CFE FD Model Solutions
Fall 2023

1. Learning Objectives:

4. The candidate will understand the application of quantitative methods and techniques with a risk management focus to business problems for financial and non-financial companies.

Learning Outcomes:

(4a) Assess and apply methods and processes for quantifying and managing hedgeable and non-hedgeable risks.

(4c) Evaluate results of deterministic, stress-testing, stochastic and simulation methods and models.

Sources:

Dowd, Measuring Market Risk 2nd ed, Chapters 13 and 15

Commentary on Question:

Candidates generally did well on this question. This question was testing the applications of stress testing and back testing. Candidates who did very well were familiar with evaluate (rather than describe) and interpret (rather than calculate).

Solution:

(a) Describe two benefits and two difficulties of stress testing.

Commentary on Question:

Candidates generally did very well on this question.

Benefits of stress testing:

1. Helps identify an institution's breaking point in order to develop risk mitigation to protect against.
2. Highlights dependences on correlation assumptions, and evaluate what happens if "normal" correlations break down and all markets move against the institution.

Difficulties of stress testing:

1. Computational problems. It is important to push the underlying risk factors rather than the individual prices by any particular multiple. This can be expensive, and there is a limit on how frequently they can be carried out.

1. Continued

2. Stress tests do not give any indication of likelihood, so the importance of the results need to be judged. A scenario that would drive the institution into insolvency may or may not be meaningful, depending on the underlying probability.

(b) Recommend a specific stress-testing approach that addresses the CRO's concerns. Justify your recommendation.

Commentary on Question:
Candidates generally did very well on this question.

Mechanical stress testing (such as Maximum Loss Optimization, Factor Push, or CrashMetrics) is recommended.

The CRO is specifically looking to understand the worst-case losses, which mechanical stress testing addresses. Breaking points can be identified through mechanical stress testing in a way that scenario testing would not accomplish. Scenario testing historical scenarios would not necessarily identify the breaking point or worst-case scenario for the company.

(c) Your manager has recommended the use of Value at Risk (VaR) as opposed to stress testing to gauge the risks to the company in crisis situations.

Evaluate your manager's recommendation.

Commentary on Question:
Candidates who did well on this question were able to identify how Value at Risk is not ideal specifically with regards to crisis situations. Many candidates discussed Value at Risk as a general concept but did not address how it performs in a crisis situation, or how it compares to stress testing in such a situation.

Value at Risk as the better risk measure is an outdated concept. It is no longer viewed as a respectable risk measure, and stress testing is now widely regarded as the better risk measure.

Breakdowns in "normal" correlation relationships: In crises, correlations often swing to extreme values, and losses can be much greater than suggested by VaR estimates based on "normal" correlation assumptions.

Concentration risks: Stress tests can reveal a much larger exposure to a single risk factor than intended, considering the unusual conditions of a crisis, which VaR can overlook because they tend to not pay much attention to crisis conditions.

1. Continued

Macroeconomic risks: Stress tests are better suited for gauging our exposure to macro-economic factors.

(d)

(i) Describe one advantage and one disadvantage of a Basic Frequency Backtest.

(ii) Interpret the results of the Backtest from the table above.

Commentary on Question:
Candidates generally performed well on part (i) but did not do well on part (ii). While many candidates were familiar with how to set up the Basic Frequency Backtest formula calculation, not all candidates interpreted the results of it.

Full credit was awarded for candidates who identified that while the observations were in excess of expected at both the upper and lower risk bounds, the observations were plausible at the upper risk bound, and not plausible at the lower risk bound, based on the results of the backtest.

(i) An advantage of Basic Frequency Backtesting is that it does not require a great deal of information. A disadvantage is that it throw away information on the sizes of tail losses predicted by risk forecasting models (in other words, a "bad" risk model will pass a frequency test if it generates an acceptably accurate frequency of exceedances, even if its forecasts of losses larger than VaR are very poor).

(ii) With n=600, p = α = .05 at the Upper Risk Bound and p = 1-α = 1-.95 = .05 at the Lower Risk Bound, n*p = 30 exceptions expected outside of both Upper and Lower Risk Bounds. Therefore, both the Upper and Lower Risk Bounds have observations in excess of the amount expected.

For the Upper Risk Bound, 36 observations is plausible, using the binom.dist fuction in Excel: =1-BINOM.DIST(36-1 , 600 , 0.05 , 1) = 15.15%.

Since this is greater than the 5% confidence interval, the number of exceedances is plausible, indicating that the risk measure on the right tail is probably not too low.

For the Lower Risk Bound, 40 observations is not plausible, using the binom.dist fuction in Excel: =1-BINOM.DIST(40-1 , 600 , 0.05 , 1) = 4.2%.

1. Continued

Since this is less than the 5% confidence interval, the number of exceedances is not plausible, indicating that the risk measure on the left tail is probably too low.

