CFE FD Model Solutions
Fall 2020

1. 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.

(1c) Evaluate the impact of non-financial factors on capital structure or capital budgeting decisions.

(1d) Assess the impact of business strategies such as acquisitions, divestitures, and/or restructurings.

Sources:

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

Jonathan Berk and Peter Demarzo, Corporate Finance, Fourth Edition, Ch 25: Leasing

Jonathan Berk and Peter Demarzo, Corporate Finance, Fourth Edition, Ch 27: Short Term Financing

Jonathan Berk and Peter Demarzo, Corporate Finance, Fourth Edition, Ch 28: M&A

Aswath Damodaran, Damodaran on Valuation, Ch 15: The Value of Synergy

F-135-19: Why Are the Parts Worth More than the Sum? "Chop Shop", A Corporate Valuation Model

Vyas, Krishna Kant, Corporate Restructuring and Value Creation

Caldwell, A Framework for Board Oversight of Enterprise Risk, CPA Canada

Commentary on Question:

Commentary listed underneath question component.

1. Continued

Solution:

(a) Critique Doe's statement.

Commentary on Question:
Answers to this question looked at diversification from one of two perspectives – either from an investor's perspective or from the company's perspective. Either perspective was acceptable. Answer 1 comes from the investor's perspective. Answer 2 shows an acceptable answer from the company's perspective.

Answer 1 (investor perspective): Diversification alone is not a good reason to move forward with an acquisition. Shareholders can diversify better on their own by diversifying their portfolio of shares. Diversification is a financial synergy that proponents of acquisitions use to justify acquiring a company. However, diversification is one of the least likely financial synergies to actually be realized in the process.

BJA could look at earnings enhancement synergies instead since SEA operates in a very different competitive product space than BJA, focusing on local, unique locations in the Pacific Northwest compared to BJA's typical hub and spoke routes.

Answer 2 (company perspective): Doe has a point to what she is saying. Diversification is not sufficient if it's the only reason; however, it could be part of the justification for an acquisition. Many things go into the decision of an acquisition and when it comes to BJA and SEA, there might be other cost synergies, expertise knowledge base, and economies of scale that highlight the benefits of the acquisition along with diversification. In this particular situation, I don't think that diversification would even be that large of a contributor to the decision since BJA and SEA are both in the aviation business. They both require similar raw materials for their planes: fuel, parts, etc. and they would be hit by similar reduction in business if there were catastrophic events (like 09/11/2011) that impact the comfort level customers have with the aviation business.

(b) Explain the synergy and economies of scale that BJA would gain if it were to acquire SEA.

Commentary on Question:
Each of the statements should be supported by the case study or information in the question itself.

1. Continued

A source of synergy is that it could leverage SEA's aircraft restoration capabilities. BJA has a need to upgrade their fleet, and SEA does this on seaplanes for customers from all over the world. However, SEA does this for seaplanes and not passenger jets, so to realize this synergy would require a lot of planning. SEA has a highly skilled maintenance team and large capacity in their maintenance hangars, so with the right planning, this synergy stands to generate significant value for BJA.

BJA has cut back on most of its training programs except for safety, but SEA has robust training programs (especially for safety) that BJA could potentially begin to offer once again with the acquisition of SEA.

SEA wants to set up partnerships with larger airline companies who have Vancouver and Seattle operations, which BJA has. Being able to better coordinate these flights would help create some economies of scale.

BJA stands to gain some financial synergies as well from SEA, as it is much more liquid than BJA is. Specifically, a cash slack synergy could be realized a SEA is relatively cash-rich but due to its small size might not be pursuing as many investment opportunities as it could if acquired by BJA.

BJA can leverage SEA's weather/safety management process to increase the efficiency of flight cancellations and delays, potentially resulting in a financial synergy by expanding operating margins.

BJA needs to revamp its booking process, and SEA has a well-developed online booking system, even praised by its customers as easy to use. BJA could leverage SEA's already-existing online booking infrastructure to revamp their own booking system at a lower cost, using SEA's expertise in this area to ensure that revamping the booking process generates value.

(c) Explain Doe's concerns with respect to the following.

(i) Probability of completing the acquisition of SEA

(ii) Control of SEA

(iii) Cost to purchase SEA

(iv) Ability of BJA to unlock value in SEA

1. Continued

Because Bill has a majority position, as long as Bill cooperates on the acquisition, the acquisition can be completed. However, Doe is concerned because disagreements amongst the board can turn an otherwise friendly takeover into something that becomes lengthy and more costly, as these board members might demand a higher premium price in order to go along with the acquisition.

By purchasing Bill's 60% stake, BJA will effectively have control of SEA. Because BJA will have majority ownership, they can replace the board of directors, if necessary, to retain control of the company.

The cost to purchase SEA may go up because of Bill's sister and the foundation. If they are resistant to the acquisition, they can demand a higher premium for the acquisition and convince Bill to seek one too. Although Bill's majority stake allows his appointees on the board to outvote his sister and the foundation's, there is still some risk to increased cost here. While not a fully hostile takeover, it will not be completely friendly either.

Unlocking value in SEA after acquisition requires a good amount of due diligence and planning. Synergies can only be realized if there are plans in place to realize them, and resistance to these plans by Bill's sister and the foundation could limit their ability to add value.

(d) Recommend if BJA should retain SEA management upon acquisition. Justify your recommendation.

Commentary on Question:
Candidates should make a recommendation and justify that recommendation.

BJA should retain SEA management upon acquisition. While retaining acquisition management typically represents a risk in the acquisition, SEA has operational expertise that should provide significant synergy benefits to BJA. Without SEAs management BJA could lose this expertise including:

- Knowledge of seaplane operations
- Pilot training program
- Maintenance staff training program and expertise

BJA should mitigate the risk of maintaining SEAs management by carefully overseeing the integration of BJA and SEA operations while also managing the SEA knowledge that could be lost without SEA management.

1. Continued

(e) Critique Doe's statement.

Doe is correct that in a perfect capital market with competitive prices, leasing vs. buying should be a comparable decision from a net present value (NPV) perspective. However, there do exist valid reasons for leasing and since BJA is already highly-leveraged, leasing may make more sense. Purchasing the fleet would require a lot of upfront capital that BJA simply doesn't have at its disposal. A key risk management objective is to maintain the credit rating of the company and taking out more debt to fund a fleet expansion will increase their already high leverage ratio and could negatively impact their credit rating.

(f) Explain four benefits to BJA of leasing the additional planes.

1. Reduced resale costs: could obtain easier access to purchasers of the planes at the end of the leasing period than it could find if it bought the planes outright
2. Expertise: The lessor of seaplanes could provide maintenance services/laborers/classes that would reduce BJAs costs to obtain this information on their own
3. Improved incentives: Assets obtained under lease arrangements can be treated better since the company does not own the asset themselves and any extraneous damage to the asset caused by negligence will likely incur costs from the lessor
4. Reduced distress costs and increasing debt capacity: BJA can avoid taking out debt in order to finance a direct purchase. One of BJA's objectives is to retain a BBB- credit rating or higher and using a lease could work towards this objective and help avoid interest rate exposure.

(g) Recommend a financing option to support leasing more planes to fulfill BJA's expansion plans. Justify your recommendation.

Commentary on Question:
There are many acceptable solutions to this part. Successful candidates made a recommendation and justified it with information from the question and the case study.

I'd recommend getting a short-term loan from RPPC to fund the leasing. It is because BJA already have a negative equity. It would be very difficult and expensive for BJA to get a funding externally. $100m of annual lease expenditure could be supported by the expected revenue of $270m.

