
SOCIETY OF ACTUARIES
Foundations of CFE Exam

Exam CFEFD

MORNING SESSION

Date: Wednesday, October 28, 2015

Time: 8:30 a.m. – 11:45 a.m.

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This examination has a total of 100 points. It consists of a morning session (worth 60 points) and an afternoon session (worth 40 points).
 - a) The morning session consists of 8 questions numbered 1 through 8.
 - b) The afternoon session consists of 5 questions numbered 9 through 13.

The points for each question are indicated at the beginning of the question. Questions 1 through 4 in the morning session 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.

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.** (8 points) Frenz's research shows that most companies in Vietombia are highly leveraged and financed through short-term debt.
- (a) (2 points) Describe three institutional environmental factors that might influence the capital structure of companies in Vietombia.

Frenz's analysis of beverage production companies in Vietombia shows that they:

- Hold more cash and inventory compared to Frenz
 - Use trade credit on terms 2/10, Net 30
- (b) (2 points)
- (i) Describe the costs and benefits of holding inventory.
- (ii) Describe the costs and benefits of holding cash.
- (c) (1 point) Explain two reasons why Frenz might hold relatively less cash than companies based in Vietombia.

Assume Frenz will use the same trade credit terms as companies in Vietombia.

- (d) (3 points)
- (i) Calculate Frenz's accounts receivable days using 2012 year-end data.
- (ii) Calculate Frenz's accounts payable days using 2012 year-end data.
- (iii) Assess whether Frenz should manage its account payables and account receivables differently if it expands into Vietombia.

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

2. (7 points) Blue Jay Tire (BJT) has manufacturing costs and revenue generated in different currencies (Case Study 3.2.11). BJT would like to protect its earnings from changes in the Malaysian currency's exchange rate.

(a) (3 points)

- (i) Describe a currency swap that BJT could execute to reduce this currency exchange risk.
- (ii) Select the type of swap counterparty that would be most advantageous to BJT. Defend your selection.

Almond Bank (Case Study 3.2.1) has made a new proposal. They state that 85% of the time, the one-year fluctuation in the cost of rubber is between -3% and $+10\%$. Therefore, BJT could reduce its outlay by selling a one year contract for \$6 million that pays \$100 million if the cost of rubber is down 3% or more.

Assume a risk-free rate of 2%, and use the securities described in Case Study 3.2.1.

(b) (4 points)