2. Learning Objectives:

1. The candidate will understand how a company optimizes its corporate finance decisions based on its business objectives.

Learning Outcomes:

(1a) Recommend an optimal capital structure for given business objectives and the competitive environment.

(1b) Compare and contrast methods to determine the value of a business or project, including the impact on capital budgeting and allocation decisions.

Sources:

Jonathan Berk and Peter Demarzo, Corporate Finance, Fifth Edition, Ch 18: Capital Budgeting and Valuation with Leverage

Case Study

Commentary on Question:

The goal of the question is to bring candidates to think critically about capital budgeting in the context of Blue Jay Air.
The candidate is expected to understand the source material and draw insights from the case study.

Solution:

(a)

(i) Calculate BJA's net debt-to-value ratio over the last three years. Show your work.

(ii) Describe the evolution of BJA's capital structure over the last three years. Support your answer by referring to the financial statements.

Commentary on Question:

(i) Most candidates received partial credits on this question. Many candidates didn't take out cash when calculating the net debt and lost partial credits.

Full credits were granted to candidates if D/V formula is correct, and any of the three cash definitions below are considered:
(1) Subtracting only "Cash and cash equivalents"
(2) Subtracting "Cash and Short Term Investments"
(3) Subtracting "Cash and Short Term Investments" and "Restricted Cash"

2. Continued

	31-Dec-22	31-Dec-21	31-Dec-20
Net Debt (= Long - term debt and finance leases + current portion of long-term debt & finance leases - total cash &ST investments)	349	469	538
Total shareholders' equity	199	77	22
Debt/Value = (Net Debt/(Net Debt+ Total shareholder's equity)	**64%**	**86%**	**96%**

(ii) To receive full credits, candidates are expected to:

1) describe that, over the last 3 years, the leverage has decreased.

2) Referencing the question and mentioning that the debt-to-equity ratio has decreased below the airline industry median.

3) *Reference to the financial statements that support the answer*

Partial credits were granted for each expectation item on the list. Most candidates received partial credits on this part of the question.

We can see in the financial statements that 100% of the net income over the last 3 years went to reducing the deficit (i.e. the negative retained earnings), thus increasing the equity value.

In addition, the "Total cash & Short-term investments" have significantly increased over the last 3 years, mainly driven by favorable "Net cash flow from operating activities", thus decreasing the Net Debt.

As a result, BJA's decisions have allowed to reduce the company's leverage and bring down the D/E ratio from 24.45 in 2020 to 1.75 in 2022

With the reduced leverage, the D/E ratio is now below the airline industry median (of 5.5x) and BJA is in a better financial position to take on debt to support expansion projects.

(b) Critique the Finance Team's capital budgeting model, assuming that the expected free cash flows are accurately forecasted.

Commentary on Question:
Candidates are expected to address both negative and position items to receive full credits. Many candidates only addressed negative items or provided very generic answers not specific to model shown, therefore received partial credits.

2. Continued

Negative: The WACC model was last updated when BJA was part of RPPC. RPPC was assuming a fixed D/V ratio, but the airline is more capital intensive and BJA D/V is expected to fluctuate over the duration of the project.
Negative: BJA is still using RPPC's assumptions for the expected cost of debt and equity
Negative: the model does not allow to vary the expected cost of debt between the two alternatives
Positive: BJA updated the D/V ratio and periodically validates that it aligns with its financial statements
Positive: The model was updated to reflect BJA's expectation of the future tax rate
Positive: the model correctly calculates the NPV using the WACC and FCF

(c) In a recent meeting with the Finance team, Elmer Saunders, the Corporate Treasurer, argued:

"I don't think it's worth exploring other capital budgeting methods. We have worked hard to develop a state-of-the-art model to forecast projected free cash flow… anyway, any capital budgeting method should ultimately produce the same estimate of the project's value… there's no point in spending more time with other methods just to get back to the same results, purchasing a new fleet for international flights has the highest NPV, it is the way to go!"

(i) Evaluate Elmer's argument.

(ii) Recommend a capital budgeting method for the international expansion strategy. Justify your recommendation.

Commentary on Question:
For part (i), candidates are expected to mention
1) *All methods won't produce the same results in this context*
2) *The D/V ratio is the main reason why the statement is incorrect.*

For part (ii), to receive full credit, candidates are expected to
1) *Selecting the correct method*
2) *Justify the selection with the fact that it is a fixed debt financing agreement*
3) *Justify with the fact the tax shield can be valued on a standalone basis.*

Most candidates received partial credits on this part of the question.

