CFE 201 Model Solutions
November 2025

1. Learning Objectives:

1. The candidate will understand how an organization 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.

(1c) Assess the impact on value creation from business strategies such as acquisitions, divestitures, or reinsurance.

Sources:

Koller, Goedhart, and Wessels, Valuation: Measuring and Managing the Value of Companies, Seventh Edition, Ch 31: Mergers and Acquisitions

CFE201-102-25: Why private equity sees life and annuities as an enticing form of permanent capital

Commentary on Question:

The goal of this question is for the candidate to analyze Darwin's acquisition of Snappy, describe some of the risks and benefits that are present when a life insurer or private equity firm acquires a life insurer, and demonstrate understanding of the way a purchase price could be structured.

Solution:

(a) Describe Darwin's rationale for the acquisition using two archetypes of value-creation.

Commentary on Question:

Candidates generally did well on this question. Common areas where candidates lost points are not quoting anything from the source material, or not having a reasonable justification of the applications to Darwin and Snappy.

Answers are acceptable as long as they are from the list of "Archetypes for value-creating acquisitions" from page 593-594 of the source material and have a valid explanation of how they apply to Darwin and Snappy.

1. Continued

- Acquire skills or technologies more quickly or at lower cost than they could be built in-house -- Darwin is hoping to acquire technological capabilities faster (and possibly cheaper) than they could build them in-house
- Create market access for the target's (or, in some cases, the buyer's) product -- Darwin is hoping to create more market access for Snappy's products since Snappy's capital constraints are limiting their sales but Darwin has more access to capital.

Other answers are acceptable as long as they are from the list of "Archetypes for value-creating acquisitions" from the source material and have a valid explanation of how they apply to Darwin and Snappy

The list of "Archetypes for value-creating acquisition" is:

1) Improve the performance of the target company
2) Consolidate to remove excess capacity from an industry
3) Create market access for the target's (or, in some cases, the buyer's) products
4) Acquire skills or technologies more quickly or at lower cost than they could be built in-house
5) Exploit a business's industry-specific scalability
6) Pick winners early and help them develop their businesses.

(b) Critique your intern's statement.

Commentary on Question:
A common areas where candidates lost points is mitakenly underpaying as not creating additional values for the company.

While Darwin is more likely to get value if they can acquire Snappy for a lower price, this is easier said than done as there aren't usually opportunities to acquire companies below their intrinsic value

(c) Explain how other parties submitting offers on Snappy could affect the expected value to Darwin of a winning bid.

Commentary on Question:
Candidates struggled with this question. Common area for losing points is not providing a reasonable answer on how it affects expected value to Darwin.

If the other insurers identify the same synergies that Darwin does, and Darwin's offer is the highest, it suggests that Darwin could be overly optimistic about the synergies and overbid.

1. Continued

(d)

(i) Explain three reasons why a private equity firm might be interested in acquiring Snappy.

(ii) Describe two risks that the private equity firm may need to mitigate if it successfully acquires Snappy.

Commentary on Question:
Common areas where candidates lost points are not providing reasonable justifications of why a private equity firm might be interested in acquiring Snappy.

(i)

- As a life insurance company, Snappy has a significant asset balance to manage, and the private equity firm could access high investment returns by shifting the investment strategy to be higher risk / higher return
- As a life insurer, Snappy has long-term assets that the private equity firm can quickly invest in alternative credit
- Snappy also has the potential for large-scale investing.

(ii)

Liquidity concerns – if they shift the investment strategy into less liquid or higher risk assets, they still need to maintain sufficient liquidity to meet policyholder needs; Regulatory concerns – life insurance is significantly more regulated than they are likely used to, so they will need to work with the regulators to build up trust.

(e) Compare and contrast the risks and benefits to Darwin if they pay in cash vs. if they pay in stock, keeping in mind that the acquisition may create or destroy value for Darwin.

Commentary on Question:
Candidates generally did well on this question. Common areas where candidates lost points are failing to identify that Darwin reaps all benefits if additional synergies are realized when paying in cash, and/or that additional value or loss is shared with Snappy's owners when paid in stocks.

- If Darwin pays in cash, Darwin carries all of the risk that they've could have overestimated the synergies and overpaid for Snappy, but Darwin also reaps all of the benefit if additional synergies are realized.
- If Darwin pays in shares and the acquisition creates value for them, the additional value is shared with Snappy's owners.
- If Darwin pays in shares and the acquisition destroys value, part of the loss is shared with Snappy's owners.

