Course 8F□
Fall 2002

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

Questions 1-4 pertain to the Case Study. Each question should be answered independently.

1. *(5 points)* Zest's Chief Executive Officer, Mr. Zach, has been approached regarding the possible acquisition of Cling To Life Insurance Company. Cling To Life has been successful in the Group Long Term Disability market (LTD) and had premiums of 350 in the year 2000. Zest feels that the purchase will be a way to rejuvenate its LTD business.

Cling To Life could be purchased for 100. If purchased, Cling To Life's assets and liabilities would be consolidated with those of Zest.

Cling To Life's year-end 2000 balance sheet is as follows:

Assets		
Public Bonds		
Investment Grade	425	
Below Investment Grade	225	
Private Bonds (Investment Grade)	200	
Commercial Mortgages (Investment Grade)	125	
Real Estate	20	
Cash and Other Short Term	5	
Total Assets		**1,000**
Liabilities	950	
Equity	50	
Total Liabilities and Equity		**1,000**

(a) *(1 point)* Calculate the effect that the purchase of Cling To Life will have on Zest's year-end 2000 required capital. Show your work.

(b) *(4 points)* Describe three options that Zest could use to fund the purchase of Cling To Life. Assess the impact of each option on Zest's balance sheet and RBC ratio.

Questions 1-4 pertain to the Case Study. Each question should be answered independently.

2. *(12 points)* You are a consulting actuary who has been hired by Mr. Cairns to review Zest's current Asset/Liability Management (ALM) policy and practice. Mr. Cairns is cognizant of the qualitative aspects of rating agencies' analyses and feels that perhaps a reformulation of Zest's ALM policy might lead NARA to adopt a more favorable outlook of Zest.

(a) *(6 points)* Evaluate Zest's current ALM policy, commenting on both the overall approach and its appropriateness for each of the products in the three main product lines.

(b) *(4 points)* Propose refinements to Zest's existing ALM strategy that may be viewed favorably by NARA. Provide support for your suggestions.

(c) *(2 points)* Describe how a holistic approach could be used as Zest's ALM process.

Questions 1-4 pertain to the Case Study. Each question should be answered independently.

3. *(12 points)* Although NARA is the pre-eminent insurance company rating agency, Zest is concerned that it may be imprudent to rely on the ratings of only one agency. Zest is contemplating approaching Standard & Poor's for a second rating, but is very concerned as to how Standard & Poor's might view its liquidity position. Zest's CFO has asked you to test Zest's results under the Standard & Poor's liquidity and earnings models.

Additional year-end 2000 information about Zest is as follows:

- The Premium Stabilization Reserve for the Group-LTD line is 1050.2.
- The Unearned Premium Reserve for the Group-LTD line 112.3.
- The Unearned Premium Reserve for the Individual Term Insurance line is 36.1.
- All private placement bonds are 144A bonds.
- All investments are in securities and assets from developed countries.
- All of the CMOs are VADMs or PACs.
- Investment grade commercial mortgages and non-CMO public bonds are split 25% NAIC '1' and 75% NAIC '2'.
- Below investment grade commercial mortgages and non-CMO public bonds are split 80% NAIC '3' and 20% NAIC '4'.
- Equities are split 10% investment grade preferred stock and 90% common stock.
- All equity securities held are from unaffiliated, publicly-traded companies.

You have access to the following information from Standard & Poor's insurance liquidity model.

Insurance Liquidity Tables

Table 1 Liability Risk Factors

Liability	Immediate Scenario (%)	Ongoing Scenario (%)
Traditional life	30	50
Term life	50% of UEPR	50% of UEPR
Interest-sensitive life	50	50
Deferred annuities	90	100
Single-premium immediate annuities	100	100
Other individual annuities	100	100
Supplementary contracts	30	50
Variable life and annuities	0	0
Individual accident and health	50% of UEPR	50% of UEPR
Individual disability	50% of any cash value	50% of any cash value
Structured settlements	100	100
GICs and funding agreements	100	100
Group annuities and other deposit funds	100	100
Group accident and health	50% of PSR and UEPR	50% of PSR and UEPR
Group life	50% of PSR and UEPR	50% of PSR and UEPR
Group long-term disability	50% of PSR and UEPR	50% of PSR and UEPR
Health claims reserves	100	100