2. Continued

(i) In this case, the APV and FTE methods won't produce the same results as the WACC method because the D/V ratio is expected to vary over time. His argument would only hold true if the key assumptions (see below) were respected, but in this case, the D/E ratio is expected to not stay constant
-project has similar risk as the firm
-ignore market imperfections
-assume constant D/E ratio

(ii) BJA should use APV method with Predetermined Debt Levels
BJA is looking to secure a fixed debt financing agreement so the debt levels would be predetermined.
BJA should expect a significant gain from the tax shield (i.e. high tax rate and high leverage) and the APV method will allow to calculate its impact on a standalone basis

3. Learning Objectives:

2. The candidate will understand how to gauge a company's performance through an evaluation of its financial reports.

Learning Outcomes:

(2a) Analyze the interrelationships between the income statement, cash flow statement, and balance sheet, in order to measure a corporation's financial performance.

Sources:

Robinson et al., International Financial Statement Analysis 4th Ed, Ch. 6 Financial Analysis Techniques

F-161-F23: Bank Profitability

Case Study

Commentary on Question:

The primary goal of this question was to assess candidates understanding of the pros and cons of banks using leverage as described in CFEFD-S2-16-21 ThisMatter: Bank Profitability. A secondary goal of this question was to assess candidates' knowledge of financial ratio analysis.

Candidates generally did very well on parts (a) and (b) with most candidates earning full or nearly full credit. On part (c), only the most prepared were able to provide strong enough answers to obtain full credit, but many candidates provided sufficient answers to obtain substantial partial credit.

Solution:

(a) List four insights financial ratio analysis can provide about a company.

Commentary on Question:

Candidates did very well on part (a). Full credit was granted for candidates who were able to list four valid insights financial ratio can provide about a company. The model solution does not contain all the insights that were granted credit.

- Economic relationships within a company that help analysts project earnings and free cash flow.
- A company's financial flexibility, or ability to obtain the cash required to grow and meet its obligations, even if unexpected circumstances develop.
- Management's ability
- Changes in the company and/or industry over time
- Comparability with peer companies or the relevant industry(ies).

3. Continued

(b) Calculate the following financial ratios for Big Ben Bank for the years 2021 and 2022. Show your work.

(i) ROA

(ii) Leverage Ratio

(iii) ROE

Commentary on Question:
Candidates generally did very well on part (b). If mistakes were made on this part, it was most often in the calculation of leverage ratio. No points were taken off for candidates who did not use the average of BOY and EOY for balance sheet items.

(i)

Formulas:
1) ROA = Net Income/Average Total Assets
2) Average Total Assets = (Total Assets BOY + Total Assets EOY)/2

Answers:
ROA (2021) = 17/((35,072+35,818)/2) = **0.05%**
ROA (2022) = 68/((35,818+35,784)/2) = **0.19%**

(ii)

Formulas:
1) Leverage Ratio = Average Total Assets/Average Total Capital
2) Average Total Assets = (Total Assets BOY + Total Assets EOY)/2
3) Average Total Capital = (Total Capital BOY + Total Capital EOY)/2

Answers:
Leverage Ratio (2021) = ((35,072 + 35,818)/2)/((1,680 + 1,681)/2) = **21.09**
Leverage Ratio (2022) = ((35,818 + 35,784)/2)/((1,681 + 1,839)/2) = **20.34**

(iii)

Formulas:
1) ROE = ROA*Leverage Ratio
Note: Use ROA and Leverage Ratio calculated above.

3. Continued

Answers:
ROE (2021) = 0.05% * 21.09 = **1.01%**
ROE (2022) = 0.19% * 20.34 = **3.86%**

(c) Recommend a leverage ratio range for Big Ben Bank to target in the future, assuming no change in the current economic environment. Justify your recommendation.

Commentary on Question:
Candidates did not do as well on this part of the question as parts (a) and (b). To obtain full credit, candidates needed to recommend that Big Ben reduce leverage while displaying strong knowledge of the Bank Profitability reading (CFEFD-S2-16-21) and the Case Study in their justification.

Most candidates did not provide sufficient detail in the justification of their recommended range for a four-point question.

Many candidates used the ROE target range (10%-15%) from Big Ben's Risk Appetite Dashboard and backed into a target leverage ratio range that would produce an ROE in that range. This answer received strong partial credit, but points were taken off for not recognizing that the level of leverage needed to reach this ROE range would be too risky for a Bank and that improving its ROA would be a better way for Big Ben to achieve its target ROE.

I recommend that Big Ben targets lowers its leverage ratio in the future and targets a range of 10-12.

All of the following factors support the recommendation that Big Ben should reduce its leverage ratio:

- A leverage ratio as high as Big Bens Bank's is very risky. It would only take a ~5% drop in the value of Big Ben Bank's assets to completely wipe out its capital.
- The amount of leverage used by Big Ben is far above the leverage used by most other banks (most banks shoot for a range of 10-12).
- There may be regulatory concerns with a leverage ratio this high. If Big Ben was an American company, they would be subject to limits on their use of leverage by the Federal Reserve.
- Big Ben's Risk Appetite Dashboard states that its risk tolerance for significant legal, ethical, and reputational events is 0. Reducing leverage will help achieve this goal of 0 events.
- Big Ben's Risk Appetite Dashboard states that its risk tolerance for significant compliance issues is 0. Reducing leverage will be viewed favorably by regulators and help Big Ben avoid any compliance events.

