SOCIETY OF ACTUARIES
Exam AFE
Advanced Finance/ERM

Exam AFE

AFTERNOON SESSION

Date: Thursday, October 29, 2009
Time: 1:30 p.m. – 4:45 p.m.

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This afternoon session consists of 6 questions numbered 7 through 12 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.

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.

Tournez le cahier d'examen pour la version française.

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Exam AFE-Front Cover

****BEGINNING OF EXAMINATION****
Afternoon Session
Beginning with Question 7

7. (*6 points*) The board of XYZ company is reviewing the following three alternative senior management compensation structures:

I. Salary of $160,000 and 25,000 stock options with an exercise price of $88 with earliest exercise date in one year

II. Flat Salary of $250,000

III. Base salary of $175,000 and 1,000 shares of stock vesting at the end of one year

XYZ expects three equally likely outcomes for the company's share price at the end of one year: $80, $90 or $100. XYZ can hedge its volatility and stabilize the firm's value at $88 per share.

(a) Describe how incentive compensation can affect risk management decisions.

(b) Assume senior management has a utility function with utility equal to the square root of individual compensation.

Demonstrate whether senior management would be motivated to implement the stock value hedge for each of the three compensation structures.

(c) Compare and contrast each of the three compensation structures.

(d) Recommend the compensation structure that best aligns with XYZ shareholder interests. Justify your answer.

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8. (*16 points*) City Global Bank (CGB) is an A-rated holding company of a bank conglomerate. From its beginnings as a US bank, CGB was one of the early achievers of best practice risk management, adopting economic capital as its management basis. CGB built on this strength and expanded to become a global bank.

In an effort to expand into other financial services CGB is deciding between two potential acquisition targets:

- A large Dutch-based P&C company rated A with global catastrophic exposure from several product lines and a globally diversified asset portfolio. Capital is managed on an economic basis.

- A small US Life Insurance Company rated AA operating in the Mid-West with an asset portfolio concentrated in US Blue Chip company asset exposures. Capital is managed to maintain a 200% capital adequacy ratio.

CGB targets its economic capital requirement to protect against losses over one year at the 99.9% confidence level to maintain its A rating.

You have compiled the following estimates of standalone economic capital for a simplified list of risk factors for each of the entities ($ Millions):

Risk Factor	**CGB**	**Dutch P&C**	**U.S. Life**
Credit	25	2	1
Market	10	18	5
Operating	15	5	3
Ins. Liability	0	25	1
Diversification Benefit Amount	−12	−18	−3
Total	**38**	**32**	**7**

A recent academic study indicated the following risk correlations for banks and life insurance companies:

	Bank Credit	**Bank Market**	**Bank Op.**	**Life Ins. Credit**	**Life Ins. Market**	**Life Ins. Op.**	**Life Ins. Liability**
Bank Credit	100%	30%	45%	90%	30%	40%	0%
Bank Market		100%	15%	30%	80%	10%	0%
Bank Op.			100%	40%	10%	50%	10%
Life Ins. Credit				100%	20%	15%	0%
Life Ins. Market					100%	15%	0%
Life Ins. Op.						100%	15%
Life Ins. Liab.							100%

8. Continued

(a) (*2 points*) Describe the "silo"-based approach to capital required by US regulation applicable to financial conglomerates. Identify and explain three major limitations of this approach.

(b) (*1 point*) For each of a Bank, P&C company and a Life company complete the following table to characterize each of the identified risks using the following scale:

0 – Very Low/None
1 – Medium
2 – Very High

	Bank	**P&C Co.**	**Life Co.**
Market			
Credit			
Insurance			
ALM			
Operating			

(c) (*1 point*) Describe the three-level, "building block approach" that could be used to aggregate risks in a financial conglomerate.

(d) (*5 points*) For each of the acquisition targets considered in isolation, qualitatively assess the impact to CGB's risk at each of the following levels of risk aggregation:

	Dutch P&C	US Life
Level I Diversification		
Level II Diversification		
Level III Diversification		

(e) (*5 points*) Using the standalone economic capital estimates, complete the table below. Show your work.

	Combined Entity Economic Capital	**Diversification Benefit Ratio**
CGB and Dutch P&C	$60.2 million	
CGB and US Life		

(f) (*2 points*) Recommend and justify the most beneficial acquisition to CGB.