1. Continued

(f) Recommend whether Darwin should offer to pay for Snappy in cash or in stock. Justify your recommendation.

Commentary on Question:
Common areas where candidates lost points are failing to connect the answer to the case study, or not meaning enough justifications.

If Darwin is confident in their ability to create value, they should pay in cash. Other considerations include capital structure and access to debt – Darwin has strong capital and access to debt through RPPC so they are able to raise the cash. Both of these reasons support Darwin paying for Snappy with cash instead of shares.

2. Learning Objectives:

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

Learning Outcomes:

(2c) Analyze the impact of accounting policies related to taxes and foreign exchange rates on financial statements.

Sources:

International Financial Statement Analysis 4th Ed, Ch. 15 Financial Analysis Techniques

Commentary on Question:

This question tested the candidate's understanding of financial statement translation, specifically relating to the potential complexities, the current rate method vs. temporal method, translation adjustments, and the impact of a hyperinflationary economy. Candidates were generally successful in selecting the correct exchange rates to use for each line item of the Balance Sheet and Income Statement, but many struggled with the placement or calculation of the translation adjustment. Additionally, many candidates struggled to determine when restatement for hyperinflation is necessary.

Solution:

(a)

(i) Critique the CEO's statement.

(ii) Translate Skylite's provided financial statements as of December 31, 2025 as they would show up on Company ABC's financial statements. Use Excel tab 2_a-ii.

(iii) Explain the impact to Skylite's equity due to FX changes at the end of 2025.

Commentary on Question:

For part (i), candidates received full credit for recognizing the functional currency, correctly stating that the temporal method must be used, and providing a critique of the CEO's statement. Many candidates were missing the critique portion, while others incorrectly stated the functional currency, stated the wrong translation method based on the rest of their response, or did not provide relevant information. If strongly justified, points were not deducted for stating the current method should be used instead of the temporal method, as there was room for interpretation in the question stem that could lead to either method.

For part (ii), candidates received full credit for correct application of the translation method stated in part (i), clear inclusion of the translation adjustment, and correctly calculating financial statement line items. Candidates generally performed well on this part, with most mistakes relating to the translation adjustment.

2. Continued

For part (iii), candidates needed to correctly recognize net asset/liability exposures from part (ii), correctly recognize the weakening of the foreign currency, correctly stating the relationship of the two previous items with various financial statement items, and ultimately stating the impact to equity. Many candidates were only missing the relation back to equity while others incorrectly stated the net asset/liability exposure or mixed up line item relationships.

(i) The CEO is incorrect, there would still be material complications in the financial reporting of Skylite. Under US GAAP, ABC must first determine the functional currency of Skylite. This is determined as the currency that most impacts the price of Skylite's goods/services. If the functional currency is deemed to be Vitor, then Skylite can use the current rate method, which is slightly simpler because it translates all balance sheet items at the current exchange rate. If the functional currency is USD, then Skylite would be translated under the temporal method, which uses historical rates to translate non-monetary accounts held at historic value. In either case there is a translation adjustment to bring the balance sheet back into balance. Based on all of these considerations, it is evident that the translation would be more complicated than by just consolidating and translating.

(ii)

Projected Skylite Balance Sheet, December 31, 2025

(USD in millions)			Temporal Method
Assets:			
Cash	129	7.0	December 31, 2025
Account Receivables	200	7.0	December 31, 2025
Inventory	234	6.4	Weighted Rate for Inventory is acquire
Fixed Assets	817	6.0	December 31, 2024
Total Assets	1,380		
Liabilities:			
Current Liabilities	71	7.0	December 31, 2025
Long-term Debt	571	7.0	December 31, 2025
Total Liabilities	643		
Initial Capital	583	6.0	December 31, 2024
Retained Earnings	153		Balancing Item
Total Equity	737		

Total Liabilities & Equity	1,380		

Projected Skylite Income Statement for the year of 2025
(Vitor in millions)

Revenue	758	6.6	Average Rate
Net Investment Income	76	6.6	Average Rate
Cost of Goods Sold	469	6.4	Weighted Rate for Inventory is acquire
Depreciation	17	6.0	December 31, 2024
General Expense	227	6.6	Average Rate
Operating Income	121		
Income Tax	30	6.6	Average Rate
Translation Gain/(Loss)	63		=153-121+30; Balancing item
Net Income	153		Equal to Retained Earnings

(iii) Skylite's monetary liabilities exceed monetary assets (net monetary liability position). Because local currency Vitor weakens, thus net income increases and equity increase.

