
SOCIETY OF ACTUARIES
Foundations of CFE Exam

Exam CFEFD

MORNING SESSION

Date: Wednesday, April 25, 2018

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 – 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.** (7 points) Frenz Corporation (Case Study, Section 4) is considering raising capital either through commercial lending or issuing equity.
- (a) (2 points) Describe four concerns that may impact a commercial lender's willingness to make a loan to Frenz.
 - (b) (1 point) Explain why issuing equity may lead to negative market reactions according to the pecking-order model.
 - (c) (2 points) Considering the Vietombia project (Case Study, Section 4.2.3 & Section 4.3 – Exhibit 5b):
 - (i) Calculate the project payback period.
 - (ii) Calculate the net present value of the project.
 - (iii) Explain why this project's cost of capital is higher than Frenz's cost of capital. Support your answer.
 - (iv) Justify the use of the net present value criterion instead of the payback period to evaluate the Vietombia project.
 - (d) (2 points) Evaluate the Vietombia project's impact to Frenz's existing business in terms of:
 - (i) Synergies
 - (ii) Cannibalization

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

2. (7 points) RPPC now requires its subsidiaries to maintain sufficient internal capital with an insolvency probability of 1% or less for a one year time period. RPPC's method assumes:

- Policyholder premiums cover the expected loss.
- Individual risks are independent and identically distributed.

Darwin is concerned with this methodology but attempts to apply this requirement to its current term block where the standard deviation of claims for a single policy is \$300.

(a) (2 points)

- (i) Calculate the minimum per policy capital requirement for 2018. Show your work.
- (ii) Critique this methodology for determining capital for Darwin's term block.

For the new ULSG block, Darwin is analyzing different mechanisms of risk transfer to reduce the capital requirement (Case Study, Section 7.7.1).

- (b) (2 points) Identify advantages and disadvantages of reinsurance as the mechanism of risk transfer in the insurance industry.
- (c) (1 point) Explain the steps Darwin should follow to use securitization.
- (d) (1 point) Recommend whether Darwin should reinsure or securitize the ULSG block as a method of transferring risk to reduce capital requirements. Justify your recommendation.
- (e) (1 point) Recommend two products within the RPPC family, other than ULSG, that would be good candidates for securitization. Support your recommendation.

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

3. (7 points)

- (a) (1 point) Identify one likely source of funding for each stage of business growth:
- (i) Seed/Start-up stage
 - (ii) Growth stage
 - (iii) Mezzanine/Bridge
 - (iv) Harvest
- (b) (2 points) Describe how RPPC's structure as a corporation aligns with its mission and strategic goals (Case Study, Section 1.1 & Section 1.2) with respect to:
- (i) Funding availability
 - (ii) Legal structure
 - (iii) Governance
 - (iv) Ownership
- (c) (2 points) RPPC is planning to invest in new ventures that develop solar energy technologies.
- (i) Evaluate RPPC's ability as a venture capital investor.
 - (ii) Recommend at which stage of business growth RPPC should invest given its risk appetite (Case Study Section 1.3.6). Justify your recommendation.

3. Continued

- (d) (2 points) Blue Energy, a start-up company developing solar energy technologies, has offered RPPC a private placement opportunity.
- (i) Describe one advantage and one disadvantage for Blue Energy to use private placement financing.
 - (ii) Evaluate the appropriateness of RPPC as the private placement investor for Blue Energy.
 - (iii) Identify key sections of a private placement memorandum.

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

- 4.** (8 points) You are an actuary working at Frenz. Shortly after a hurricane impacts the region where Frenz sources its tea, you receive the following email from Robert Kaplan, the new CRO.

“I hired Consultants R Us (CRS) to build Frenz a new commodity model. I felt that our current model was too simple, and that we needed a more sophisticated model. Also, climate change is causing more severe weather events which will make our commodity risk more pronounced.”

“The consultants complied with all the RPPC Model Risk Management requirements. They also ran tests to assess the model risk, and they classified it as ‘low’.”

“I would like for you to start using their model, let me know if you have any concerns.”

- (a) (1 point) Interpret CRS’ classification of model risk as ‘low’.
- (b) (2 points) Explain three ways that model risk can increase due to using CRS for model development.

You receive a follow-up email from Kaplan before you have a chance to respond to his first:

“In addition, since the CRS model is so much more advanced, I don’t think we need to spend time on validating the model, or conducting stress testing going forward.”

- (c) (1 point) Critique Kaplan’s statement.
- (d) (1 point) Propose three stress tests using scenario analysis to address Frenz’s supply-chain risks (Case Study, Section 4.3 – Exhibit 2).

4. Continued

In addition to stress tests using scenario analysis, you are asked to design a mechanical stress test using factor push analysis based on the following information:

(in USD \$M)	Mean Annual Cost	Standard Deviation
Coffee Beans	300	10
Tea Leaves	60	2
Shipping	20	5

- Each annual cost has a distribution independent from each other.
 - Confidence Level Parameter $\alpha = 2$
- (e) (1 point) Calculate the maximum loss based on two costs from above that would produce the worst-case scenario.
- (f) (2 points)
- (i) Explain the meaning of the Confidence Level Parameter, α , in a VaR context.
 - (ii) Identify one advantage of factor push analysis compared to scenario analysis.
 - (iii) Describe two reasons why this mechanical stress test may misestimate Frenz's supply-chain risks.