9. (*11 points*) You are an actuary working for ABC Life Insurance Company. On January 1, 2008, the company implemented FAS 157. ABC Life has only one block of business subject to fair value accounting: Single Premium Variable Annuity with Guaranteed Minimum Accumulation Benefit (GMAB). All contracts were issued on January 1, 2000 and mature on January 1, 2010.

Assumptions on January 1, 2008:

(i) The risk-free rate is 4%.

(ii) ABC's credit default swap (CDS) spread of 2% is used to reflect nonperformance risk.

(iii) Surrender rates are the only uncertainty.

(iv) Mortality is ignored.

The following table summarizes the sensitivity of the present values of guaranteed benefits and charges on January 1, 2008 to the level of surrender rates and discount rates. These present values were determined using a range of risk neutral scenarios.

GMAB PV Cash Flow	Surrender Rate	Discount Rate		
		2%	4%	6%
Benefits	Best Estimate	115	100	90
	110% of Best Estimate	95	85	77
	90% of Best Estimate	145	125	113
Charges	Best Estimate	55	50	46
	110% of Best Estimate	50	45	41
	90% of Best Estimate	60	55	51

(a) (*2 points*) Describe three fair valuation principles and explain how these principles apply to ABC Life.

(b) (*1 point*) Present arguments for and against using an entity's own credit standing in fair value accounting.

(c) (*2 points*) Explain the hierarchy levels of fair valuation methods and recommend one for valuing the GMAB. Justify your selection.

9. Continued

(d) (*4 points*) ABC Life employs the present value technique to value the GMAB.

(i) Calculate the January 1, 2008 GMAB reserve.

(ii) Calculate the market value margins.

(iii) Calculate the present value of ABC Life's nonperformance risk.

Show your work.

(e) (*2 points*) The following events occurred in 2008:

- ABC was downgraded and its CDS spread increased by 200 bps.
- The GMAB became significantly in the money for all contracts, and therefore ABC changed its surrender rate assumption to zero.
- The risk-free rate decreased by 200 bps.

(i) Reassess your previously recommended level of hierarchy in (c) given the changes since January 1, 2008.

(ii) Identify factors that could have contributed to the reserve difference between January 1, 2008 and January 1, 2009.

10. (*13 points*) Equinox Life Financial (ELF) is an A-rated life insurance company that has recently begun using RAROC in its management of Economic Capital. ELF's ALM group manages the duration risk for three product lines: Product A, Product B, and Product C. To further understand the performance of these three product lines, ELF has just devised an internal Transfer Pricing process.

The following information is used to calculate RAROC for the three product lines:

	Economic Capital	Revenues	Maintenance Expenses	Actual Operational Losses (Benefits)	Transfer Price
Product A	1,000	450	200	100	–25
Product B	500	175	50	65	–12
Product C	100	40	15	15	–3

ELF invests its Economic Capital at a 5% risk-free rate and has a hurdle rate of 15%.

Additionally, detailed returns of the products and their benchmarks for the Transfer Pricing analysis are as follows:

	Duration	Convexity	Credit Score	Mark-to-Market Performance
Product A				
Assets	12.4	3.2	BBB	16.5%
Liabilities	12.5	3.1	A	15.5%
Benchmark A1	12.5	3.1	A	14.5%
Benchmark A2	12.4	3.2	BBB	15.0%
Product B				
Assets	6.2	1.2	A	14.9%
Liabilities	6.1	1.2	A	14.5%
Benchmark B1	6.1	1.2	A	14.0%
Benchmark B2	6.2	1.2	A	13.9%
Product C				
Assets	2.6	0.5	AA	12.5%
Liabilities	2.3	0.4	A	14.0%
Benchmark C1	2.3	0.4	A	13.0%
Benchmark C2	2.6	0.5	AA	11.0%

(a) (*1 point*) Describe three advantages to ELF of using RAROC as a capital management tool.

(b) (*1 point*) Describe the role of Economic Capital in a financial institution.

10. Continued

(c) (*3 points*) Calculate the actual RAROC for each of the three products using the Economic Capital data above, and based on these calculations, assess the RAROC performance of each product. Show your work.

(d) (*1 point*) Describe three potential benefits to ELF of using a Transfer Pricing process.