3. Continued

It is also noteworthy that Big Ben is currently falling short of its ROE target (from Risk Appetite Dashboard) of 10-15%. Since ROE = ROA*Leverage Ratio, one route Big Ben could take to increase its ROE is increasing its leverage ratio. However, this would be too risky for all the reasons stated above, so Big Ben should instead focus on increasing its ROA to help reach its target ROE range.

4. Learning Objectives:

3. The candidate will understand how managerial accounting, ERM and operational processes impact performance evaluation and decision making.

Learning Outcomes:

(3b) Assess and recommend methods a company may use to allocate its costs and how these methods impact the perceived performance of a company or its component lines of business.

(3d) Evaluate ERM risk measurement, modeling, and management of financial and non-financial risks that impact organizational performance.

(3e) Recommend best practices in business and ERM processes to achieve operational excellence.

Sources:

F-156-21: Activity-Based Costing and the Life Insurance Industry

Lam, Implementing Enterprise Risk Management from Methods to Applications, Ch 17: Integration of KPIs and KRIs

Lam, Implementing Enterprise Risk Management from Methods to Applications, Ch 18: ERM Dashboard Reporting

Commentary on Question:

This question tests the candidate's ability to recommend best ERM practices and evaluate cost allocation methods. In order to perform well, candidates needed to apply ERM and cost allocation concepts to the SIT case study. Candidates generally did well on this question.

Solution:

(a)

(i) Describe three key questions applicable to SIT that the ERM dashboard should address. Justify your response using the Case Study.

(ii) Recommend three Key Risk Indicators (KRIs) that are specific to SIT. Justify your answer.

Commentary on Question:

Candidates generally did well on this question. In order to receive full marks, candidates needed to provide justifications specific to the SIT case study.

4. Continued

(i) *Below are 5 possible answers.*

Key question: Which if any of our business objectives are at risk?
Justification: Tracking the progress of SIT's objectives, such as improving the performance of its underwriting and fraud detection capabilities, can be done with indicators to signal if each objective is on track, threatened, or off track.

Key question: Are we in compliance with laws, regulations, and policies?
Justification: InsurTech marketplaces have significant regulatory and compliance risks.

Key question: What risk incidents have been escalated?
Justification: If risk incidents occur, the ERM dashboard should be able to escalate critical risk incidents to the appropriate person. For example, major risk incidents involving compliance should be escalated to MaryAnn Seer (CCO) in real time.

Key question: What key indicators require attention?
Justification: The ERM dashboard should indicate potential problems before they arise. For example, KPIs/KRIs related to SIT's product risks should explain "how are we doing?" and "where are we heading?".

Key question: What risk assessments need review?
Justification: There should be a summary of qualitative risk assessments on the ERM dashboard, such as an assessment of the operational risk from their administration system.

(ii) *Below are 4 possible answers.*

KRI: Inflation
Justification:

- See the following in the case study:
  - "Inflation has hit the loss ratio of auto insurance. There is a lag in the pricing of unexpected costs, such as when inflation jumps up very quickly."
- Characteristics of this KRI: external benchmark, simplify risk without being simplistic, quantifiable

4. Continued

KRI: Number of manual data transfers / technology hand-offs
Justification:

- See the following in the case study:
  - "There still needs to be data transfer with the insurer for the exposure it is taking on. Generally, this data transfer is done manually through a secure portal, largely due to the lack of technology capability of the insurance partner."
  - "SIT believes there is less operational risk if there are fewer hand-offs with its insurance partners given the legacy technology of the traditional insurance industry."
- Characteristics of this KRI: quantifiable, timely, incorporates a risk driver (exposure)

KRI: % of fraud cases missed
Justification:

- See the following in the case study:
  - "SIT uses machine learning to identify fraud potential, using consumer retail, social media, and insurance data. However, an audit has indicated that there are at least another 5% of fraud cases that are being missed."
- Characteristics of this KRI: quantifiable, incorporates a risk driver (probability), simplify risk without being simplistic

KRI: Number of cyber attacks
Justification:

- See the following in the case study:
  - "Cyber risk is high in a heavily digitalized InsurTech with high dependence on consumer data. SIT has a Chief Information Security Officer (CISO), responsible for managing this risk. SIT has built a cybersecurity framework following industry best practices and meeting regulatory requirements."
- Characteristics of this KRI: quantifiable, incorporates a risk driver (probability)

(b)

(i) Describe the three key stages in the implementation of an ABC system.

(ii) Explain, using two specific examples from the Case Study, how ABC implementation considerations for the Life Insurance partner differ from those for the P&C partner.

