SOCIETY OF ACTUARIES
Exam AFE
Advanced Finance/ERM

Exam AFE

MORNING SESSION

Date: Friday, May 11, 2007
Time: 8:30 a.m. – 11:45 a.m.

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This examination has a total of 120 points. It consists of a morning session (worth 60 points) and an afternoon session (worth 60 points).

   a) The morning session consists of 7 questions numbered 1 through 7.

   b) The afternoon session consists of 6 questions numbered 8 through 13.

   The points for each question are indicated at the beginning of the question. Questions 1 - 4 pertain to the Case Study, which is enclosed inside the front cover of this exam booklet.

2. Failure to stop writing after time is called will result in the disqualification of your answers or further disciplinary action.

3. While every attempt is made to avoid defective questions, sometimes they do occur. If you believe a question is defective, the supervisor or proctor cannot give you any guidance beyond the instructions on the exam booklet.

Written-Answer Instructions

1. Write your candidate number at the top of each sheet. Your name must not appear.

2. Write on only one side of a sheet. Start each question on a fresh sheet. On each sheet, write the number of the question that you are answering. Do not answer more than one question on a single sheet.

3. The answer should be confined to the question as set.

4. When you are asked to calculate, show all your work including any applicable formulas.

5. When you finish, insert all your written-answer sheets into the Essay Answer Envelope. Be sure to hand in all your answer sheets since they cannot be accepted later. Seal the envelope and write your candidate number in the space provided on the outside of the envelope. Check the appropriate box to indicate morning or afternoon session for Exam AFE.

6. Be sure your written-answer envelope is signed because if it is not, your examination will not be graded.

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Exam AFE-Front Cover

****BEGINNING OF EXAMINATION****
ADVANCED FINANCE/ERM
MORNING SESSION

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

1. *(8 points)* The Zoolander Board has decided that in place of annual capital contributions of $10M to Eagle, it will instead provide $50M in capital up front in the form of straight debt with 7-year maturity. In order to mitigate the credit risk exposure this creates, Zoolander is exploring various credit risk mitigation alternatives.

(a) *(3 points)* Describe each of the following traditional credit risk mitigation techniques and explain why the technique is likely or unlikely to work for Zoolander in this situation.

(i) Netting
(ii) Collateralization
(iii) Mark to market
(iv) Termination
(v) Reassignment to Insuratron
(vi) Embedded put options

(b) *(3 points)* For each of the two following credit risk mitigation techniques, explain how such a transaction would be structured, specifying the role and payment obligations of each party involved.

(i) Entering into a 5-year credit default swap with Insuratron at an annual cost of 50 basis points.
(ii) Entering into a 5-year total return swap (TRS) with another counter party, e-ZBank, with an annual spread of 200 basis points.

(c) *(1 point)* Outline the considerations involved in determining the optimal annual spread rate for the TRS with e-ZBank described in (b) (ii).

(d) *(1 point)* Recommend how Zoolander should mitigate the credit risk in implementing the Board's directive. Support your recommendation.

USE THIS PAGE FOR YOUR SCRATCH WORK

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

2. *(14 points)* Zoolander anticipates that principles-based reserve (PBR) methods will be adopted by all state regulators as the new minimum valuation standard.

(a) *(2 points)* Zoolander currently values Term life reserves on a CRVM basis using prescribed interest rates and mortality tables. Explain how the methodology and assumptions of a PBR valuation method would differ.

(b) *(2 points)* Identify the impact the PBR valuation method may have on Zoolander with respect to operations, reserve levels, and credit ratings.

(c) *(4 points)* With respect to setting assumptions for Zoolander's Term life insurance block, describe the considerations in setting "prudent best estimate assumptions":
(i) in general;
(ii) for mortality;
(iii) for the Treasury Yield Curve.

(d) *(2 points)* Given the data you have available, estimate the Deterministic Reserve under PBR for Zoolander's Term life business. Identify three improvements in data or methodology that would be necessary to produce a more accurate value.