(e) (*2 points*) Describe how ELF has constructed benchmarks in its Transfer Pricing process to measure the following divisions of performance:

(i) Product performance

(ii) ALM performance

(iii) Asset performance

(f) (*2 points*) Using the Transfer Pricing data above, calculate the mark-to-market performance for each product and attribute it to each of the divisions of performance identified in the table below:

	Product A	**Product B**	**Product C**
Total Performance			
Product Performance			
ALM Performance			
Asset Performance			

(g) (*3 points*) For products not meeting the RAROC hurdle rate:

(i) Assess the areas of strengths and weaknesses according to your Transfer Pricing analysis.

(ii) Recommend management actions that could raise the RAROC to the hurdle rate.

11. (*8 points*) K-Life currently has three product lines with risk exposures, expected earnings and correlations shown in the tables below. Due to deteriorating market conditions, K-Life's free capital has declined to $500 million. The company's aggregate internal limit for minimum capital is 200% of the 99% VaR of the products' annual net income.

Line of Business	**Expected annual net income ($ Millions)**	**Volatility of annual net income per year**
Variable Annuity (VA)	300	40%
Long Term Care (LTC)	100	20%
Disability Insurance (DI)	80	10%

Correlation of annual net income	Variable Annuity (VA)	Long Term Care (LTC)	Disability Insurance (DI)
Variable Annuity (VA)	1.00	0.25	0.40
Long Term Care (LTC)		1.00	0.75
Disability Insurance (DI)			1.00

X	$\Phi(X)$
99.5%	2.58
99.0%	2.33

K-Life plans to sell either the LTC or the DI line of business. Assume that K-Life would receive the same price for either line of business.

(a) Demonstrate that the company is currently not in compliance with its aggregate internal limit for capital adequacy.

(b) Determine which of the two lines of business K-Life should sell to maximize expected annual income and comply with the capital limit. Show your work.

11. Continued

(c) K-Life is considering improvements to the Variance-Covariance methodology.

(i) Evaluate the appropriateness of the Variance-Covariance methodology to assess tail risk.

(ii) Compare the Variance-Covariance approach to each of the following two approaches to calculating VaR:

- Monte Carlo Simulation
- Historical Simulation

(iii) Recommend an approach in (ii) to improve K-Life's tail risk analysis.

(d) K-Life is considering extending its VAR approach to include CTE.

(i) Demonstrate graphically the difference between CTE and VaR.

(ii) Describe the advantages of CTE over VaR.

(e) Describe three additional extensions to K-Life's current VaR approach. Provide one advantage for each extension.

12. (*6 points*) You have been hired as a consultant to assess the hedging practices of WithBothHands, a holding company with two subsidiaries: Sugarfactory Inc., a sugar producer, and Candy Co., a candy maker that uses sugar in its production.

Sugarfactory's contribution to WithBothHands' profits is determined by the unit price of sugar (P) and a random, idiosyncratic risk factor (s): $\Pi_S = 20 + 10P + s$

Candy Co.'s contribution to the profits is determined by the unit price of sugar (P), and a random, idiosyncratic risk factor (c): $\Pi_C = 100 - 5P + c$

The expected values and standard deviation for P, s, and c are listed below. The three variables are independent of one another.

$$E(P) = 10 \qquad \sigma(P) = 5$$
$$E(s) = 0 \qquad \sigma(s) = 5$$
$$E(c) = 0 \qquad \sigma(c) = 10$$

A hedge instrument, H, derived from the underlying price of sugar is available and pays $H = E(P) - P$. The market value of the instrument is 0, but the transaction cost of buying or selling a unit of the derivative is 1.

Currently, Sugarfactory's contribution to WithBothHands is fully hedged against the price of sugar. Candy Co. does not hedge in any way.

The CFO's hedging goal is to eliminate WithBothHands' exposure to sugar prices. The hedging method recommended by the CFO is for Candy Co. to independently and fully hedge.

(a) (*1 point*) Explain why the CFO's hedging goal and recommended hedge method are not optimal for WithBothHands.

(b) (*1 point*) Describe and recommend the optimal hedge position to mitigate the risk of WithBothHands' total exposure to sugar prices.

(c) (*4 points*) Calculate the increase in profit and reduction in risk that WithBothHands could achieve by adopting your recommendation compared to:

(i) WithBothHands' current method;

(ii) The CFO's recommendation.

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