4. Continued

Commentary on Question:
Candidates generally did well on this question. In order to receive full marks, candidates needed to use specific examples from the case study in part (ii).

(i) Stage 1 - Identify the key activity groups for each of its major business operations and underlying processes.

Stage 2 - Cost those activities according to the resources which they consume.

Stage 3 - Attribute the overheads for each activity group to cost objects (such as products or cost centres) using the key cost drivers.

(ii) *Below are 3 possible answers.*

Example: sales activities
Explanation: The sales activities are different between Life and P&C. Life has chatbox + live assistance while P&C is all digital.

Example: marketing activities
Explanation: The marketing activities are different between Life and P&C. Life has a partner with access to online platforms of wirehouses and brokerage firms while P&C relies on data analytics for targeting consumers.

Example: emergency and roadside assistance
Explanation: P&C has emergency and roadside assistance which doesn't apply to Life.

(c)

(i) Calculate the overhead allocation to each business unit (Life and P&C) using the traditional costing method. Show your work.

(ii) Calculate the overhead allocation to each business unit (Life and P&C)) using the ABC method. Show your work.

(iii) Recommend which overhead allocation method SIT should use. Justify your answer using the results from (i) and (ii) above.

Commentary on Question:
Candidates generally did well on this question. Nearly all candidates were able to see the benefits of ABC in part (iii).

Please refer to the spreadsheet model solution.

5. Learning Objectives:

4. The candidate will understand the application of quantitative methods and techniques with a risk management focus to business problems for financial and non-financial companies.

Learning Outcomes:

(4b) Evaluate model risks and processes
- (i) Assess model tradeoffs among usefulness, resource constraints, timeliness, fidelity, and accuracy
- (ii) Assess processes for vetting models

Sources:

F-165-F23: Decentralized Finance: On Blockchain- and Smart Contract-Based Financial Markets

F-166-F23: Runhuan Feng, Decentralized Insurance

Dowd, Measuring Market Risk 2nd ed, Ch 16 Model Risk

Commentary on Question:

The goal of the question is to explore the benefits and risks of using blockchain in insurance, whether that's adding cryptocurrencies to an investment portfolio or utilizing the technology within insurance functions. To receive maximum points, answers must be clear and well-supported. In general, candidates did well identifying and explaining the benefits of blockchain technology. However, candidates were not as clear with outlining the risks.

Solution:

(a) Critique the following statements that the member of the task force makes.

(i) A Dai stablecoin is a safe investment because it is “stable.”

(ii) A centralized exchange is more user-friendly than a decentralized exchange.

(iii) A centralized exchange does not use custodial trading, and, therefore, there is less trust required.

Commentary on Question:

Full credit was given to answers with clear language (“True” or “False”) and supporting explanation. Partial credit was given in part for mentioning cryptocurrency risks or for showing an understanding of centralized and decentralized exchanges without a direct answer.

5. Continued

(i) False. A Dai stablecoin is not a safe investment, because it is not stable. The issuer of Dai tokens, MakerDAO, must lock Ether as underlying collateral, and the USD/Ether exchange rate is not fixed. MakerDAO requires 150% of Ether to be collateralized in order to mitigate the risk of falling prices, but the stability fee or maximum interest rate has continued to fluctuate wildly over the past few years.
(ii) True. A centralized exchange is more user-friendly than a decentralized exchange. For investors, especially beginner investors that are familiar with banks but not crypto, they have a better user experience.
(iii) False. A centralized exchange does use custodial trading. Traders are required to deposit assets with the exchange. This trading occurs in the database of the exchange and is not recorded on chain. Therefore, more trust is required.

(b) Describe two ways a smart contract supports the ideals of decentralized insurance.

Commentary on Question:
Full credit was given to answers that included mentions of cost & speed efficiency, transparency, security, lack of intermediary, automatic payments, and anonymous consensus mechanisms. Additionally, the answers must have supporting explanation.

1) One ideal of decentralized insurance is a lack of intermediary. Smart contracts support this by permitting trusted transactions to be carried out among anonymous participants without a central authority, unlike centralized systems.
2) Another ideal of decentralized insurance is transparency. Smart contracts support the ideals of decentralized insurance by enabling direct peer-to-peer contingent payments that are fully auditable and public, unlike an insurer's opaque underling risk sharing mechanism.

(c) The task force is considering implementing blockchain technology in two operational areas, underwriting and claims processing. It develops a proposal for doing so, as follows:

- Term insurance policies are written as smart contracts.
- The smart contract instruction set determines underwriting and pricing for a potential policyholder.
- Once approved, the smart contract creates an unchangeable policyholder record that can immediately pay out legitimate claims based on a death certificate verification.
- If a claim is deemed false, the smart contract dissolves.

Describe two benefits and two risks of the proposal.

