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**SOCIETY OF ACTUARIES**  
**Foundations of CFE Exam**

# Exam CFEFD

## MORNING SESSION

**Date:** Wednesday, November 1, 2017

**Time:** 8:30 a.m. – 11:45 a.m.

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### 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 – 6 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 – 6 pertain to the Case Study.  
Each question should be answered independently.*

**1.** (6 points) You are an actuary in Darwin Life’s Risk Management department. Your boss, John Clark, has asked you to review the capital measurement and management recommendations by Consultants R Us (CRS). CRS has recommended Risk-Adjusted Return on Capital (RAROC).

- (a) (1 point) Identify two pros and two cons of RAROC as compared to total stock return.
- (b) (1 point) Identify two pros and two cons of RAROC as compared to IRR.

You have reviewed the GAAP projections (Case Study, Section 7.8) for use in the RAROC calculation.

- (c) (2 points) Recommend three improvements to Darwin’s GAAP projections in order for the data to be appropriate for calculating RAROC.

CRS has estimated the RAROC for the new ULSG product offering (Case Study, Section 7.7.1) at 11.5% and estimated Darwin’s cost of capital at 10.8%. CRS has assumed higher mortality rates, lower lapse rates and lower asset returns than Darwin assumed.

- (d) (1 point) Recommend whether Darwin should invest in the ULSG product based on CRS’ analysis. Support your recommendation.
- (e) (1 point) Describe how behavioral factors could impact management’s decision to invest in the ULSG product.

*Questions 1 – 6 pertain to the Case Study.  
Each question should be answered independently.*

- 2.** (8 points) The RPPC Board of Directors and CEO have stated the following four expectations:
- I. Standardize model validation and risk management practices across the organization.
  - II. Ensure that all business unit models are internally consistent with each other, as applicable.
  - III. Validate the appropriateness of the models used by the business units.
  - IV. Establish best practices for RPPC’s model risk management.
- (a) (2 points)
- (i) Sketch the critical path regarding the order of model risk validation.
  - (ii) Justify the order of the critical path in part (i).
- (b) (1 point) Propose a method to manage model risk with respect to expectations I and II.
- (c) (2 points)
- (i) Evaluate two key model risks specific to Blue Ocean P&C’s reserving model (Case Study, Section 5.2.4).
  - (ii) Propose an approach to mitigate each model risk identified in part (i).
- (d) (1 point) Recommend potential improvements to the interest rate hedging model used by Blue Jay Air (Case Study, Section 2.5.3) with respect to expectation III.
- (e) (2 points)
- (i) Recommend four improvements to RPPC’s model risk management (Case Study, Section 1.3.10) to achieve expectation IV.
  - (ii) Identify the type of model risk that each of these improvements mitigates.

*Questions 1 – 6 pertain to the Case Study.  
Each question should be answered independently.*

**3.** (9 points) Blue Ocean is considering raising additional capital to fund the Renewable Energy Insurance Business. It has focused on debt financing options. (Case Study, Section 5.2)

(a) (1 point) Explain why Blue Ocean is able to raise debt through a bond offering instead of resorting to notes or debentures.

Instead of raising additional capital, CFO Michael Tan would prefer to free up some of Blue Ocean's existing capital. Tan asks the Chief Actuary, Anne Green, to consider both securitization and reinsurance of Blue Ocean's current lines of business. (Case Study, Section 5.1.6 – 5.1.8)

(b) (3 points) Evaluate whether reinsurance or securitization is more appropriate for capital requirement reduction and risk transfer for each line of business:

(i) Marine Insurance

(ii) Pet Insurance

(iii) Travel Insurance

Blue Ocean has decided to pursue securitization. Since this is a new undertaking for the company, Tan would like to set up an advisory board.

(c) (1 point) Describe the functions of an advisory board.

(d) (1 point) Explain the benefits to Blue Ocean of creating an advisory board as opposed to appointing additional members to its Board of Directors.

Potential legislation has been introduced that would make Blue Ocean's securitization unprofitable. If the legislation does not pass this time, then it is assumed that it will never pass. The results of the legislation will be known before Blue Ocean can complete the securitization process.

(e) (1 point) Describe how Blue Ocean can use real options to decide if it should incur the initial securitization costs today.

