Exam CFEFD

Date: Thursday, October 28, 2021

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This examination has 10 questions numbered 1 through 10 with a total of 100 points.

   The points for each question are indicated at the beginning of the question. Questions 2 – 6 and 8 – 10 pertain to the Case Study.

2. 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 provided in this document.
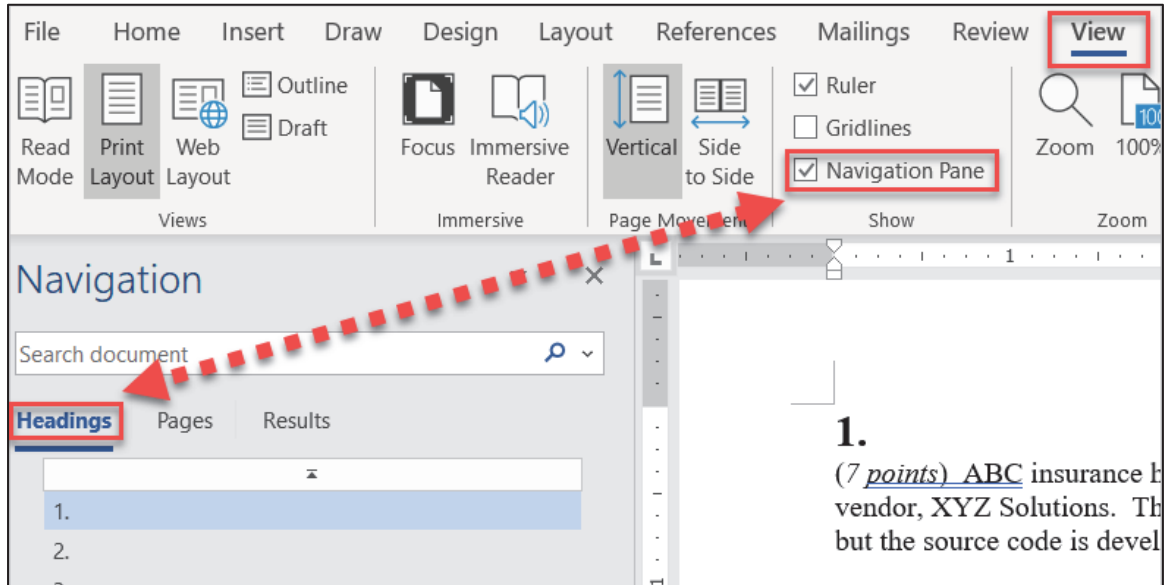
Written-Answer Instructions

1. Each question part or subpart should be answered either in the Word document or the Excel file as directed. Graders will only look at work in the indicated file.

   a) In the Word document, answers should be entered in the box marked ANSWER. The box will expand as lines of text are added. There is no need to use special characters or subscripts (though they may be used). For example, β_1 can be typed as beta_1 (and ^ used to indicate a superscript).

   b) In the Excel document formulas should be entered. Performing calculations on scratch paper or with a calculator and then entering the answer in the cell will not earn full credit. Formatting of cells or rounding is not required for credit.

   c) Individual exams may provide additional directions that apply throughout the exam or to individual items.

2. The answer should be confined to the question as set.

3. Prior to uploading your Word and Excel files, each file should be saved and renamed with your five-digit candidate number in the filename.

4. The Word and Excel files that contain your answers must be uploaded before the five-minute upload period expires.

Recognized by the Canadian Institute of Actuaries.

Navigation Instructions

Open the Navigation Pane to jump to questions.

Press Ctrl+F, or click View > Navigation Pane:

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.

1.

(*9 points*) You work for Company X, a major U.S. medical device manufacturing company. Company X is considering entering a new market in Country Y, a developing country with a large population. Country Y has had fast but unstable economic growth and overall costs have been increasing in recent years. Country Y's local currency is Tatl. There are two possibilities you have been asked to consider:

- A. Manufacture devices in the home country (U.S.) and ship to Country Y for distribution and sales
- B. Manufacture devices in Country Y and distribute in Country Y

Company X has never utilized before the type of strategy in proposal B. You are given the following information about the two proposals and relevant financials. These are considered the most accurate estimates by the finance department, but because Country Y is a new market some of these assumptions are based on limited information.