(e) *(2 points)* Assume that the net dollar cost loss variable for the Term block is normally distributed. You are given ten stochastically derived scenario reserves on the Term block and selected points from the Normal distribution.

Scenario Reserve

350.1
348.7
336.5
330.0
327.7
327.5
320.0
307.4
304.1
297.2

Normal Distribution:

$N(x)$	(x)
0.788	0.8
0.816	0.9
0.841	1.0
0.885	1.2
0.903	1.3
0.919	1.4
0.933	1.5
0.945	1.6

2. **Continued**

(i) Estimate the Reported Reserve under PBR for Zoolander's Term life insurance block at the CTE (80%) and CTE (60%) levels, showing each of the reserve components.
(ii) Determine the probability that reserves are insufficient to cover losses at the CTE (80%) level.
(iii) Determine the probability that reserves are insufficient to cover losses at the CTE (60%) level.
(iv) Evaluate which of these CTE levels is consistent with setting reserves at a level to cover one standard deviation from the mean.

Show your work.

(f) *(2 points)* Present arguments in support of or against the inclusion of stochastic scenarios in the determination of reserves for the Term block.

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

3. *(13 points)* Bill Buck has expressed some concern about the Hedge Fund initiative proposed by Peter Fish. He feels that more due diligence needs to be done before approval can be given.

(a) *(1 point)* Define model risk.

(b) *(3 points)* Explain the potential shortcomings of the Efficient Market Hypothesis (EMH) belief that pseudo-arbitrageurs' activity will quickly bring prices back in line with fundamentals.

(c) *(5 points)* Explain each of the following elements of model risk management, and assess Zoolander's application of them for the Hedge Fund initiative:

(i) Traditional Model Validation
(ii) Gathering Market Intelligence
(iii) Reverse-Engineering: Plain Vanilla Instruments
(iv) Reverse-Engineering: Complex Products

(d) *(4 points)* Cite three recommendations of the Group of Thirty (G-30) that Zoolander is violating in its derivatives practices, and recommend changes necessary at Zoolander to comply with the recommendations.

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

4. *(7 points)*

(a) *(3 points)* The Board is concerned about the volatility of the future value of Zoolander's stake in Eagle. Zoolander is considering a hedge offered by Insuratron under which Insuratron agrees to buy out Zoolander's interest at the end of ten years for $95 million.

(i) Compute the future value of this hedge assuming that Zoolander will pay capital gains taxes on the proceeds from the disposition net of the initial $50 million investment. Show your work.

(ii) Compute the future value of this hedge assuming that Zoolander will pay no capital gains taxes on the net proceeds from the disposition due to the availability of loss carryforwards. Show your work.

(iii) Explain the conditions under which purchasing a hedge will produce a tax benefit for Zoolander.

(b) *(3 points)* Zoolander plans to follow the PTS recommendation to hire a consultant to manage its stake in Eagle. Assume:

- the consultant has a utility function: $u(x) = \sqrt{(x)}$
- under the PTS-proposed pay structures, the pre-tax value of Zoolander's position is considered to be $95 million if the hedge is in place.

Evaluate whether or not the consultant would be incented to recommend the hedge under each of the two PTS-proposed pay structures. Show your work.

(c) *(1 point)* Based on your analysis above, you are concerned that the consultant could be biased by self-interest in making his hedging recommendation. Suggest a pay structure that would render the consultant indifferent to whether Zoolander hedges or not. Support your recommendation.

5. *(5 points)* You are the Chief Actuary of Calhoun Insurance, a U.S. company. You are trying to convince your CEO that the company should be using internal reporting and compensation benchmarks that are aligned with the economic value of the company.

(a) Outline the differences between the U.S. GAAP accounting system and a fair value approach.

(b) Outline the arguments for and against incorporating liquidity risk in fair valuation.

(c) Define EVA and describe how it can be used to increase shareholder value.