2. 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.

(2b) Identify and analyze the impact of unusual accounting practices on the quality of earnings and assets of a corporation, including analyzing the signs of questionable accounting.

Sources:

Robinson et al., International Financial Statement Analysis, Ch. 17 Evaluating Quality of Financial Reports (Section 1-6 Only)

Commentary on Question:

This question is trying to test candidate's ability to identify and analyze the impact of unusual accounting practices on the quality of earnings, including recognizing the signs of questionable accounting. Candidate should know the major types of ratios, what they are used for, and be able to perform analysis to compare with industry norms. Candidates are also expected to have a good understand of Altman Z-score and the Beneish Model.

Solution:

(a) Evaluate how each action individually impacts BJT's financial statements.

Commentary on Question:

In order to earn full marks, candidate must be able to identify/explain the issue as well as state the impact on financial statements.

(i) BJT's activity is referred to as "channel stuffing", this activity inflates the current results by pulling future sales into present. This will accelerate revenue and enhance earnings to make BJT's income statement look more appearing than reality.

(ii) Income Taxes Payable should be classified as current liabilities as oppose to non-current liabilities. This misclassification will mislead investors by show a more attractive financial ratio (e.g. current ratio) comparing to BJT's peers for financial strength analysis.

(iii) Classification shifting from investing cashflow to operating cashflow does not change the total cashflows but creates inconsistency between financial years. This can affect investor's evaluation of BJT's cashflows (trend analysis) and expectations for future cashflows.

2. Continued

(b)

(i) Analyze Day's Sales Outstanding and Accounts Receivable Turnover for BJT for financial reporting year 2018 and 2019. Show your work.

(ii) Evaluate BJT's sales and receivables as compared to industry norms.

Commentary on Question:
Many candidates failed to recall and calculate the ratios correctly. Candidates are expected to know what the ratios are used for, and be able to perform analysis with them to compare to industry benchmarks.

(i)
Days Sales Outstanding = Account Receivable / (Revenue /365)

Account Receivable Turnover = 365/ Days sales outstanding

DSO(2018) = 108 / (366/365) = 107.7

DSO(2019) = 113 / (385/365) = 107.1

ART(2018) = 365/ DSC(2018) = 3.39

ART(2019) = 365/ DSC(2019) = 3.41

BJT's ART and DSO ratios are both relatively stable for financial reporting year 2018 and 2019.

(ii)
Number of days sales outstanding indicates how fast receivables are paid each year. BJT's DSO ratio is high comparing to industry average, indicating that receivables were not being collected on a timely basis, or possibly that revenue may not be right in the first place.

Account receivable turnover is the number of times the receivables are converted to cash each year. BJT's ART ratio is very low in both 2018 and 2019 comparing to industry average, indicating that cash is being collected in an extremely slow manner.

2. Continued

(c)

(i) Assess the likelihood of bankruptcy using Altman's Z-score on BJT's 2019 financials, replacing Market Value of Equity with the Book Value. Show your work.

(2) Recommend four ways for BJT to improve its current Altman's Z-score. Justify your recommendation.

Commentary on Question:
Most candidates were able to calculate the Z-score but some failed to comment on the likelihood of bankruptcy. In order to receive full marks in part ii), candidates also needed to justify their recommendations.

(i)
Altman Z-score = 1.2*(592-244)/1420+1.4*(271/1420)+3.3*(78/1420)+ 0.6*(496/923)+ (385/1420) = 1.34

Since Altiman Z-score is 1.34 (<1.81), the probability of BJT going bankrupt appears to be elevated.

(ii)
BJT could improve its's current Altman Z-score by doing any of the following:

1) Improve asset turnover. Sales of $385M on $1,420M of assets appears to be a very low Asset Turnover ratio.
2) Improve operating returns. EBIT/Total Assets = 78/1420 = ~6% indicates that either industry is very competitive, or management isn't doing a great job.
3) Increase working capital (current liabilities could be reduced. Current assets are also relatively small compared to total assets).
4) Replace some of the $923M of liabilities with equity. Very high E/D ratios almost guarantee a good Z-score."

(d)

(1) Explain specific implications for BJT based on the components of the Beneish Model below. Show your work.

I. Gross Margin Index (GMI)
II. Sales Growth Index (SGI)

(2) Assess the likelihood of misreporting for BJT if M-score is -1.47. Show your work.

Commentary on Question:
Many candidates failed to calculate the index correctly.

2. Continued

(i)
GMI = Gross margin t-1 / Gross margin t
SGI = Sales t / Sales t-1

GMI (2019) = 140/171 = 0.8187

GMI of 0.8187 means that the gross margin is increasing, a healthy growing margin implies lower chance of manipulate earnings.

SGI = 385/366 = 1.0519

SGI of 1.0519 means that the sales growth is positive related to the previous year. BJT could be predisposed to manipulate earnings to manage perceptions of continuing growth and to obtain capital needed to support growth.

(ii)
By looking up the Normal CDF table, the probably of manipulation = 1 - 0.9292 = 0.0708

The probability of manipulation for BJT is 7.09%. Although the classification of companies as manipulators depends on their relative cost of type I and type II errors, the value greatly exceeds the cut off of 2.9% the Beneish identified as the relevant cut off. Therefore, the likelihood for misreporting for BJT is high.

(e) Explain two specific areas of concern for any investment decision in BJT.

Commentary on Question:
Many candidates failed to recognize BJT's issue with questionable sales figures or revenue recognition practice. However, partial credit was given if other areas of concerns were identified.

Based on the Beneish Model results and the other financial information identified above regarding BJT's practices, there is a chance that BJT could be currently misreporting. This implies that any investor in BJT lacks a reliable source of information about the firm due to not being able to rely on the financial statements.

The results of the Z-Score also indicates that BJT has a high-than-threshold bankruptcy risk. Although BJT is unlikely to go bankrupt as it is a subsidiary of RPPC, investors should still be concerned for their investment.

Based on the two areas of concerns identified above, potential investors should avoid investment in BJT.

3. 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.

(1c) Evaluate the impact of non-financial factors on capital structure or capital budgeting decisions.

Sources:

F-133-19: Handbook of Corporate Finance, Ch. 10: Payout Policy

Commentary on Question:

This question was designed to test the candidates' understanding of how different personal and firm capital composition's affect a firm's desire and ability to take on new projects, complete acquisitions, and issue dividends.

In section a) candidates needed to demonstrate an understanding of the relationship between the firm debt-equity ratio and the individual debt-equity ratios of management. Section b) tested this understanding further by testing how this relationship is affected by different levers controlled by management. Section c) tested the candidate's understanding of how dividends are used as a capital management and signaling mechanism, and why certain members of management may not agree with firm's decision to distribute dividends.

Solution:

(a) Evaluate which executive(s) would be most likely to encourage investment in the project based on the deferred compensation package provided above. Justify your response and show your work.

Commentary on Question:

The best candidates demonstrated how the relationship between the individual leverage ratios and the firm leverage ratio influence individual decision making. Partial credit was given for answers that focused exclusively on the individual debt-equity ratios without making an overall comparison to Frenz.

The NPV of the project being considered by the executives will influence who wants to invest in the project.

-15,000,000 * 0.85 + 40,000,000 * 0.15 = -6,750,000

3. Continued

This is a project with a negative NPV, but a very high upside. Under the theory of the relationship between Executive Compensation and Firm Leverage, the executives that would want to take on this project would be executives with a lower debt-equity value than the Frenz firm.

