
SOCIETY OF ACTUARIES
Foundations in CFE Exam

Exam CFEFD

AFTERNOON SESSION

Date: Wednesday, October 30, 2013

Time: 1:30 p.m. – 3:45 p.m.

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This afternoon session consists of 5 questions numbered 10 through 14 for a total of 40 points. The points for each question are indicated at the beginning of the question. Questions 10-13 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.
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 CFEFD.

Written-Answer Instructions

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

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****
Afternoon Session
Beginning with Question 10

Question 10 pertains to the Case Study.
Each question should be answered independently.

- 10.** (5 points) Assume Frenz is a stand-alone enterprise and the market capitalization as of 12/31/2012 was \$813 million.
- (a) (1 point) Calculate the following for Frenz as of 12/31/2012. Show your work.
- (i) Market-to-book ratio
 - (ii) Book debt-equity ratio
 - (iii) Market debt-equity ratio
 - (iv) Enterprise value
- (b) (1 point)
- (i) Contrast book value and market value of equity.
 - (ii) Explain how enterprise value can be used to evaluate the business.
- (c) (2 points) Referring to Frenz's Financial Statements as of 12/31/2012:
- (i) Calculate Frenz's ROE. Show your work.
 - (ii) Calculate the net profit margin, asset turnover, and equity multiplier. Show your work.
 - (iii) Calculate the increase in sales needed to increase ROE to 35%, assuming Frenz is unable to increase its net profit margin or change its total assets. Show your work.

***Question 10 pertains to the Case Study.
Each question should be answered independently.***

10. Continued

(d) *(1 point)*

- (i) Calculate the accounts receivable days, inventory days, and accounts payable days as of 12/31/2012. Show your work.
- (ii) Calculate the cash conversion cycle (CCC) as of 12/31/2012. Show your work.

Question 11 pertains to the Case Study.
Each question should be answered independently.

11. (8 points) Blue Jay Air has negotiated a contract to upgrade its fleet, as seen in Exhibit 4 of Section 2.6. The cost of capital for evaluating the upgrade is 12%, and the risk-free rate is 2%.

(a) (1 point) Calculate the value of upgrading its fleet today.

Blue Jay Air is considering waiting one year to upgrade its fleet, which would allow Blue Jay Air to gather more information.

You are given the Black-Scholes (B-S) formula:

$$C = S^x N(d_1) - PV(K)N(d_2), \text{ where } d_1 = 0.11 \text{ and } d_2 = -0.07$$

(b) (3 points) The CFO has asked you to evaluate the decision to delay upgrading the fleet for one year.

B-S Parameters	As Defined when Evaluating Real Options	Value
S^x	Current value of asset without dividends prior to option expiry	
$PV(K)$	PV to upgrade in one year	
Dividend		\$10.8 million

- (i) Complete the three missing elements in the table above. Show your work, where applicable.
- (ii) Calculate the value of the option to delay one year. Show your work.
- (iii) Recommend whether Blue Jay Air should upgrade immediately or wait one year to upgrade. Justify your recommendation.

***Question 11 pertains to the Case Study.
Each question should be answered independently.***

11. Continued

- (c) (2 points) Describe the effect on the value of the option to delay from each of the following:
 - (i) Competition from a new high-speed rail corridor increases the volatility of returns.
 - (ii) The delay of the upgrade is two years instead of one year.

- (d) (2 points) Blue Jay Air's CFO is concerned about the difficulty of implementing option analysis on an ongoing basis and has asked you for a simpler approach.
 - (i) Describe two commonly used rules of thumb to account for an option to delay.
 - (ii) Recommend which rule of thumb is more applicable to Blue Jay Air. Justify your recommendation.

***Question 12 pertains to the Case Study.
Each question should be answered independently.***

12. (8 points) You are asked to classify RPPC's models among the following three model types:

- I. Fundamental models
- II. Descriptive models
- III. Statistical models

(a) (2 points)

- (i) Describe each of the three model types.
- (ii) Identify an example of each model type and its purpose within either Frenz or Blue Jay Air.