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

5. (9 points) RPPC’s vision statement notes that the company is guided by “A Risk Appetite that shapes business strategies and is integrated into our decision-making processes” (Case Study, Section 1.3.1). RPPC’s CRO, Julia Reich, would like to revisit the company’s risk appetite (Case Study, Section 1.3.6).

- (a) (2 points) Propose a process using Applied Information Economics (AIE) to strengthen RPPC’s current risk appetite statement by better quantifying its risk tolerance.
- (b) (2 points)
 - (i) Identify two weaknesses with RPPC’s key indicators regarding the cost of capital.
 - (ii) Explain how an AIE approach could correct those issues.

The Board members of Frenz Corporation disagree on the best way to allocate marketing dollars across Frenz Corporation’s six marketing strategies (Case Study, Section 4.1.3). Reich proposes using the Lens Model as a quantifiable process for determining the strategy that will yield the highest percentage increase in customers.

- (c) (3 points)
 - (i) Propose three factors for Frenz to include in the model to determine the optimal marketing strategy.
 - (ii) Describe how Frenz would use the factors you proposed in part (i) in the Lens Model.

Frenz Corporation’s Chairman of the Board, Felix Hermans, believes that instead of doing a full Lens Model process, the Board should use an Analytic Hierarchy Process to evaluate marketing strategy alternatives.

- (d) (1 point) Describe how an Analytic Hierarchy Process could be applied to Frenz’s selection of alternative marketing strategies.
- (e) (1 point) Identify three common weaknesses of the Analytic Hierarchy Process model.

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

6. (8 points)

- (a) (1 point) Describe why future stock price returns may be lower after a seasoned equity offering targeted at new investors versus a rights offer targeted at a firm's long-term shareholders.
- (b) (1 point) Calculate RPPC's expected after-tax cost of capital. Show your work.

Assume that Blue Jay Air's management team believes this cost of capital is low and would like to take advantage of it by pursuing an update to its Business Lounges (Case Study Section 2.4.4).

- (c) (3 points)
 - (i) Recommend which of the potential Business Lounge upgrades Blue Jay Air should pursue, assuming its goal is to maximize the return on capital. Justify your recommendation.
 - (ii) Determine whether the investment decision would change if the managers of Blue Jay Air were compensated based on achieving the highest NPV. Show your work.
- (d) (2 points)
 - (i) Explain why current shareholders would want Blue Jay Air to use the NPV standard.
 - (ii) Explain two reasons why managers prefer IRR over NPV.
- (e) (1 point) Evaluate how over-confidence by Blue Jay Air management may impact their decision on Business Lounge upgrades.

7. (8 points) A national chain of gas stations wants to enhance its loyalty program with a new perk, offering members free gourmet coffee beverages for a certain amount of gasoline purchased in a year. Two major risks have been identified:

- members' utilization of the benefit
- the future price of coffee beans

To measure the member utilization risk, management is considering two options to acquire more information.

Option	Cost	Reduction in Uncertainty
A – Consultant Engagement	\$2,000,000	95%
B – Customer Survey	\$100,000	50%

(a) (2 points) Describe the decision making process to select between options A and B.

To measure coffee bean price risk, a team of analysts has been asked to establish the price of a call option on the price of coffee beans. The team plans to set up a stochastic algorithm based on the Heston model (as shown below). Assume coffee bean prices follow a log-normal distribution.

$$dS(t) = rS(t)dt + \sqrt{v(t)}S(t)dW_1(t)$$

$$dv(t) = \kappa(\theta - v(t))dt + \sigma\sqrt{v(t)}dW_2(t)$$

- (b) (1 point) State two reasons why a Black-Scholes model is an oversimplification for pricing an option.
- (c) (2 points) Describe the algorithm to simulate the price paths in the Heston model based on the Euler-Maruyama scheme.

An analyst has expressed concern that the simulated volatility could be negative for an iteration under the Euler-Maruyama scheme.

- (d)
- (i) (1 point) Explain why this can lead to an issue in the Heston model.
- (ii) (2 points) Describe three methods to address this iteration error.

8. (6 points) You are an actuarial analyst working for Bailey Life, an insurer that sells life insurance and annuities throughout Europe. Justin Case, the chief risk management actuary, has approached you regarding his concern about mortality risk for the company's single premium term life business. Justin would like to know the market value of this product's claim liability (MVL).

- (a) (1 point) Explain what is required to determine the value of Bailey's claim liability in a Solvency II framework.
- (b) (1 point)
- (i) Identify one hedgable and one non-hedgable risk within Bailey's term product.
- (ii) Explain why a Market Value Margin (MVM) is only required for non-hedgable risks.

You use the following information to complete the analysis:

- Projection of claims that are assumed to be paid mid-year:

Year	1	2	3
Projected Claim Amount	\$1.6M	\$2.2M	\$1.8M

- PV of claims is the best proxy for measuring the Solvency Capital Requirement (SCR)
 - SCR at time 0 is \$779,923
 - Cost of capital for non-hedgable risks is 3.75%
 - Swap rate is 5% (yield curve is assumed to be flat)
- (c) (3 points) Calculate the MVL for this product. Show your work.
- (d) (1 point) Critique the method used to calculate the MVL in part (c).

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

USE THIS PAGE FOR YOUR SCRATCH WORK