Frenz Long-Term Debt + Liabilities = 152,900,000
Frenz Capital + Retained Earnings = 148,276,000
Overall Frenz Debt / Equity Ratio = 152,900,000 / 148,276,000 = 103%

To calculate the personal executive compensation debt-equity ratio, divide the present value of the future pension by the value of stock + options.
- CEO = 1,000,000 / 1,530,000 = 65%
- CFO = 550,000 / 275,000 = 200%
- CAO = 475,000 / 470,000 = 101%
- CRO = 800,000 / 600,000 = 133%

Compare the debt-equity ratio of Frenz to the individual executive compensation ratios.
CEO: 65% < 103%
CFO: 200% > 103%
CAO: 101% <103%
CRO: 133% > 103%

The CEO will select the project because the CEO's debt-equity ratio is less than the debt-equity ratio of Frenz. Having a lower debt-equity ratio than the firm increases management incentive for "over-investment" to increase the equity value of the firm and correspondingly, the personal value of the stock and options.

The CAO may be inclined to select the project because the CAO's debt-equity ratio is less than the debt-equity ratio of Frenz, even though the personal debt-equity ratio is greater than 100%.

The CFO and CRO will not be inclined to select the project due to having higher debt-to-equity ratios than the firm.

(b) Assess the expected impact on each executive's incentive to have Frenz invest in the above project for each of the scenarios I and II. Show your work.

Commentary on Question:
The best answers on Part B identified and explained how each scenario impacted the relationship between the individual and firm debt-to-equity ratios.

3. Continued

(i) In this case, issuing $20,000,000 of stock will increase the outstanding capital for Frenz and will subsequently decrease the debt to equity ratio.

Frenz Long-Term Debt + Liabilities = 152,900,000
Frenz Capital + Retained Earnings + New Stock = 148,276,000 + 20,000,000
Overall Frenz Debt / Equity Ratio = 152,900,000 / 168,276,000 = 91%

Compare the debt-equity ratio of Frenz to the individual executive compensation ratios.
CEO: 65% < 91%
CFO: 200% > 91%
CAO: 101% > 91%
CRO: 133% > 91%

As a result of changing the debt-equity ratio for Frenz, the CAO now has a higher debt-equity ratio than Frenz. As such, the CAO would no longer want to take on the negative NPV project, as the CAO's incentive for over-investment is reduced.

(II) In this case, the decision is made using the debt-equity ratio of the entire group.
Sum of Future Pension = $2,825,000
Sum of Stock + Options = $2,875,000
Executive D/E Ratio = $2,825,000 / $2,875,000 = 98%

Given that total D/E ratio is lower than the 103% of the firm, the executive committee would be more likely to accept the negative NPV project.

(c) Frenz is considering paying a special dividend, which is unexpected by the market.

(i) Describe two reasons that Frenz's ability to pay this special dividend might be limited.

(ii) Explain three reasons why the executives of Frenz may be opposed to the payment of this special dividend.

(iii) Explain three potential market signals that Frenz could be trying to convey by electing to pay a special dividend instead of repurchasing shares.

3. Continued

Commentary on Question:
Candidates generally did well on this question. The most successful answers for part i) focused on mechanisms / scenarios that would limit paying the dividend. In part ii), successful answers focused on the specific motivations of the executive board. For part iii), successful answers identified the signals that a special, one-time dividend would communicate, as opposed to the introduction of a new permanent dividend.

(i) Management could have put in direct dividend constraint into existing bond convents. These bond covenants would have created a maximum threshold of cash dividends (or share repurchases) that could be performed. Alternatively, there could be indirect constraint via a bond covenant such as a stockholder's commitment, which could specify either a minimum net worth, a minimum level of working capital, or a maximum ratio of debt-to-assets.

(ii) Reason #1 - Paying dividends reduces the free capital available and potentially increases the riskiness of their personal debt component (the present value of future pension).

Reason #2 - The Frenz executive compensation package includes both stocks and options. To the extent that the exercise prices of the options are not adjusted downward on the ex-dividend day (that is, the day after the dividend has been paid), the stock options will be worth less.

Reason #3 - From a behavioral perspective, executive management generally would rather increase the pool of assets they are managing from a social status perspective. This human element can make executive committee's reluctant to pay dividends.

(iii) Signal #1 - Frenz could be trying to signal an increase in their expectation future earnings, which cannot be communicated otherwise via public statement.

Signal #2 - Ex-dividend stock prices tend to move in the same direction as a dividend announcement when the dividend is unexpected, so this dividend increase could increase Frenz's stock price. This could be used for two potential signals: Frenz could be signaling future management actions, such as an acquisition of another company, which would benefit from an increase in Frenz's stock price. Frenz could also be signaling that they could be acquired and may want to inflate their stock price in advance of the acquisition.

Signal #3 - Frenz could be signaling a lack of viable investment alternatives, determining that distributing cash back to shareholders is the most efficient use of funds.

4. Learning Objectives:

4. The candidate will understand the application of quantitative methods with a risk management focus to business problems.

Learning Outcomes:

(4a) Assess methods and processes for quantifying and managing risk 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:

Dowd, Measuring Market Risk 2nd ed, Ch 13 Stress Testing Risk
Dowd, Measuring Market Risk 2nd ed, Ch 15 Back Testing Risk
Dowd, Measuring Market Risk 2nd ed, Ch 16 Model Risk
ASB 56: ASOP on Modeling
F-139-19: How to Improve the Quality of Stress Tests through Backtesting

Commentary on Question:

The best candidates demonstrated an understanding of the application of quantitative methods with a risk management focus and an understand of testing results and its implications.

Solution:

(a) Recommend two improvements to RPPC's Model Risk Management Framework to strengthen the model validation process. Justify your recommendation.

Commentary on Question:

Candidates needed to identify two improvements and provide descriptions for each to receive full credit. Candidates had difficulty providing complete answers for this question. In addition to the answers listed below, graders also considered reasonable solutions specific to model validation to receive credit.

RPPC should require benchmark modeling.
Risk manager should use the benchmark model to check the performance of the proposed model.

4. Continued

RPPC should require independent output validation
Validate that the model output reasonably represents that is being modeled. Includes testing against historical actual results, performing statistical tests on model output to assess their reasonableness, running tests of variations on key assumptions to test against expectations, comparing model output to those of an alternative model.

(b) Critique Patel's statement.

Commentary on Question:
To receive full credit on this question, candidates are expected to comment on the validity of each item and provide explanations on each.

He is correct that stress tests on their own do not give any indication of likelihood. However, stress tests can be integrated into formal risk modelling by assigning probabilities to stress test scenarios. The resulting estimates then incorporate both traditional market risk estimates and the outcomes of stress tests, as well as the probabilities of each.

He is incorrect that stress tests have limited value.

Stress testing highlights exposures that other risk measurement approaches might easily overlook, i.e., can identify an institution's breaking point.

Stress tests can be an effective means of communicating risk information because they are easy to understand and free of any dependence on probability notions.

Stress tests can guide decision-making and setting position limits, allocating capital, and managing funding risks.

Stress testing can help firms design systems to protect against bad events.

(c)

(i) Critique Big Ben's stress testing.

(ii) Recommend two improvements to Big Ben's stress testing. Justify your recommendation.

Commentary on Question:
In general candidates scored well in part (i) but in part (ii) most candidates recommended points to improve general testing, but not stress testing. To receive full credit, candidates were expected to (i)identify each strength/weakness of Big Ben's model (ii)provide improvement recommendations and a brief description of its importance.