### 3. Continued

Blue Ocean's management team is deciding how to allocate the remaining available capital to grow its three current lines of business. Tan makes the following comments:

- I. *Just because Marine Insurance contributes the most profit to Blue Ocean does not mean it should receive the most capital next year.*
- II. *We need to allocate capital to the lines of business with the greatest growth potential, with particular focus on near-term profit.*
- III. *Stress tests can help us understand each line of business' downside risk, so there's no need to include these risks in the expected cash flow projection.*

(f) (2 points) Critique each of Tan's comments.

**Questions 1 – 6 pertain to the Case Study.**  
**Each question should be answered independently.**

**4.** (6 points)

- (a) (1 point) List four factors of a country's institutional environment that can influence a company's capital structure and debt maturity choices.

Blue Jay Air (BJA) is considering whether to embark on an expansion project to either lease or purchase more aircraft (Case Study, Section 2.4.1). Due to the significant costs, BJA will require either a capital injection or debt guarantees from RPPC.

- (b) (1 point) Explain why equity financing is not an option for BJA.
- (c) (4 points) BJA is making its decision on the fleet expansion based on NPV analysis using RPPC's weighted average cost of capital (Case Study, Section 2.6 – Exhibit 4). If BJA purchases the fleet, assume the fleet is sold at the end of five years at a salvage value of \$1B.
- (i) Evaluate the lease option using NPV analysis.
  - (ii) Evaluate the buy option using NPV analysis.
  - (iii) Calculate the tax shield advantage of the buy option.
  - (iv) Calculate a purchase price that would make BJA indifferent between leasing or buying the fleet.



**Questions 1 – 6 pertain to the Case Study.  
Each question should be answered independently.**

**5.** (7 points) Blue Ocean is considering offering renewable energy insurance (Case Study, Section 5.2). Blue Ocean’s CFO, Michael Tan, asks what is the return on investing in this insurance program.

- (a) (2 points)
  - (i) Explain why Tan’s question is not suitable for measurement within the Applied Information Economics (AIE) framework.
  - (ii) Propose an alternative question to be answered that is suitable under the AIE framework.

Blue Ocean’s team has identified weather as one of the major risks of the new insurance program. (Case Study, Section 5.2.2).

(b) (2 points) Describe the process to quantify weather as a risk factor under an AIE framework.

Blue Ocean launched Solar Personal Energy Insurance. Blue Ocean’s costs are fees paid per kWh to homes, and its revenues are Energy Co resale rates as shown in the business case (Case Study, Section 5.2.3). Operations in 2015 and 2016 went exactly as expected. However, a change in regulation will reduce restrictions on nuclear power and allow new plants to be built. This influx of additional power sources will reduce the Energy Co resale rate, effective at the beginning of 2017.

Assume the following:

- Expected decrease to Energy Co resale rate has the following distribution:

Probability	50%	50%
Amount of Decrease (cents)	15	30

- The amount of decrease to the resale rate will be the same for all years.
- Discount rate is 10%.
- Other factors are the same as in the original business plan.
- All policies will terminate by the end of 2019.

In exchange for an upfront, lump-sum premium, a reinsurance company is willing to cover the loss when the energy resale rate goes below fees paid to homes.

(c) (3 points) Calculate the maximum premium Blue Ocean should pay, based on information given above. Show your work.

**Questions 1 – 6 pertain to the Case Study.**  
**Each question should be answered independently.**

**6.** (8 points) Frenz plans to raise capital to drive its marketing and growth strategies (Case Study, Sections 4.1.3 & 4.2.3). The following funding sources are available:

- I. Venture capital
- II. Commercial loans
- III. Franchising / licensing

(a) (2 points)

- (i) Assess each of the options I-III listed above as possible funding sources for Frenz.
- (ii) Recommend the best funding source for Frenz. Justify your recommendation.

Frenz's Marketing VP, Anthony Pirot, and Frenz's CRO, Robert Kaplan, disagree on how capital should be allocated to achieve Frenz's marketing goals and to follow the company's risk management guidelines.

- Pirot said *“Our top priority is to expand into the Asian market. We currently have a lot of cash on hand and we can afford to invest in Asia on any project we like, as long as we can earn more than we do now.”*
- Kaplan replied *“We should evaluate the Asian expansion and all projects based on risk. By investing and expanding in the Asian market, we are 100% diversifying our portfolio and can effectively mitigate risk.”*

(b) (2 points) Critique each statement using the lessons learned from JP Morgan's, “Best-in-Class Capital Allocation” paper.