(d) Propose a new corporate compensation system that is consistent with EVA concepts.

6. *(9 points)* Charleston First Bank (CFB) uses an internal risk rating system to determine obligor and facility ratings. CFB's Risk Rating System uses the following Risk Ratings (RR):

Risk	RR	Approximate S&P Rating	
Sovereign	0	N/A	Investment Grade
Low	1	AAA	
	2	AA	
	3	A	
Average	4	BBB	
	5	BB	Below Investment Grade
High	6	B	
	7	CCC	
	8	CC	
	9	In default	

CFB will provide loans only if both the obligor and facility rate as investment grade.

For its quantitative assessment, CFB relies upon four financial ratios, which are weighted equally in the ratings development process, as follows:

Financial Ratio Measure	**Risk Rating**							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Cash Interest Coverage	> 16	(16.0, 8.5)	(8.5, 6.0)	(6.0, 3.5)	(3.5, 1.6)	(1.6, 0.9)	(0.9, 0.2)	< 0.2
Debt to Asset %	< 52	(52, 70)	(70, 80)	(80, 95)	(95, 120)	(120, 150)	(150, 165)	> 180
EBITDA / Total assets %	> 15	(15, 12)	(12, 10)	(10, 7)	(7, 4)	(4.0, 1.5)	(1.5, -2.0)	< -2
Total Debt / EBITDA	< 3.5	(3.5, 5.5)	(5.5, 7.5)	(7.5, 11.0)	(11.0, 14.5)	(14.5, 17.5)	(17.5, 20.0)	> 20

West Texas Airways (WTA) has applied for a 25-year $50 million loan from CFB.

WTA is a small- to mid-size American airline serving much of the Southwestern US and Mexico. WTA recently replaced most of its management team with a group of successful executives from the oil industry to bring in a new perspective. WTA also brought in a leading audit firm to revamp the company's financial reporting system.

WTA's recent marketing campaign, "Cattle Car of the Sky", failed to attract the bargain fliers the company was targeting in an attempt to reverse its declining market share in the financially-troubled airline industry. This campaign instead resulted in reduced revenues.

6. Continued

Now WTA is seeking $50 million in funding to:

- revamp WTA's aging fleet,
- increase routes to/from Mexico, and
- establish a maintenance base in Mexico to take advantage of lower labor costs.

CFB's proposed loan to WTA would include strong covenants and give CFB a seniority position with collateral provided by the new jets to be purchased.

You are given the following financial data for WTA:

	($ millions)
Total Assets	3,640
Total Liabilities	2,780
Interest Expense	150
EBITDA	250

(a) *(1 point)* Describe the benefits and concerns raised by the use of an internal risk rating system.

(b) *(4 points)* Describe the nine steps required for a robust risk rating system.

(c) *(4 points)* Apply the nine steps above, using CFB's Risk Rating System, to determine whether CFB would grant this loan to WTA. Show your work.

7. (*4 points*) Plantation Life Insurance Company has the following financials as of 12/31/06.

Shares	300,000
Share price	$100
Total Shareholder Return	12%
Franchise Growth Rate	10%

	Amounts in millions
Statutory Assets	100
Statutory Liabilities	80
GAAP Assets	110
GAAP Liabilities	85
Required Capital	10
Economic Capital	7
Shareholder Dividends paid for year 2006	5

(a) Calculate the following for Plantation:

(i) Franchise Value at 12/31/06
(ii) 2006 ROE
(iii) 12/31/07 Statutory assets, assuming shareholder dividends and liabilities remain constant in 2007

Show your work.

(b) Plantation's leverage position is currently considered low by industry analysts and management. The company is exploring a capital restructuring via a share buyback funded through debt, which will increase its leverage position to a moderate level.