Table 2 Surrenderability Factor	
Provision	**Factor (%)**
No surrenders allowed	0
Market-value adjustment	50
Surrender charges greater than or equal to 5%	50
Surrender charges less than 5%	100
No surrender charges	100

Table 3 Allowable Asset Factors		
	Immediate Scenario (%)	Ongoing Scenario (%)
Cash and short-term investments	100	100
U.S. government securities	100	100
Agency passthrough MBS	90	90
CMOs-VADMs, PACs, and TACs	90	90
CMOs-sequentials	80	80
CMOs-Z tranches	0	50
Other CMOs	0	0
NAIC '1' CMBS	90	90
NAIC '2' CMBS	75	90
NAIC '1' public corporate bonds	98	100
NAIC '2' public corporate bonds	96	100
NAIC '1' 144A private placements	80	90
NAIC '2' 144A private placements	65	75
NAIC '1' non-144A private placements	70	80
NAIC '2' non-144A private placements	40	50
NAIC '3' public corporate bonds	0	25
NAIC '3' 144A private placements	0	20
Asset-backed securities	90	90
Other noninvestment-grade bonds	0	0
Unaffiliated public investment-grade preferred stock	100	100
Unaffiliated public common stock	70	85
Assets in securities lending programs-fully collateralized	100	100
Assets in securities lending programs-otherwise	70	100
Funds withheld reinsurance assets	0	0

(a) *(6 points)* Calculate Zest's liquidity ratio using year-end 2000 information from the case study and the tables listed above.

(b) *(3 points)* Describe the process Standard & Poor's would use to review Zest's earnings.

(c) *(3 points)* Recommend whether Zest should approach Standard & Poor's for a rating.

Questions 1-4 pertain to the Case Study. Each question should be answered independently.

4. *(12 points)* Zest has been monitoring its capital position as measured by NARA's Capital Requirements formula. NARA has agreed to postpone an immediate rating downgrade if Zest can provide a viable plan for improving its capital position within the next nine months.

You have been hired as a consultant to help Zest develop the plan. As a first step, you decide to provide Zest with an extensive list of options to consider, including both internal actions and external marketplace solutions.

Describe the alternatives on your list. Comment briefly on the relative effectiveness and practicality of each for Zest's situation.

5. *(6 points)* Your company has an opportunity to invest in an all-equity project for $52 million to build a plant for a new product line. It is expected that one year later this project will generate an expected present value of subsequent cash flows of $60 million if the product is successful or $45 million if the product is unsuccessful. There is a 50% chance that the product will be successful. Your CFO has rejected funding for this project.

Subsequently, you have determined that an additional outlay of $56 million at the end of one year would double the scale and value of the project.

Assume the following:

- The risk free interest rate is 4%.
- A "twin security" trades in the financial markets and has the same risk characteristics and the same proportional payoffs as the project.
- The current price of the "twin security" is $100.
- The beta of the "twin security" is 1.9.
- The market risk premium is 3.8%.

(a) Demonstrate why the CFO might have rejected providing capital to this project. Show your work.

(b) Calculate the value of the managerial option to expand the project in one year. Show your work.

(c) Determine if arbitrage opportunities exist for your company. Show your work.

6. *(5 points)* ABC is a large, well-established multi-line insurance company with triple-A ratings from all major rating agencies. XYZ, a small wholly owned subsidiary of ABC, starts operation on the morning of December 31, 2001, with paid-in capital of $10 million. XYZ issues a one-year Guaranteed Investment Contract (GIC) and invests both the proceeds from the sale of the GIC and the paid-in capital in a diversified portfolio of stocks.

You are given the information below and the Standard Normal Table on the next page.

Guaranteed Investment Contract:

- Maturity Date: December 31, 2002
- Face Value: $100,000,000
- Net Proceeds from the Issue: $99,125,000
- Guaranteed Interest: 3.75%-with semi-annual compounding
- Method of Payment: Principal and accumulated interest due on maturity date

Diversified Investment Portfolio:

- Market value, as of close of market on December 31, 2001: $108,762,500
- Purchase price (cost basis) of portfolio (including brokerage commissions): $109,125,000
- Expected annualized continuously compounded rate of return: 8.5%
- Standard deviation of annualized continuously compounded rate of return: 20.0%
- Dividends will be reinvested.