You are considering Frenz's opportunity to invest in the Vietombia proposal (Case Study, Section 4.3 Exhibit 5) from a capital budgeting standpoint.

(c) (2 points) Describe Frenz's decision making process with respect to each of the following:

- (i) Timing of this investment
- (ii) Frenz's cost of capital for the Vietombia proposal

(d) (2 points) Explain why Frenz might proceed with the Vietombia project.

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7. (10 points)

- (a) (1 point) Identify advantages and disadvantages of entering into a swap arrangement.

Companies X and Z can raise funds using a fixed interest loan or a floating interest loan as shown below:

	Company X	Company Z
Fixed Interest Rate	6.00%	9.00%
Floating Interest Rate	LIBOR + 1.00%	LIBOR + 2.00%

X believes LIBOR will decrease while Z believes LIBOR will increase. The two companies could select one of the following options:

- I. X raises funds with a floating interest rate and Z raises funds with a fixed interest rate.
- II. X raises funds with a fixed interest rate, Z raises funds with a floating interest rate, and then they enter into a swap arrangement. The swap will be arranged such that X and Z split the funding cost reduction evenly.

- (b) (3 points) Consider option II.

- (i) Draw the diagram of transactions for option II.
- (ii) Determine the combined reduction in funding costs for the two companies as compared to option I.
- (iii) Calculate the fixed and floating rates of the swap.

X and Z have each taken a \$100M loan effective 2018-01. Terms of the loans require a lump sum repayment in three years and interest payments at the end of every six months. The expected annual interest rates (compounded semi-annually) are provided in the table below.

Date	Company X		Company Z	
	Fixed Interest Rate	Expected 6 month LIBOR	Fixed Interest Rate	Expected 6 month LIBOR
2018-01	6.00%	6.00%	9.00%	6.00%
2018-07	6.00%	5.00%	9.00%	7.00%
2019-01	6.00%	4.50%	9.00%	7.50%
2019-07	6.00%	5.00%	9.00%	9.60%
2020-01	6.00%	4.00%	9.00%	9.80%
2020-07	6.00%	3.80%	9.00%	10.00%
2021-01	6.00%	4.00%	9.00%	11.80%

## 7. Continued

- (c) (2 points) Under option II:
- (i) Calculate X's semi-annual net payment flows under its expectations.
  - (ii) Calculate Z's semi-annual net payment flows under its expectations.

Three years later, actual LIBOR rates were as follows:

Date	LIBOR
2018-01	6.00%
2018-07	6.50%
2019-01	5.80%
2019-07	4.70%
2020-01	5.80%
2020-07	7.80%
2021-01	7.20%

- (d) (2 points) Calculate the semi-annual net payment flows for X and Z under:
- (i) Option I
  - (ii) Option II
- (e) (1 point) Describe the risk management considerations when collateral is required for a swap.
- (f) (1 point) Describe how a company's risk profile changes if swaps are cleared through a centralized counterparty.

8. (6 points) Duvalt, Inc., a start-up company, is planning to invest in a simple project. You have the following information:

- Duvalt's debt to equity ratio is 1.0 and will stay constant
- Cost of debt is 6%
- Cost of equity is 15%
- Tax rate is 35%
- Project investment is \$9,500,000 at the beginning of the year
- Expect return is \$11,000,000 at end of the year

(a) (1 point) Calculate the NPV of the project using the WACC method. Show your work.

Your co-worker reconciled the value using the Adjusted Present Value (APV) method. Below are his calculations:

- Discounted present value (ignoring the tax shield) is \$9,954,751
- Unlevered cost of capital is 10.5%
- Value of tax shield  $\left[ \frac{(50\% \times 9,500,000 \times 6\% \times 35\%)}{1.105} \right]$  is \$90,271
- Value of the project with leverage is \$10,045,023.

(b) (1 point) Identify your co-worker's error(s). Justify your response.

Duvalt is evaluating its capital structure. The CFO made the following statements:

- Cost of capital is unaffected by choice of capital structure of our company.*
- Cost of capital falls as debt increases for our company.*
- This project can be 100% debt financed and be risk free too.*

(c) (2 points) Evaluate each of the CFO's statements, I-III.

Duvalt has had significant growth in the past few years and is considering going public.

(d) (2 points)

- Discuss four rule of thumb criteria that Duvalt should meet before launching an IPO.
- State two advantages and two disadvantages to Duvalt of going public.

**\*\*END OF EXAMINATION\*\***

**Morning Session**

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