SOCIETY OF ACTUARIES
Foundations of CFE Exam

Exam CFEFD

AFTERNOON SESSION

Date: Wednesday, October 28, 2015
Time: 1:30 p.m. – 3:45 p.m.

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This afternoon session consists of 5 questions numbered 9 through 13 for a total of 40 points. The points for each question are indicated at the beginning of the question. No questions pertain to the case study.

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 because 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 CFEFD.

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 CFEFD-Front Cover

****BEGINNING OF EXAMINATION****
Afternoon Session
Beginning with Question 9

9. (*6 points*) You work for Greene Insurance Company. Greene's block of Long Term Disability (LTD) business has 5,000 insureds, none of whom are currently disabled.

If an insured becomes disabled, the LTD will provide an annual benefit until the insured terminates at the earliest of recovery, death, or attainment of age 65.

Greene has asked you to model the one-year loss distribution of its LTD block. You have decided to use Monte Carlo Simulation.

Assume the following:

- Benefit amount for each insured: $b_1, b_2, \ldots, b_{5000}$
- Probability of disability this year for each insured: $d_1, d_2, \ldots, d_{5000}$
- Probability of termination of a claim for a given year is: $Q(t) = (0.5)^t$, where t is the number of years since becoming disabled
- LTD benefits are paid at the end of the year
- Modeled loss is defined as the present value of benefits paid over the entire duration of an insured's disability
- Level discount rate

(a) (*3 points*) Describe the steps of the Monte Carlo Simulation to model the one-year loss distribution using 1,000 simulations.

You performed 1,000 simulations and rank-ordered the one-year losses, where $x_1 < x_2 < x_3 < \ldots < x_{1000}$.

$$\sum x_i / 1{,}000 = \$88{,}882$$

$$\sum x_i^2 / 1{,}000 = \$7{,}910{,}811{,}905$$

9. **Continued**

x_i	Loss
x_{989}	96,541
x_{990}	96,575
x_{991}	96,645
x_{992}	96,890
x_{993}	96,964
x_{994}	97,178
x_{995}	97,340
x_{996}	97,849
x_{997}	97,864
x_{998}	97,899
x_{999}	98,895
x_{1000}	99,841

(b) (*1 point*)

(i) Calculate one-year 99% VaR.

(ii) Calculate one-year 99% TCE.

The 99.5 percentile of the standard normal distribution is 2.575.

(c) (*1 point*) Calculate the 99% confidence interval for the expected one-year loss using the normal distribution.

Before seeing your results, a colleague, who has a reputation for overconfidence, suggests that he is 99% sure that the expected one-year loss is less than $90,000.

(d) (*1 point*) Describe two methods of improving your colleague's estimation skills.

10. (*10 points*) Awburn Insurance Company holds a portfolio of fixed income securities and is considering investing in a new sovereign bond, the first of its type, issued in an emerging market. Awburn's portfolio contains investments in other emerging markets in the same region. Awburn's ERM team has been asked to model the effect on portfolio VaR of investing in the new bond.

As the CRO, you suggest mapping the new bond to benchmark reference instruments in order to model portfolio VaR.

(a) (*1 point*) Explain the benefits of mapping the new bond to reference instruments.

An actuarial student on your team has proposed mapping the new bond to a forward rate agreement and a vanilla interest rate swap issued by a counterparty in the same region.

(b) (*2 points*)

(i) Critique the student's proposed reference instruments. Support your critique.

(ii) Recommend alternative instruments that can be used as reference instruments.

Awburn is considering purchasing $1,000,000 of the new bond at par. It has a semi-annual coupon of 6% per annum and will mature in 1 year. The new bond will be issued one month from today. Given below are spot rates applicable to this market. Assume the new bond is default-free in the emerging market's currency.

Month	3	15
Spot Rate	4.00%	5.00%

(c) (*4 points*) Derive equivalent cash flows of reference instruments in the emerging market's currency. Show your work.

10. Continued

Awburn's current portfolio has a 95% VaR of $2,000,000.

An actuarial student on your team has pointed out that there is not enough interest rate and foreign exchange information for this emerging market to model the new bond's impact on portfolio VaR. Based on information from other emerging markets in the region, you estimate Awburn's portfolio 95% VaR will take on the following values with the given probabilities:

Probability	Portfolio 95% VaR
0.60	$1,920,000
0.40	$2,070,000

(d) (*2 points*) Recommend whether Awburn should invest in the new bond, based on the above information. Support your recommendation.

