November 2001 - Course 8F
Society of Actuaries

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

Questions 1 – 3 pertain to the Case Study.
Each question should be answered independently.

1. *(11 points)* In response to agents' requests for an individual savings product to complement Zest's current portfolio, Mr. Bolthaup (Marketing Vice President) has proposed a Single Premium Deferred Annuity (SPDA). The product would be surrenderable at book value at any time, and policy loans would be permitted.

In reaction to NARA's most recent rating assessment, Mr. Zach, Zest's CEO, has expressed concern about an increase in policyholder withdrawal of funds. He is afraid that the new product will add to liquidity concerns.

(a) *(6 points)* Evaluate the liquidity of Zest's existing asset/liability portfolios. Identify any areas of concern.

(b) *(2 points)* Recommend product design features for the proposed SPDA that will reduce the disintermediation risk to Zest. Justify your response.

(c) *(3 points)* Recommend a risk management process for the new SPDA, and explain why it is appropriate.

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2. *(14 points)* Zest's newly-appointed Chief Risk Officer, Jonathan Woodrow, has decided that Zest needs to develop a more robust approach to capital allocation, in order to measure risk-adjusted return on capital for its four main product lines (variable life, term life, LTD and GICs).

(a) *(2 points)* Outline four risk management objectives that the Chief Risk Officer may be trying to achieve in asking for capital allocation and risk-adjusted return by product line.

(b) *(7 points)* Using NARA's required capital formula,

(i) calculate the risk-adjusted return on required capital for 1999 for each of the four product lines,

(ii) comment on the main factors driving these results, and

(iii) comment on the appropriateness of using risk-adjusted return to allocate capital.

Show all work.

(c) *(5 points)* Describe three methodologies that can be used to reflect the benefits of diversification in the capital allocation formula. Indicate the expected effect each method would have on the GIC product line.

Questions 1 – 3 pertain to the Case Study.
Each question should be answered independently.

3. *(13 points)* Zest is considering acquiring 100% of the shares of Tread Lightly Financial Corporation (TLFC) for a cost of 50.0. This would be financed out of retained earnings.

TLFC offers one product, a variable annuity contract with a 10 year 100% guaranteed maturity benefit with elective resets (GMAB). The product does not provide a minimum death benefit nor a minimum income benefit.

In December 2000, Zest's senior management team met with NARA to discuss the potential acquisition. NARA indicated that they plan to adjust their RBC formula by adding to the C-2 component 100% of the "Total Balance Sheet Requirement" for segregated fund guarantees using the new OSFI guidelines. NARA will apply the OSFI factors on an aggregate basis.

You are given the following information about TLFC at 31 December 2000:

FUND	Guaranteed Value	Market Value	Reinsurance Credit	MER
Money Market	3.0	3.0	0	175 b.p.
Balanced	200.0	250.0	0	225 b.p.
Aggressive Equity	2.0	5.0	0	250 b.p.
Fixed Income / Bond	50.0	37.5	0	200 b.p.

All the guarantees apply on a deposit by deposit basis.
On an aggregate basis (over all funds) the average years to maturity is 7.5 years.
Based on reliable company experience, the reset utilization rate is 100%.
For all the funds, the Time Diversification Factor is 1.0.
The "Margin Offset" is zero for all funds.

The following factors have been provided to you.

TABLE 1 – Basic Factor Table

	Money Market	Fixed Income	Balanced	Diversified Equity	Intermediate Risk Equity	Aggressive Equity
Minimum Maturity Benefit						
100% 10-year with resets	0.06%	1.00%	5.83%	13.31%	19.18%	25.79%

TABLE 2 – MV/GV and Time-to-Maturity Adjustments (Status Factor)

	Money Market	Fixed Income	Balanced	Diversified Equity	Intermediate Risk Equity	Aggressive Equity
Maturity Benefit – With Resets: (>3 Years to Maturity) 10-Year Term						
$MV / GV \geq 2.00$	0.48	0.61	0.77	0.89	0.92	0.96
$1.50 \leq MV / GV < 2.00$	0.48	0.61	0.77	0.89	0.92	0.96
$1.25 \leq MV / GV < 1.50$	0.48	0.61	0.77	0.89	0.92	0.96
$1.00 \leq MV / GV < 1.25$	1.00	1.00	1.00	1.00	1.00	1.00
$0.75 \leq MV / GV < 1.00$	100.51	9.60	2.50	1.64	1.45	1.23
$0.50 \leq MV / GV < 0.75$	420.16	29.45	5.91	3.16	2.58	1.93
$MV / GV < 0.50$	1379.11	88.99	16.15	7.73	6.16	4.38

3. Continued

TABLE 3 – MER Multiplier (Per Percentage Point Difference in MER)