	Proposal A	Proposal B
Sales	\$200 M Tatl in Year 1, grows at 5% each year	
Cost of goods sold (% of sales)	50%	30%
Operating Expenses (% of sales)	20%	10%
Initial Investment	\$20M USD	\$120 M Tatl
Equipment	\$16M USD	\$100 M Tatl
Depreciation	Straight line over 10 years	
Tax Rate	21%	34%

Company X expects the project will last 10 years after which a new generation of devices will replace it. There will be no salvage value.

You are also given following financial information:

Risk Free Rate (U.S.)	Risk Free Rate (Country Y)	Current Spot Exchange Rate
2.50%	7.50%	\$5 Tatl to \$1 USD

Company X Current Financials:

Assets	USD(\$M)	Liabilities	USD(\$M)	Cost of Capital	
Cash	\$100,000	Debt	\$300,000	Debt	5%
Other Assets	\$500,000	Equity	\$300,000	Equity	12%

1.   Continued

(a)   (*3 points*)

   (i)   Calculate Company X's Weighted Average Cost of Capital (WACC). Show your work.

The response for this part is to be provided in the Excel spreadsheet.

   (ii)   Recommend which proposal Company X should accept using the projection information above, Company X's WACC and the current Spot exchange rate. Show your work and justify your recommendation.

The response for this part is to be provided in the Excel spreadsheet.

(b)   (*2 points*) Assess the appropriateness of the decision made in part (a)(ii). Justify your answer.

ANSWER:

Company X wants to evaluate the risks of fluctuating exchange rates and costs of goods sold (COGS) in Country Y. It chooses to model scenarios within the 95th percentile of each risk, and believes this can be achieved by modeling the following:

- 5 exchange rate scenarios;
- 3 COGS scenarios.

You assume:

- Each scenario (x) has the following probability of occurring:
$$P(x) = 2^{-m} \frac{m!}{x!(m-x)!}$$
where m is the number of possible states;
- Exchange rate and COGS scenarios are independent.

(c)   (*1 point*) Explain how the 95th percentile for exchange rates will change as Company X learns more information about the Country Y exchange rate.

ANSWER:

1. Continued

(d)   (*2 points*) Explain two shortfalls of your modeling approach.

> ANSWER:

Management is concerned with how risky operating in Country Y is and would like options to decrease these risks. You think a stop-loss strategy might be appropriate.

(e)   (*1 point*)

(i)   Explain how Company X could use its model to establish a stop-loss strategy for operating in Country Y.

> ANSWER:

(ii)   Explain how the size of the loss limit impacts the modeled VaR.

> ANSWER:

2.

(*10 points*) You work as an analyst at Blue Jay Tire (BJT) company.

(a)   (*3 points*)

   (i)   Identify four key insights from real options.

ANSWER:

   (ii)   Assess how each key insight could impact BJT's current business decisions and strategies. Provide one specific example from the case study for each insight.

ANSWER:

2. **Continued**

Current market conditions disallow BJT from building its own specialty tire plant. You have been assigned to help assess the potential acquisition of True North Tire Company (TNT)(Case Study Section 3.4).

BJT has negotiated an acquisition deal with TNT. The terms of the contract specify BJT can acquire TNT immediately, in exactly one year, or not at all. In addition to the projections in the Case Study Section 3.4, Whitewall Consulting also expects:

- TNT's average profits will increase by 3% per year.
- The volatility of TNT's value is expected to be 25% per year.
- The appropriate Cost of Capital and Risk-Free Interest rate are 12% and 2% respectively.
- If BJT decides to wait one year, it must pay a contract holding fee today of $0.5M.

(b)   (*4 points*)

   (i)   Determine the value of the option to wait to acquire TNT. Show your work.

The response for this part is to be provided in the Excel spreadsheet.

   (ii)   Recommend whether BJT Management should acquire TNT today, wait one year, or never acquire TNT. Justify your response using results from part (i).

The response for this part is to be provided in the Excel spreadsheet.

   (iii)   Determine the volatility in TNT's value at which BJT would be indifferent between waiting and acquiring TNT today. Show your work.

The response for this part is to be provided in the Excel spreadsheet.