5. Continued

Commentary on Question:
Acceptable benefits and risks included a wide variety of answers if related to blockchain technology and/or term insurance. Benefits include lower expenses, faster processes, less counterparty risk, security, transparency, and lower bias but not access to insurance or risk/claim assessors unless tied to aforementioned benefits. Risks include coding errors, cyber security, external data reliance, environmental cost, and confusing claims processes but not fraudulent claims unless tied to aforementioned risks. All answers must have supporting explanation for full credit.

Benefits:

1) A benefit of this proposal is lower expenses. Less involvement in the day-to-day underwriting & claims process tasks may lead to fewer employees needed and lower expenses.
2) A benefit of this proposal is efficiency. The underwriting & claims process will be faster and no counterparties need be involved to introduce counterparty risk.

Risks:

1) A risk of this proposal is coding errors. Coding errors may potentially create vulnerabilities that allow an attacker to drain the smart contract's funds, cause chaos, or render the protocol unusable.
2) A risk of this proposal is security. Holders of admin keys at the company may not store keys securely and be vulnerable to cyberattacks, or they may be corrupted by perverse incentives.

6. Learning Objectives:

2. The candidate will understand how to gauge a company's performance through an evaluation of its financial reports.

Learning Outcomes:

(2c) Analyze the impact of tax accounting and policies, local regulations, and foreign exchange rates.

Sources:

Robinson et al., International Financial Statement Analysis 4th Ed, Ch. 15 Multinational Operations

Solution:

(a)

(i) Describe the method Conglomerate Holdings should adopt to translate the company's financial statements into $US.

(ii) Prepare the 2022 balance sheet under US GAAP according to the method described in (i). Show your work.

Part i:

1. US GAAP prescribes temporal method for translation when foreign subsidiary operates in a hyperinflationary economy
2. Translation gain/loss will be reported through income statement

Part ii: See excel

(b)

(i) Describe Sunshine Sprockets' net monetary exposure.

(ii) Explain the impact of the net monetary exposure during this period of hyperinflation to Sunshine Sprockets.

Part i:

Monetary exposure is dependent on the level of assets exposed to the current exchange rate vs. the amount of liabilities exposed to the current exchange rate.

Given Sunshine Sprockets has only accounts payable as a liability, and most of its assets (cash & short-term investments and accounts receivable) are monetary assets, and that it's monetary assets are greater in value vs. monetary liabilities, this creates a net asset balance sheet exposure.

Monetary Assets = 'Cash / Short Term Investments' + 'Accounts Receivable'
= 3,000 + 4,000 = 7,000

6. Continued

Monetary Liabilities = 'Accounts Payable' = 2,000

Part ii:
As Sunshine Sprockets has a net asset balance sheet exposure, hyperinflation will likely create a negative translation adjustment on the balance sheet with the temporal method and reduce the amount of equity that is translated onto Conglomerate Holdings' balance sheet.

(c) Analyze how using Shinee-denominated long-term debt to fund the purchase of Sunshine Sprockets' plant and equipment would have impacted the translation of the company's equity at the end of the year, assuming no depreciation. Show your work.

See excel for calculation

As debt is a monetary liability (translated at the current exchange rate under the temporal method) and property is a non-monetary asset translated at the historical exchange rate, by taking out debt to purchase property and equipment Sunshine Sprockets would then have a large net liability exposure. A large net liability exposure will create a positive translation adjustment to equity and increase the value of Sunshine Sprockets to Conglomerate Holdings

(d) Recommend two actions, in addition to having borrowed to purchase plant and equipment, that Sunshine Sprockets could have taken to reduce the negative impact of hyperinflation on Sunshine Sprockets' value to Conglomerate Holdings. Justify your recommendation.

-Reducing the amount of assets translated at current rates or increasing the amount of liabilities at current cates are both ways to make Sunshine Sprockets have less of a net asset exposure.

-Ideas for doing this are:
1. Issuing Debt: Increases the total liability amount translated at current rates.

2. Reducing the amount of cash and short term assets / repositioning them into property: Non-Monetary assets are translated at Historic Rates.

3. Provide less favorable credit terms for purchasers of sprockets, thus creating a lower accounts receivable balance. Reducing the amount of accounts receivable will reduce Sunshine Sprockets' net asset exposure.

4. Increasing other non-monetary liabilities (e.g. borrow via accounts payable): Increases the total liability amount translated at current rates.

5. Hold assets in USD

7. Learning Objectives:

4. The candidate will understand the application of quantitative methods and techniques with a risk management focus to business problems for financial and non-financial companies.

Learning Outcomes:

(4a) Assess and apply methods and processes for quantifying and managing hedgeable and non-hedgeable risks within any business enterprise.