	Money Market, Fixed Income, and Balanced Funds			
	MER Delta < 0		*MER Delta* > 0	
	$MV / GV < 1$	$MV / GV \geq 1$	$MV / GV < 1$	$MV / GV \geq 1$
Maturity Benefit Factor				
≤ 3 years to maturity	0.03	0.24	0.03	0.27
> 3 years to maturity	0.27	0.46	0.34	0.63

	Equity Funds			
	MER Delta < 0		*MER Delta* > 0	
	$MV / GV < 1$	$MV / GV \geq 1$	$MV / GV < 1$	$MV / GV \geq 1$
Maturity Benefit Factor				
≤ 3 years to maturity	0.02	0.10	0.02	0.10
> 3 years to maturity	0.13	0.21	0.13	0.24

The Basic Factor Table used the following MER assumptions:
Basis Points

	Money Market	Fixed Income	Balanced	Diversified Equity	Intermediate Risk Equity	Aggressive Equity
Maturity Benefits						
100% ten-year	110	225	265	290	290	290

TABLE 4 – Margin Offset Factors (per 100 basis points of margin offset)

	Money Market	Fixed Income	Balanced	Diversified Equity	Intermediate Risk Equity	Aggressive Equity
Minimum Maturity Benefit						
100% 10-year with resets	-0.0755	-0.0790	-0.0825	-0.0955	-0.1315	-0.1720

The formula for C-2 risk for this benefit is: $(A \times B \times C + D) \times (1 - E)$,
where the formula is as defined in the study note "Segregated Fund Guarantees"

(a) *(2 points)* Describe the implications of NARA's adoption of the OSFI guidelines for segregated fund death and maturity guarantees on Zest's existing liabilities at 31 December 2000.

(b) *(6 points)* Calculate the RBC ratio at 31 December 2000 for Zest, assuming that they had purchased TLFC at that time and that NARA's new capital requirements were in effect. You may ignore the impact of NARA's new capital requirements on Zest's existing portfolio.

(c) *(2 points)* Identify two alternative approaches to hedging for the potential new variable annuity line that Zest could use to reduce the impact on its RBC ratio, and compare their relative effectiveness.

(d) *(3 points)* Propose product modifications that Zest could make to the potential new variable annuity product to reduce the capital requirements for new business, and describe how each product design change would impact the RBC ratio.

4. *(4 points)* You are Senior Vice President of Investments of a large U.S. life insurance company. You have proposed to the Board a new investment policy for the company's fixed income portfolio. The current portfolio consists of 30% U.S. government bonds and 70% publicly traded corporate bonds. Your proposal includes:

- maintaining the current percentage of U.S. government bonds
- reducing the current percentage of U.S. corporate bonds
- adding foreign government bonds to the portfolio
- adding mortgages to the portfolio
- hedging currency exposure with forward contracts
- reducing the portfolio duration by 1 year

You have stated that you expect the company's current AA rating to be unaffected by these changes.

The Appointed Actuary has expressed concern about an increase in investment risk under your proposed policy. Identify the likely areas of concern and respond to each.

5. *(12 points)* You have been hired as a consultant by Mr. Willow, the CEO, President, and Chairman of the Board for Cash Cow (CC) Life Insurance Company, a large mature publicly-traded stock insurance company.

CC has an old block of whole life policies which is producing large profits. CC also has a term product which had high sales when it was introduced, though sales have slowed down in recent years due to increased competition. Finally, CC has a small block of SPDAs, a successful product line with growing sales but high administrative expenses due to high fixed costs.

CC is beginning to see fair amounts of cash being generated by its in force business. However, there hasn't been a sufficient level of new business sales to redeploy the excess cash.

As a result of its overcapitalization, Mr. Willow feels that CC is vulnerable to a hostile takeover by Hungry Wolf Financial, a large, diversified financial services company that has grown through acquisition. The twenty member board of CC, consisting mostly of current and former officers of the company, has proposed using the excess cash to subsidize term rates and regain market share. A few outside shareholders would prefer returning excess cash to the shareholders.

(a) *(1 point)* Describe the problems facing an overcapitalized company like CC.

(b) *(4 points)* Describe two methods of returning cash to shareholders that address the overcapitalization problem. Suggest the likely implications of these actions.

(c) *(3 points)* Explain how CC could immediately alleviate the overcapitalization problem through a reinsurance transaction. Describe the implications of such a transaction.

(d) *(4 points)* Assume the immediate threat of takeover has been averted. Recommend a corporate governance plan and an employee incentive structure for CC that would align the interests of management with those of the company's shareholders.

6. *(6 points)* Birchwood Life is a small mid-western U.S. mutual life insurance company. Birchwood has its own captive agency force and sells only term life insurance. Birchwood's board of directors has expressed a desire to demutualize Birchwood Life.