4. Continued

(i) Big Ben's stress test model is run annually, which is BAD because stress tests should be run frequently enough to ensure that results are up to date and relevant. A bank should run every week/ month

Big Ben runs one historical scenario based on 2008/2009 financial crisis, which is GOOD because historical scenarios are plausible and easily understood, but BAD because it's only one scenario. It is important to strike a balance between hypothetical plausible and historical scenarios.

Big Ben's stress scenario is calculated over a 1-year holding period.

It is important to carry out stress events on longer holding periods.

(ii) Recommendation #1: Big Ben should perform liquidity stress tests.

Distress after the Lehman failure confirms the importance of the spiral between market and funding liquidity and its fragile link to the solvency of an institution.

A stress test is very good at identifying liquidity risk factors that might not otherwise be apparent and quantifying liquidity exposures.

Liquidity effects (impacts of interest rates on collateral requirements or credit triggers, widening bid-ask spreads, increasing execution times, etc) can be quite subtle. VaR systems cannot do them justice, but they are amenable to well-designed stress tests. The information provided by liquidity stress tests can be crucial in determining how to deal with the risks concerned.

Recommendation #2: Big Ben should perform credit stress tests.

Credit risk testing is the most important area of stress testing for a bank due to its loan portfolios, and given the inherent uncertainty in predicting credit risk and the expert judgement involved. Credit risk involves assumptions on PD, LGD, and EAD which impact banks in various ways. Big Ben should perform interest rate and currency risk stress testing.

(d)

(i) Describe two pieces of important backtesting information not provided in the above statement.

(ii) Explain how the missing information described in (i) can be a concern to Big Ben.

4. Continued

Commentary on Question:
The candidates were expected to identify the issues and explain each impact on Big Ben to receive full credit.

The backtest result statement does not indicate the frequency of exceedences.

If the number of tail losses is greater than expected, the risk measures are too low or there could be a problem with the VaR model.

The backtest result statement does not indicate the size of exceedences.

Model forecasts of losses larger than VaR may be very poor.

(e)

(i) Interpret the backtesting results above.

(ii) Recommend whether further action is needed based on the results above. Justify your recommendation.

Commentary on Question:
To receive full credit, candidates are expected to explain the Rosenblatt transformation and correctly apply the Rosenblatt transformation and determine the normal cdf is 0.8 for all observations. Very few candidates were able to relate this question to valid transformations. Candidates had difficulty with this question.

(i) Using the Rosenblatt transformation, it can be shown that the normal cdf value for all observations is ~0.80.

The Rosenblatt transformation takes each realised P/L through the relevant parameterised normal cdf function to give us the cdf value.

Under the null hypothesis that the model is adequate, the Rosenblatt transformed data are predicted to be distributed as standard uniform, U(0,1), but as shown below, all data in the sample are at 0.80.

Day	P/L	Forecast Mean	Forecast STD	Normal cdf
1	4065	3250	967	0.800333432
2	4297	2925	1629	0.800171647
3	2981	2275	838	0.800240923
4	3505	2958	650	0.799976826
5	2977	1922	1252	0.800288382

4. Continued

(ii) Since all the P/L data are mapped to one point under the transformation, it appears that there is a problem with the model that needs to be further investigated. The application of the Rosenblatt transformation allows us to apply distribution-equality tests to assess model adequacy. Under the null hypothesis that the model is adequate, we would expect the lowest 10% of transformed observations to fall in the region between 0 and 0.10, the next lowest 10% of observations to fall between 0.10 and 0.20, and so on.

5. Learning Objectives:

3. The candidate will understand how to apply and recommend appropriate ERM framework, principles and strategies to manage, evaluate, analyze and mitigate risk exposures faced by an entity and to ensure operational excellence in any industry.

Learning Outcomes:

(3a) Assess the potential impact of risks faced by an entity in any industry.

(3c) Develop an appropriate risk mitigation or risk transfer strategy for any given situation.

(3d) Recommend best practices to achieve operational excellence.

(3e) Design, analyze and develop ERM strategies for financial and non-financial companies.

Sources:

Olsen and Wu, Enterprise Risk Management Models, Ch. 1
Olsen and Wu, Enterprise Risk Management Models, Ch. 3
Jonathan Berk and Peter Demarzo, Corporate Finance, Fourth Edition, Ch 28: M&A (pages 962-978)

Commentary on Question:

This question is really testing the understanding of importance of different factors in an M&A case. In general, the candidates did well in part a, d and e. Many candidates did not understand the part b, nor did they provide 3 level explanations to the analysis. On part c, most candidates failed to provide omitted factors.

Solution:

(a) Describe one example that applies to BJA for each of the supply chain risk categories.

Nature risk:
Natural disaster, flood, earthquake, Fire hazards, volcano eruption that occurs in any of the areas that will interrupt BJA flight operation or affect one of BJA's suppliers

Political System:
War, terrorism, labor disputes, customs and regulation changes, travel ban between countries

5. Continued

Competitor and market:
Price fluctuation, economic downturn, exchange risk, consumer demand volatility due to either economy or pandemic; new technology reduces demand for business travel, fuel prices fluctuation, low-budget airline competition on cost

Internal operation:
BJA' s ability to correctly forecast future demand and plan for required aircrafts, fuels, staff and other things such as inflight meals etc., safety, quality, on time delivery

Information system:
IT system such as reservation system or loyalty program breakdown

(b) Apply the top-down value hierarchy framework to each of the key supply-chain risks discussed in the Commercial Airline Industry Profile (Case Study 2.1).

Commentary on Question:
The risks identified in the sample solution are not exhaustive but are examples of correct answers. The answers should have correctly identified each level in the hierarch and tied the answer back to the case study.

1) Timely aircraft delivery

Top level: service risk - BJA is in a competitive industry, and service standard/quality. Reputation is the top level of supply chain risk. At top level, BJA's business could be significantly impacted by the service received from the commercial fleet manufactures.

Second level: on time delivery - BJA's business operation depends on the timely delivery of new fleets; and such dependability is reflected in the life cycle value to BJA's customers.

Third level: Ability to expand service - BJA's business growth is dependable on the manufacture's ability and willingness to meet BJA's future growth. Outsourcing opportunity cost or risk trade off - BJA may rent the new fleets instead of buying, and the cost associated with the alternatives should be quantified and compared to the cost of owning fleets.

2) Airplane not tested thoroughly

Top level: product risk - BJA's new fleets will need to meet the standard quality control to serve the life cycle to its customers.

5. Continued

Second level: quality - BJA's business operation depends on the reputation and value proposition to its customers. Quality control in its new fleets may post significant risks to its operation.

Third level: service level tradeoff - BJA's operation is dependable on the service agreement between BJA and the manufacture. BJA need to access the risk propositions between the service level and the cost savings.

(c) Critique the consultant's choice of factors proposed to BJA for assessing the acquisition of SEA. Justify your answer.

Commentary on Question:
Below is a sample answer, other answers were able to get full credit.

Market Position:
"SEA's market position provides a good opportunity for creating Synergy; it is an important factor to consider during acquisition

Revenue enhancement - expansion of routes in China with access to RPPC's capital

Revenue enhancement - with integration into BJA's system so passengers can get from other markets to SEA's market

Cost reduction - with the merged airlines, only need one set of management/staff reductions in non-air personnel"

Alliance
As this is an acquisition situation and SEA right now doesn't have strong partnership with another larger carrier, this should not be a main factor from BJA's perspective

Market Share
SEA operates at relatively small scale and is not dominating the seaplane market; this should not be the most important factor to consider

Reputation
Since SEA is the acquisition target and is small compared to BJA, the reputation of SEA may not be the most important factor,

Philosophy
Since SEA is the acquisition target and is small compared to BJA, the management philosophy and policies of SEA may not be the most important factor

5. Continued

Factors not included

Shareholder support and commitment – This factor is important as BJA needs to have support from its shareholder for this transaction. BJA should also consider as SEA is privately owned, what the ownership structure will mean to the acquisition strategy

Fleet profile – A seaplane crash is especially damaging to the seaplane business, the quality of SEA existing fleet should be a very important factor

Capital Structure and liability management – This factor is very important. BJA itself has very high leverage and negative equity, where it can get the capital for the acquisition and what's the impact of the acquisition on BJA's capital structure are all very important issues to consider

(d) Determine which company to acquire using the SMART method proposed by the consultant. Show your work.