For each of the following changes, compare and explain the effect the change would have on Franchise Value (i) before any share buyback and (ii) after the share buyback:

- Reduction in asset expenses
- Increase in growth rate
- Lower taxes
- Lower agency costs
- Lower economic capital

****END OF EXAMINATION****
Morning Session

SOCIETY OF ACTUARIES
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Exam AFE

AFTERNOON SESSION

Date: Friday, May 11, 2007
Time: 1:30 p.m. – 4:45 p.m.

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This afternoon session consists of 6 questions numbered 8 through 13 for a total of 60 points. The points for each question are indicated at the beginning of the question. There are no questions that pertain to the Case Study in the afternoon session.

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

8. *(7 points)* Your company has a large credit exposure to Hunley Manufacturing Company. You have gathered the following data:

		One-Year Forwards	
Maturity *t* (years)	U.S. Treasury Spots (%)	U.S. Treasury Forwards (%)	Hunley Forwards (%)
1	4.95	4.95	5.30
2	4.75	4.55	4.95
3	4.65	4.45	4.90
4	4.55	4.25	4.75
5	4.50	4.30	4.85

You have estimated that the Loss Given Default for Hunley is 40%.

(a) *(5 points)* You are considering a 3-year credit default swap on Hunley to hedge your company's exposure.

Calculate the expected annual fee for the swap using the Reduced-Form approach to measuring credit risk, ignoring counterparty risk. Show your work.

(b) *(2 points)* Explain how you would validate your Reduced-Form model.

9. *(15 points)* You are an actuary working in the newly-formed Risk Management Department of Mills Insurance company, a public company that has traditionally sold Whole Life Insurance and Immediate Annuities.

Mills has recently begun selling a single premium variable annuity (SPVA) with a Guaranteed Minimum Withdrawal Benefit (GMWB) rider. The GMWB rider provides a lifetime annual withdrawal benefit of 4% of the initial premium after a 10-year waiting period. The product was priced using a cash-flow projection based upon assumptions derived from "expected" deterministic values.

Your key initiative this year is to build the Enterprise Risk Management (ERM) framework for the company. Your main focus is risk aggregation (including the new risks of the GMWB product) and its impact on capital.

(a) *(4 points)* For Mills' SPVA product with GMWB rider:

(i) Describe the product assumption risks associated with the pricing of the GMWB rider.

(ii) Describe the insurance related risks.

(iii) Identify and describe diversification effects from adding the GMWB product to the company's current portfolio.

(b) *(2 points)* After analyzing the risks above, you have developed Economic Capital amounts (in millions) for four broad categories of risk on a stand-alone basis.

Risk Category	**Economic Capital**
Credit Risk	23
Market Risk	15
Insurance Risk	16
Operational Risk	21

(i) Develop a simplified correlation matrix, using the following values:

1	for positively correlated risks
-1	for negatively correlated risks
0	for risks that are assumed uncorrelated

(ii) Calculate Mills' Economic Capital using a Gaussian approach with your simplified correlation matrix.

(iii) Calculate the diversification effect based on your simplified correlation matrix.

Continued on next 2 pages

9. Continued

(c) *(3 points)* As a refinement to your correlation matrix approach, you are considering using a Copula technique.

(i) Describe the advantages of the Copula technique over the correlation matrix approach.

(ii) Rank the following approaches in ascending order of likely resulting capital requirements. Justify your ranking.

- T-Copula method with 7 degrees of freedom
- Gaussian Copula technique
- Correlation matrix approach using your simplified correlations
- Correlation matrix approach using the US RBC dependence
- Correlation matrix approach using correlation assumptions in Canadian MCCSR

(d) *(2 points)* You are considering two types of measures for setting the level of Economic Capital: VAR and Conditional Tail Expectation.

Compare these two risk measures, including an explanation of how each satisfies the criteria for a coherent measure.