One-Year Treasury Rate:

- Rate as of December 31, 2001: 2.17%-with semi-annual compounding

(a) *(1 point)* Describe three different, but theoretically correct, methods for estimating the value of the future liability cash flows, in the absence of observable market prices.

(b) *(4 points)* Calculate the fair value of the GIC issued by XYZ as of December 31, 2001:

(i) if the payment of principal and interest is guaranteed by ABC and backed with specific assets placed in a trust;

(ii) if there are no guarantees from the parent.

Show your work.

7. *(8 points)* You are an analyst at Reliable Ratings Corporation, a company that rates property-liability companies. Biking Liability Insurance Company (BLIC) has traditionally issued motorcycle insurance and has recently begun to sell airplane insurance, necessitating a review of its rating.

Currently BLIC's reserve amounts are $750 million for the motorcycle insurance line and $100 million for the airplane insurance line. Your analysis reveals the following expected claims distribution for the next year:

Motorcycle		Airplane	
Claim Amount ($ million)	Probability	Claim Amount ($ million)	Probability
250	70%	10	25%
1,000	25%	40	50%
2,000	5%	250	25%

Given the characteristics of these lines, you assume that there is no correlation in the claims between the two lines.

Local regulations require that capital be held such that the expected policyholder deficit does not exceed 10% of expected losses.

A quick analysis of the asset portfolio reveals that BLIC is holding $1.5 billion in cash with no other securities in the portfolio.

Reliable Ratings assigns ratings based on the following minimum ratios of recorded capital to risk-based capital.

Credit Rating	Minimum Capital Ratio
AAA	2.50
AA	2.25
A	2.00
BBB	1.75
BB	1.50
B	1.25
CCC	1.00

(a) *(1 point)* List criteria that a risk-based capital methodology should satisfy in order to ensure equity to all parties.

(b) *(4 points)* Assign a credit rating to BLIC. Show your work.

(c) *(1 point)* Explain the implications to required capital of assuming no correlation between the motorcycle line and the airplane line.

(d) *(2 points)* Describe how the owners of BLIC hold a position similar to a stock option.

**** BEGINNING OF EXAMINATION ****
AFTERNOON SESSION
Beginning with Question 8

8. *(20 points)* You are the Treasurer of SPE Corp, a life insurance company with a liability profile consisting of 70% deferred annuities and 30% traditional life. Total assets are $1 billion.

Six months ago, SPE Corp purchased at par $100 million of senior secured debt issued by Huge Energy Corp, rated Baa. The bond pays a 10% annual coupon and matures in five years.

When SPE Corp purchased these bonds, a stand-alone CreditMetrics™ calculation for this bond was performed using a one-year time horizon and the following data.

1-Year Average Transition Matrix

INITIAL RATING	RATING AT YEAR END (%)							
	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	91.82	7.37	0.81	-	-	-	-	-
Aa	1.21	90.76	7.67	0.28	0.08	-	-	-
A	0.05	2.49	91.97	4.84	0.51	0.12	0.01	0.01
Baa	0.05	0.26	5.45	88.54	4.72	0.72	0.09	0.17
Ba	0.02	0.04	0.51	5.57	85.42	6.71	0.45	1.28
B	0.01	0.02	0.14	0.41	6.69	83.37	2.57	6.79
Caa-C	-	-	-	0.62	1.59	4.12	68.04	25.63

Illustrative Recovery Rate by seniority class (% of face value, i.e., par)

SENIORITY CLASS	MEAN ($)	STANDARD DEVIATION (%)
Senior Secured	55	30
Senior Unsecured	50	25
Senior Subordinated	40	25
Subordinated	35	20
Junior Subordinated	20	10

Illustrative one-year forward curves by credit rating category and one-year forward values for a Baa bond plus coupon