Sum of Factor Rating = 0.9+0.7+1+0.8+0.6 = 4

Proportion is obtained by dividing each rating by the sum of ratings

SEA has the highest SMART rating of 0.715 and should be acquired.

	Relative rating	SEA	B	C
Market Position	0.225	0.18	0.2025	0.1575
Alliances	0.175	0.105	0.0525	0.14
Market Share	0.25	0.125	0.225	0.15
Reputation	0.2	0.2	0.08	0.14
Philosophy	0.15	0.105	0.045	0.075
	1	0.715	0.605	0.6625

(e) Describe two shortfalls of the SMART method.

Shortfall 1: during the process of identifying the relevant dimensions for evaluation, wrong dimensions or incomplete dimensions may be used.

Shortfall 2: The ranking of dimensions can be very subjective, especially in group situation; it will be difficult to reach agreement

6. **Learning Objectives:**

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

3. The candidate will understand how to apply and recommend appropriate ERM framework, principles and strategies to manage, evaluate, analyze and mitigate risk exposures faced by an entity and to ensure operational excellence in any industry.

4. The candidate will understand the application of quantitative methods with a risk management focus to business problems.

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.

(3b) Recommend best practices in risk measurement, modeling, and management of various financial and non-financial risks.

(3c) Develop an appropriate risk mitigation or risk transfer strategy for any given situation.

(3d) Recommend best practices to achieve operational excellence.

(4a) Assess methods and processes for quantifying and managing risk within any business enterprise.

Sources:

Olsen and Wu, Enterprise Risk Management Models, Ch. 6
F-151-20: Foundations of Airline Finance-3rd Ed-Ch.11
F-146-20: 2012 Fuel Hedging at JetBlue

Commentary on Question:

This question tests candidates understanding on the practical application of hedging and risk management strategies. The emphasis of the answers should be explaining.

Solution:

(a) Describe one pro and one con to each of the following strategies.

(i) Do nothing

(ii) Hedge using derivative instruments

6. Continued

Pros and Cons of "Do-Nothing" strategy are:
1. Pros: Less complex and there is no hedging cost associated with this strategy.
2. Cons: The operating expense will remain volatile due the input price.

Pros and Cons of "Hedging Using Derivative" strategy are:
1. Pros: The operating expense will be less volatile as the input price will be smoothen out.
2. Cons: There is cost associated with hedging and reduction in input price will not reflect in operating cost.

(b)

(i) Describe how a futures contract can be used to hedge the rubber cost.

(ii) List two key differences between a futures contract and a forward contract.

(i) A futures contract is an agreement to buy or sell a specified quantity and quality of a commodity for a certain price at a designated time (usually 3 months) in the future. Blue Jay Tires, which is the buyer, needs to enter long position with notional based on anticipated demand, to offset against the rubber price rise.

(ii) Contrast between futures and forward contracts:
a. Futures contracts are traded in exchanges whereas forwards are over-the-counter contracts.
b. Futures are marked-to-market daily whereas forward contracts are settled at the end of the contract period.

(c)

(i) Describe how a zero-cost collar can be structured to hedge the rubber cost.

(ii) Critique Reich's argument that there is no cost associated with the zero-cost collar hedging strategy.

(i) To structure a zero-cost collar to hedge rubber cost the following instruments should be used
a. Long position in out of the money call options with strike close to current price
b. Short position in out of the money put options with strike close to current price

The premiums collected from selling the put options should compensate the premiums paid for the call options. Therefore, actual strike and notional of call and put options will depend upon the price of the options.

6. Continued

(ii) While there is no upfront cost for Zero-Cost collar, it will be inappropriate to say that this strategy does not have any cost associated with it. The cost associated with Zero-Cost Collar are:

- When rubber price rise, Blue Jay Tires will get compensated with payoff from call options. However, when the price drop, the benefit will not be transferred to Blue Jay Tires due to the short put positions.
- There is transaction cost associated with the trades. Moreover, it is unlikely that Call and Put options will have the same strike. Thus, there will be small fluctuation in prices when the rubber price is between the two strikes.

(d)

(i) Evaluate the expected outcome of each of the three instruments on Value-at-Risk (VaR) for BJT's operating income.

(ii) Explain which of the above instruments reduces VaR for BJT's operating income the most.

(i) The impact of the instruments on VaR is as below:

Futures:
Reduces VaR compared to no hedging strategy. However, The hedge is not perfect due to basis risks and standardizations of the contracts.

Forwards:
Reduces VaR compared to no hedging strategy. The hedge can be customized and made perfectly aligned to the risk being mitigated.

Zero Collar Strategy:
Reduces VaR compared to no hedging strategy. However, there can be hedge breakage as the strike prices for options may not be perfectly aligned.

(ii) Of the three hedging strategies, Forwards will be the best to reduce VaR as forwards can be customized. The hedge breakage is the least with forward contracts.

(e)

(i) Explain the benefit of using cash flow hedge accounting treatment.

(ii) Describe the condition that prohibits the use of hedge accounting for hedging cash flow.

(iii) Explain the drawbacks of not using hedge accounting.

6. Continued

(i) The cash flow hedge accounting treatment allows for gains and losses on the effective portion of qualifying hedges to be deferred until the underlying planned consumption occurs. Deferring the expense better matches hedge cost with the appropriate revenue and hence the income statement is better representation of the operation. This also reduces volatility in operating income by reducing the volatility.

(ii) To be able to use Cash Flow hedge accounting complex work needs to be done to show hedge instruments mitigate risk effectively. If there is high basis risk between hedge instrument and actual sport price or if the hedge structure is inappropriate, the company cannot claim hedge effectiveness. If there is high ineffectiveness of the hedges, then these derivative assets will be deemed speculative and will not qualify for Cash Flow hedge accounting treatment.

(iii) If Cash flow hedging treatment is not allowed, then

1. The gains/losses arising out of derivative positions will be recognized immediately in that period and will be included in earnings. The earning statement become more volatile due to this.
2. As the gains/losses from derivative positions are recognized immediately, the earnings statement of Blue Jay Tire will become less representative of the core operations of the company.

(f)

(i) Describe the four essential steps of a simulation process of the VaR calculation for BJT's operating income.

(ii) Identify three material risk drivers for BJT's operating income may require simulation. Justify your response.

(i) The following framework can be used to calculate Value-At-Risk using Monte Carlo simulation:

- Build the Simulation Model:
  Each of the key drivers (both stochastic and deterministic) for operating expense needs to be identified. From the case study exhibit we can note that some of the key drivers can be gross sales, cost of raw materials, production cost, sales cost, selling cost, currency cost etc.

  Each of the variables should be fitted with statistical distribution or deterministic equations using prior data.

6. Continued

- Verify and Validate Data:
  A subset of the prior data (training data) should be used to fit the simulation model. Then the model should be validated using rest of data.

