SOCIETY OF ACTUARIES
Exam AFE
Advanced Finance/ERM

Exam AFE

MORNING SESSION

Date: Friday, April 30, 2010
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 5 questions numbered 8 through 12.

   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.

Tournez le cahier d'examen pour la version française.

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CASE STUDY INSTRUCTIONS

The case study will be used as a basis for some examination questions. Be sure to answer the question asked by referring to the case study. For example, when asked for advantages of a particular plan design to a company referenced in the case study, your response should be limited to that company. Other advantages should not be listed, as they are extraneous to the question and will result in no additional credit. Further, if they conflict with the applicable advantages, no credit will be given.

BEGINNING OF EXAMINATION
MORNING SESSION

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

1. (*5 points*) Bill Buck understands that strategic risk management and risk governance are important aspects of an effective Enterprise Risk Management program. He believes that Zoolander has shortcomings in these areas and has requested your help in identifying the issues and recommending improvements.

(a) (*1 point*)

(i) Define strategic risk.

(ii) Describe the strategic risk management process.

(b) (*4 points*) For <u>each</u> of the following, provide three shortcomings specific to Zoolander, and recommend an action to address each shortcoming:

I. Corporate governance

II. Reward/punishment mechanisms

III. Risk management culture

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

2. (*9 points*) Purchaser Life, a multi-line international insurer, has offered to purchase the term life inforce block as of year-end 2009 from Zoolander for $65M. The purchase of the block would include transferring to Purchaser Life the reserves and required surplus currently backing the block in Zoolander. In light of this offer, Tomas Lyon has requested a review of the Embedded Value (EV) methodology and the value Zoolander attributes to the term life block.

(a) (*1 point*) Define and describe the two major elements of EV.

(b) (*1 point*) Describe the Risk Discount Rate (RDR) used in the EV calculation. Identify two methods which may be used to determine the RDR.

(c) (*3 points*) Assuming no IMR or AVR is attributed to the term life block and that the shareholder equity for each line of business equals the statutory required surplus (all free surplus is allocated to "Corporate"):

(i) Calculate the EV of Zoolander's term life block using the projections provided by Sam Otter and Zoolander's balance sheet. Show your work.

(ii) Based solely on the results in (i), recommend whether to accept or reject Purchaser Life's offer.

(d) (*2 points*) Explain why Purchaser Life may calculate a different EV amount from Zoolander.

(e) (*2 points*) Zoolander recently completed a review of the assumptions for the term life block of business.

Determine the direction and relative magnitude of the impact that each of the following assumption changes will have on the EV of the term life block. Explain your answers.

(i) Capital requirements on the block should be 20% lower than currently assumed.

(ii) Pre-tax asset yield should be 0.25% higher than currently assumed.

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

3. (*10 points*) As the CFO, you are concerned that Zoolander is not prepared to expand its product guarantees with the "VA Plus" line of business. You convince Tomas Lyon that Zoolander should delay the launch of the GMIB product, but he still believes new GMDB and GMAB products must be launched in order to grow the VA line.

(a) (*1 point*) Lyon wants to offer the GMDB with a premium accumulation factor of 5% at no additional charge. He claims this is not a risky product offering, because 5% is below the historical average equity return, and benefits are only paid if the annuitant dies during periods of equity market underperformance, a rare combination.

Evaluate Lyon's claim. Justify your evaluation.

(b) (*2 points*)

(i) Recommend a risk mitigation approach Zoolander could implement to manage financial risk for the "VA Plus" line of business.

(ii) Identify two advantages and two disadvantages of your proposal that are specific to Zoolander.

(c) (*5 points*) Zoolander has decided to add the GMAB provision as outlined in Danielle Wolfe's email to Wanda Fox dated March 18, 2010.

You are given:

- $BSP_0(t)$ is the cost at issue of a put option that matures in t years
- $BSP_0(t) = Ge^{-rt}\Phi(-d_2) - S_0(1-m)^t\Phi(-d_1)$ where Φ is the standard normal cumulative distribution function.
- $S_0 = 1$
- Risk free rate = 6%
- $d_1 = \left[\ln(S_0(1-m)^t / G) + (r+\sigma^2/2)t\right] / \left[\sigma\sqrt{t}\right]$
- $d_2 = d_1 - \sigma\sqrt{t}$
-

x	$\Phi(x)$	$\Phi(-x)$
0.046	0.518	0.482
0.231	0.591	0.409
0.746	0.772	0.228
1.142	0.873	0.127

3. Continued

t	${}_tp_{50}^{\tau}$	ZooBalanced $BSP_0(t)$	ZooEquity500 $BSP_0(t)$
10	0.35	0.033	$BSP_0(10)$
20	0.25	0.018	0.024
30	0.05	0.007	0.011

(i) Compute the missing $BSP_0(10)$ value in the table above. Show your work.

(ii) Assuming:

- The policyholder issue age is 50.
- The GMAB final maturity occurs in thirty years.
- The only premium is paid at issue.
- All policyholder funds are invested in the ZooBalanced fund.

Calculate the hedge cost for the GMAB survival benefit. Show your work.

(d) (*2 points*) The March 12, 2010 email from Wanda Fox to Danielle Wolfe contains recommendations to simplify modeling and reduce the computing power needed to implement the new hedging programs for the "VA Plus" line of business. Evaluate these recommendations.

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

4. (*6 points*) Zoolander's risk management team is preparing an assessment of operational risk exposures.

(a) (*1 point*) Define operational risk, operational strategic risk and operational failure risk.