You have been presented with the following table of information for Birchwood:

Book Value of Assets	20,000
Book Value of Liabilities	17,650
Fair Value of Assets	19,750
Fair Value of Liabilities	17,250
Embedded Value of Business	470
Goodwill attributed to new business	1,125
Statutory Earnings in 2000	250

You are also aware of the following ratios for three insurers that recently demutualized:

	Price/Earnings Ratio	Price/Book Ratio
Pine Grove Life	17.0	1.50
Spruce Meadow Health	19.0	1.72
Shady Maple Annuities	16.7	1.63

(a) Calculate the appraisal value of Birchwood Life. Show all work.

(b) An analyst representing Redwood Capital Markets has placed a value of 3,750 on Birchwood using capital markets pricing techniques. Describe the capital markets approach, and explain why it produces results that differ from those calculated using the appraisal valuation approach.

(c) Describe the methods that Birchwood could use to convert to a stock company.

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

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

Beginning with Question 7

7. *(9 points)* You are the tax planner for John Bigbux, who is considering the following assets. His time horizon is one year.

(i) A fully taxable bond with a pretax return of 12.0% and a required pretax risk premium of 5%.
(ii) A bond that is only 40% taxable, offers a pretax return of 16.0%, and has a required pretax risk premium of 10%.
(iii) A tax-exempt, risk-free bond offering a return of 4.9%.
(iv) A growth stock with twice the systematic risk of the general market and a required pretax total return of 30.0%.

Based on your experience and research, you have determined the following:

- Expected stock market return is 15.0%
- John's salary is $1 million per year
- Tax rate on bond interest is 30%
- Capital gains tax rate is 20%
- Tax rate schedule on non-investment related income:

  25% on first $100,000
  40% on excess

(a) *(5 points)* Compare these investments on the basis of tax rates, returns provided, and riskiness.

(b) *(3 points)* Demonstrate how John could reduce his income tax liability using the assets described in (i) and (ii) above.

(c) *(1 point)* Describe the limitations that might exist to prevent such arbitrage opportunities.

Show your calculations.

8. *(3 points)* You are given the following monthly costs:

Category	Full Requirement	Sustenance Requirement
Shelter	$100	$70
Entertainment	$90	$15
Food	$50	$40
Insurance	$25	$5
Charity	$15	$10
Pension Contribution	$8	$4

Describe how the following behavior types would spend $130 in order of preference.

i. Resourceful, evaluative, maximizing model
ii. Political model
iii. Psychological model

Explain your answer.

9. *(18 points)* You are the CFO for MegaHold Incorporated, a widely held U.S.-based large conglomerate holding company. Megahold's various subsidiaries are involved in financial services, media, and health services. Revenues and income for Megahold have been increasing steadily over the past five years at an annual rate of 5%. Given this lackluster performance, your CEO has decided to diversify the company even further by entering the technology sector.

MegaHold's debt ratio is 20% and senior management holds less than 2% of the equity. MegaHold's compensation package is based upon the Economic Value Added® system. Middle managers receive a cash bonus each year equal to a percentage of total economic value added in that year. The bonus for top management is also based on total economic value added, but a portion of their compensation is deferred through leveraged stock options. MegaHold's current stock price is $30 per share. Based upon your estimates, you feel that its actual value should be approximately $40 per share.

TechStar is a medium sized company whose revenue has been increasing at over 30% per year for the past five years. Although TechStar's bottom line has been showing consistent losses, the company expects to show a profit within 3 years. TechStar has a debt ratio of 5% and its senior management holds about 40% of the equity (with the president holding 25%). TechStar's compensation package is based upon a cash bonus using actual versus budgeted earnings per share (EPS) results.

MegaHold wishes to acquire TechStar and has decided to finance the purchase externally.

You are considering three possible sources of external financing:

- issue new equity
- issue a 30 year public bond where the principal repayment is inversely related to changes in MegaHold's public debt rating
- enter into a 5 year fixed rate bank loan

(a) *(4 points)* Compare and contrast the incentives inherent in the compensation structures used by MegaHold and TechStar.

(b) *(3 points)* Analyze and compare the agency costs that currently exist in both organizations.

(c) *(6 points)* Rank the forms of financing, with the first being the form that you would recommend. Justify your ranking.

(d) *(2 points)* Assume that MegaHold has made the decision to issue new equity. Describe the possible methods to market the security offering.

(e) *(3 points)* MegaHold has evaluated the acquisition by discounting TechStar's expected after-tax cash flows. Describe the weaknesses of this approach. Identify improvements that could be made to MegaHold's evaluation process for the acquisition.

