Society of Actuaries Course 8I Fall 2003

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

1. (*4 points*) The Chief Actuary of a small life insurance company expects large fluctuations in future interest rates.

(a) Describe measures the Chief Actuary would use to help predict the impact of interest rate fluctuations.

(b) Describe asset/liability matching methods that the Chief Actuary can use to minimize the financial effect of interest rate fluctuations on the portfolio.

(c) Explain the desired relationship between the asset and liability durations given the relative significance of disintermediation and reinvestment risk.

Question 2 pertains to the case study.

2. *(12 points)* Saturn Life is considering the introduction of variable immediate annuities to help retain assets accumulated within their deferred variable annuities.

(a) Assess Saturn's opportunity for growth with respect to:
   (i) Historical results,
   (ii) Strengths and
   (iii) Weaknesses.

(b) Describe pricing considerations for a variable immediate annuity.

(c) Describe the steps to implement stochastic modeling for pricing a rider option that provides a floor for the monthly payments.

(d) Marketing has suggested that clients be given the choice of Assumed Investment Returns (AIR). You are given:

		Annuity Payments	
Year	Unit Value	AIR 3%	AIR 5%
1	10.0000	$2,120	$2,200
2	9.2500		
3	9.6200		
4	10.1972		
5	11.0130		

   (i) Calculate the missing values in the above table. Show all work.

   (ii) Re-calculate the missing values in the above table, assuming the attachment of a rider that provides a floor for the monthly payments equal to 90% of the initial payment.

   (iii) Identify design choices that would manage the cost of the AIR choice granted to the customer.

3. *(7 points)* Company XYZ currently sells level premium term products with Smoker and Nonsmoker underwriting classes. The products will be re-priced with 3 underwriting classes (Smoker, Standard Nonsmoker, Preferred Nonsmoker). A fourth underwriting class, Super Preferred Nonsmoker, is also being considered.

The following underwriting definitions have been proposed:

	Smoker	**Standard Nonsmoker**	**Preferred Nonsmoker**	**Super Preferred Nonsmoker**
Personal History				
Maximum Total Cholesterol Level	280mg/dec	280mg/dec	240mg/dec	205 mg/dec
Maximum Blood Pressure (untreated)	160/95	160/95	140/90	130/85
Diabetes acceptable	Yes	Yes	Yes	No
Tobacco Use	Yes	None within past 60 months	None within past 60 months	None within past 60 months
Maximum # of moving violations within a 3 year period	3	3	2	2
Regular exercise	Not Required	Not Required	Required	Required
Family History				
Heart Disease death prior to age 65	Allowed	Allowed	Not Allowed	Not Allowed
Cancer death prior to age 70	Allowed	Allowed	Allowed	Allowed

3. **Continued**

You are given:

- The male age 40 aggregate rate from the 1975-80 Ultimate Table is 1.56 per 1000.
- 40% of the current Nonsmoker class will qualify for the Preferred Nonsmoker class of the 3-class product.
- The Preferred Nonsmoker class of the 3-class product will experience 38% of the aggregate 1975-80 Ultimate Table.
- If a Super Preferred Nonsmoker class is added to a 3-class product, a 5% discount in mortality is expected from the Preferred Nonsmoker class.
- 35% of the Preferred Nonsmoker class of a 3-class product will qualify for the Super Preferred Nonsmoker class of a 4-class product.

(a) Evaluate the Preferred Nonsmoker underwriting definitions proposed by the underwriters.

(b) Calculate the expected mortality rate for a male age 40 Preferred Nonsmoker for a 4-class product. Show all work.

(c) Describe considerations used in determining the amount of discount to be assumed in developing a mortality assumption and a qualifying percentage.

4. *(7 points)* ABC Life is demutualizing. One hundred million shares are to be allocated, and each policy will receive 5 shares as a fixed allocation. You are given:

	Number of Inforce Policies	Base Policy: Actuarial Contribution Per Policy	Riders: Actuarial Contribution Per Policy
Product A	1 million	50	-25
Product B	1 million	-25	25
Product C	1 million	-25	0
Product D	1 million	15	10

(a) Describe considerations in calculating actuarial contributions.

(b) Explain considerations in the allocation of positive and negative actuarial contributions.

(c) Determine the number of shares that each policyholder will receive for each of the applicable methods of allocating policyholder contribution.

5. *(5 points)* ABC Life is a stock life insurance company looking to grow its immediate annuity sales volumes.

You are given:

- The product is distributed through independent brokers to individual clients.
- Annuity payment rates reflect the declining interest rates and lengthening life expectancies of the last few years.
- ABC Life has lost market share.
- Current payment rates per $1,000 of single premium are 15% to 25% lower than rates for competitors.
- Commission rates are similar to those of competitors.