(b)

(i) Translate Skylite's financial statements as of December 31, 2025, before consolidation under the hyperinflation scenario provided on Excel tab 2_b-i.

(ii) Explain the impact to Skylite's equity due to FX changes at the end of 2025.

Commentary on Question:
Candidate performance on (b) was similar to (a). For part (i), in addition to the same requirements from (aii) candidates needed to recognize the need for the temporal method without restating for inflation in order to receive full credit. The most common mistake was restating for inflation prior to translation, with another mistake being misplacement of the translation adjustment under the temporal method. Grading points were not deducted for mistakes carried over from previous parts of the question.
For part (ii), the same considerations were necessary as in (aiii) to receive full credit. Many candidates lost points due to the exclusion of a tie back to equity, lack of mentioning the net asset/liability exposure, or simply stated numbers from (bi).

2. Continued

i)

Projected Skylite Balance Sheet, December 31, 2025

(USD in millions)			Temporal Method
Assets:			
Cash	113	8.0	December 31, 2025
Account Receivables	175	8.0	December 31, 2025
Inventory	221	6.8	Weighted Rate for Inventory is acqu
Fixed Assets	817	6.0	December 31, 2024
Total Assets	1,325		
Liabilities:			
Current Liabilities	63	8.0	December 31, 2025
Long-term Debt	500	8.0	December 31, 2025
Total Liabilities	563		
Initial Capital	583	6.0	December 31, 2024
Retained Earnings	179		Balancing Item
Total Equity	762		
Total Liabilities & Equity	1,325		

Projected Skylite Income Statement for the year of 2025

(Vitor in millions)

Revenue	714	7.0	Average Rate
Net Investment Income	71	7.0	Average Rate
Cost of Goods Sold	441	6.8	Weighted Rate for Inventory is acqu
Depreciation	17	6.0	December 31, 2024
General Expense	214	7.0	Average Rate
Operating Income	114		
Income Tax	29	7.0	Average Rate
Translation Gain/(Loss)	94		=179-114+29; Balancing item
Net Income	179		Equal to Retained Earnings

ii) Skylite's monetary liabilities exceed monetary assets (net monetary liability position). Because local currency Vitor weakens, thus net income increases and equity increases.

2. Continued

(c) Recommend two actions that can be used to minimize Company ABC's financial statement volatility. Justify your recommendation.

Commentary on Question:
Candidates generally did well on this part, with full credit being given for two valid methods of reducing financial statement volatility and explanations that related back to ABC. Grading points were not deducted for responses stating ABC could simply not acquire Skylite, as the lack of acquisition would minimize volatility and the question stem does not state that the acquisition is assumed to be carried out.

To minimize financial statements volatility, the company needs more monetary assets or less monetary liabilities. Examples of how this could be accomplished include:

buy back long-term debt
issue equity and invest proceeds in bonds
reduce fixed assets to the extent not needed
possibility of putting on hedges that get monetary asset treatment

3. Learning Objectives:

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

Learning Outcomes:

(2a) Analyze the reported financial statements and the interrelationships among them, in order to measure financial performance.

Sources:

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

Commentary on Question:

The question is trying to test the conceptual understanding of financial analysis, analytical judgement, interpretation and technical application of financial analysis. The subparts (a), (b) and (d) are fairly straightforward questions. Part (c) requires calculation in spreadsheet and depending upon method selection, there can be several answers that are correct. Collectively, this question evaluates a student's ability to move through the full financial analysis process: understanding limitations → selecting appropriate tools → applying methods → interpreting results → making a justified decision. It reflects how financial statement analysis is used in practice, particularly in investment and valuation contexts such as buy-out fund decisions.

Solution:

(a) Describe two limitations of ratio analysis that may present challenges when comparing Blue Jay Air and Frenz.