Continued on next page

9. Continued

(e) *(4 points)* To improve your analysis, you build a stochastic model of Economic Capital with the following output:

Scenario Rank	Average of cell PV of future profits for scenario range (millions)	Variance of PV of future profits for scenario range (millions)
1991-2000	-70	18
1981-1990	-35	9
1971-1980	-23	3
1961-1970	-20	2
1951-1960	-17	1
1941-1950	-15	2
1931-1940	-13	1
1921-1930	-11	1
1911-1920	-9	0
1901-1910	-7	0
1891-1900	-7	0
:	:	:
101-110	50	0
91-100	57	0
81-90	67	1
:	:	:
41-50	197	1
31-40	200	1
21-30	208	2
11-20	220	3
1-10	225	8

You are also given the following points from the Normal distribution:

$N(x)$	x
0.99	2.34
0.95	1.64
0.90	1.28
0.80	0.84

Calculate the Economic Capital Level for each of these measures:

(i) 95% VAR
(ii) 95% CTE
(iii) Upper bound of the 80% confidence interval of the 95% VAR assuming a Normal distribution

Show your work.

10. *(9 points)* Carolina Inc. is an insurance company that has issued $10 million of benefit-responsive GICs. The assets backing the GICs are invested in corporate bonds and mortgage-backed securities (MBS).

You are the newly hired Chief Risk Officer of Carolina. You plan to put in place a comprehensive risk management framework in an effort to reduce capital requirements under Standard & Poor's Financial Product Company (FPC) capital adequacy model.

You are provided the following information:

Asset		Liability	
Corporate Bond	5,000,000		
MBS	5,000,000	GIC	10,000,000

Volatilities (in basis points) used for the risk buckets in the MR-1 delta risk:

6 Months	24 Months	60 Months	120 Months
220	210	180	190

The modeled market value changes of the assets and liabilities based on interest rate shifts are:

	Downward Shifts (basis points)			Upward Shifts (basis points)			
Modeled Market Value Change ($)	Down 200	Down 150	Down 100	Up 100	Up 150	Up 200	DV01*
Corporate Bond	550,000	403,125	262,500	-237,500	-346,875	-450,000	-2,499
MBS	600,000	412,500	250,000	-150,000	-187,500	-200,000	-1,995
GIC	-1,200,000	-787,500	-450,000	150,000	112,500	0	2,985

*DV01 is the market value change for one basis point upward parallel shift.

(a) *(4 points)* Describe all the components of the FPC model applied to insurance companies, including the methodology to determine each component.

(b) *(4 points)* Calculate the capital charge for the MR-2 Gamma risk based on the current investment portfolio. Show your work.

(c) *(1 point)* You are concerned about the high level of MR-2 Gamma risk charge. Propose two possible changes in asset strategy that could reduce the charge. Explain why each would work.

11. *(14 points)* Citadel Life Insurance Company has a significant block of in force whole life policies that have been consistently profitable. Citadel expects sales for its newly launched UL product will cause significant surplus strain. The CFO is considering various approaches to address the strain demands of the UL product.

One solution being reviewed by Citadel is to obtain reinsurance for the UL block. The company has obtained the following two quotes from authorized reinsurers:

Quote 1. Magnolia Re assumes that Citadel will cede some quota share percentage of the UL business on a modified coinsurance basis, and, in exchange, Magnolia Re will provide a first year ceding allowance equal to 16% of ceded premium.

Quote 2. Palmetto Re has provided a quote for YRT with zero first year premium. Palmetto Re will establish an unearned premium reserve for the assumed mortality risk based on a weighted valuation mortality rate of 0.014 in the first year and a valuation discount rate of 5%. Reserves for all policies are calculated assuming annual reinsurance premiums with a mid-year issue date.

You are given asset share results showing projected values for the UL product, assuming Citadel issues $100 million in face amount:

	First Year Statutory Income Statement for the UL Product (thousands)
Gross Premiums	1,000.00
Investment Income	10.00
Commissions	(700.00)
Expenses	(200.00)
Death Benefits	(35.00)
Change in Reserves	(500.00)
Pre Tax Income	(425.00)
DAC Tax Amount	73.15
Taxable Income	(351.85)
Tax (35%)	123.15
Post Tax Income	(301.85)
Strain Ratio (as % of Gross Premiums)	30.2%

Assume that there is no DAC tax on reinsurance cash flows and that Citadel has adequate overall positive income enabling the full negative tax deduction shown above.