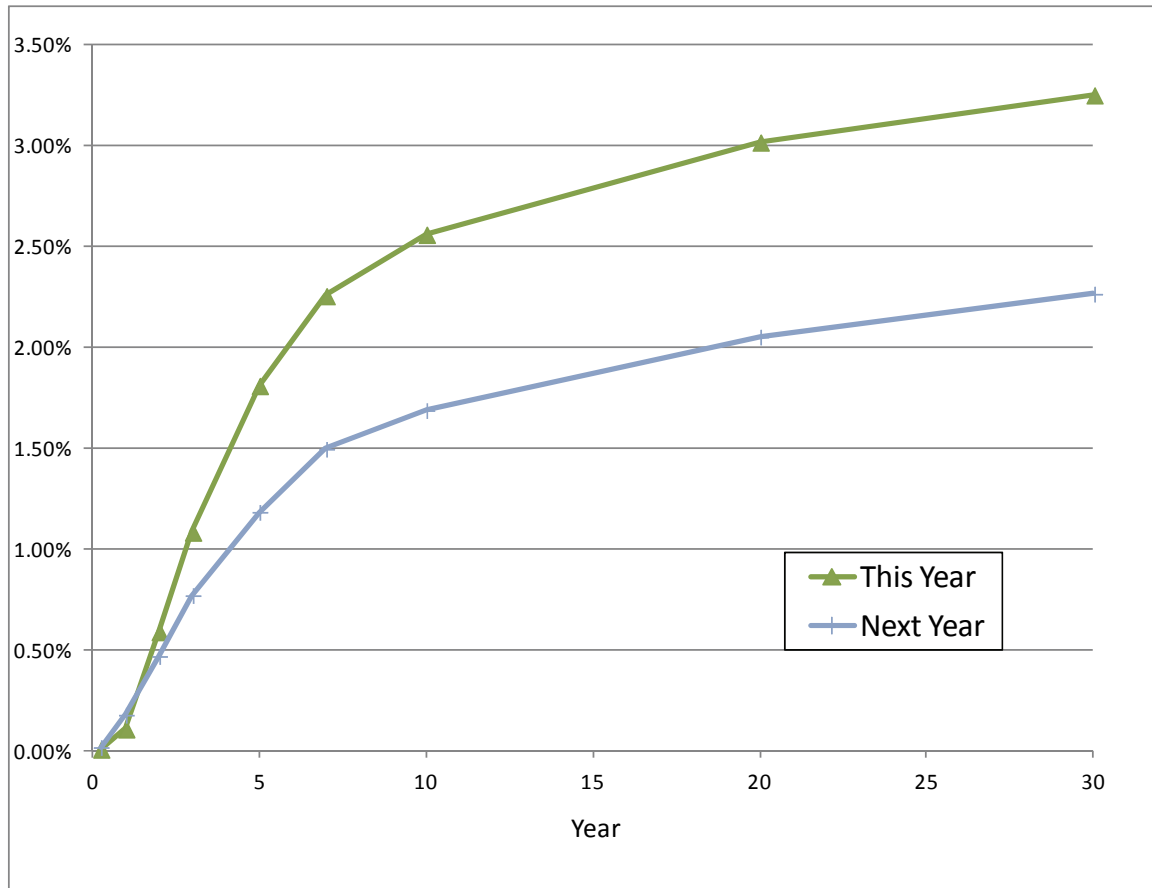
- (i) Calculate the price of protection that would pay BJT \$100 million if the cost of rubber is between 10% and 15% higher at the end of the year. Show your work.
- (ii) Determine the risk neutral probability of the cost of rubber being more than 10% higher at the end of the year.

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

- 3.** (8 points) Your consulting firm is evaluating Darwin's General Account interest rate risk exposure (Case Study 7.8, Exhibit 2). Your firm has calculated the following:
- Market value of liabilities: \$10 billion
 - Duration of liabilities: 8 years
- (a) (2 points)
- (i) Calculate Darwin's sensitivity to interest rates as of December 31, 2014, using duration.
 - (ii) Describe the impact of a 1% change in interest rates on Darwin's economic surplus, measured as the market value of assets minus the market value of liabilities, as of December 31, 2014.
- (b) (2 points) Determine whether the following techniques will be effective in reducing Darwin's exposure to interest rate risk. Support your answers.
- (i) Rebalancing its asset portfolio
 - (ii) Entering an interest rate swap
 - (iii) Entering an excess of loss reinsurance arrangement for its term insurance business

3. Continued

Darwin asks your firm to consider the following stress test: Assume credit spreads have widened and the risk-free yield curve has changed as shown below:



- (c) (2 points) Evaluate the effectiveness of each technique in part (b) in protecting Darwin's economic surplus under this stress test.

Assume the duration of a 10-year, fixed-coupon bond is 6.5 years.

- (d) (2 points) Design an interest rate hedge to immunize Darwin's economic surplus.

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

4. (7 points) Blue Ocean is considering what portion of its capital is needed to cover lost net revenues on rainy days (20 cents per kWh per home) for its Solar Personal Energy Insurance business (Case Study 5.2). Able Energy collected the following sample statistics:

Years	Average Number of Rainy Days per Year (μ)	Sum of Observed Value Minus the Mean Squared, $\sum(x - \mu)^2$
2000-2010	79.8	607.6

Able Energy estimates the number of rainy days per year, by observing the weather for one week. Two days were rainy.

- (a) (2 points)
- (i) State which sampling method was used by Able Energy.
 - (ii) Contrast the effectiveness of Able Energy’s method versus spot sampling.

Blue Ocean is concerned that climate change may decrease the relevance of older data. They decide to use 2009 and 2010 observations only.

- (b) (2 points)
- (i) Calculate the standard deviation of the number of rainy days.
 - (ii) Estimate the maximum number of rainy days with 97.5% likelihood.
 - (iii) Evaluate whether this is an appropriate sample size to estimate likelihoods. Support your evaluation.

