SOCIETY OF ACTUARIES
Foundations of CFE Exam

Exam CFEFD

AFTERNOON SESSION

Date: Wednesday, April 25, 2018
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. (*8 points*) Golden Day Cruise (GDC) Lines has decided to purchase a fleet of ships for international cruises. To take advantage of a low interest rate environment, GDC has decided to issue floating rate bonds. The CFO asks you to evaluate if GDC should enter an interest rate swap.

(a) (*1 point*) Describe how an interest rate swap can hedge GDC's interest rate exposure.

Assume GDC enters into the swap. Subsequently, the yield curve steepens significantly but short term rates remain the same.

(b) (*1 point*) Describe the impact on GDC in terms of:

(i) Financial position

(ii) Risk exposure

GDC quantifies interest rate risk using deterministic interest rates in a stress testing analysis.

(c) (*1 point*) Explain how GDC could benefit from a stochastic interest rate model.

(d) (*1 point*) Contrast the following stochastic interest rate models:

I. Hull-White model
II. Heath-Jarrow-Morton model

To hedge its currency exposure from international cruise revenues, GDC wants to add stochastic currency scenarios to the existing stochastic interest rate model.

(e) (*1 point*) Determine the impact of using stochastic interest rates to model currency options.

The CFO wants to evaluate GDC's derivative positions frequently without increasing computing expenses significantly. She recently read about companies using proxy models to manage risk.

9. Continued

(f) (*3 points*)

(i) Describe four types of proxy models.

(ii) Explain to the CFO why using proxy models is not appropriate for managing GDC's derivative positions.

10. (*7 points*) Bonham, a highly leveraged, publicly traded U.S. company, is considering whether to buy or lease equipment from Zanco Inc.

Assumptions for buying the equipment:

- Purchase price is $700M
- Bonham borrows $700M from Zanco
- Depreciation is $100M per year
- Additional expenses are $3M per year
- Bonham will sell the equipment at the end of four years for $300M

Assumptions for leasing the equipment:

- Lease term is four years
- Equipment's remaining useful life is five years after the end of the lease
- Leasing fee is $120M per year

Additional assumptions:

- Tax rate is 35%
- Discount rate is 3%
- Additional revenue from use of the equipment is $150M per year
- All cash flows are at the end of the year except for the equipment purchase and lease payments which are at the beginning of the year.

(a) (*2 points*)

(i) Compare a capital lease to an operating lease in terms of the impact on Bonham's balance sheet.

(ii) Explain whether the FASB criteria would classify the lease as an operating or capital lease for Bonham.

Assume the lease is a true tax lease.

(b) (*1 point*) Explain why Zanco would prefer to lease rather than sell the equipment to Bonham.

(c) (*2 points*) Recommend whether Bonham should buy or lease the equipment based on the cash flows. Show your work.

10. Continued

Now assume that the lease is a non-tax lease.

(d) (*2 points*)

(i) Explain how the lease cash flows change.

(ii) Recommend a change to the lease terms that would leave Bonham indifferent between buying or leasing the equipment based on the cash flows. Show your work.

11. (*10 points*) Esparza Life's product development department wants to identify strategies to grow its Individual Variable Annuities (IVA) business. To do this, Esparza selects the following indicators based on available data:

- Average length of time to answer customer phone calls
- IVA sales in the industry
- Esparza's external ratings

(a) (*1 point*) Explain why Esparza may not be able to make effective decisions using Applied Information Economics.

Esparza is setting up its economic capital framework for the IVA product. It needs to generate risk neutral simulations of the S&P500 index. Management decides to use a geometric Brownian motion model with a constant volatility calculated using historically observed index data.

(b) (*1 point*) Assess the reasonableness of this methodology to generate risk neutral simulations.

Esparza wants to improve its model by revising the calibration of the volatility parameter with a term structure and has collected the following data:

- Current price $S_0 = 1,200$
- Continuously compounded risk-free rate $\mu = 6\%$
- Index volatilities implied by at-the-money call options with following maturities:

Maturity	1 year	2 years
Implied Volatility	10%	20%

- Two random simulations from the standard normal are $z_1 = 0.34$ and $z_2 = -0.21$

(c) (*2 points*) Simulate the index price at the end of year 1 and year 2.

(d) (*2 points*)

(i) Describe one deficiency of using a term structure for volatility calibration.

(ii) Recommend an alternative model that improves the deficiency noted in part (i).

11. Continued

Esparza is considering VaR(99) and CTE(95) as potential risk measures of economic capital for an IVA product with a living benefit rider. As income is guaranteed for life, this product has significant tail risks that are sensitive to economic changes, and a negatively skewed liability distribution. VaR(99) and CTE(95) currently result in the same economic capital amounts.