- Design Experiments using the model:
  The value of controllable variables to be studied are determined to address the objective of the experiment.

- Perform the Experiment and analyze the results:
  Using the model, several simulations are run. Based on the results, value at risk for operating income is calculated at a certain percentile level.

(ii) The three material risk drivers for Blue Jay Tire's operating income requiring simulation are below:

1. Highly volatile input material prices due to commodity price fluctuation. (" Cost of raw materials" line)
2. The volatility of Lost Time Injury Frequency Rate (LTIFR), or injury claims. ("Other" line on statement of operation)
3. Potential impact from currency risk as BJT must deal with Canadian $, US $ and Malaysian Ringgit (Foreign exchange gain/loss)

7. Learning Objectives:

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

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

3. The candidate will understand how to apply and recommend appropriate ERM framework, principles and strategies to manage, evaluate, analyze and mitigate risk exposures faced by an entity and to ensure operational excellence in any industry.

Learning Outcomes:

(1d) Assess the impact of business strategies such as acquisitions, divestitures, and/or restructurings.

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

(3b) Recommend best practices in risk measurement, modeling, and management of various financial and non-financial risks.

(3d) Recommend best practices to achieve operational excellence.

Sources:

Robinson et al., International Financial Statement Analysis, Ch. 7 Financial Analysis Techniques

Jonathan Berk and Peter Demarzo, Corporate Finance, Fourth Edition, Ch 28: M&A

Commentary on Question:

Candidates should demonstrate an understanding of financial ratios and how to utilize them to analyze annual statements and inform business decisions. The candidates should know the major types of ratios, what they are used for, and be able to perform analysis to compare two companies.

Solution:

(a)

(i) Explain the purpose of each of the Activity, Liquidity, Solvency, and Profitability ratios.

(ii) Recommend a specific ratio within each ratio type in (i) that will be useful to analyze the potential acquisition. Justify your recommendation.

7. Continued

Commentary on Question:

(i) Candidates generally understood the ratios and were able to explain their purposes.

(ii) Many candidates could provide examples of specific ratios and discussed their recommendation. Candidates should keep their answers tied to the case study.

Activity ratios measure the efficiency of a company's operations, such as collection of receivables or management of inventory.

Major activity ratios include inventory turnover, days of inventory on hand, receivables turnover, days of sales outstanding, payables turnover, number of days of payables, working capital turnover, fixed asset turnover, and total asset turnover.

Comparing the Receivables Turnover between SEA and BJA would provide significant insight into whether there might be any efficiencies in collecting payments from customers at BJA that could be gained at SEA upon acquisition.

Liquidity ratios measure the ability of a company to meet short-term obligations.

Major liquidity ratios include the current ratio, quick ratio, cash ratio, and defensive interval ratio. Current Ratio would be important to know in order for RPPC to know how the overall liquidity profile of their conglomerate might change, which would be especially important if airline sales were to decrease unexpectedly.

Solvency ratios measure the ability of a company to meet long-term obligations.

Major solvency ratios include debt ratios (including the debt-to-assets ratio, debt-to-capital ratio, debt-to-equity ratio, and financial leverage ratio) and coverage ratios (including interest coverage and fixed charge coverage). Debt-to-equity Ratio is something that RPPC would potentially want to adjust for their own target, in order to calculate the value of the company to them.

Profitability ratios measure the ability of a company to generate profits from revenue and assets.

Major profitability ratios include return on sales ratios (including gross profit margin, operating profit margin, pretax margin, and net profit margin) and return on investment ratios (including operating ROA, ROA, return on total capital, ROE, and return on common equity).Gross profit margin may provide some indication of marginal profitability to RPPC if they believe there is some level of scale at BJA that could be utilized for managing SEA.

7. Continued

(b)

(i) Perform a DuPont analysis using the five-way decomposition method on the 2019 financials for both BJA and SEA. Show your work.

(ii) Contrast three structural differences between BJA and SEA, based on the DuPont analysis.

Commentary on Question:
Candidates had difficulty with the DuPont analysis and the application of the financial ratios.

(i)
Five way DuPont Analysis:

$$\frac{\text{Net income}}{\text{Average shareholders' equity}} = \frac{\text{Net income}}{\text{EBT}} \times \frac{\text{EBT}}{\text{EBIT}} \times \frac{\text{EBIT}}{\text{Revenue}} \times \frac{\text{Revenue}}{\text{Average total assets}} \times \frac{\text{Average total assets}}{\text{Average shareholders' equity}}$$

which can be interpreted as:

$$\text{ROE} = \text{Tax burden} \times \text{Interest burden} \times \text{EBIT margin} \times \text{Total asset turnover} \times \text{Leverage}$$

				Tax Burden		Interest Burden		EBIT Margin		Total assets turnover		Leverage	
SEA	ROE	Income	217	Net Income	217	Earnings before tax	334	Earnings before interest and tax	457	Revenues	10920	Average 18/19 Assets	6500
				Earnings before		Earnings before				Average 18/19		Average 18/19	
		Equity	2627	tax	334	interest and tax	457	Revenue	10920	Assets	6500	Equity	2627
			8.3%		65.0%		73.1%		4.2%		168.0%		247.4%
BJA	ROE	Income		Net Income	117	Earnings before tax	126	Earnings before interest and tax	167	Revenues	1841	Average 18/19 Assets	1485.5
				Earnings before		Earnings before				Average 18/19		Average 18/19	
		Equity		tax	126	interest and tax	167	Revenue	1841	Assets	1485.5	Equity	-172
			-68.0%		92.9%		75.4%		9.1%		123.9%		-863.7%

(ii)
Some observation on structural differences between BJA and SEA are given below:

- SEA has a much higher tax burden as compared to BJA
- BJA has a better margin than SEA, pointing to lower expenses per dollar of revenue
- SEA has a higher asset turnover ratio, pointing to a more efficient use of inventory
- BJA is much more leveraged than SEA (higher debt to equity ratio)

7. Continued

(c)

(i) Perform a horizontal analysis over 2017-2019 for each of BJA and SEA using an appropriate liquidity ratio. Show your work.

(ii) Compare BJA's and SEA's ability to meet liquidity needs over the past 3 years.

Commentary on Question:
Many candidates had difficulty with this part as well. Candidates needed to apply the financial ratios to information from the case study.

(i)

		2019	2018	2017
SEA	Current Ratio	145%	147%	149%
	Quick Ratio	82%	83%	84%
	Cash Ratio	47%	47%	48%
	Defensive Int	75.0	77.2	77.7

	2019	2018	2017
Current Assets	**3,669**	**3,611**	**3,555**
Cash & Short-Term Investments	1,179	1,161	1,143
Receivables	890	876	862
Current Liabiliti	2,532	2,458	2,387
Total Operating Expenses	**10,463**	**10,019**	**9,801**
Depreciation & Amortization	393	387	381

		2019	2018	2017
BJA	Current Ratio	173%	162%	132%
	Quick Ratio	106%	102%	78%
	Cash Ratio	70%	65%	37%
	Defensive Int	135.1	126.7	79.1

	2019	2018	2017
Current Assets	**966**	**701**	**406**
Cash & Short-Term Investments	390	283	113
Receivables	200	160	127
Current Liabiliti	558	432	309
Total Operating Expenses	**1,691**	**1,352**	**1,176**
Depreciation & Amortization	96	77	67

(ii)
BJA is in a better liquidity position than SEA, i.e. better able to meet its short-term obligations.

BJA has improved its liquidity position substantially over the last 3 years whereas SEA has maintained a relatively stable ratio.