10. *(7 points)* Elmwood Company's balance sheet currently consists of $500 million in assets financed in part by $375 million of equity. Debt financing is currently provided by a single source, Lender A, at a pretax rate of 10%. The after-tax return on equity is normally distributed with a mean of 15% and standard deviation of 6%. Assume that Elmwood's tax rate is 25%.

You are given the following statistics with respect to the Standard Normal Distribution:

$\Pr(X \le z)$	z
0.50	0.000
0.67	0.431
0.75	0.674
0.80	0.842
0.90	1.282
0.95	1.645
0.99	2.326

(a) Lender A requires that the return on equity (ROE) exceed 5% with at least 95% probability. Determine the maximum leverage for Elmwood that satisfies Lender A's constraint. Show all work.

(b) Lender B is willing to extend loans junior to Lender A at a pretax rate of 18% and requires that the maximum probability of a negative ROE be 20%. Determine the debt structure that would maximize Elmwood's leverage and be acceptable to both Lender A and Lender B. Show all work.

(c) Identify the factors that impact the debt capacity decision for Elmwood and for Lender A.

(d) As the CFO for Elmwood, recommend a debt structure assuming that financing is available from both Lender A and Lender B. Support your decision.

11. *(15 points)* You are the new CFO of a medium-sized mutual life insurance company that primarily issues fixed dollar funding agreements. A significant portion of the funding agreements are putable to the company with 7 days notice. The company primarily invests in two asset classes: low-grade debt with embedded options, such as callable bonds, and investment grade CMOs.

The company offers competitively priced products, has a strong market niche among small to medium corporations, and appears to be very profitable. However, the sales department believes that you are losing out on sales opportunities due to your mediocre published Risk-Based Capital (RBC) ratios and claims-paying ability / financial strength ratings from major rating agencies.

After your review of the product, you believe that the company is taking on significant risks that are not being recognized.

(a) *(5 points)* Identify and describe the three most relevant financial risks that you believe the company is undertaking. Describe the specific steps you would take to better understand and quantify each of these risks.

(b) *(4 points)* Based on the information provided above, explain how the company's RBC ratios and insurance company ratings may have been adversely affected.

(c) *(3 points)* Explain how and why the new C-3a RBC component, introduced this year, will affect the company.

(d) *(3 points)* Describe a strategy or external transaction that your company could effect to address the mediocre RBC ratio. Indicate specifically how this action would impact the RBC ratio and the rating agencies' assessments of the company.

12. *(5 points)* You are given the information below for a selected corporate bond.

Years to maturity:	Two years, Face value is paid at maturity
Coupon Rate:	5% of Face Value, paid annually
Face Value:	$100
Current Credit Rating:	BB
Recovery Rate Upon Default:	50%

One-Year Transition Matrix (%):

Initial Rating	Rating at Year-End (%)							
	AAA	AA	A	BBB	BB	B	CCC	Default
AAA	93.83	5.67	0.39	0.08	0.03	0.00	0.00	0.00
AA	0.64	91.94	6.77	0.47	0.06	0.09	0.02	0.01
A	0.07	2.16	92.04	5.02	0.47	0.19	0.01	0.04
BBB	0.03	0.24	4.56	89.80	4.24	0.76	0.15	0.22
BB	0.03	0.06	0.40	6.09	84.61	6.87	0.96	0.98
B	0.00	0.09	0.29	0.41	5.11	85.32	3.48	5.30
CCC	0.13	0.00	0.26	0.77	1.66	8.93	66.26	21.99

Current spot rates for corporate zero-coupon bonds by credit rating category (%):

Credit Rating	One-Year to Maturity - S1	Two-Year to Maturity - S2
AAA	3.60	4.15
AA	3.65	4.20
A	3.70	4.30
BBB	4.10	4.70
BB	5.50	6.00
B	6.00	7.00
CCC	15.00	15.00

(a) Describe the fundamentals of the *CreditMetrics* approach to measuring C1 risk inherent in a portfolio of fixed-income securities.

(b) Calculate X such that there is a 5 percent likelihood that the actual value of the bond at the end of the first year will be less than X. Show your work.

13. *(3 points)* Local Pines, a furniture manufacturer, is conducting an annual review of the retirement benefits it offers its employees. To attract and retain quality employees, Local Pines is considering offering post-retirement health benefits.

Assume the following:

- Personal income tax rate is 28% and is not expected to change in the future
- Corporate income tax rate is 35% and is not expected to change in the future
- Return on assets in the Pension fund = 10%
- After-tax return on corporate funds = 6%
- Assume 10 employees, all age 45
- Probability of 45 year old employee surviving to age 65 is 95%

Calculate the current after-tax cost of providing $1 of post-retirement health benefits to each employee at age 65 under:

(i) the Sweetened Pension Benefit approach, and

(ii) the Pay-As-You-Go approach.

Show all work.

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