Commentary on Question:

This part tests the student's understanding of ratio analysis and its weaknesses. The goal is to ensure students recognize that ratios are not universally comparable and may be affected by factors such as accounting policy differences, firm size, or industry characteristics. Students are expected to demonstrate critical thinking by explaining why ratio analysis alone may be insufficient when comparing two companies.

1. The heterogeneity of the two business's operating models. i.e. the two companies operate in different industries which may make it difficult to compare common ratios.

2. The use of alternative accounting methods. Blue Jay Air is incorporated in the United States, whereas Frenz is incorporated in Belgium. This and other accounting choices may make comparing the two companies difficult with ratio analysis.

3. Continued

(b)

(i) Describe the two types of common size analysis.

(ii) Recommend one type of analysis for analyzing both Blue Jay Air and Frenz. Justify your recommendation.

Commentary on Question:
Part b(i) This component evaluates knowledge of financial statement analysis techniques. Students must correctly identify and describe the two main types of common size analysis, demonstrating understanding of how income statements and balance sheets can be standardized for comparison purposes. Part b(ii) assesses the student's ability to interpret and apply judgement. Rather than simply listing tools, students must select the most appropriate type of analysis for comparing Blue Jay Air and Frenz and justify their choice. This mirrors real-world financial analysis, where analysts must decide which tools are most relevant to the decision at hand.

(i) Cross-sectional analysis: (sometimes called 'relative analysis'), compares a specific metric for one company with the same metric for another company or group of companies, allowing comparisons even though the companies might be of significantly different sizes and/or operate in different currencies.

Trend Analysis: provides important information regarding historical performance and growth and, given a sufficiently long history of accurate seasonal information, can be of great assistance as a planning and forecasting tool for management and analysts.

(ii) Given that Blue Jay Air and Frenz use different currencies and operate in different industries, cross-sectional or relative analysis is more appropriate.

(c) Perform the common size analysis for Blue Jay Air and Frenz that you recommended in part (b).

Commentary on Question:
This part of the question tests technical application skills. Students must correctly convert financial statement data into percentages and present a common size analysis in a consistent and accurate manner. This demonstrates competence in applying analytical methods using real financial data.

3. Continued

Relative Analysis of the Balance Sheets

	2024	
	Blue Jay Air	**Frenz**
Cash and Short Term Investments	24%	6%
Accounts Receivable	14%	2%
Current Assets	**66%**	**12%**
Goodwill	2%	14%
Other Long-term Assets	32%	74%
Total Assets	**100%**	**100%**
Accounts Payable	8%	4%
Advanced Ticket Sales	16%	n/a
Current Debt	5%	3%
Current Liabilities	**29%**	**7%**
Long-Term Debt	37%	45%
Pension Benefits	11%	n/a
Other Long-term Liabiilities	13%	n/a
Total Liabilities	**90%**	**52%**
Paid-in Capital	12%	10%
Retained Earnings	-2%	38%
Total Equity	**10%**	**48%**

(d) Recommend which company to buy for the buy-out fund based on the conclusions that can be drawn from the common size analysis performed in part (c).

Commentary on Question:
This part targets analytical and evaluation skills. Students must interpret the results of their common size analysis and translate those findings into a clear investment recommendation. The emphasis is on evidence-based reasoning—students must link their conclusion directly to insights drawn from the analysis rather than personal opinion.

Asset Observations
-BJA has much more cash and short term assets than Frenz
-BJA has more assets tied up as accounts receivable than Frenz

3. Continued

Liability Observations
- a sizable portion of BJA's liabilities are advanced ticket sales, and a pension liability, which are N/A for Frenz
- both companies operate with similar levels of debt

Equity Observations
- both companies have similar levels of paid-in-capital but BJA has struggled with profitability and has negative overall retained earnings

Conclusions
- While Frenz appears to be the more profitable and healthier company, this would be considered in the purchase process and would likely drive up the price. BJA on the other hand looks like it could be optimized further and would likely come at a discount given the low amount of shareholder equity.

- for example, BJA has a high level of cash and short-term assets that could potentially be put to use for other purposes, or could be more efficient at collecting on accounts receivable.

4. Learning Objectives:

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

Learning Outcomes:

(3c) Recommend best practices in business processes to achieve operational excellence.

