****BEGINNING OF EXAMINATION 8****
INDIVIDUAL INSURANCE – U.S.
MORNING SESSION

1. *(5 points)* ABC Life has a career agency distribution system. ABC's management is reviewing their financing plan for new agents.

(a) Describe the different types of financing plans for new agents and explain the advantages and disadvantages of each according to LIMRA.

(b) You are given the following information:

Year	Average Annualized First Year Premium	Agent Termination Rate	Subsidy	Validation Schedule Commission
1	$60,000	50%	120%	$20,000
2	$80,000	25%	80%	$25,000
3	$100,000	10%	40%	$30,000
4+	$120,000	0%	0%	$0

- Commissions are paid on annualized first year premium.
- Agent termination occurs at the end of the year.
- 6% of first year premium is priced into products to cover agent financing.
- The interest rate is 0%.

(i) Calculate the average financing cost for a new agent as a percentage of first year premium for each of the first three years. Show all work.

(ii) Determine the number of years it will take for ABC to recover the financing costs on 100 new agents. Show all work.

2. *(11 points)* XYZ Life is evaluating a block of identical special life contingent annuities issued January 1, 2004 by ABC Life. You are given:

- Total required capital as a percentage of solvency reserves is 5%.
- Assumed investment interest rate on required capital is 4%.
- Hurdle rate is 15%.
- Each annuity payment is $71,280.
- Payments are made at the end of each year during the annuitant's lifetime.
- Deaths occur at the end of the year before the annuity payment.
- No taxes or maintenance expenses.

	Actual	Projected		
	1/1/2004	12/31/2004	12/31/2005	12/31/2006
Policy count	100	75	50	25
Solvency reserves ('000s)	$9,864	$5,011	$1,697	$0
Premium ('000s)	$10,000	$0	$0	$0
Commission ('000s)	$400	$0	$0	$0
Benefits ('000s)	$0	$5,346	$3,564	$1,782
Investment income on solvency reserves and cashflows ('000s)	$0	$838	$426	$144

(a) *(3 points)* Explain the process for determining the statutory valuation rate under the Standard Valuation Law for these life contingent annuities.

(b) *(4 points)* Calculate the embedded value of this block at January 1, 2004. Show all work.

(c) *(3 points)* You are given the following binomial distribution for mortality:

n	q	f(25)	F(25)
100	0.25	0.0918	0.5525

Calculate the probability of solvency earnings exceeding $250,000 in 2004. Show all work.

(d) *(1 point)* On January 1, 2005, XYZ Life buys the remaining block of 75 contracts.

Calculate the maximum amount of assets ABC transfers to XYZ assuming no transaction expenses. Show all work.

3. *(12 points)* ABC Life is selling a deferred variable annuity product that provides for a return of premium death benefit. ABC is considering alternative death benefit designs.

(a) *(3 points)* List the sectors included in an environmental analysis and evaluate the sectors as they relate to variable annuity death benefits.

(b) *(3 points)* The marketing area would like to add an annual ratchet design.

(i) Compare the risk associated with the annual ratchet design to other possible death benefit designs. Explain your answer.

(ii) Describe techniques to manage the risks associated with alternative death benefit designs.

(c) *(6 points)* You are given:

Account Value on valuation date	$980.00
Separate Account Value on the valuation date	$980.00
Net asset charges	1%
Valuation rate	7%
Assumed year 1 drop in Account Values	-14%
Assumed recovery rate	14%
Surrender charges	None
Highest Anniversary Account Value	$1,000.00
Average Account Value year 1	$1,009.40
Average Account Value year 2	$1,069.96
Account Value at time 1	$1,038.80
Account Value at time 2	$1,101.13
Mortality rate for year 1	0.017
Mortality rate for year 2	0.019
Survival rate from time 0 to end of year 1	0.983
Survival rate from time 0 to end of year 2	0.964

Calculate the statutory reserve for the annual ratchet death benefit at time 0, 1 and 2 using the methodology prescribed in the *Valuation of Living and Death Benefit Guarantees for Variable Annuities* note. Show all work.

4. *(5 points)*

(a) Describe the advantages and disadvantages of:
(i) YRT reinsurance, and
(ii) Coinsurance.

(b) You are given the following information for a level term life insurance product:

Total Face Amount	$100,000,000
First Year Premium	$1,000,000
Policy Fee	None
Premium Tax	2%
First Year Commission	50% of first year premium
Other First Year Expenses	$750,000
Solvency Reserve at Issue	$50,000

Assume:
- Premium and reinsurance premium are paid annually at the beginning of the year.
- Unearned portion of a one-year term insurance benefit equals 50% of the YRT reinsurance premium.
- No federal income tax or required capital.
- Ceded percentage equals 90%.
- YRT reinsurance premium rate equals 0.20 per thousand of face amount.
- Coinsurance reinsurance allowance equals 90%.

Calculate the estimated first year strain at issue for
(i) YRT reinsurance, and
(ii) Coinsurance.

Show all work.