For a fee of $25,000, an investment bank can perfectly predict the above outcomes for Awburn before it invests in the new bond.

(e) (*1 point*) Assess whether Awburn should pay the investment bank for the information. Support your assessment.

11. (*9 points*) Chestnut Brown, Inc. ("Chestnut"), a life insurance company, is deciding whether to launch a new life insurance product now, or wait for one year. The new product would be one of Chestnut's biggest investments in recent years and is deemed critical for its long-term strategy.

After the annual capital budget allocation process, the product development area receives the same budget allocation as last year.

(a) (*1 point*) Identify two weaknesses of Chestnut's capital budget allocation process.

Chestnut gathers the following cash flow estimates for the new product:

Initial Investment	Initial Annual Cash Flow	Average Annual Cash Flow Growth Rate	Volatility of Annual Cash Flow
\$10M	\$2M	2%	30%

Chestnut evaluates the project at its WACC (10%). The risk free rate is 3%.

An excerpt of the standard normal table is below.

	0	**0.01**	**0.02**	**0.03**	**0.04**	**0.05**	**0.06**	**0.07**	**0.08**	**0.09**
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990

(b) (*3 points*)

(i) Recommend whether Chestnut should launch now or wait one year. Justify your answer.

(ii) Describe how a change to each of the four cash flow estimates for the new product could change your recommendation in (i).

11. Continued

Chestnut gathers information regarding its competitors: Holly and Berry.

	Chestnut	Holly	Berry
WACC	10%	10%	10%
Expected Growth	5%	7%	10%
Cash ($B)	2	1.6	1.6
Total Assets ($B)	15	9	6
Organizational Capital Constraints	Low	Medium	High

One of Chestnut's finance directors observes, "I know Berry uses a hurdle rate of 20% for evaluating its projects. Berry has the same WACC as we do. Why are we evaluating our project using the WACC?"

(c) (*3 points*)

(i) Identify three possible reasons for Berry's higher hurdle rate.

(ii) Explain why it may be appropriate for Chestnut to use a lower hurdle rate for evaluating this project.

Chestnut's CFO responds, "We are one of the largest insurance companies, have great access to external capital markets, and hedge as much market risk as we can. Therefore, we should evaluate our projects at the cost of capital."

The Treasurer adds, "Berry is holding too much internal cash. If we need to finance a big project, we can easily raise funds in the market. It's the same as if we are holding cash."

(d) (*2 points*) In the context of *Risk Management, Capital Budgeting and Capital Structure Policy for Insurers and Reinsurers:*

(i) Critique the CFO's comment.

(ii) Critique the Treasurer's comment.

12. (*10 points*) Assume the following market situation for valuing a long-term liability:

- The yield curve is directly observed for durations 1-30.
- For all durations greater than 30, the annual effective forward rate is constant at 4.1%.
- At the end of year 30, the present value of future liability cash flows is 1,806.
- At the end of year 30, the duration of future liability cash flows equals 15.

	Value of a 30-year Zero-Coupon Bond	Value of a 29-year Zero-Coupon Bond
Time 0	0.3713	0.3887
In One Year	0.3696	0.3805

(a) (*1 point*) Identify the advantages of the Static Control Model versus the Yield Curve Extension Approach.

(b) (*1 point*) Construct a static hedge at time 0 using a monopole strategy for the given long-term liability cash flows beyond 30 years.

(c) (*2 points*) Explain whether the static hedge strategy in part (b) is an acceptable risk management strategy. Support your explanation.

(d) (*1 point*) Calculate the gain or loss from the static hedge in part (b) after one year, assuming the new one-year forward rate at duration 30 is 3.94%.

(e) (*2 points*) Construct a static hedge at time 0 consisting of an investment in a monopole and a dipole.

(f) (*2 points*) Explain whether the hedge strategy in part (e) is an acceptable risk management strategy. Support your explanation.

(g) (*1 point*) Describe two sources of bias in the dipole model.

13. (*5 points*)

(a) (*3 points*)

(i) Describe the "market timing and catering" theory of behavioral corporate finance.

(ii) List two key building blocks of this theory.

(iii) Justify the reasonableness for each key building block provided in (ii) using two examples.

The management of Dark Beige, a publicly traded company, believes its equity is overvalued.

(b) (*1 point*) Describe possible strategies to preserve excess value for Dark Beige's long-run shareholders.

Dark Beige's new CFO does not agree with the "market timing and catering" theory.

(c) (*1 point*) Describe two arguments that support the CFO's viewpoint.

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

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