(b) (*2 points*) List and explain the steps of the general risk assessment framework that Zoolander should use to create a complete risk assessment report.

(c) (*2 points*) Based on information specific to Zoolander, explain why each of the following risks is higher now than in the past:

(i) Risk of rating agency downgrade

(ii) Modeling risk related to the hedge fund initiative

(d) (*1 point*) Describe the potential impact to Zoolander of a rating agency downgrade.

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5. (*14 points*) Safari Adventures is a licensed insurance company which also offers wildlife spotting tours for $1000. This price covers the $725 operating cost of the tour, as well as $100,000 in life insurance should the passenger be eaten by a lion while on the tour.

In a typical year, lions eat 0.1% of tourists. This year, with the wildebeest population low, there is a 25% chance the lions will be driven to increase their tourist consumption rate to 0.5%.

To handle this uncertainty, Safari Adventures may choose to pay Lion Re, a highly rated counterparty, a $200 per passenger fee on January 1, 2010 to coinsure 90% of the mortality risk.

Safari Adventures has enrolled 1000 tourists this year, each of whom has paid the $1000 fee on January 1, 2010. All other tour costs and claims will be paid at the end of the year.

Below is selected financial data for the publicly traded Safari Adventures.

Values as of December 31, 2009

Safari assets	$150,000
Safari debt	$0
Tax rate (income up to $25,000)	0%
Tax rate (income in excess of $25,000)	25%
Tax loss carry-forwards	Not allowed
Legal fees in bankruptcy (to settle claims)	$10,000
Safari asset earned rate	5%
Risk free rate	4%
Market price of risk (for insurance)	0.02

(a) (*2 points*) Calculate the fair value of the insurance liability Safari has sold to its customers as of January 1, 2010 using the risk-neutral (martingale) approach. Show your work.

(b) (*2 points*) Describe two alternate methods which can be used to calculate the fair value of the insurance liability. Explain how the results might differ from the current risk-neutral method when using either of these alternate methods.

5. Continued

(c) (*3 points*) Assume that both the life insurance liability and a reserve for the tour operating costs are calculated with the risk neutral (martingale) approach to fair value.

Construct the balance sheet for Safari as of January 1, 2010 ignoring taxes, showing assets, liabilities and surplus:

(i) Without reinsurance

(ii) With reinsurance

Show your work.

(d) (*5 points*) Tourist loss is defined to be uncollected death benefits. Fill in the values for the table below by computing the gain or loss for the shareholders and the tourists. Show your work.

	Without Reinsurance		With Reinsurance	
	0.1% Claims Rate	0.5% Claims Rate	0.1% Claims Rate	0.5% Claims Rate
Shareholder Gain/Loss				
Tourist Loss				

(e) (*1 point*) Based upon your calculations above, determine if conflict exists between the shareholders and the tourists regarding whether Safari should enter into the reinsurance agreement.

(f) (*1 point*) The CEO of Safari owns 40% of the outstanding company shares and has no other assets. She seeks to maximize her expected utility and has the following utility function:

$$U(\text{wealth}) = \text{wealth}^{\left(\frac{1}{2}\right)}$$

Determine whether the CEO favors the reinsurance agreement. Show your work.

6. (*8 points*) Harbourside Property and Casualty Company offers private mortgage insurance (PMI), which protects mortgage lenders against mortgage defaults. PMI coverage terminates when the mortgage terminates or when the borrower can show that equity in the home has reached 20%. PMI premiums are paid monthly by the borrower and are determined at issue solely as a function of the initial size of the mortgage and the initial down payment.

Margins on this business have deteriorated since 2007 due to rising mortgage defaults. As Chief Actuary, you are considering implementing a Dynamic Financial Model (DFM) to gain a better understanding of how future profits are affected by the general economic environment and Harbourside's specific market. Assume the following:

- Mortgage defaults are primarily a function of overall unemployment and the property location.
- Typical mortgages have 30 year terms, but more than 95% of PMI policies are closed out within 10 years as a result of refinancing, appreciation in home values or home sales.
- New business sales are expected to continue at least five years into the future (with a re-evaluation at that point), but rates may be adjusted during this period if loss ratio experience warrants it.
- Reserves are invested in Treasuries and high-grade corporate bonds. However, loss experience has a greater impact than asset earnings on Harbourside's net income.

(a) (*1 point*) For insurance applications:

(i) Describe Dynamic Financial Analysis.

(ii) Describe how using a DFM may help you accomplish your objective.

(b) (*4 points*) Regarding the DFM design:

(i) Describe the four primary model design considerations.

(ii) For each of these, recommend and justify your approach to modeling PMI.

(c) (*3 points*)

(i) Describe three potential modeling dangers/pitfalls for Dynamic Financial Analysis.

(ii) For each of these, describe the implication for modeling Harbourside's PMI business.

7. (*8 points*) Consider the OSFI, Basel II, COSO and G-30 risk management frameworks with respect to the following scenarios.

> Scenario 1: The Board meets once every 12 months.
>
> Scenario 2: Summary reports (including supporting detail) are compiled quarterly and presented to the CIO.
>
> Scenario 3: The Board defines appropriate limits on risk taking for a large multi-line insurance company.
>
> Scenario 4: A bank measures its credit risk on the largest 90% of its derivative holdings, and ignores netting arrangements.

For each of the four scenarios listed above:

(i) Identify which framework(s) is/are relevant to the scenario.

(ii) Identify which aspect(s) of each relevant framework should be applied to assess the scenario.

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