(4b) Evaluate model risks and processes

(i) Assess model tradeoffs among usefulness, resource constraints, timeliness, fidelity, and accuracy

(ii) Assess processes for vetting models

Sources:

Kelleher, Mac Namee, and D'Arcy, Fundamentals of Machine Learning for Predictive Analytics 2nd Ed, Ch. 9 Evaluations

Kelleher, Mac Namee, and D'Arcy, Fundamentals of Machine Learning for Predictive Analytics 2nd Ed, Ch. 12 Case Study: Customer Churn

F-131-16: Heavy Models, Light Models, and Proxy Models, sections 1-5, 7 (excl appendices)

Commentary on Question:

In general, most candidates did well on this question. Most candidates can define the terminologies, perform the calculation, and provide evaluation correctly. Some candidates didn't perform the calculation correctly due to the incorrect formula been used.

Solution:

(a) Define the following terms:

I. Descriptive features

II. Prediction subject

Commentary on Question:

Candidates did well on this question. Most candidates would be able to provide definitions of descriptive features and prediction subject correctly.

Descriptive features refer to variables or characteristics of a system or data set that can be used to make accurate predictions or forecasts about future outcomes.

7. Continued

The prediction subject refers to the specific target or outcome that a predictive model aims to predict. It is the variable or attribute of interest for which the predictive model is designed to make predictions or forecasts.

(b)

(i) Calculate the precision and recall based on the table provided. Show your work.

(ii) Evaluate the model performance. Justify your answers.

Commentary on Question:
Candidates did well on this question. Most candidates would be able to calculate the precision and recall correctly, and evaluate the model with the calculated results. Candidates need to use the precision and recall calculated from part i to evaluate the model, and explain the meaning of precision and recall in order to get full credits.

The sample answer will be provided in the excel workbook separately.

(c)

(i) Assess the reliability of a predictive model over time.

(ii) Propose two ways to address the concern from senior management.

Commentary on Question:
Candidates did well on this question. Most candidates would be able to point out that predictive models would go stale over time, and explain why this is happening. Most candidates could provide 2 valid methods for monitoring. Some candidates got partial credits if only 1 method was provided.

Predictive models are based on the assumption that the patterns learned in the training data will be relevant to unseen instances that are presented to the model in the future. However, the data is not constant as time passed by. In that case, ongoing validation is need after a model is deployed.

Following are some methods can be used to monitor the model:
1. Monitoring changes in performance measures
2. Monitoring model output distribution changes
3. Monitoring descriptive feature distribution changes

8. Learning Objectives:

1. The candidate will understand how a company optimizes its corporate finance decisions based on its business objectives.

Learning Outcomes:

(1a) Recommend an optimal capital structure for given business objectives and the competitive environment.

(1b) Compare and contrast methods to determine the value of a business or project, including the impact on capital budgeting and allocation decisions.

Sources:

F-159-F23: A Brief Primer on Financial Reinsurance

SOA Reinsurance News: Return on Capital Enhancement Opportunities for the Life Insurance Industry

Commentary on Question:

This question tested candidate's understanding of different capital components and risk management techniques. The most successful candidates were able to demonstrate a robust understanding of source material through reasonable explanations and sound justification.

Solution:

(a)

(i) Define redundant reserves.

(ii) Explain why some of Darwin's products may have redundant reserves.

Commentary on Question:

Candidates generally performed well on parts (i) & (ii). Either of the two explanations provided below were sufficient for full credit.

Redundant reserves are statutory reserves minus economic reserves, where economic reserves are calculated using best-estimate assumptions.

Statutory reserves tend to use conservative assumptions as regulators are conserved about policyholder protection. This results in higher reserve levels than what would result from using best-estimate assumptions.

Statutory reserves may be redundant due to prescribed assumptions of high mortality, low interest rates, high lapse, and otherwise conservative methodologies.

8. Continued

(b) Explain two pros and two cons associated with using a captive reinsurer.

Commentary on Question:
Additional answers not listed below were sufficient to earn full credit if relevant and correctly explained.

Pros:
- Increased returns on the block are achieved as lower cost of capital is obtained through direct access to wholesale reinsurance markets and/or alternative funding sources.
- Reinsurance coverage through captives is flexible and can be specially tailored to meet specific underwriting and financing needs of the company.
- Captives can be established in locations with favorable tax codes, reducing total cost of reinsurance.

Cons:
- Captives can result in increased regulatory scrutiny as regulators may be concerned with funding liabilities offshore.
- Captives can be costly to set up and require additional administrative burden.
- Captives can introduce significant complexity to the insurer.

(c)

(i) Describe how you would calculate the value of each capital tranche of Darwin's term business.

(ii) Describe two different ways that a reinsurer might be willing to provide capital support.

Commentary on Question:
Candidates generally had a difficult time communicating appropriate steps to value capital tranches. Successful papers identified and explained relationships between key capital components per the source material. Full credit answers for VIF should mention that it is the result of projecting or modeling future cash flows of the business. Bifurcation of Conservative & Optimistic VIF was not necessary for full credit.