11. Continued

(a) The CFO's objective is to reduce the first year strain on UL sales from the projected 30.2% to 20% of direct premium. First year strain is defined as the negative of net earnings after tax but before cost of capital. Determine the quota share percentage to cede to Magnolia Re in order to achieve this objective. Show your work.

(b) Compute the strain ratio for Citadel if it cedes mortality risk on a 90% quota share basis to Palmetto Re. Show your work.

(c) The CFO asks you to compare the modified coinsurance and YRT reinsurance alternatives. Outline your response, including

(i) a comparison of the advantages and disadvantages of modified coinsurance and YRT reinsurance to the ceding company, and
(ii) an evaluation of the effectiveness of the two specific quotes being considered in providing strain relief for Citadel.

(d) As an alternative, Citadel is considering the securitization of future cash flows from the whole life block as a means of raising capital.

(i) Describe how a securitization of the in force block would address Citadel's strain problem.
(ii) Identify the parties normally involved in a securitization and the role each plays.
(iii) Explain advantages and disadvantages of a securitization of the whole life block as compared to an assumption reinsurance transaction for this same block.

12. *(11 points)* You are the Chief Actuary of Sumter Life Insurance Company. Your company's target market is approaching saturation, and you are looking for growth opportunities. Your CFO tells you that Knox Life, one of your competitors, is putting itself up for sale in a public auction. She asks you to evaluate the acquisition.

An independent actuary's appraisal has estimated that Knox's business will generate $50 million of distributable earnings at the end of each of the next five years. You are given the following information regarding Sumter:

Current capital structure:

Asset Class	Amount (Millions)	Expected After-Tax Return
Cash	$10	2.00%
Debt	$10,497	5.00%
Equity	$24,493	??

Covariance between Sumter's equity portfolio return and the market return:	0.3750
Variance of market return:	0.2500
Expected equity market return:	11.00%
Risk-free rate:	4.00%

(a) *(2 points)* The sale of Knox is being handled through a public auction. Describe two other sales methods and the advantages and disadvantages of each compared to public auctions.

(b) *(2 points)* Identify five reasonable methods of selecting a discount rate for valuing an acquisition and describe the circumstances under which each would be appropriate.

(c) *(2 points)* Given the data provided above, calculate an appropriate discount rate to use in valuing this acquisition. Show your work.

(d) *(1 point)* Calculate the value of the Knox business ignoring distributable earnings beyond the fifth year. Show your work.

(e) *(1 point)* Give the formula for determining "adjusted book value".

(f) *(3 points)* Your CFO claims that the synergy value of the acquisition justifies increasing the bid by $1 million in order to barely outbid a competing offer. Outline the components of synergy value and explain the pitfalls of incorporating them in the price.

13. *(4 points)* Cooper Re is a reinsurance company that has recently started operations with initial funding via private equity. Cooper Re is fulfilling the strong market demand for GMDB coverage. The company has been growing very quickly and expects this trend to continue. This fast growth has made additional financing necessary. It is expected that Cooper Re's financing needs will be alleviated in about 5 years, when income on in force business will be able to support new business strain.

(a) Identify four sources of corporate debt that Cooper Re might consider. Compare them with respect to average maturity, covenants and issue costs.

(b) Recommend an appropriate source of debt for Cooper Re. Justify your recommendation.

(c) Describe the effects on Cooper Re of initiating debt financing.

(d) Assume Cooper Re has reached a mature state five years hence, with increasing income and lower growth opportunities.

Explain the effects if Cooper Re continues to maintain debt financing at that time.

****END OF EXAMINATION****
Afternoon Session