CFE FD Model Solutions
Spring 2024

1. Learning Objectives:

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

Learning Outcomes:

(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 4th Ed, Ch. 11 Financial Reporting Quality

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Explain how inventory accounting choices impact the income statement.

Commentary on Question:

Candidates scored reasonably well in this question. Quite a few candidates only provided inventory accounting choices and explained each of them. Partial credits were granted in this case. Candidates are expected to touch on the impact to income statement to receive full credits.

Management's choice among acceptable inventory assumptions and methods affects profit.

The selection of an inventory costing method is a policy decision, and the companies cannot arbitrarily switch from one method to another.

The selection does matter to profitability, it also matters to balance sheet. Inventory accounting choices can be made to create biased financial reports intentionally. Earnings can be increased by accounting choices and expenses can be deferred into the next reporting period to lower the total expenses this period intentionally.

1. Continued

Inventory accounting choices can also affect the presentation of the reports and earnings, to be likeable to the investors.

Finally, inventory accounting choices can be aggressive or conservative, aggressive accounting choices may decrease the financial position in later periods.

(b) Describe how earnings for 2021 and future years would differ based on the two inventory accounting methods.

Commentary on Question:
Candidates scored well in this question and demonstrated good understanding on different inventory account choices.

In periods of changing prices, the FIFO cost assumption will provide a more current picture of ending inventory value, because the most recent purchases will remain in inventory. Frenz's COGS will be lower hence the earnings in the statement would be higher.

Under the weighted-average cost assumption, however, it will display a blend of old and new costs.

During inflationary periods, the value of the inventory will be understated. However, the more current costs are shown in COGS, hence, Frenz's earning would be lower.

(c)

(i) Determine the reporting quality of Frenz according to the Quality Spectrum of Financial Reporting. Justify your answer.

(ii) Recommend two ways to improve Frenz's reporting quality. Justify your recommendations.

Commentary on Question:
(i) Candidates are expected to provide the rating and justify the rating from at least three different reasonable angles (some samples listed below) to receive full credit. Most candidates received partial credit on this question.
(ii) Candidates are expected to provide two reasonable recommendations that are applicable to Frenz. No credits were granted for general recommendations that do not apply to Frenz. Candidates scored well in this part of the question.

1. Continued

(i) Decision-useful, sustainable, and adequate returns

- Provide enough information for investors to assess the company performance contain relevant information.
- Provide 3-year projections to show the potential growth of the company. It embodies the characteristics of decision useful information.
- The projections indicate an adequate level of return on investment and derive from activities that a company will likely be able to sustain in the future.
- In the case study, it didn't specify any new activities other than expansion plan, so it's assumed that the growth shown in the projection are organic.
- However, it's not providing enough explanation on items that have significant changes (i.e. cash) and some of them are oversimplified, which doesn't help with decision making process.

(ii) Examples of reasonable recommendation:

- Include footnotes for Frenzh to provide additional information on the accounting basis for items - so that any adjustments are justified and clear to public.
- Make sure Frenz's accounts payable and accounts receivable to reflect actual numbers - so to make the reports more accurate.
- Avoid over-simplified numbers to make the reports more compelling.
- Provide explanation on increasing depreciation year over year as increase depreciation seems a bit so that investor/analyst have more information other than the numbers itself.

(d) Evaluate the impact of the planned reporting changes on the quality of Frenz's financial statements.

Commentary on Question:
To receive full credit, candidates are expected to assess the earning quality, reporting quality, and investor impact and also describe the direct impact. Most candidates received partial credit for this part of the question.

Revenue perspective
It improves the revenue growth on the report. The revenue will increase significantly. This act can be a warning sign. CEO tries to classify one-time sales included in revenue to enhance revenue growth, CEO is motived to issue less than higher quality financial reports to boost the stock price. This is not sustainable earnings, cannot provide a sound platform for forecast.

1. Continued

Expense perspective
Expense would be lower then the profit margin would be higher, it's making the operating performance look more attractive by carving out the household coffee business expense (expense would be lower then the profit margin would be higher)

This is incorrect as the household coffee business is part of Frenz business and it's still recurring until the business get sold hence, it shouldn't be excluding in the income statement.

Both acts lower the reporting quality as well as earnings quality. It doesn’t help with assessing the company's performance. It can mislead when making investment and other decisions. This can give investors a false impression of the company's sustainable revenue-generating capability.

2. Learning Objectives:

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

Learning Outcomes:

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

Sources:

Jonathan Berk and Peter Demarzo, Corporate Finance, Fifth Edition, Ch 22: Real Options

Commentary on Question:

Candidates generally did very well on this question.
The goal of this question is to test candidates' understanding of real options and how they might arise in a business setting. Candidates were expected to calculate the value and implications of deciding which projects to pursue when the projects have different lifetimes.

Solution:

(a) Calculate the cost of business travel for one sales professional using the equivalent annual benefit method under each of options I and II, assuming a sales professional averages 20,000 miles annually. Show your work.

	Buy	Reimburse
Car purchase (one time)	35,000.00	-
Reimbursement per year	-	17,000.00
Gasoline	2,000.00	-

Standalone NPV	43,658.95	73,601.10
Equivalent Annual Benefit	10,084.12	17,000.00

The Standalone NPV is the present value of each scenario, with the car purchase at time zero and the reimbursements and gasoline at the end of each year.

The Equivalent Annual Benefit was determined by dividing the Standalone NPV by the present value factor, which is determined as: ((1/.05)*(1-(1/(1.05))^5))

(b) Describe the types of real options that XYZ owns if they initially purchase the cars.