This question pertains to the Case Study

5. *(6 points)* You are Saturn Life's product management actuary for the term life insurance portfolio. Your responsibilities include:

- Monitoring term life new-business sales and in-force experience,
- Advising product development, investment and marketing departments of current developments, and
- Reporting product profitability and capital requirements to senior management.

(a) *(1 point)* Identify and describe the types of internal product management reports.

(b) *(5 points)* Explain how each would be used to manage Saturn's term life business.

6. *(12 points)* XYZ Life is developing a dual-life status flexible premium joint and last survivor universal life insurance product (Survivor UL).

(a) *(3 points)* For pricing the Survivor UL product:
- (i) Describe approaches to reflect the dual-life status including the advantages or disadvantages of each approach.
- (ii) Explain other factors to be considered in developing a mortality assumption unique to a last survivor product.

(b) *(3 points)* XYZ Life's current single-life UL products have experienced withdrawal rates of 7% in policy year 1, grading to 5% by policy year 5.
- (i) Describe considerations in setting persistency assumptions for Survivor UL.
- (ii) Propose changes to the lapse rate assumption to reflect persistency in a volatile interest rate environment.

(c) *(6 points)* The following steps outline a procedure to determine minimum UL reserves for duration t.

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

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 $\left(PVFB_t\right)$ 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 ${}_tV^{CRVM} = {}_tV^{NL} - EA^{CRVM}$

7. *(5 points)* Your company is designing a product for the Lottery Commission. Winners have a choice between a lump sum payment and an equivalent 25-year period certain annuity.

(a) Describe key considerations in developing pricing assumptions for the annuity.

(b) You are considering the following product design features for the annuity:

- Surrender provision
- Medical bailout provision
- Variable payout based on investment results

Describe advantages and disadvantages of including these features in the product design.

8. *(4 points)*

(a) *(3 points)* Describe the indicators being used as preferred risk criteria for life insurance according to the *Report of the Society of Actuaries Task Force on Preferred Underwriting*.

(b) *(1 point)* A company with a single non-smoker class would like to introduce a preferred class.

You are given:

- Male age 55 aggregate mortality is 6.00 per thousand.
- 30% of the non-smoker class is expected to qualify for the new preferred class.
- A 15% reduction in mortality is expected for the new preferred non-smoker class.

Calculate the expected mortality rate for both the preferred non-smoker and the residual non-smoker classes. Show all work.

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

****BEGINNING OF EXAMINATION 8****
INDIVIDUAL INSURANCE – U.S.
AFTERNOON SESSION
Beginning with question 9.

9. *(6 points)* ABC Life offers a disability premium waiver benefit rider sold with life insurance products.

(a) *(5 points)* Explain the assumptions required to calculate the experience premiums for this rider.

(b) *(1 point)* You are given the following information for an individual insured age 55:

- Level annual premium waived is $100.
- Disability occurs at the middle of the policy year when the insured is age 55.
- Waiver benefits end at age 60.
- There is a 6-month waiting period, with coverage retroactive to the date of disability.
- Premium and benefit payments are payable continuously throughout the policy year.

$\left[x+k+\frac{1}{2}\right]+s+\frac{1}{2}$	$\bar{D}^{i}_{\left[x+k+\frac{1}{2}\right]+s+\frac{1}{2}}$	$D^{i}_{\left[x+k+\frac{1}{2}\right]+s+\frac{1}{2}}$
$\left[55\frac{1}{2}\right]+\frac{1}{2}$	97.80	100.16
$\left[55\frac{1}{2}\right]+1\frac{1}{2}$	93.19	95.47
$\left[55\frac{1}{2}\right]+2\frac{1}{2}$	88.72	90.94
$\left[55\frac{1}{2}\right]+3\frac{1}{2}$	84.38	86.53
$\left[55\frac{1}{2}\right]+4\frac{1}{2}$	80.18	82.27
$\left[55\frac{1}{2}\right]+5\frac{1}{2}$	76.09	78.12

Calculate the present value of the net benefit at the end of the waiting period. Show all work.

10. *(12 points)* You are given the following features for a proposed single-premium equity-indexed annuity product:

Index	S&P 500
Index Period	3 years
Index Growth Method	Point-to-Point
Ratchet	Annual
Participation Rate	90%
Margin	0.5%
Cap	15%
The participation rate, margin and cap features are applied in the order listed above.	
The product provides a Guaranteed Minimum Account Value of 90% of the single premium, accumulated at 3% annual interest rate.	

You are also given the following information:

- The net earned rate is 5.5%.
- The marketing area estimates it will sell $100 million in single premium in the first year.
- The annuity product will be marketed primarily through independent stockbrokers.
- Variable expenses are 4% of the single premium.
- Fixed expenses are $1 million in each of the next 3 years.
- To improve policyholder persistency, the marketing area has proposed a series of discretionary "customer appreciation campaigns" that enhance the product's account values. The revised present value of index-based interest budget to support these campaigns is estimated to increase from 6% to 9%.

10. Continued

(a) *(2 points)* You are given the following values of the S&P 500 index:

Time	S&P 500
0	1000
1	1050
2	1250
3	1175

Calculate the Index Account Value as a percentage of the single premium at the end of the Index Period. Show all work.