2. **Continued**

BJT management is familiar with the Profitability Index Rule to evaluate real options but is unfamiliar with the option pricing approach used in part (b). To invest now, BJT management requires a Profitability Index of 0.50 on all new investment opportunities that can be delayed.

(c)   (*1 point*) Assess whether BJT should purchase TNT now given the Profitability Index. Justify your assessment.

> ANSWER:

(d)   (*2 points*) Describe two advantages and two disadvantages for each approach – the option pricing approach from part (b) and the Profitability Index Rule from part (c).

> ANSWER:

3.

(*12 points*) Seaplane Expeditions and Aviation Company (SEA) has contacted Mr. Gilroy Clyde, CEO of RPPC Dynasty Corporation (RPPC), seeking a capital infusion. Gilroy is hesitant given SEA's lack of available performance and risk metric reporting and has asked you to work with SEA management to create an ERM dashboard so that he can better understand the potential risks and returns of the venture.

(a)   (*1 point*)

      (i)   List the four attributes of good Key Performance Indicator (KPI) development.

ANSWER:

      (ii)   Describe four characteristics of an effective Key Risk Indicator (KRI).

ANSWER:

(b)   (*2 points*) Explain the process of creating an ERM dashboard for SEA including specific considerations to meet Gilroy's needs.

ANSWER:

3. Continued

To develop SEA's KPIs and KRIs, you are provided with the company's income statement and balance sheet (Case Study section 8.6). You estimate the following for 2021:

- Both total operating revenue and net income increase 8% from prior year.
- Total Liabilities increase 7% from prior year. Capital does not change.
- Retained earnings are only increased by net income.
- Economic (risk) capital is 80% of owner equity.
- The cost of capital is 6% of economic capital.
- A 1 in 100 tail event is ~24% of total operating revenue.

(c)   (*4 points*)

    (i)   Recommend two KPIs and two KRIs useful to RPPC in assessing SEA. Justify your recommendation.

> ANSWER:

    (ii)   Calculate those four indicators from 2019 to 2021 using the Excel worksheet that is provided.

> *The response for this part is to be provided in the Excel spreadsheet.*

(d)   (*3 points*) Develop a one-page ERM dashboard for Gilroy using the Excel template that is provided, including qualitative and quantitative attributes.

> *The response for this part is to be provided in the Excel spreadsheet.*

(e)   (*2 points*) Describe four considerations for whether a capital infusion in the form of debt or in the form of equity would be preferrable for SEA.

> ANSWER:

4.

(*10 points*) You are an analyst working for Kitty Dunn, Chief Accounting Officer at Frenz (Case Study section 4). Frenz created a subsidiary called Ishmael Roasters at the end of 2019, a coffee house chain in the country of Mobia, with the plan to allow local operations to develop without interference. You have been tasked with incorporating and translating Ishmael's financials into the Frenz financial statements.

(a)   (*1 point*) State four reasons why Mobia's local currency, Mobucks, should be the functional currency for Ishmael instead of Euros.

> ANSWER:

(b)   (*2 points*)

> (i)   Identify the appropriate currency translation method.

> > ANSWER:

> (ii)   Explain how to translate each of assets, liabilities, equity, revenue and expenses.

> > ANSWER:

4. Continued

You are then provided the following data about Ishmael and Mobia. Assume changes in these financial statement items happened evenly throughout the year.

| Ishmael Financial Information | Dec. 31, | Dec. 31, |
Mobucks in thousands	2020	2019
Cash	1,000	1,000
Inventory	500	0
Property	5,000	5,000
Accounts Payable	800	0

	Mobia General Price Index	Euros per Mobuck
12/31/2019	100	1.0
Average	150	0.7
12/31/2020	225	0.5

(c)   (*1 point*) Explain the advantage that being a subsidiary of Frenz brings Ishmael from a funding perspective.

ANSWER:

(d)   (*2 points*)

(i)   Describe the implications of the prior year's price index change on the translation of Ishmael's financial statements.

ANSWER:

(ii)   Explain how the translation of the financial statements will differ from part (b)(ii).

ANSWER:

4. Continued

(e)   (*1 point*) Assess if Ishmael had a purchasing power gain or loss in 2020 from the price index change. Justify your response.

