****BEGINNING OF EXAMINATION 8****
INDIVIDUAL INSURANCE – CANADA
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)* With respect to *Minimum Continuing Capital & Surplus Requirements for Life Insurance* companies and each of the following risks:

- Mortality
- Pricing interest margin
- Change in the interest rate environment.

(i) Describe the nature of the risks.

(ii) Calculate the minimum capital requirement at December 31, 2004 for the risks. Show all work.

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

2. (Continued)

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

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 Value	-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 consistent with the Canadian Asset Liability Method.

Step	Procedure
1	The amount of policy liabilities for a scenario equals the amount of supporting assets which the actuary deems as a reasonable allocation. In forecasting the cash flow, the actuary should take account all policyholder expectations, and make provision for any adverse deviations that the insurer may experience.
2	The policy liabilities in respect of a relevant policy comprise all of that policy's cash flow after the date of issue of a relevant policy. Policy liabilities consist of claim liabilities including all benefit and expense cash flows.
3	If applicable regulation requires policy liabilities to be valued without taking account of the time value of money, then the actuary should report a value for the policy liabilities in accordance with accepted actuarial practice, and report this amount with reservation on account of the regulation.
4	The actuary's best estimate of mortality should include the effect of any anti-selection. The low margin for adverse deviation is an addition of 3.75 to the mortality rate per 1000. The high margin for adverse deviation is an addition of 10 to the mortality rate per 1000.
5	The margins for adverse deviation for withdrawals are an addition of between 5% and 25% of the best estimate withdrawal rates.

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 – CANADA
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.

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

(i) Explain the concept of policyholder reasonable expectations with respect to Canadian valuation standards of practice.

(ii) Assess the implications the proposed customer appreciation campaigns may have on the valuation of policy liabilities with respect to policyholder reasonable expectations.

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 than expected.

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

12. *(6 points)* XYZ Life has been experiencing poor sales and a lower than expected return on equity (ROE) on their Fixed Premium Individual Universal Life (UL) product. The following table summarizes the assets in XYZ's portfolio:

Asset	Amount
Cash	$10,000
AAA Rated Bonds	$0
AA Rated Bonds	$0
A Rated Bonds	$1,000,000
BB Rated Bonds	$5,000,000
Common Stock	$10,000,000
Real Estate	$1,000,000
Commercial Mortgages	$5,000,000
Impaired Investments	$0

Assume:

- Current MCCSR ratio is 150%.
- XYZ Life guarantees a 4% credited rate.
- Over the past four years, the market has shown a significant reduction to both short and long term interest rates.
- Long term yields on government bonds are now less than 5% and are expected to remain level.

(a) *(5 points)* XYZ Life is reviewing the surplus position relative to the MCCSR guidelines for Canadian life insurance companies.

(i) Define each of the risk components that are applicable to XYZ Life's UL product according to the MCCSR guidelines.

(ii) Propose changes to the asset portfolio and product design to reduce the required surplus of XYZ Life.

(iii) Explain how your proposed changes impact the ROE of XYZ Life.

(b) *(1 point)* Describe the impact the decline in interest rates has had on the prescribed interest rate scenarios used by the Appointed Actuary in setting the interest rate assumption.

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) Saturn's current term valuation mortality assumption is as follows:

- Best estimate equals 95% of expected mortality
- There are no adjustments for anti-selection at renewal
- Margin for adverse deviation equals $3.75/e_x$

Assess the appropriateness of these assumptions and recommend any changes.

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 Life 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