Sources:

CFE201-106-25: Procurement, early warning systems, and the next disruption
CFE201-107-25: Financial institutions and nonfinancial risk: How corporates build resilience
CFE201-108-25: When Nothing is Normal: Managing in Extreme Uncertainty
Case Study

Commentary on Question:

This question tested the candidate's understanding of managerial decision making, establishment of resilience, and risks faced by Snappy Life Insurance Company. In addition to demonstrating knowledge of the concepts in each part of the question, candidates were expected to make concrete connections to Snappy based on the case study.

Solution:

(a) Describe two pitfalls Snappy is facing due to management not responding to the crisis.

Commentary on Question:

To receive full credit on part (a), candidates were expected to list 2 management pitfalls and describe each in relation to Snappy Life. Credit was given for explanation of a pitfall without explicitly calling it out by the name provided in the textbook. Candidate performance was overall low, with many incorrect descriptions of a pitfall in relation to Snappy or vague descriptions of a risk being faced.

optimism bias - shows through management's disregard for the drop in capital—Snappy faces multiple challenges such as slowing sales, exposure to heightened competition and lack of expertise in financial reporting. Management's tendency to downplay these warning signs may lead them to overestimate the company's resilience and assume that these issues are temporary, rather than proactively addressing them. Such a mindset could delay strategic moves like seeking reinsurance or investing in better technology and cyber defenses, ultimately jeopardizing the company's long-term stability. Ignoring the declining capital position, Snappy risks being caught off guard by more severe financial or operational shocks.

4. Continued

informational instability - rapidly shifting and often unreliable data can mislead decision making. Snappy lacks robust financial projection and does not have the appropriate personnel to move it forward. Snappy is at risk of basing its strategic decisions on outdated or imprecise information. Snappy might fail to recognize the true extent of the capital decline or misjudging competitive pressures or underestimate the risk of competing solely on price, or risk of the new arrangement with NMO. Underestimating these risks leave Snappy vulnerable to uncertainties.

Wrong answer – leaders must be sensitive to possibility that information they thought was clear and certain could turn out to be wrong. Snappy is ignoring the declining capital, continuing to operate based on outdated or overly optimistic assumptions about the financial health of the company. Snappy leaders could be misreading the issues they are facing, slowing sales, sourcing business, increasing competition, lack of robust financial projection, lack of expertise of work force as well as cybersecurity deficiencies. This behavior means they're effectively holding onto a "wrong answer" regarding the company's resilience. By not re-evaluating their assumptions considering emerging data—such as falling capital ratios. Snappy is at risk of making strategic decisions that worsen their situation rather than addressing it.

Paralysis by analysis. Confusing and ever-changing data can cause managers to delay decisions as they search for more analytical rigor. They may never find it, given the extent of the crisis we are in. Delay is in itself a decision, since taking no action has consequences. Managers should rather act on what they do know and adapt their strategy as new information becomes available. Snappy have many issues, slow sales, decreasing capital, increased competition, sourcing business, unknown cyber security and lack of robust financial projection and staff to move it forward. Decision delays can exacerbate the firm's vulnerabilities

Organizational exhaustion - In extreme uncertainty, organizations are usually unable to return to business as usual for a long time, sometimes years. This exposes managers and their teams to the risk of exhaustion in the face of constant and apparently never-ending change. It can take a toll on managers' mental and physical health, causing major harm to organizational effectiveness, from a decline in responsiveness to a deterioration in the overall quality of work. Snappy is in a perpetual high-stress environment combined with management's tendency to ignore critical financial signals can trap the organization in a cycle where reactive measures or delays in decisions lead to deeper operational and strategic problems. Snappy is dealing with slow sales, limited future growth, sourcing business, last of robust financial projections, lack of appropriate workforce, and threat of data breaches.

4. Continued

(b)

(i) List the three most important resilience dimensions that can be tested by Snappy.

(ii) Rank the three resilience dimensions from part (i) based on how important each is to Snappy. Justify your ranking.

(iii) Explain one opportunity for Snappy to improve its resilience in each dimension from part (i). Justify your responses.