> ANSWER:

Given fluctuations in the Mobia general price index over the past several years, Ishmael is considering locking in supplier contracts in Euro denominated prices.

(f)   (*1 point*) Explain how the above action would impact the methodology of calculating the NPV of Ishmael distributable earnings.

> ANSWER:

(g)   (*2 points*) Calculate the impact to Frenz's 2020 current ratio and debt-to-assets ratio from incorporating Ishmael into its financials. Show your work.

> *The response for this part is to be provided in the Excel spreadsheet.*

5.

(*10 points*) You work in the financial department of Blue Jay Air (BJA). (Case Study section 2)

(a)   (*1 point*) Define the following tax related concepts:

   (i)   Deferred Tax Asset (DTA)

   (ii)   Income Tax Payable

   (iii)   Tax Expense

   (iv)   Tax Base

ANSWER:

BJA proceeded with the "Purchase Proposal for International Plane Fleet" (Case Study Section 2.7, Exh. E.2) and received the new aircraft on 1/1/2021. The tax authority specified the fleet should be depreciated on a straight-line basis over a 25 year-period with no salvage value.

An outside consultant says, "The different depreciation schedule creates a permanent difference between tax and financial reporting of revenue. Additional deferred tax liability (DTL) should be booked to capture the difference. The slower tax depreciation schedule will also lower the effective tax rate."

(b)   (*3 points*)

   (i)   Critique the consultant's comment.

ANSWER:

   (ii)   Calculate the change in DTA/DTL related to this project from 12/31/2021 to 12/31/2022 assuming the tax rate will change from 21% to 28% on 1/1/2022. Show your work.

The response for this part is to be provided in the Excel spreadsheet.

5. **Continued**

Management finances the purchase with a 25 year secured loan that has a $65m financing cost every year by setting up a subsidiary. BJA estimates the revenue of the new international route for the next 5 years in the table below.

	Revenue (Next 5 Years)	Probability
Scenario 1	$305m	30%
Scenario 2	$270m	40%
Scenario 3	$235m	30%

(c)   (*2 points*) Determine how this estimation will impact the DTA/DTL under both IFRS and USGAAP. Show your work.

> *The response for this part is to be provided in the Excel spreadsheet.*

Three months before BJA's annual report, analysts estimate the Earnings Per Share (Basic) of BJA will increase by $0.73 from operating in the new international routes. However, BJA management expects the earnings in this year will be $35m higher than analysts' expectation.

Since earnings are expected to be higher than the analysts' estimate, management would like to achieve the following objectives:

Objective A: Bring expected earnings in line with analysts' estimate
Objective B: Avoid poor reporting quality
Objective C: Increase future earnings potential

(d)   (*3 points*) Evaluate if the following options will achieve managements' objectives. Explain your answer.

(i)   Adopt an accelerating depreciation method so that the aircraft depreciation will be $35m more for the year of 2021

> ANSWER:

(ii)   Invest $35m in the Luxury Lounges

> ANSWER:

5. Continued

      (iii)   Purchase $35m of additional fuel

ANSWER:

      (iv)   Invest $35m to enhance data analytic capabilities

ANSWER:

      (v)   Pay out $35m in restricted stock units (RSU) with 1/4 vesting each year starting on 12/31/2022

ANSWER:

(e)   (*1 point*) Recommend which option from part (d) BJA should choose. Justify your recommendation.

ANSWER:

6.

(*11 points*)   Snappy (Case Study Section 7) has a block of simple non-participating whole life policies that contains significant mortality and interest rate risks. As the valuation actuary at Snappy, you use an old spreadsheet-based software for the insurance liability valuation, which runs slowly for large quantities of data. The model assumptions contain multiple dimensions and interdependencies.

Regulations require Snappy to run four deterministic sensitivities. To perform these sensitivity tests, you want to create a polynomial model that uses policy characteristics observed directly from policy data to approximate the reserves of the full model.

The polynomial model is in the form

$$\sum_{k=1\ldots K} \beta_k X_k(r_1(s), \ldots, r_N(s)) = y(s)$$

(a)   (*1 point*) Describe the following parameters.