(d) Recommend whether SEA should be acquired as a direct subsidiary of RPPC or incorporated into BJA. Justify your response.

Commentary on Question:
The answer to this question is very broad. Acceptable responses varied and included arguments involving tax, funding, currency, synergy and other cross-benefits. Candidates needed to build a recommendation and justify it.

BJA should pursue SEA through acquisition to be a direct subsidiary.

7. Continued

SEA shows revenue growth in both passenger and other and strong profitability, despite some increase in the cost of fuel in 2019. Additionally, SEA has a healthy debt to equity ratio.

There are promising synergies to be had from the acquisition. Primarily the pilot training program the SEA has can supplement or potentially replace BJA's training program, which is of high importance to BJA. Additionally, SEA's presence in Canada could help BJA's ambitions to expand internationally. There are also efficiencies to be had with airplane maintenance and fuel costs. As a larger company they can reduce redundancies and perhaps achieve lower prices or at least leverage better processes or systems for maintenance and fuel costs.

(e) Based on the Framework for Board Oversight of Enterprise Risk,

(i) Describe four areas the RPPC Board should focus on during the due diligence process.

(ii) Evaluate the level of involvement the RPPC Board would have with respect to each of the risks listed in SEA's Risk Profile (Case Study Section 9.3) after acquisition.

Commentary on Question:
Candidates did well on this part of the question.

(i)

1. Review in advance scope of the due diligence plan
2. Should perform comprehensive customer interview in addition to the financial, legal and operational due diligence
3. Should perform due diligence on SEA existing leadership if RPPC to keep current management
4. Stress testing using financial modeling especially if the acquisition requires external financing

(ii)

- Level 1 risks include customary operational risks, such as health, safety and environment and facility or system disruption, and other risks where the potential adverse effect on the business is moderate or has been offloaded such as through an insurance program or other means. Provided the board is satisfied with the efficacy of the risk management systems and processes, board oversight for Level 1 Risks would involve customary questioning, review of periodic reporting, counselling and monitoring.

7. Continued

- Level 2 Risks-Board involvement in risk oversight would be heightened for Level 2 Risks, which fall into two categories:
    1. High-impact risks that cannot be adequately mitigated
    2. Risks involving the presence of management bias.

8. Learning Objectives:

4. The candidate will understand the application of quantitative methods with a risk management focus to business problems.

5. The candidate will understand advanced techniques to evaluate and manage non-hedgeable risks in financial and non-financial organizations.

Learning Outcomes:

(4a) Assess methods and processes for quantifying and managing risk within any business enterprise.

(5a) Evaluate the extent to which risks are hedgeable or non-hedgeable.

(5b) Apply frameworks or methods to evaluate non-hedgeable risks.

(5d) Evaluate the efficacy of different approaches to managing non-hedgeable risks, including risk capital positions, operational risk management practices, risk mitigation and transfer strategies.

Sources:

F-153-20: Commodity Hedging – the advent of a new paradigm
F-149-20: Catastrophe Bonds: An Important New Financial Instrument
F-152-20: Demystifying the Risk Margin Theory Practice and Regulation

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a)

(i) Propose a contract that Frenz can enter into with its supplier to manage its coffee price volatility. Justify your answer.

(ii) Describe how a catastrophe bond with a parametric trigger can help Frenz manage the supply-chain risk of coffee beans.

(iii) Evaluate the effectiveness of the two instruments in (i) and (ii) to mitigate the stated risks.

Commentary on Question:

Candidates struggled to explain how a parametric trigger works and how a trigger impacts Frenz's supply chain and then explaining that the catastrophic bond would help Frenz.

8. Continued

(i)
Frenz can negotiate a fixed price contract with suppliers, where Frenz pays the suppliers a set price for coffee beans, regardless of the coffee bean market price.

The contract will transfer the risk to suppliers and encourage the suppliers to manage their cost volatility.

Frenz gets cost certainty even if the cost ends up being higher than it would've been without the contract.

(ii)
A parametric trigger is based on the occurrence of a specific natural event such as hurricane category 5.

In the event that hurricane category 5 occurs, all or a portion of the principal is kept by the issuing company.

Since coffee supply and price can be affected by weather condition, tail risk could arise from catastrophic events.

Hurricane category 5 is an example of catastrophic events relevant to Frenz.

For Frenz, the principal would help find alternative coffee beans in the meantime of cover operating costs from the lack of beans.

(iii)
Forward Contract:
This is an effective way to hedge price volatility because Frenz receives price certainty for the duration of the contract. A forward contract locks in the price of the coffee beans, so any movement will not impact Frenz.

Cat Bond:
This is not an effective way to hedge supply chain risk. It poses basis risk to Frenz because the trigger isn't directly related to their loss. There are other loss events in the supply chain that the cat bond wouldn't cover (e.g. a worker strike, different weather event, etc.)

8. Continued

(b) Assess whether adding a risk margin is appropriate for the following risks.

I. Coffee price volatility
II. Supply-chain risk

I. Coffee price volatility:
The risk margin approach is not appropriate for coffee price volatility since the risk is hedgeable. Frenz can enter into a future contract in the Arabica coffee futures market to lock down coffee prices.

Alternatively, candidates may argue that a risk margin should be held if the futures market dries up in the future and price volatility is no longer hedgeable because of excessive volatility for example.

II. Supply-chain risk
The risk margin approach is appropriate for supply risk since this risk is non-hedgeable. The supply risk is non-hedgeable because there isn't a deep market for an instrument (e.g. cat bonds) that would hedge the risk.
OR
Because Frenz cannot hedge the risk at low cost since it has become expensive for Frenz to negotiate with suppliers.

(c)

(i) Describe how Frenz can use the modified assumptions approach and its supply-demand economic model to calculate its supply-chain risk margin.

(ii) Evaluate two limitations of Frenz's application of the modified assumption approach.

Commentary on Question:
Candidates did generally well in this question. The candidates that did not do well failed to provide explanations that directly applied to the approach to Frenz's expansion to China.

(i) A supply-demand model can predict coffee demand in the Asian market. Frenz modifies the assumptions in their supply-demand economic model to an insufficient supply to meeting its demand. The cash money to hold is the added cost of coffee beans purchase needed to meet that higher demand.

8. Continued

(ii)Frenz is using a simplified model that does not capture complex interdependencies. This could misrepresent the company's risk which means they might hold an inappropriate risk margin.

The employees do not have any experience in Asia, so it's questionable that they would have sufficient data or knowledge to properly model supply in that market.

9. Learning Objectives:

5. The candidate will understand advanced techniques to evaluate and manage non-hedgeable risks in financial and non-financial organizations.

Learning Outcomes:

(5b) Apply frameworks or methods to evaluate non-hedgeable risks.

(5c) Assess strengths and biases of techniques to measure risks given limited information for a range of business situations.

(5e) Assess drawbacks and other costs to risk transfer solutions versus other internal risk management approaches for non-hedgeable risks.

Sources:

F-150-20: A Fundamental Approach to Cyber Risk Analysis
Hubbard, How to Measure Anything, Ch 14

Commentary on Question:

This question covered both cyber-insurance knowledge and the ability to synthesize information from the Hubbard reading on techniques applicable to Applied Information Economics (AIE)

Solution:

(a)

(i) Define systemic and symptomatic vulnerabilities in a cyber risk context.

(ii) Describe an example scenario for each of a systemic and a symptomatic vulnerability that would impact Snappy.

(iii) Identify the form of cyber risk insurance that would address each scenario in (ii). Justify your response.