(e) (*2 points*) Compare how the two measures would change under the following scenarios:

(i) Increase the interest rate hedge percentage

(ii) Equity volatility increases

(f) (*1 point*) Recommend which risk measure Esparza should use for robust capital management. Support your recommendation.

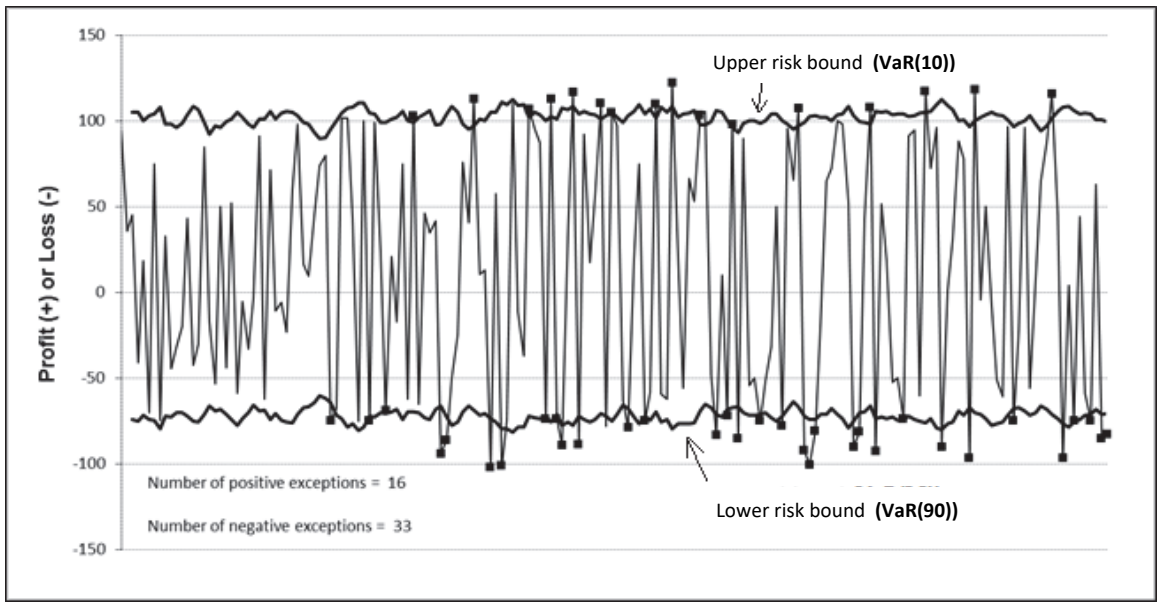
(g) (*1 point*) Describe the static control model approach to managing the IVA product's long-term living benefit liability.

12. (*8 points*) Your colleague has gathered data on investment grade bond trading activity at your company to validate a VaR reporting model, whose assumptions were updated 18 months ago. The data she gathered includes the following information:

- Two years of rolling weekly average profits and losses (P/L)
- Trading fees adjusted to reflect the midpoint of the bid-ask spread
- Bonds rated below investment grade are excluded

(a) (*2 points*) Evaluate the appropriateness of the data for its stated purpose.

After some modifications to the P/L: data, a time series chart was developed including a lower risk bound, VaR(90), and an upper risk bound, VaR(10).



(b) (*3 points*)

(i) Identify four key observations from the chart.

(ii) Interpret these observations with respect to model validation.

12. Continued

Your manager suggests three approaches to validate this model:

I. Christoffersen Backtest

II. Rosenblatt Transformation

III. Berkowitz Transformation

(c) (*3 points*)

(i) Describe each of these three approaches for model validation.

(ii) Recommend one of these approaches as the next step in the risk model validation process. Justify your recommendation.

13. (*7 points*) Autry is a fast-growing company. To accommodate potential expansion needs, the company is buying land. The company may build on the land if demand is steady and sustainable; otherwise Autry may either hold on to the land or, eventually, sell the land.

(a) (*2 points*)

(i) Identify the real options embedded in Autry's strategy.

(ii) Describe four key insights in considering the real options identified in part (i).

(iii) Explain which real option can be regarded as similar to a call option.

Autry has the option to build an additional facility. The facility has $20M of upfront costs but will be obsolete and closed 20 years from today (i.e. in 2038). Until then, the facility would generate $2M annual profit with certainty. The current risk-free rate for a 20-year annuity is 10%. However, in one year all risk-free interest rates will be either 12% or 6% and stay at that level forever. The current one-year risk-free rate is 8%.

(b) (*2 points*) Calculate the value today of the investment opportunity. Show your work.

The CFO comments, "*This project is not risk free, and hence should be discounted at the company's WACC. Similarly, if we discount the option to delay at the risk-free rate, we would overestimate the value of the option.*"

(c) (*1 point*) Critique the CFO's comment.

Autry decides to model interest rates stochastically.

(d) (*2 points*) Outline the steps to calculate the value of the project using Monte-Carlo Simulation.

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

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