail of 10% of index return in excess of 3% • 10% Free Partial Withdrawal annually

Evaluate each of the proposed designs and recommend changes required for these products to be marketable and profitable for Mercury Life.

(e) *(2 points)* Explain why it is inappropriate for Mercury Life to use ROI as the single pricing measure for the annuity line.

Questions 8 – 10 pertain to the Case Study.
Each question should be answered independently.

9. *(3 points)* Saturn Life has decided to add a death benefit to its variable annuity products. The preliminary pricing results for the death benefit are not competitive. The following assumptions were used:

	Assumption
Lapse rate (Includes full lapses, partial lapses and annuitizations)	15%
Annual lognormal volatility	14%
Average age of owner	45
Average Asset Return	8%
Mortality	100% of 83 IAM

The product includes the following design features:

- Surrender Charges:

Year (t)	Charge as Percent of Account Value
1 to 7	8 – t
8 +	0

- 5-year ratchet or step up on death benefit, with no age limits

Evaluate the appropriateness of changing each pricing assumption and design feature to lower the estimated cost of the death benefit.

Questions 8 – 10 pertain to the Case Study.
Each question should be answered independently.

10. *(10 points)* Mercury Life is developing a distribution channel using banks. Many banks have agreements with PPG, Inc., a successful personal-producing general agency. PPG obtains banks' endorsements and a list of depositors expressing interest in life insurance and annuity products. In exchange, PPG pays the banks a commission on all insurance and annuity sales and provides demographic analysis of their depositors. In dealing with banks, PPG emphasizes its own specialized knowledge of the banking market, rather than the characteristics of the products sold or the strength and reputation of the underwriting insurance company. PPG does not appear to have strong ties to the life insurance companies it currently deals with and periodically changes the companies it represents.

(a) *(4 points)* Define the attack strategies listed below and assess how Mercury Life might use them to compete against PPG in the bank distribution channel.

- Frontal Attack Strategy
- Encirclement Strategy
- Product Proliferation Strategy
- Product Innovation Strategy
- Improved Service Strategy
- Distribution Innovation Strategy

(b) *(6 points)* Describe the considerations in partnering with PPG, with specific reference to the economic criteria and channel conflict concerns.

11. *(11 points)* ABC Life is exploring ways to broaden its share of the income annuity market. The marketing department is proposing the development of a medically underwritten SPIA.

(a) (1 point) Describe the procedure for identifying market segments for the income annuity market.

(b) (4 points) List the pricing considerations for a medically underwritten SPIA product, and describe how they would differ from those for a non-underwritten SPIA product.

(c) (4 points) Describe methods of modifying the SPIA mortality assumption to reflect substandard mortality. Assess the appropriateness of each method with respect to pricing, solvency-based reserves and income-based reserves.

(d) (2 points) Describe the stochastic methods ABC Life could use to understand the mortality risk associated with the medically underwritten SPIA products.

12. *(6 points)* ABC Life is selling standard class life insurance. Some competitors have begun to introduce preferred underwriting classes, while others are reducing premiums for their standard class life insurance.

(a) Explain strategies that ABC Life should consider in response to the actions noted above.

(b) Outline the critical assumptions required to develop preferred underwriting classes.

13. *(5 points)* The statement of actuarial opinion for ABC Life Insurance Company must be based on an asset adequacy analysis. Define asset adequacy, and describe considerations when performing such an analysis.

14. *(4 points)* The auditors of ABC Life Insurance Company are reviewing the reserves as of December 31, 2000. They have requested documents supporting the change in the Life Insurance Incurred but Not Reported Liability (IBNR) from year-end 1999 to year-end 2000.

The formula ABC Life uses for IBNR takes into account the average number of days from death to date of notice, and expected death claims.

Describe your report to the auditor, following the guidelines of Actuarial Standards of Practice 21.

15. *(7 points)* ABC Life and Health Insurance Company desires to enter the life insurance market. Their actuarial staff has prepared the following financial information, based on their analysis of the proposed business plan:

	2001	*2002*	*2003*
	(in millions of dollars)		
Premiums	27.1	64.4	105.8
Acquisition Costs	61.7	74.1	86.4
GAAP Net Income	5.1	12.3	20.2
Statutory Reserves	10.3	61.8	166.6
Statutory Required Surplus	23.7	50.5	80.2
GAAP Benefit Reserves	6.0	19.0	39.2
Unamortized GAAP Deferred Acquisition Costs	51.7	117.2	187.7
Projected Cost of Capital	15%	15%	15%

(a) (5 points) Evaluate the desirability of ABC's entry into the life insurance market from a strategic management of surplus perspective. Show all work.

(b) (2 points) ABC's Chief Actuary has proposed reinsuring the product. Provide rationale to support this proposal.

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