CATEGORY	YEAR 1 (%)	YEAR 2 (%)	YEAR 3 (%)	YEAR 4 (%)	BOND VALUE ($)
Aaa	3.5	3.75	4.0	4.25	130.97
Aa	4.0	4.25	4.5	4.75	128.94
A	5.0	5.5	6.0	6.5	122.41
Baa	6.5	7.0	7.5	8.0	117.03
Ba	8.5	9.5	10.5	11.5	106.14
B	11.0	12.0	13.0	14.0	99.04
Caa-C	14.0	16.0	18.0	20.0	85.34

8. Continued

The results of the Credit Metrics ™ calculation for this bond are:

- Expected market value = $116.58
- Fifth percentile level value = $106.14
- Standard deviation = $4.15

Last week Huge Energy Corp defaulted on the bond, and it is now trading at $20 per $100 of maturity value. This resulted in an $80 million loss to SPE Corp's portfolio, which represents 8% of SPE Corp's total assets.

Still in shock from the $80 million loss on Huge Energy Corp, SPE Corp's Chief Financial Officer (CFO) stopped in your office yesterday and said,

"I can't believe that our CreditMetrics ™ analysis was so inconsistent with the performance of Huge Energy! At my last continuing education seminar, a consultant suggested that something called VAR would solve all of our problems. We're having an executive board meeting next Monday, and I'd like you to explain this VAR to us. How is it any better than CreditMetrics ™ ? What are its limitations? And we'd like to see some numbers, too!"

To plan your presentation to the executive board, you perform Monte Carlo simulations of the Huge Energy Corp bond as of the date of purchase. Your results, based on a one-year time horizon, are shown in the following table. You decide to use a 5% confidence level.

PROBABILITY (%)	RETURN $ MILLION
1	-50
2	-25
3	-10
5	0
10	5
20	10
30	15
15	20
10	25
3	30
1	50

The expected return is $12.6 million.

(a) *(4 points)* Explain why the CreditMetrics ™ measure of credit risk could have been so inaccurate.

(b) *(2 points)* Describe the more complete CreditMetrics ™ analysis that could have been performed six months ago to manage SPE Corp's exposure to this issuer.

8. **Continued**

(c) *(6 points)* Outline your report to the executive board on VAR, addressing each of the CFO's comments.

(i) Explain the VAR measure and how it could be used by SPE Corp.

(ii) Compare VAR to CreditMetrics ™ .

(iii) Indicate the limitations of VAR.

(iv) Provide a numerical demonstration of the application of VAR to the Huge Energy Corp bond.

(d) *(2 points)* A board member expresses concern that VAR does not adequately capture the asset / liability risk of the company. You believe that Moody's new C-3a risk-based capital approach could be adapted to VAR. Describe the C-3a approach, and propose the adaptations you plan to make.

(e) *(5 points)* Due to the $80 million loss on Huge Energy Corp, SPE Corp is now capital constrained. The CEO asks you to review all capital market activities and determine the appropriate amounts of risk capital for each business unit. Outline the steps in developing a risk allocation methodology, and identify issues that SPE Corp must consider.

(f) *(1 point)* One of SPE Corp's asset managers has received approval to originate a portfolio of Baa bonds and is allocated capital based on the new methodology. Over the next twelve months the asset manager originates a portfolio consisting only of Aaa bonds. Describe the performance issues SPE Corp now faces.

9. *(4 points)* You are the Chief Actuary of Conglomerate Life Insurance Company of Kansas (CLICK), with life operations in the US. CLICK is considering expansion into either Canada or Australia. Your pricing actuaries are developing a 10-year non-participating endowment insurance product, ClassicExample, for sale in the expansion country. Premium for the new product is payable each policy year. The Chief Financial Officer is interested in profit emergence for the product under the Canadian GAAP and Australian MOS systems.

(a) Describe the reserve methodology under each system.

(b) Describe the latitude CLICK will have in setting reserve assumptions under each system.

(c) Describe the treatment of acquisition costs under each system.

(d) Explain what would happen under each system if actual experience proved much less favorable than the initial assumptions.

10. *(14 points)* You work for the Chief Financial Officer (CFO) of Maple Leaf Life, a Canadian insurance company that demutualized one year ago. After last year's IPO, Maple Leaf has no debt or preferred stock on its balance sheet.