Commentary on Question:
For part (bi), full credit was awarded for candidates that correctly listed 3 of the top 4 resilience dimensions for life insurance companies as described in the reading. Partial credit was awarded to candidates that listed at least 1 of the top 4 dimensions or at least 2 on the entire list. Candidates struggled with this question as very few received full credit, with many candidates listing risks or topics unrelated to the resilience dimensions.
For part (bii), candidates needed to distinctly rank the resiliency dimensions listed in part (bi) and provide justification for their rankings. Candidate performance was mixed, with many candidates receiving nearly full credit and the rest receiving little credit. The most common mistakes were simply defining the resilience dimensions, not providing adequate justification for their rankings, or not relating to Snappy Life.
In part (biii), most candidates performed well. Full credit was awarded for valid recommendations relating to each resilience dimension listed and in relation to Snappy. Candidates that received little or no credit typically provided vague actions without any further explanation.

(i) operational, financial, digital and technological, market position and innovation, organizational, disruption and crisis response, foresight, reputation, brand and customer

(ii) #1: operational - customer data and servicing is state of the art and good underwriting
#2: financial - requirement to maintain 19% profitability & RBC ratio of approx. 250%
#3: digital and technological - use of AI and modernized system
#4: market position and innovation - looking at new strategies write other insurance companies policies
#5: organizational - no separate risk department, issues are reported to Veltro
#6: disruption and crisis response - while Snappy isn't in crisis it is good to have procedures in place
#7: foresight - less important since snappy relies on straight foreword financials and not scenario based

4. Continued

#8: reputation, brand and customer - this is secondary importance - since sales come from the internet, speed/automation is more important

(iii) operational - build a realtime monitoring system to build in redundancies into the underwriting and policy issuance systems so issues can be resolved quickly because - customer data and servicing is state of the art and good underwriting

financial - build a system to do scenario testing to better respond to changes in profitability or RBC levels because requirement to maintain 19% profitability & RBC ratio of approx. 250% - because this is static

digital and technological - use of AI and modernized system - since everything is online enhance the cyber security system to protect against hacks
market position and innovation - looking at new strategies - write other insurance companies policies since sales are slowing plus new competition

organizational -develop a robust risk department since there is no separate risk department, issues are reported to Veltro

disruption and crisis response -develop an a crisis management response since Snappy isn't in crisis it is good to have procedures in place

foresight -create a heat map that shows potential risk since snappy only uses static metrics

reputation, brand and customer - this is secondary importance - since sales come from the internet, speed/automation is more important the articles don't address specific

(c) Outline a system for Snappy to improve its resilience, given these risks.

Commentary on Question:
Candidate performance was generally strong on part (c) of this question. To receive full credit, candidates needed to correctly identify an approach to mitigating each of the three listed risks from the question stem, which generally included a description of the risk itself. Successful candidates also linked the three approaches in a system, such as the creation of a heatmap to rank the risks, though this was not required for full credit. Common mistakes included weak or irrelevant justification for an approach aimed at addressing the risk or complete misunderstanding of the risk itself.

4. Continued

Absolute shortage risk - this makes sure critical inputs like capital, reinsurance, technology remains available as the demand for their products grows or there is a disruption in growth or capital. Value chain review of product demands and capital requirement, have a historically review and project how future developments can unfold. This should be part of a regular report.

Supplier risk - reduce risk from suppliers, create a heat map for technology, AI, underwriting, reinsurance, other partners. Use the seven dimensions to evaluate, operational, structural, financial, regulatory, data security, reputational and organizational maturity. rate the risk by showing high medium low

Inflation risk - identify where inflation can hurt the most for raising costs, using 3 step approach

1. cleansheet approach allows Snappy to identify what costs are fixed vs variable and which ones are sensitive to fluctuations
2. Snappy models the expected price changes for all costs involved that are sensitive to fluctuations
3. Snappy ranks the risks of inflation by category

Using above data create a heat map shown on page 6t o identify what areas are at risk, underwriting, technology, data security etc. and rank low to high risk

5. Learning Objectives:

4. The candidate will understand the appropriate application of evolving quantitative methods and technologies that help to manage the business.

Learning Outcomes:

(4a) Evaluate the appropriateness of applying evolving methods and technologies to manage specific business issues.

(4b) Apply evolving methods and technologies for quantifying and managing business risks and opportunities

Sources:

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

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Compare and contrast the use of hold-out sampling and k-fold cross validation for the quality control analysis.

Commentary on Question:

Many candidates failed to answer properly according to the question stem, which asked candidates to compare and contrast. Many candidates simply defined the methods, which did not earn full credit.

Compare: Both hold-out sampling and k-fold cross validation involve splitting the data set into separate subsets for training versus testing. In this way, both methods test the model on previously unseen data to reduce overfitting and appropriately estimate how well the model will perform on new data.