   (i) β_k

   (ii) $X_k()$

   (iii) $y(s)$

   (iv) $r_N(s)$

   ANSWER:

(b)   (*2 points*) Explain the following considerations behind developing the proxy model for Snappy:

   (i)   Formula structure

   (ii)   Data selection

   ANSWER:

6. **Continued**

You determined the formula structure of the proxy model to be as follows:

$$y(s) = \beta_1 \frac{Insured\ Volume\ ('000) * Premium\ Payment\ Period}{Annual\ Premium} + \beta_2\ Age\ Function$$
$$+ \beta_3\ \frac{Attained\ Age * Insured\ Volume\ ('000)}{1000}$$
$$+ \beta_4\ Cash\ Surrender\ Value$$

Where Age Function is:

$$Age\ Function = \begin{cases} If\ male:\ (Attained\ Age)^2 \\ If\ female:\ 0 \end{cases}$$

Using the data provided in the Excel spreadsheet:

(c)   (*4 points*) Calibrate the parameters of the proxy model using the unweighted
Least Squares method. Show your work.

> *The response for this part is to be provided in the Excel spreadsheet.*

Your supervisor does not understand how the proxy model can be used to satisfy
reporting requirements and believes additional validation work is required.

(d)   (*4 points*)

   (i)   Explain four shortcomings of using this proxy model approach for
required sensitivities.

> ANSWER:

   (ii)   Recommend two changes to your modeling process to improve its
robustness. Justify your response.

> ANSWER:

7.

(*11 points*) The data science team at Bank XYZ is building a machine learning model (FDM v1.0) to predict and classify the legitimacy of online credit card transactions. Transactions the model predicts as fraudulent are flagged for further investigation by the fraud analysis team, whereas transactions predicted as legitimate will be automatically approved by the system. The data science team is given a dataset of 10,000 past transactions for this project.

The team is considering the following three approaches to train and test the model:

       I. Hold-out sampling
      II. k-Fold cross validation
      III. Bootstrapping

(a)   (*3 points*)

      (i)   Describe each approach I - III.

> ANSWER:

      (ii)   Evaluate whether each of I - III is appropriate for the data science team to use. Justify your response.

> ANSWER:

(b)   (*3 points*) Based on the model results of 100 data samples provided in the Excel spreadsheet:

      (i)   Create a confusion matrix. Show your work.

> *The response for this part is to be provided in the Excel spreadsheet.*

      (ii)   Calculate the model's precision and recall. Show your work.

> *The response for this part is to be provided in the Excel spreadsheet.*

      (iii)   Evaluate the model based on your results.

> *The response for this part is to be provided in the Excel spreadsheet.*

7. **Continued**

After testing FDM v1.0 for a few months, the data science team realizes that not all claims can be clearly identified as fraudulent or legitimate. It has decided to replace the old categorizations with three new categories based on the score assigned by the model. The new categories are "High", "Medium", and "Low" probability of being fraudulent. The prediction is based on the position of the score in relation to the thresholds. Your team only has enough employees to investigate 25% of transactions, so only the "Medium" transactions will be investigated.

(c)   (*2 points*)

    (i)   Describe how the confusion matrix from part b) would change under these new categorizations.

> ANSWER:

    (ii)   Assess the thresholds given in the new sample dataset provided in the Excel spreadsheet. Justify your assessment.

> *The response for this part is to be provided in the Excel spreadsheet.*

You reevaluate this new model three months later with 100 new data points.

(d)   (*3 points*)

    (i)   Define concept drift.

> ANSWER:

    (ii)   Recommend one ongoing model validation scheme that could prevent concept drift.

> ANSWER:

    (iii)   Assess whether you observe concept drift in the 100 new data points (provided in the Excel spreadsheet). Justify your assessment.

> *The response for this part is to be provided in the Excel spreadsheet.*

8.

(*7 points*) You are reviewing Blue Jay Tire's (BJT)financials for 2020 (Case Study Section 3.5, Exhibit A).

(a)   (*2 points*)

(i)   Explain why one would question BJT's 2020 financials.

ANSWER:

(ii)   Describe how a dysfunctional incentive created by absorption cost systems may lead to the problem discussed in i).