Financial information (in millions):

	2001	**2002**
Premium	$50.00	$50.00
Benefits	$2.40	$6.60
Expenses	$6.30	$6.40
Inv Inc on Solv Reserves	$9.80	$13.70
Solvency Reserves	$150.00	$198.00
Required Capital	$1.50	$2.95
Inv Inc on Required Capital	$0.06	$0.20
Benefit Reserves	$130.00	$170.00
DAC Amortization	$5.00	$9.50
Deferred Tax Provision	$0.00	$0.00
GAAP Assets	$49.66	$98.35

(a) Assess the applicability of possible pricing strategies.

(b) Calculate the distributable earnings for 2002, assuming solvency earnings are taxed at 40%. Show all work.

6. *(6 points)* ABC Life is a market leader in the fixed premium deferred annuity market and would like to offer a product that allows participation in the stock market.

An equity indexed annuity has been proposed with the following product design and pricing assumptions:

Minimum interest guarantee	3% accumulated on 90% of the premium
Participation	85%
Equity index formula	Increase is based on the highest contract anniversary value of the index
Equity index	Dow Jones Industrial Average
Investment Strategy	Purchase path-dependent options in the over-the-counter market
Investment hedge administration	Purchase hedge assets weekly

(a) *(2 points)* Compare advantages and disadvantages of marketing an equity indexed annuity versus:

(i) A conventional fixed premium deferred annuity
(ii) A variable annuity

(b) *(4 points)* Evaluate the appropriateness of the proposed features and assumptions. Recommend any necessary changes.

7. *(7 points)* ABC Life sells structured settlement annuities in the U.S. The portfolio consists of non-life contingent lump sum benefits with the following characteristics:

- There are 10,000 individuals receiving lump sum benefits.
- The benefits are certain payments of $100,000 at the end of twenty and forty years.
- The broker's commission is 2% of premium.

(a) Explain the process for:

  (i) Calculating U.S. GAAP reserves and statutory reserves, and
  (ii) Appraising the adequacy of the statutory reserves.

(b) Explain the effect of issuing these contracts on GAAP:

  (i) Income statements, and
  (ii) Future earnings.

(c) ABC considers ceding the portfolio under a mod-co financial reinsurance arrangement.

  (i) Explain advantages and disadvantages of mod-co financial reinsurance.
  (ii) Assess financial implications of using mod-co on the portfolio.

Question 8 pertains to the case study.

8. *(9 points)* Saturn Life is proposing to enter the reinsurance market. As pricing actuary for Saturn Life, you have been asked to investigate an opportunity to reinsure Mercury's universal life product with YRT reinsurance.

(a) You are given the following information about Saturn Life's opportunity:

Market Attractiveness Factors	**Weight**	**Score (1 = Low; 5 = High)**
Market Size	25%	3
Market Growth Rate	25%	5
Competitive Intensity	50%	2

Business Strength Factors	**Weight**	**Score (1 = Weak; 5 = Strong)**
Price Competitiveness	60%	4
Cost Efficiency	20%	4
Marketing Capabilities	20%	5

Evaluate the opportunity to enter into the reinsurance market by using the market attractiveness/business strength matrix analysis concept.

(b) You are considering using Saturn Life's ART experience in the pricing of the YRT reinsurance for Mercury's UL product.

(i) Compare the drivers of the mortality experience for Saturn's ART product and Mercury's UL product.

(ii) Assess the appropriateness of using Saturn's ART product pricing mortality assumption to price the YRT reinsurance on Mercury's UL product.

(c) You are given:

- Saturn reports its income using the Canadian GAAP financial reporting.
- The proposed valuation mortality assumption for the new YRT reinsurance product is based on the pricing mortality assumption, which includes projected improvements, and includes a 3% margin for adverse deviations.
- The mortality basis is locked-in at issue.

Evaluate the proposed valuation mortality assumption.

9. *(3 points)* Your company is considering upgrading its top term life product by adding one of the following product features:

(i) Premium increase tied to an external trigger

(ii) Partially guaranteed refund of premium

(iii) Affiliated company guarantee

(iv) Fully guaranteed refund of premium

(v) Re-entry plan

(a) Describe each of the above features.

(b) Explain how the above features are impacted by Actuarial Guideline AXXX.

****END OF EXAMINATION****

****BEGINNING OF EXAMINATION****
AFTERNOON SESSION
Beginning With Question 10

10. *(4 points)* You are auditing the GAAP results for ABC Life, a company that has recently begun worksite marketing with the introduction of a new simplified issue version of its flagship whole life product.