Maple Leaf is uniquely positioned to take advantage of expansion opportunities. It has:

- High product profit margins
- Lower operating costs than its peers
- A strong international life insurance distribution system
- A large presence in the domestic group benefits market

Maple Leaf is considering expanding in the group benefits market using its international sales distribution system. Its low cost structure gives it a natural advantage in this market. While the opportunities are forecasted to provide a high return, they do require additional capital.

The senior management team has proposed two alternatives:

- The Chief Operating Officer suggests that capital needs could be met by reducing shareholder dividends.
- The CFO believes that adding debt capital would be the most desirable way to fund expansion.

The Chief Executive Officer wishes to sustain Maple Leaf's growth while increasing the company's stock price, which has traded at a low price to book ratio relative to its peers since the IPO. Since Maple Leaf is widely held, he is concerned about how the management team's actions will be perceived in the market. Additionally, he wants Maple Leaf to remain an independent company with a strong balance sheet.

The CFO has asked you to assist in the evaluation of these two alternatives.

(a) *(6 points)* Describe the considerations of reducing shareholder dividends as they apply to Maple Leaf.

(b) *(6 points)* Describe the considerations of issuing debt as they apply to Maple Leaf.

(c) *(2 points)* Recommend which alternative Maple Leaf should choose, and justify your recommendation.

11. (*8 points)* You have been asked to evaluate a potential project to bring a new asset-backed insurance product to the marketplace. It is not known whether Bob, the intended project manager, will remain with the company after his current employment contract ends in two years. As Bob's skill set is considered extremely important to the project, two separate cash flow streams have been projected.

You have the following information regarding the project:

- Covariance (annual return on the project, annual return on the market) 14.97
- Variance (annual return on the market) 9.98
- Expected annual return on the market portfolio 11.00%
- Risk-free interest rate 3.00%
- Initial investment $300,000
- Probability of Bob's contract being renewed 50%

Potential cash flow streams from the project (excluding the initial investment):

Duration (in years)	Cash Flow Stream 1 (Bob's contract renews)	Cash Flow Stream 2 (Bob's contract is not renewed)
1	70,000	70,000
2	80,000	80,000
3	100,000	80,000
4	125,000	80,000
5	175,000	80,000

(a) *(3 points)* Calculate the net present value of the project and assess whether the company should go ahead with the project based on the information available at this time. Show your work.

(b) *(4 points)* The company has the option to defer the project for two years, at which time Bob's contract status will be known. If Bob continues under contract, the new cash flow stream will be equal to cash flow stream 1 with cash flows decreased by 10%. Without Bob, the new cash flow stream will be equal to cash flow stream 2 with cash flows decreased by 20%. Assess the impact of deferring the project and recommend a course of action. Show your work.

(c) *(1 point)* Calculate the option premium associated with the option to defer discussed in (b). Show your work.

12. *(10 points)* You are the 100% owner of Dot Life, a US-based life insurance company that sells two product lines: 1 year term and 5 year level-premium term. Given the highly competitive US market, you have started selling your products in a Latin American country, where you expect higher profit margins. Currently, sales are 75% from domestic operations and 25% from the Latin American operations.

As a non-public company, you have never calculated GAAP statements. 2001 financial results showed a loss using solvency-based reserves. You feel that solvency-based reserving is too conservative and have asked your actuary to calculate results based upon the fair value of liabilities.

(a) *(4 points)* Describe various calculation methodologies for determining the fair value of liabilities.

(b) *(1 point)* Explain the key considerations for Dot Life in setting appropriate assumptions for a fair value of liabilities methodology.

(c) *(2 points)* Contrast the information Dot Life can expect to obtain from the fair value calculation with the information obtained from a solvency reserve calculation.

(d) *(3 points)* You expect Latin American earnings to increase to 50% of the company's earnings by 2006. Describe the issues Dot Life should consider when assessing whether to hedge the foreign currency exposure.

13. *(4 points)* As the appointed actuary for a newly formed life insurance company, you are responsible for signing the Actuarial Opinion. You have decided to use asset adequacy analysis to support your Opinion.

(a) *(1 point)* Define asset adequacy analysis and comment on its appropriateness in this situation.

(b) *(3 points)* You must develop a process for your asset adequacy analysis.

(i) List the considerations and decisions to be made in setting up the process.

(ii) Describe the annual modeling and analysis process.

****END OF EXAMINATION****