Contrast: Hold-out sampling requires a sufficiently large dataset to train an accurate model and evaluate its performance, while k-fold cross-validation can be used on a smaller set of data or a dataset targeting relatively rare events (such as landing gear defects). Hold-out sampling splits the data once into training and test sets, while k-fold cross validation splits data into 'k' folds that the model iteratively uses as k-1 folds of training data and 1 fold of test data before aggregating results. Hold-out sampling is more subject to a “lucky split” such that the test set is an easy set for the model to predict.

5. Continued

(b) Create a confusion matrix using the information provided in the table below (see Excel tab 5_b&c). Show your work.

Statistic	Value
Total Observations	1,750
Total Defective Units	50
Precision	20%
Recall	100%

Commentary on Question:
Many candidates performed well on this task. Candidates who did not perform well often failed to show work leading to their solutions, making partial credit challenging.

See excel solution (screenshot below):

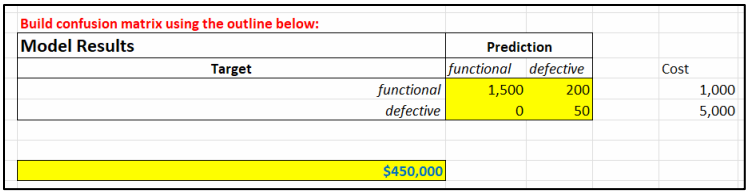
Model Results	**Prediction**	
Target	*functional*	*defective*
functional	1,500	200
defective	0	50
Total Defective Units = TP + FN =	50	
Total Functional Units = TN + FP =	1,700	
Precision = TP / (TP + FP)	20%	
Recall = TP / (TP + FN)	100%	
TP =	50	
FN =	0	
FP =	200	
TN =	1,500	

(c) Calculate the expected annual cost of ensuring quality landing gears. Show your work.

Commentary on Question:
Most candidates performed well on this part of the question. Even when the candidate's solution to (b) was incorrect, candidates were often able to pivot to a solution for (c) that was correct in the context of their work for (b).

See excel solution (screenshot below): This should be a simple sumproduct() function or the typed out equivalent.

5. Continued



Build confusion matrix using the outline below:

Model Results	Prediction		
Target	*functional*	*defective*	Cost
functional	1,500	200	1,000
defective	0	50	5,000
$450,000			

(d) You review your results with the Production Manager, who is new to these statistical techniques. He says, "Great work, but my product line is being held to a tight budget. From what you're showing me, if we just improve the precision of the model, we'll reduce those pesky false positives that create inspection delays."

Critique the Production Manager's statement.

Commentary on Question:
Many candidates did not structure a true "critique" of the manager (both ways in which the manager is correct and ways in which the manager's statement could use correction). Additionally, many candidates did not make the full connection out to the business context (catastrophic business risk associated with false negatives).

In order to modify precision, the model's positive prediction threshold would need to be modified to be more selective. This can reduce the number of false positives, thereby reducing the cost of inspection delays. That is what the production manager is likely expecting here.

However, there is a tradeoff that may arise where the number of correctly identified true positives may also be reduced. Missing some true positives, in the context of the business, would be catastrophic, as ABC Inc. is reviewing its quality control processes for landing gear. The cost of false negatives, both financially and reputationally, could be substantially greater than the cost of inspection delays the production manager is hoping to avoid.

6. Learning Objectives:

4. The candidate will understand the appropriate application of evolving quantitative methods and technologies that help to manage the business.

Learning Outcomes:

(4a) Evaluate the appropriateness of applying evolving methods and technologies to manage specific business issues.

(4b) Apply evolving methods and technologies for quantifying and managing business risks and opportunities

Sources:

Kelleher, Mac Namee, and D'Arcy, *Fundamentals of Machine Learning for Predictive Analytics 2nd ed.*, Ch. 2: Data to Insights to Decisions

Kelleher, Mac Namee, and D'Arcy, *Fundamentals of Machine Learning for Predictive Analytics 2nd ed.*, Ch. 14: The Art of Machine Learning for Predictive Data Analytics

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Commentary on Question:

This question was aimed at determining the candidate's knowledge of considerations related to machine learning, model selection, and data feasibility. In addition to recalling key concepts requested in the question stems, the candidate was expected to describe the concepts and make recommendations specifically in relation to Blue Jay Air.