- A bonus commission was used to promote the product's launch.
- Pricing mortality for the new product is based on a blend of the company's experience and industry worksite marketing experience.
- The provision for adverse deviation (PAD) on the new product is the same as the PAD for the flagship product.
- A new valuation system is being used for both products.

(a) Explain the general guidelines for performing a satisfactory audit.

(b) Describe what items you would highlight as part of your work plan.

(c) Assess the appropriateness of the PAD for the new product.

11. *(11 points)* XYZ Life is a U.S. mutual life insurance company that sells individual term and participating whole life insurance products. XYZ is developing either a flexible premium universal life insurance product (FLEXUL), or a fixed premium universal life insurance product (FIXUL).

You are given the following for the proposed FIXUL product, for a male, issue age 35:

- Premium is $1,200 payable annually for life.
- The initial face amount is $100,000.
- Guaranteed face amount is $100,000 for life.
- Current assumptions are 5.5% credited interest rate and cost of insurance rates equal to 50% of the 1980 CSO Male Aggregate Mortality table.
- Guaranteed and Nonforfeiture assumptions are 4.5% interest and 100% of the 1980 CSO Male Aggregate Mortality. Assume that these assumptions are acceptable under the Standard Nonforfeiture Law for Life Insurance Model Regulation.
- Cash surrender values will be the current fund value, less the applicable policy year surrender charge.
- Surrender charges are 125% of the annual premium in years 1-5, grading linearly to zero at the end of year 15.

Key tabular values for a male, issue age 35:

	Current Assumptions			Guaranteed Assumptions		
End of Policy Year	Fund Value	PV of Future Benefits	PV of $1 Premium Paid Annually	Fund Value	PV of Future Benefits	PV of $1 Premium Paid Annually
At Issue	N/A	$13,060	$16.67	N/A	$21,620	$18.20
1	$1,159	13,657	16.56	$1,040	22,425	18.01
2	2,375	14,279	16.44	2,113	23,256	17.82
3	3,652	14,926	16.32	3,221	24,113	17.62
4	4,991	15,600	16.19	4,364	24,998	17.42
5	6,396	16,301	16.05	5,540	25,908	17.21

11. Continued

(a) Identify internal and external constraints that might cause XYZ to be unsuccessful offering universal life insurance.

(b) Describe product characteristics that distinguish fixed premium UL from flexible premium UL.

(c) Determine the fifth year current cash surrender value for a male issue age 35 and verify that it complies with the fifth year cash surrender value as calculated under the Universal Life Insurance Model Regulation. Show all work.

(d) Assess the benefits of using reinsurance and issuing surplus notes to assist with capital management as the new product line grows.

12. *(7 points)* A Canadian insurance company sells only universal life with equity and segregated fund investment options. The company would like to increase sales by introducing its product in the United States.

You are given the following information about the current universal life product:

- Flexible premiums within limits allowed by Canadian and U.S. tax laws
- Cost of insurance charges are level to age 100
- Per policy annual charge of $60
- Investment options: 5-year guaranteed interest, Canadian equity, U.S. equity, International equity
- Minimum death benefit is 75% of premiums paid
- Surrender charges are 100% of the target premium for 5 years, grading to zero by the end of 10 years
- An annual bonus equal to 0.25% of the accumulation fund is paid starting in year 15

(a) With respect to introducing this product in the U.S., assess the appropriateness of each of the following target marketing strategies.

(i) Undifferentiated marketing
(ii) Concentrated marketing
(iii) Differentiated marketing

(b) Assess the appropriateness of the UL product features and recommend changes that would make this product easier to introduce in the U.S.

(c) Describe factors to consider when setting future premium assumptions for valuation under the Canadian Asset Liability Method.

Question 13 pertains to the case study.

13. *(9 points)* Mercury Life has entered into an agreement with Old World Insurance (OWI), which is ceasing operations.

Under the terms of the agreement, Mercury Life will:

- Assume OWI's inforce business.
- Become the endorsed insurer for Old World Clubs of the USA, an affinity group located in several cities across the country.

Old World Clubs of the USA was attracted to Mercury Life because of its modern and competitively priced whole life, term, and universal life products. OWI's policies were marketed solely to Old World Club members and their families.

You are given:

- OWI's in force business is individual participating life insurance.
- Marketing to Old World Club members is primarily through direct mail, supplemented by informational programs at Club meetings and telephone solicitations at life events such as births, graduations, and marriages.
- The average attained age of OWI's policyholder is higher than that of Mercury Life's whole life policyholders and the average face amount is lower.
- More than 80% of Old World Club members have at least one life insurance policy with OWI, and most do not have any other life insurance.
- The Membership in the Old World Clubs has been slowly declining.