Commentary on Question:

The candidates should exhibit the concept of risk arrivals, targets and various risk insurances – the conventional insurance, cyber-asset insurance, cyber-threat insurance, and cyber insurance. Below are shown examples of successful answers. Other answers were accepted for full credit.

(i) From a cyber risk context, a systemic risk impacts many firms and a symptomatic risk only impacts a single firm.

(ii) Systemic vulnerability: A third-party application used by multiple insurers' client interface software has a vulnerability that allows. Symptomatic vulnerability: A Snappy employee opens a phishing email that freezes the server used to make underwriting decisions.

9. Continued

(iii) Systemic risk: The hackers use a logic risk arrival (hacking) to access an information asset (policyholder data). This would be covered by cyber insurance.

Symptomatic risk: An electronic virus is a logic risk arrival threat. In this case, it causes computer freezes which is a physical asset. This would be covered by cyber-threat insurance because the virus arrives through logic and shuts down physical assets (computers).

(b) Using the Applied Information Economics (AIE) approach:

(i) Recommend the parameter that would benefit the most from the value of information analysis. Justify your recommendation.

(ii) Describe how you could improve your information on the parameter identified in (i).

Commentary on Question:
The candidates are expected to use VIA (value of information) concept to reach recommendation and develop action step to reduce the risk

(i) Two selected recommendations are accepted for grading purpose:
- Recommendation 1: Use of mobile application for underwriting. It has the highest probability of loss and its confidence level, while higher than third-party software, is still fairly low given its likelihood of occurrence; Or
- Recommendation 2: Exposure from third-party software. Its confidence level is the lowest, and while its probability of occurrence is the lowest it does have a high magnitude of loss.

(ii) Example
- Recommendation 1: Discuss vulnerabilities with the mobile application development team and the ERM function to learn. more specifics about what information is at risk and what the business impacts would be. Or
- Recommendation 2: Have the Snappy IT team analyze the exposure to third parties and what information, or systems are vulnerable to each exposure. Learn what safeguards have been put in place to mitigate exposure.

9. Continued

(c) Critique Veltro's comment from the perspective of:

(i) Snappy

(ii) An insurance company offering cyber insurance to Snappy

Commentary on Question:
The candidates are expected to agree or disagree with the CFO's comments and provide the rationale.

(i) The candidates can either agree or disagree with Vetro's comments:

- The CFO is correct. Snappy may have vulnerabilities from third-party suppliers and Snappy cannot control their vulnerabilities. Snappy could invest heavily in top-of-the-line security systems only to be exposed by its weakest third-party. The money is better spent investing in core competencies and relying on insurance to protect the firm from cyber risk losses;
  Or
- The CFO is incorrect. A vulnerability exposing policyholder data would lead to severe reputational damage as well as liability and compliance costs. Cyber insurance will not cover losses due to reputational damage. Strong security can be a competitive advantage for Snappy.

(ii) From insurance company viewpoint, the CFO is incorrect. If companies do not invest in their own cyber security, then the probability and magnitude of losses will increase. In turn, cyber insurance companies will increase the price of coverage to the point where it will be unaffordable. This is especially true for a Snappy policy because all their sales are online which means they have more security risk than other insurers. They should invest in their security to keep cyber insurance prices affordable.

10. Learning Objectives:

4. The candidate will understand the application of quantitative methods with a risk management focus to business problems.

Learning Outcomes:

(4a) Assess methods and processes for quantifying and managing risk 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:

ASOP 56: Modeling
Kelleher, Mac Namee, and D'Arcy, Fundamentals of Machine Learning for Predictive Analytics, Ch. 8 Evaluations
Kelleher, Mac Namee, and D'Arcy, Fundamentals of Machine Learning for Predictive Analytics, Ch. 10 Case Study: Galaxy Classifications

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Describe two best practices recommended in Actuarial Standard of Practice No. 56 to evaluate a predictive model.

Commentary on Question:
Candidates generally did well for this part, best practices were correctly named with reasonable description.

Model output validation: The actuary should evaluate whether the model applied to hold-out data produces model output that is reasonably consistent with model output developed without the hold-out data, as may be used for predictive models.

Model meeting the intended purpose: When evaluating a model, the actuary should confirm that, in the actuary's professional judgment, the model reasonably meets the intended purpose.

10. Continued

(b)

(i) Interpret the Recall results.

(ii) Interpret the Precision results.

(iii) Critique the CEO's statement.

Commentary on Question:
Most candidates were able to interpret the recall and precision results correctly. However, only a few candidates critiqued the CEO's comments with respect to ABC's goal of the predictive model which were time and accuracy.

(i) Recall is equivalent to true positive rate (TPR). Recall tells us how confident we can be that all instances of the target level have been found by the model. The model correctly classifies the 'Preferred' contracts 96% of the time and misclassifies them 4% of the time. The model correctly classifies the 'Standard' contracts 56% of the time and misclassifies them 44% of the time.

(ii) Precision captures how often, when a model makes a prediction, this prediction turns out to be correct. Precision tells us how confident we can be that an instance predicted to have the target level actually has the target level. When the model predicts 'Premier', it has correctly classified a 'Premier' contract as 'Premier' 88% of the time and misclassified a 'Standard' contract as 'Premier' 12% of the time. When the model predicts 'Standard', it has correctly classified a 'Standard' contract as 'Standard' 80% of the time and misclassified a 'Premier' contract as 'Standard' 20% of the time.

(iii) The CEO is incorrect. The CEO might be looking at the class accuracy which is 86%, whereas the average class accuracy of 75.7% does not meet ABC's goal of 90%. The Profit Matrix shows that misclassifying a Premier contract as Standard results in a loss of $100, which is the loss due to not getting the business. ABC will want high accuracy for both Premier and Standard classifications in order to meet the average class accuracy goal given the frequency of Premier and the cost of misclassifying Standard.

(c) Recommend a credit review approach that meets ABC's goals. Justify your recommendation.

10. Continued

Commentary on Question:
Very few candidates recommended a 2-stage model which meets both the time and accuracy goal of ABC. Credit was given to alternative responses if it showed that the model could meet ABC's goal.

A 2-stage model is recommended – 2-stage model means the premier+ and premier will be using the predictive model since both the recall and the precision results are good. The standard++, standard+ and standard class will be manually underwritten to improve its results.

This 2-stage model will satisfy ABC's goal for both time and accuracy:

Average class goal of 90%:
The recall for standard++, standard+ and standard class will be 100% if they were underwritten manually, therefore the average class accuracy of the 2-stage model is expected to be 98%=(96%+96%+100%+100%+100%)/5。

At least 50% reduction in processing time of current portfolio:
Current processing time is 161 days – 1 day each for 161 policies.

The expected processing time of the 2-stage model is 33 days (1 day each for 33 policies and instant results for the rest of the policies). Therefore, the processing time is cut by 80%.

(d)

(i) Explain the downside to relying on stability index results.

(ii) Recommend next steps for ABC based on the stability index results. Justify your recommendation.

(i) A stability index does not directly measure the performance of a model. A high stability index may reflect a change in the underlying population rather than a change in model performance. Relying solely on a stability index can lead to models being rebuilt when it is not required.

(ii) At T1, the stability index is 0.179, which is between 0.1 and 0.25 and indicates that some change has occurred, and further investigation may be useful.

At T2, the stability index is 0.320, which is greater than 0.25 and suggests that a significant change has occurred, and corrective action is required.

10. Continued

Although the high stability index reflects the change in the underlying population, it is important that ABC take corrective action because the Standard classes are growing faster than the Premier classes. The current 5-class model does not predict these classes well and the misclassification of these classes is very costly.