(b) *(5 points)* A 100% increase in the present value of index-based interest budget generates a 150% increase in the demand for the product, measured in dollars of single premium sold.

(i) Describe factors that affect the price elasticity of demand.

(ii) Determine the change in the present value of profits in dollars from offering the proposed campaigns and recommend whether to proceed. Show all work.

(c) *(5 points)* With respect to cash flow testing, assess the selection of a long-term lapse assumption for this product, considering the effects of the proposed campaigns.

11. *(9 points)* A financial review of the term portfolio reveals a lower level of profitability from the 5-year level term product than originally projected. You have been asked to re-price the 5-year level term product for your brokerage and direct response distribution channels.

(a) Compare the effect each of these distribution channels has on the following assumptions.

(i) Mortality
(ii) Lapse
(iii) Interest
(iv) Expense

(b) Describe elements of compensation used for brokerage distribution.

(c) The term portfolio has experienced lower policy persistency.

(i) Describe the factors that affect persistency.
(ii) Recommend steps to improve persistency for the product.

12. *(6 points)* XYZ Mutual is planning to sell a new 5-year term dividend-paying product subject to SFAS120 guidelines.

You are given the following projected best estimate values:

Year	Gross Premiums	Death Benefits	Investment Income On NLP Reserves	Acquistion Expenses		Maintenance	
				Deferrable	Non-Deferrable	Expenses	Dividends
1	1000	224	45	550	100	250	70
2	900	237	63			225	98
3	810	263	54			203	124
4	770	274	45			193	149
5	730	287	39			183	175

You are also given the following projected changes to the Net Level Premium (NLP) reserve:

Year	Change Due to Premiums	Change Due to Benefits	Change Due to Interest
1	600	-337	36
2	540	-356	50
3	486	-394	43
4	462	-412	36
5	438	-431	31

Assume:

- No surrender Benefits
- Discount rate equals 6%
- No taxes

(a) Contrast the SFAS120 and SFAS60 accounting methodologies with respect to the recognition of income statement items.

(b) Assess the recoverability of the deferred expenses for this policy and recommend any changes if necessary. Show all work.

Questions 13 and 14 pertain to the Case Study.

13. *(8 points)* The valuation actuary at Saturn Life is concerned about the mortality experience of the term portfolio.

(a) Assess the effect of Saturn's conversion, re-underwriting and termination options on the renewal ART mortality assumption.

(b) You are given the following additional information for Saturn's 5-year level term plan:

- Mortality is 90% of the 1975-80 Ultimate Table in the absence of selective lapsation
- $q_{x+5,\,t-5}$ equals 80% of $q_{x,\,t}$
- Duration five lapse rate is 20%
- 75% of duration five lapses are assumed to be selective

Calculate the duration five mortality rate for a female age 40 using the conservation of deaths principle. Show all work.

(c) Current best estimate assumptions have been updated to reflect higher expected mortality due to increased anti-selection at renewal. Other assumptions remain unchanged. You are given the following as of December 31, 2003, based on current best estimate assumptions:

- PV benefits and expenses equals $15,000,000
- PV premiums equals $50,000,000

(i) Calculate the premium deficiency for the term portfolio. Show all work.

(ii) Identify any required adjustments to the December 31, 2003 U.S. GAAP Term Life Insurance balance sheet.

Questions 13 and 14 pertain to the Case Study.

14. *(6 points)* You have been hired by Mercury Life to evaluate their primary markets.

(a) *(1 point)* Describe the criteria involved in evaluating potential target markets.

(b) *(5 points)* Evaluate the suitability of each of Mercury Life's primary markets as target markets.

15. *(5 points)* XYZ Life plans to enter the term insurance market.

(a) Describe the five elements that should be included in the comprehensive business analysis, as presented in the LOMA text, to decide whether to enter the term insurance market.

(b) Explain why XYZ would use reinsurance to manage the financial position of its term portfolio.

16. *(8 points)* You are given the following annuity payments:

Payment Date	Payment at Payment Date
January 1, 2006	$50,000
July 1, 2006	$60,000
January 1, 2007	$55,000
July 1, 2007	$70,000
January 1, 2008	$60,000
July 1, 2008	$80,000

(a) Describe the Modified Duration method of duration matching including any problems associated with it.

(b) Calculate the Modified Duration of the annuity payments as of July 1, 2005, based on an interest rate of 4%. Show all work.

(c) Describe the Exact Matching method of duration matching including any problems associated with it.

(d) Non-callable bonds have been purchased to exactly match the annuity payments as of July 1, 2005 using the Exact Matching Method.

Information about the bonds is shown in the following table:

Years to Maturity	Annual Coupon Rate
1.5	4.0%
2.0	4.5%
2.5	5.0%
3.0	5.5%
Bonds have a par value of $100.	
Coupons are paid semi-annually.	

Determine the number of bonds with a maturity of 2 years that were purchased. Show all work.

(e) Describe the Horizon Matching method and its appropriateness for the annuity payments.

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