To produce a business plan for 2014-2018, Blue Ocean uses all 11 data points, from 2000-2010 (Case Study 5.2.3) and holds reserves to cover expected lost revenue. An amount equal to 10% of “Target Capital” is proposed to protect against additional lost net revenue due to a higher than expected number of rainy days.

- (c) (2 points) Demonstrate that the proposed amount is sufficient with 97.5% certainty for 2014-2018. Show your work.
- (d) (1 point) Identify four reasons why a publicly traded company might be reluctant to pay out excess capital.

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5. (7 points) The board of directors of Empryss Corporation (“Empryss”) met to discuss its future market strategy using Applied Information Economics. The following statements were made at the meeting:

- I. “We will no longer be able to buy advertising at both the World Cup and the Olympics. Advertising for both events is expected to cost the same amount and generate the same revenue. How can we measure which alternative is preferable?”
- II. “We would like to determine the value of the Human Resources Department (“HR”) at Empryss, in order to help decide whether we should maintain or eliminate HR. What metrics can we use to determine the value of HR? How would we estimate this?”
- III. “Last week, we began modeling potential reputational risk using last year’s consumer survey. In two months, we have a meeting to develop strategies based on model results.”

(a) (2 points) Explain why Empryss may not be able to make an effective decision pertaining to each of the three statements.

5. Continued

Empryss can perform a field study of all projects under the following conditions:

- The study would cost \$500,000.
- The study would revise the probabilities of failure and success.
- Empryss can spend no more than \$3,000,000 combined on the projects and field study.
- Empryss selects projects in an attempt to maximize the difference between Impact to PV of Revenue and Project Cost, with and without the field study.

		Current Probabilities (without Field Study)		Revised Probabilities (Known Only After Field Study is Conducted)		Impact to PV of Revenue if Project is Launched	
		Project Cost	Failure	Success	Failure	Success	Failure
Project A	\$2,000,000	20%	80%	35%	65%	\$(10,000,000)	\$7,500,000
Project B	\$500,000	10%	90%	40%	60%	\$(750,000)	\$1,200,000
Project C	\$2,500,000	40%	60%	10%	90%	\$(2,000,000)	\$4,000,000
Project D	\$750,000	13%	87%	27%	73%	\$(9,000,000)	\$3,000,000
Project E	\$1,500,000	20%	80%	40%	60%	\$(4,350,000)	\$2,000,000

- (b) (5 points) Determine the Expected Value of Information of performing the field study.

6. (6 points) You founded your own firm, Olive, Inc., three years ago by contributing \$10 million of capital in exchange for 10 million Series A shares. One year later, an additional 5 million Series B shares were sold to Angel Investors, LLC, at \$2 per share.

(a) (1 point) Calculate the post-money valuation of Olive after selling shares to Angel Investors.

Subsequently, although concerned about decreasing ownership equity, you decide to sell another 5 million Series C shares through an auction initial public offering (IPO). Olive has received the following bids:

Price per Share (\$)	Number of Shares Bid (millions)
4.75	0.25
4.50	1
4.25	2
4.00	3
3.75	5
3.50	5
3.25	5

(b) (1 point) Calculate the post-money valuation of Olive after the Series C IPO.

Since the IPO, Olive has been growing rapidly and its share price has significantly increased, although Olive remains relatively unknown to outside investors.

You are aware of potential investment opportunities available in the next few years and would like to raise \$40 million today.

Magenta Consulting suggests you raise the additional funds via a seasoned equity offering (SEO), saying that it will increase Olive's value. Your CFO replies, "How we raise the \$40 million is not important; the value of Olive is the present value of its future cash flows and that won't be affected by how we raise the funds."

(c) (2 points)

- (i) Critique Magenta's suggestion.
- (ii) Critique your CFO's statement.

6. Continued

Instead of a SEO, you consider issuing convertible bonds to raise the \$40 million.

- (d) (2 points) Recommend the better alternative, a SEO or convertible bonds, for raising the \$40 million. Justify your answer.