Tranche valuation should add together economic capital, redundant capital, and VIF. Redundant capital is equal to statutory reserves & capital minus economic reserves & capital. Although not officially represented on the balance sheet, Value-in-Force reflects the present value of future profits of in force business. VIF has two primary components:

8. Continued

Conservative Value in Force = Conservative estimate of PV of future cash flows associated with in force business under conservative assumptions.

Optimistic Value in Force = Estimate of PV of future profits above conservative VIF, reflecting potential upside on conservative assumptions.

Reinsurers can offer capital support in two primary ways:
1) Statutory Capital Relief: Deal structured to directly reduce the statutory reserve by reinsuring risks related to solvency margins.
2) VIF Financing: Allows a company to increase its statutory surplus by monetizing a portion of its value-in-force.

(d)

(i) Compare and contrast the following two approaches from Alexis's message:

I. Traditional reinsurance

II. Financial reinsurance

(ii) Recommend the best approach given Alexis's view of the company. Justify your recommendation.

Commentary on Question:
To receive full credit, candidates needed to include at least one comparison item in part (i). Well explained items not listed below were also awarded credit as appropriate. In part (ii) a maximum of half credit was awarded if Traditional Reinsurance was recommended with reasonable justification.

Both Traditional and Financial Reinsurance involve transfer of statutory reserves from cedant to reinsurer and provide reserve credit.

Traditional reinsurance involves the reinsurer taking on insurance risks such as mortality exposure. As such, the reinsurer stands to earn profits if the insurance experience performs better than expected.

Financial reinsurance involves very little insurance risk transfer is used only for "remote" types of risks and/or capital structuring. The reinsurer's profits are generally only tied to fees.

For Darwin, Financial reinsurance is recommended. The company currently does not need to reduce its risk exposure as its business blocks are secure and stable. Financial Reinsurance would help free up capital to invest in other high growth business opportunities.

9. Learning Objectives:

4. The candidate will understand the application of quantitative methods and techniques with a risk management focus to business problems for financial and non-financial companies.

Learning Outcomes:

(4a) Assess and apply methods and processes for quantifying and managing hedgeable and non-hedgeable risks within any business enterprise.

(4b) Evaluate model risks and processes

(i) Assess model tradeoffs among usefulness, resource constraints, timeliness, fidelity, and accuracy

(ii) Assess processes for vetting models

(4c) Evaluate results of deterministic, stress-testing, stochastic and simulation methods and models

Sources:

Nested Stochastic Modeling for Insurance Companies (excl Appendix)

Commentary on Question:

The graders found the candidates were not doing well in general. In particular, the candidates had hard time to finish all the essay questions which were supposed to capture some points easily. The candidates were struggled with part b and c. Many candidates missed the point that g(x) is a decreasing function of X. Therefore, it's fairly easy to reduce the number of scenarios needed in Var 99% calculation

Solution:

(a) Write an expression for the value of the liability at time zero in terms of $y(t)$ and $X[t]$.

The liability at time zero is the discounted to time zero value of the Liability calculated at time t:

$$\overline{e^{-t \cdot y_t} \cdot g(X_t)}$$

(b)

(i) Explain how VaR99 can be calculated by computing g for fewer than 10,000 outer scenarios of $X[t]$.

(ii) Determine the minimum total inner scenario computations needed to determine VaR99.

9. Continued

Since

$$X_t^{(1)} \leq X_t^{(2)} \leq \cdots \leq X_t^{(10000)}$$

and g is decreasing function of X, we have:

$$g(X_t^{(1)}) \geq g(X_t^{(2)}) \geq \cdots \geq g(X_t^{(10000)})$$

Var 99 will be the 99th (worst) percentile of the Loss:

This will correspond to the smallest 1% of the outer scenario value

i.e.,

$$g(X_t^{100})$$

Since each computation is over 200 inner scenarios, this one computation of g will require 200 inner scenario computations.

(c)

(i) Determine a function for A.

(ii) Determine the value of B.

(iii) Determine a function for C.

CTE99 is the average of all values at least as worse as the VaR99.

$$\text{CTE99} := \frac{1}{100} e^{-t \cdot y_t} \sum_{1 \leq j \leq 100} g\left(X_t^{(j)}\right)$$

(i) A = exp (-tyt)

(ii) B = 100

(iii) C = g(Xt(i))

9. Continued

(d) Determine how many computations are required for computing CTE99 given that g is a decreasing function of X[t].

There are 100 computations for

$\overline{g(.)}$, each of which requires 200 inner scenario computations for a total of

100x200=20000 inner scenarios for CTE99.

Without the result in (b) above, one would compute g over all the 1000 outer scenarios, each of which requires 200 inner computations to obtain g(.) This answer (2M) is incorrect.

(e) After building the above nested stochastic model, your intern produced the following results below for your review:

Metric	Value (in M)
VaR 99	134
CTE 99	120

Evaluate the validity of these results.

No, the results are invalid
The CTE99 >= VaR99 but provided results show the opposite.