(b) (3 points) For Blue Ocean's proposed renewable energy business:

- (i) Identify four types of model risk present in its reserving model.
- (ii) Describe how each type of model risk identified in part (i) relates to its reserving model.

(c) (3 points) Recommend four improvements that would reduce the model risk of Blue Ocean's proposed renewable energy reserving model. Justify your recommendations.

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*Question 13 pertains to the Case Study.
Each question should be answered independently.*

13. (12 points) Darwin Life is concerned with the risks of the guaranteed benefits in its group annuity block of businesses. The CRO would like to risk map the entire block and is considering approaches to model both the separate account (equity) and fixed income portfolios.

(a) (2 points)

- (i) Describe the risk mapping process.
- (ii) Describe the benefits of risk mapping for Darwin Life.

You are given the following assumptions:

- The CRO views the fixed income portfolio identical to a non-callable zero-coupon bond which matures for \$1 billion in 6 years.
- 5-year spot rate $(r_5) = 3\%$
- 10-year spot rate $(r_{10}) = 7\%$

(b) (4 points) You map the portfolio to just the 5-year and 10-year spot rates.

- (i) Calculate the reference rate for the portfolio. Show your work.
- (ii) Calculate the sensitivity of the portfolio to an up 1% parallel shift in the spot rate curve. Show your work.
- (iii) Calculate the reference point cash flows at 5 years and 10 years that have the same interest rate sensitivity as the portfolio cash flows. Show your work.

*Question 13 pertains to the Case Study.
Each question should be answered independently.*

13. Continued

The CRO is pleased with your work and uses it to hedge the entire group annuity block, using the following mapping:

- Fixed income portfolio: 5-year and 10-year spot rates
- Equity: 100% US large cap equity

Over the next year, both the fixed income and equity portfolios experience significant losses due to hedge breakage.

- (c) (2 points) Describe three reasons for Darwin's large losses due to hedging breakage in the fixed income portfolio.
- (d) (2 points) Describe three reasons for Darwin's large losses due to hedging breakage in the equity portfolio.
- (e) (2 points) Recommend four improvements to the hedging program described above. Justify your recommendations.

- 14.** (7 points) You are calibrating an equity model to 50 years of monthly log returns, Y_t , where:

$$Y_t = \ln(S_t / S_{t-1})$$

S_t is the stock price at time t , where $1 \leq t \leq 600$.

You are also given order statistics:

$$Y_6 = -0.12$$

$$Y_{15} = -0.097$$

$$Y_{585} = 0.118$$

$$Y_{594} = 0.145$$

and summary statistics:

$$\sum(Y_i) = 4.65$$

$$\sum(Y_i^2) = 2.17$$

Your manager has asked you to calibrate a lognormal model to the monthly stock returns:

$$S_t / S_{t-1}$$

- (a) (1 point) Explain how parameters are calibrated using Maximum Likelihood Estimation (MLE).
- (b) (1 point) Calculate the necessary parameters to fit the given stock returns to a lognormal model using MLE. Show your work.

14. Continued

After completing this preliminary calibration of your model, you learn that this model will be used for a variable annuity product with a 5-year GMAB that is expected to pay off in less than 10% of scenarios.

- (c) (2 points)
- (i) Recommend a more appropriate calibration method for the model based on the characteristics of the product and the given data. Justify your recommendation.
 - (ii) Calculate the model parameters for the lognormal model using the method you chose in part (i). Show your work.

A colleague of yours has already calibrated a regime-switching lognormal model with 2 regimes (RSLN-2). The RSLN-2 model has a log-likelihood function, $l(\theta)$, of 850, while your lognormal model has an $l(\theta)$, of 840.

- (d) (1 point) Describe how the following quantitative measures for evaluating parameter calibration might inform your choice between the lognormal and RSLN-2 models above:
- (i) Likelihood Function
 - (ii) Schwarz-Bayes Criterion
- (e) (2 points) Your manager suggests that you recalibrate your existing model to the cumulative 5-year return at the end of each historical month, where available.
- (i) Identify the error in your manager's proposal.
 - (ii) Recommend an improvement upon your manager's suggestion. Justify your recommendation.

****END OF EXAMINATION****

Afternoon Session

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