7. (10 points) Your company, Fairweather Funds, has just added a new feature, called “AirLift,” to its actively managed Humilis equity mutual fund. If the Humilis Fund underperforms a benchmark index in all three months of a calendar quarter, then AirLift is triggered: the difference in performance is deposited into the investor’s account. Measurement to determine underperformance is as of the last business day each month.

To qualify for AirLift, the investor must remain invested in the fund, with no transfers in or out of the fund, for the three-month calendar quarter. AirLift is first offered with the calendar quarter starting on July 1, 2015.

AirLift is designed to reduce the portion of transaction costs stemming from investor transfers in and out of the fund. Fairweather Funds uses a three-month 95% VaR as its primary risk measure.

Eighteen months of Humilis Fund returns relative to the benchmark index return are shown below.

	First Quarter			Second Quarter			Third Quarter			Fourth Quarter		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2014	+2%	+4%	+3%	+1%	−2%	+1%	+2%	+5%	+4%	+6%	+2%	−1%
2015	−3%	−2%	−1%	−1%	+2%	+3%						

- (a) (2 points)
- (i) Calculate the three-month 95% VaR as of June 30, 2015, for the AirLift feature, based on the results of the prior eighteen months, assuming monthly results are independent. Show your work.
 - (ii) Calculate the transaction cost savings, as basis points of fund value per month, needed to break even, assuming that 5% of fund value is paid when an AirLift payout occurs. Show your work.

You are the new portfolio manager for the Humilis Fund. You ask your team to model the distribution of AirLift payouts and stage a team competition to most accurately model alpha, calculated as

$$\text{alpha} = \frac{1 + \text{Humilis return}}{1 + \text{benchmark index return}} - 1$$

7. Continued

Alice, one team member, develops separate lognormal models for $(1 + \text{return})$ for both the Humilis Fund and the benchmark index.

(b) (2 points)

- (i) Describe two shortcomings of modeling equity returns with a lognormal model.
- (ii) Assess whether these shortcomings are likely to have a material effect on Alice's analysis.

Bob, a second team member, develops a lognormal model for $(1 + \text{monthly alpha})$. He calibrates his model by randomly sampling daily alpha results from the past 10 years to construct monthly alpha samples.

(c) (2 points)

- (i) State whether Bob's model is equivalent to Alice's model. Justify your answer.
- (ii) Describe a mis-specified relationship due to Bob's calibration method.
- (iii) Describe a problem in Bob's calibration method.

Charlie, a third team member, models both sets of returns using a stochastic volatility model with a square-root-diffusion process, using Bob's monthly data to calibrate the model.

- (d) (1 point) Describe a potential model risk specific to Charlie's modeling approach.
- (e) (2 points) Explain how endogenous model risk may result in higher transaction costs from the AirLift feature.
- (f) (1 point) Explain the advantages and disadvantages of using a competition to reduce model risk.

8. (7 points) Gold Standard Corporation (GSC), a publicly traded company, has begun its annual reviews of upcoming product initiatives and management compensation.

- (a) (1 point) Explain two frictions faced by GSC in determining optimal capital structure and management compensation.
- (b) (2 points) Describe how the frictions in part (a) evolve, from the perspective of outside investors, during the following periods:
 - (i) The beginning of a production process
 - (ii) The middle and end of a production process

Jean Smith is the Executive Vice President of GSC’s product development department. She has been successful in her current role and is highly sought after by competitor firms. GSC is reviewing the following compensation packages for Smith:

Package	Base Pay	Termination Payment
1	\$400,000	\$50,000
2	\$300,000	\$200,000 plus 100,000 shares of GSC stock

The Termination Payment is payable if Smith is terminated due to a merger or acquisition involving GSC.

- (c) (2 points) Recommend which compensation package GSC should offer Smith to ensure she remains productive. Support your answer.

A year later, GSC raises capital to launch a new product line under Smith’s leadership. GSC finances the new product line using 80% debt and 20% equity.

- (d) (2 points) Recommend changes to Smith’s compensation package to better align her interests with those of the new outside investors. Support your recommendations.

****END OF EXAMINATION****
Morning Session

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