Solution:

(a) Describe three issues to consider beyond model accuracy when selecting the type of machine learning approach to use in a business situation.

Commentary on Question:

To receive full credit, candidates were expected to correctly list 3 considerations and include thorough explanation of at least 2. Candidates generally struggled with this question. Rather than listing and describing the key considerations in model selection, candidates often listed data considerations or other general risks that did not relate specifically to machine learning models.

- Prediction Speed: How quickly a model can make predictions
- Capacity for Retraining: Need to monitor the performance of a model so as to flag the occurrence of concept drift and indicate if a model has gone stale. When this occurs, the model needs to be changed in some way to adapt to the new scenario.
- Interpretability: Most businesses will not accept the results as is and automatically incorporate them into decision making, but rather will want the predictions to be explained or justified.

6. Continued

(b) Evaluate the data feasibility considerations specific to BJA's implementation of a machine learning model.

Commentary on Question:
Candidates received full credit on this part for correctly listing 4 data feasibility considerations, providing brief descriptions of each, and tying them back specifically to Blue Jay Air. Candidates struggled with producing the feasibility considerations and often provided vague, general descriptions of each with no reference to Blue jay Air.

- The key objects in the company's data model and the data available regarding them: For BJA, the key objects are likely to be loyalty members, their flying data, costs of flights, use of cross-selling products (Big Ben Bank's bank credit and debit cards), cost for enhanced air points, expansion of sales as incentive for travel by business executives, in addition to key objects of previous loyalty program.
- The granularity of the data available to BJA: The current application form is a lot of questions related to customer's personal information and preferences.
- The volume of data involved: The current completion rate is much lower than the target rate due to the extensive information requested, and the information gathered may not sufficient to make credible assumptions about customer behaviors.
- The time horizon for which data is available: It is important that the data available covers the period required for the analytics solution. BJA has used the new application for only 3 years and applicants have only filled it out one time.

Candidates need only evaluate 4 considerations to get full credit. Other considerations from the text may be used.

(c) Explain whether BJA is more likely to encounter agency risk or moral risk through the use of the machine learning model.

Commentary on Question:
In order to receive full credit, since both agency risk and moral risk are present in the given situation, candidates needed to identify which risk is more likely in the case of Blue Jay Air. The candidate should then have briefly described the risks and adequately explained why one is more prevalent than the other. Candidates performed reasonably well on this question, with common mistakes including only speaking to one of the risks or not taking a stance either way.

6. Continued

The model is more likely to introduce agency risk than moral risk.

Agency risks stems from things that aren't under the control of a specific business or user. Thus, when a breakdown or unintended result occurs, it is often unclear what led to the breakdown and which "agent" is responsible. For BJA, if the loyalty program is not successful in its targeting of business travelers, it may be difficult to assess what role, if any, the model algorithim played. Did it do a poor job of identifying business travelers, or did it do a good job but the travelers simply didn't have any interest or take any action?

Moral risks stem from autonomous decision introducing ethical dilemmas or bias. BJA would have more control on the training of the model and validation of the model to avoid an undesirable result such as bias (or be able to correct problems it notices).

(d) Recommend two questions BJA management should ask when deciding between locking or unlocking its machine learning model. Justify your recommended questions using information from the case study.

Commentary on Question:
Candidates performed very well on this part. Full credit was given for responses that asked two questions deemed to be directly relevant to locking vs. unlocking the machine learning model and took into account considerations specific to Blue Jay Air. Grading points were deducted for questions that were nearly identical to each other, a lack of relation to Blue Jay Air, or irrelevant questions.

- Biases: How representative was the training data relative to what population the algorithm will ultimately operate in? In the case of BJA, the data used to train the algorithm is age-biased so unlocking may allow the model to adjust to better target business travelers of all ages. However, BJA should ensure unlocked model doesn't become discriminatory in other ways such as race, sex, etc
- Accuracy and competitiveness: How much is the performance of the system likely to improve with the volume of new data if model is unlocked? In the case of BJA, will a modification to the existing application process improve the relevance and accuracy of data being fed back to the system so that business travelers are better ID'd? BJA currently has a low completion rate of its application process.

Other questions from the source and applications to the case study are acceptable.