ANSWER:

To investigate further, you request an analysis of BJT's budgeted costs for materials and labor. BJT provides the following comparison of actual and standard amounts.

	Materials				Labor	
	Price	Quantity			Wage	Hours
Standard	$25	2,300		Standard	$20	3,000
Actual	$23	2,826		Actual	$15	3,500

(b)   (*1 point*) Describe how a company may use Standard Costs for:

(i)   Decision making.

ANSWER:

(ii)   Control.

ANSWER:

8. Continued

(c)   (*2 points*)

   (i)   Calculate the total materials variance in terms of price variance and quantity variance. Show your work.

   > ANSWER:

   (ii)   Calculate the total labor variance in terms of wage variance and efficiency variance. Show your work.

   > ANSWER:

   (iii) Interpret the results in (i) and (ii).

   > ANSWER:

(d)   (*2 points*) Explain why BJT should be concerned about favorable variances, providing two reasons based on its risk profile.

   > ANSWER:

9.

(*10 points*) Information on Frenz Corporation can be found in Section 4 of the Case Study.

Jeff Bemowski and Kitty Dunn have asked you to investigate Frenz's overhead allocation methods.

(a)   (*2 points*)

   (i)   Calculate the overhead rate for Frenz from 2016 through 2020. Show your work.

   The response for this part is to be provided in the Excel spreadsheet.

   (ii)   Critique Kitty's statement to Jeff (Case Study Section 4.5, Exhibit B) regarding the success of the current allocation method.

   ANSWER:

(b)   (*2 points*) Explain why Jeff believes that Frenz is allocating overhead in a way that punishes the most successful store managers.

   ANSWER:

(c)   (*2 points*) Explain how Jeff benefits from:

   (i)   The existing allocation method.

   ANSWER:

   (ii)   His suggested allocation method.

   ANSWER:

9. Continued

(d) (*1 point*) Explain one reason why Frenz should not use allocated costs to price its products.

> ANSWER:

The overhead allocation conversation has been escalated to Jade Phan, Marketing Vice President of Frenz. Jade says "Frenz's marketing strategy is a holistic, global strategy. I believe our allocation strategy should reflect that".

(e) (*3 points*)

    (i) Describe three considerations that Jade needs to address in the strategy to allocate marketing costs.

> ANSWER:

    (ii) Recommend an allocation strategy that would meet Jade's marketing strategy goals. Justify your answer using each of the considerations in (i).

> ANSWER:

10.

(*10 points*) Blue Jay Tire (BJT) is undergoing an evaluation of its supply chain and associated enterprise risk management processes (Case Study section 3).

BJT is considering the following scenarios in evaluating its supply chain:

      I. BJT Tire Recall
     II. COVID-19 Pandemic
    III. Political upheaval in Malaysia

(a)   (*4 points*)

      (i)   Classify each scenario, I - III, above using the four categories of the "supply chain disruption" approach (Cause, Life Cycle, Type, Decision Focus). Justify your response for each categorization.

> ANSWER:

      (ii)   Recommend one supply chain disruption risk mitigation or recovery strategy for BJT for each scenario, I - III. Justify your recommendation.

> ANSWER:

In light of the COVID-19 pandemic, BJT management believes that the risks of a pandemic expand beyond the commodity risk that catastrophe insurance would cover (Case Study section 3.3.1).

Management would like to perform an assessment using the ISO 31000 framework.

(b)   (*1 point*) Explain why the ISO 31000 framework is a good framework to use to assess the impact of a pandemic on BJT, based on the framework's definition of risk.

> ANSWER:

10. Continued

(c)   (*3 points*)

(i)   Identify four significant risks to BJT presented by a potential pandemic based on BJT's Risk Profile in Case study section 3.3.

ANSWER:

(ii)   Explain how each risk in (i) is impacted by the pandemic.

ANSWER:

(iii)   Explain the approach to evaluate these key risks under the ISO 31000 framework for BJT.

ANSWER:

(iv)   Describe how BJT should monitor, review, and communicate risks under the risk framework.

ANSWER:

(d)   (*2 points*) Recommend an appropriate "risk treatment approach" for each of the risks identified in part (c)(i) under the ISO 31000 framework. Justify each recommendation.

ANSWER:

END OF EXAMINATION