(a) Categorize OWI and Mercury Life as separate business units, and describe the marketing strategies suggested for each by the Boston Consulting Group's Market Share/Market Growth Matrix.

(b) Describe considerations in determining whether an across-the-board replacement of OWI business with Mercury's products would be in the best interest of OWI policyholders.

(c) Assess whether Old World Club membership meets the criteria for an effective market segment for purposes of future marketing by Mercury Life.

(d) Recommend changes that Mercury Life should consider, if any, to the distribution system for Old World Club members.

14. *(7 points)* ABC Life, a U.S. based life insurance company, would like to introduce a flexible premium deferred annuity with the following features:

- Each deposit receives a guaranteed interest rate for the first five years based on new money rates, with an annual renewable interest rate thereafter.
- Minimum interest rate credited on funds and in determining minimum nonforfeiture amounts is guaranteed to be no less than 3%.
- Surrender charge = 20% of the current contract year premium, plus 10% of the prior contract year premium.
- Surrender charges are waived upon annuitization.
- No bailout or medical bailout provision.
- Return of principal is guaranteed during the 1st contract year.
- No death benefit provided during the deferral period.
- Two percent annuitization bonus.
- Annual contract charge = $100.

(a) Assess the appropriateness of this annuity design with respect to the Standard Nonforfeiture Law, and identify any necessary changes.

(b) Evaluate the proposed product design.

Questions 15 and 16 pertain to the case study.

15. *(7 points)* As the valuation actuary for Mercury Life, you have been asked to conduct a cash flow analysis of the universal life reserves under fifty economic scenarios. Mercury Life is concerned about the adequacy of its universal life reserves given the following current economic conditions:

- Low interest rate environment
- Poor stock market performance

(a) *(1 point)* Explain how the following two methods are used to generate interest rate scenarios to be used in the cash flow analysis:

(i) Transitional probability approach

(ii) Successive ratios approach

(b) *(2 points)* Categorize the forms of risk Mercury Life faces on its universal life product.

(c) *(4 points)* Analyze risks inherent in Mercury Life's universal life asset portfolio.

Questions 15 and 16 pertain to the case study.

16. *(10 points)* Mercury Life's traditional insurance product offerings have been successful with its existing agency distribution. Mercury is expanding its distribution through a bank channel. The Sales Department believes a term product may be more viable in this market.

The actuary in charge of experience studies has determined that Mercury's term mortality experience is not credible. In setting a pricing basis for the bank channel term product, the pricing actuary has decided to blend company experience with a similar industry table.

(a) List the steps of the product development process described by LOMA, including the tasks involved with each step.

(b) Describe criteria used in a screening process and assess the feasibility of Mercury's initiative using screening.

(c) Explain factors for Mercury to consider when relying on an industry table for the development of the mortality assumption.

(d) You are given:

	Mortality Rates (q_x) Per Thousand Lives in Force	
Age	Company	Industry
0	0.1	0.2
1	0.3	0.5
2	0.5	0.7
3	0.7	0.9
4	1.0	1.0

Calculate the blended mortality rates for each age given above, assuming a 50/50 mix of Company and Industry mortality at age zero. Show all work.

17. *(5 points)* You are given the following information for the calendar year 2002 on a closed block of 1,000 whole life policies in force on January 1, 2002.

Policy Specifications	
Face amount of each policy	$100,000
Annual Premium per $1,000	$30
Policy Fee	$30

Pricing Assumptions	
Maintenance Expense per Policy	$10, though actual in 2002 was $12, which will be used for projection in 2003 and beyond.
Maintenance Expense Percent of Premium	5%, though actual in 2002 was 6%, which will be used for projection in 2003 and beyond.
Renewal Commissions Percent of Premium	15%
Hurdle rate	10%
Shareholder dividend is equal to statutory gain/loss each year (i.e., the year end statutory surpluses are equal to zero)	
Premiums and commissions are paid at the beginning of the calendar year	
Expenses are paid at the end of the calendar year based on policies effective beginning of the year	
Target surplus and taxes are zero	

Financial Information	
Total benefits paid in 2002	$3,000,000
Total investment income received in 2002	$900,000
12/31/2001 statuary reserves in force	$10,000,000
12/31/2002 statuary reserves in force	$12,000,000
12/31/2001 economic value	$10,000,000
12/31/2001 PV of projected maintenance expenses	$2,000,000

Calculate the actual value-based earnings as of December 31, 2002 on this closed block. Assume that 2002 actual experience matched expectations, except for maintenance expenses noted above. Show all work.

****END OF EXAMINATION****