2. Continued

Commentary on Question:
Many candidates answered "option to wait," which is not a real option in this scenario.

XYZ has the option to abandon by selling the cars if the sales professionals aren't driving enough miles to make it worthwhile to keep owning the cars.

XYZ has the option to expand (aka growth option) and buy more cars if they hire more sales professionals.

(c) Calculate the value of the real option to wait by reimbursing mileage for the first year, assuming a time horizon of 5 years from today (i.e., 4 years from the potential future purchase date). Show your work.

Commentary on Question:
Candidates generally did well on the calculations of each of the NPVs, although many candidates did not recognize that the value of the real option is the difference between the lesser of the value of the options to Buy Now and Reimburse Now, and Wait. Many candidates calculated the value as the difference between the average of the Buy Now and Reimburse Now values, and Wait.

5 Year NPVs:
Wait-Reimburse (5,000 miles): $18,400.28
Wait-Buy (25,000 miles): $64,871.31
Reimburse Now (5,000 miles): $18,400.28
Reimburse Now (25,000 miles): $92,001.38
Buy Now (5,000 miles): $37,164.74
Buy Now (25,000 miles): $45,823.69

	5-year NPV
Wait	41,635.79
Buy Now	41,494.22
Reimburse Now	55,200.83

Value of real option	(141.58)

The 5-year NPV of each option is calculated as the weighted probability of each decision (50% probability of 5,000 miles, 50% probability of 25,000 miles).

The value of real option is the difference between the minimum of the Buy Now and the Reimburse Now values, and the value of the option to Wait.

2. Continued

(d) Describe two shortcomings associated with the calculations you performed in part (c).

Commentary on Question:
Two examples are listed below, but other examples were accepted for full credit.

1. The calculations assume a single time horizon (EAB would have a different value of the option)
2. There is uncertainty in the assumptions (e.g., there is uncertainty in the price of cars and gasoline in the future, or mileage driven by the sales professionals might continue to be unknown at the end of the year or might vary over time)

3. Learning Objectives:

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

Learning Outcomes:

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

(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 15 Back Testing Market Risk Models

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

Commentary on Question:

The candidates mostly did well on part a and b; but many failed to complete part c, such as the normal PDF calculation and recognizing the hypothesis. The graders understood that part c had good amount of calculations; and awarded partial credit for many candidates.

For part a, some candidates did not understand the P/L calculation.

Solution:

(a)

(i) Assess Emily's suggestion to use the investment department data.

(ii) Recommend two methods to address the issue with data accuracy.

3. Continued

(i) Her suggestion is correct
As this task is for risk management purpose, P/L data reflecting underlying volatility rather than accounting prudence is more important.

(ii) Clean the P/L data to reflect end-of-day market positions.
Use hypothetical P/L data obtained by revaluing trading position from one day to next.

(b)

(i) Describe the purpose of back-testing in this context.

(ii) Explain which CRISP-DM stage the back testing procedure belongs to.

(i) The risk prediction model must be validated before being used to predict return in the future. This involves applying a quantitative method to judge whether the actual investment P/L data are consistent with the proposed model assumption.

(ii) Modelling phase.
It involves validating the model assumption and parameter of the predictive model.

(c)

(i) Perform the Rosenblatt Transformation on the data provided in Excel tab Q3_c. Show your work.

(ii) Determine if the null hypothesis can be accepted. Justify your answer.

See attached spreadsheet for model solutions.

4. Learning Objectives:

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

Learning Outcomes:

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

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

Sources:

Managing Business Process Flows, Ch 1: Products, Processes, and Performance

Managing Business Process Flows, Ch 2: Operations Strategy and Management

F-162-F23: Procurement, early warning systems, and the next disruption

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Explain two ways Frenz is attempting to achieve a sustained competitive advantage.

Examples of activities (choose 2) include:
1) Having operations and coffee shops in most major cities
2) Offering high-end specialty coffee; dominating that market
3) Expanding into other countries (Asian market)
4) Product innovator - exploring coffee made from exotic coffee beans and special tea leaves
5) Exploring vertical integrations to improve operational efficiencies and reduce cost.

The best candidates noted that the combination was stronger than the individual components

4. Continued

(b) The consultant makes the following statements:

I. Frenz's current offerings give flexibility in determining the company's strategic positioning. There is room for Frenz to position itself in area C, offering customers a moderate variety of products with only a short wait time.

II. Moving to area C would require Frenz to make strategic tradeoffs.

III. The operational frontier is fixed, making it easier for Frenz to achieve area C.

Evaluate each of the consultant's statements, I-III, based on the operational frontier above.

1) the consultant's statements are accurate. By definition, strategic positioning is the direction the firm wants to move from their current position. Frenz can move from point A in any number of directions towards the operational frontier, that is flexibility with regards to strategic positioning.
2) The consultant's statement is not correct. The operational frontier is concave and Frenz is not on the frontier, therefore they do not need to make tradeoffs. Tradeoffs only apply to companies on the operational frontier.
3) The consultant's statement is not correct. The operational frontier can be pushed out by improvements in technology or management practices.

(c) For each supplier:

(i) Assign a risk priority from 1 to 3 for each risk A and B in the Excel chart in tab Q4_c.

(ii) Justify your prioritizations in (i) using information from Section 4.3 from the Case Study.

(i)

Supplier	Absolute Shortage	Supplier Default
XYZ Coffee Grower	2	3
QRS Tea	3	3
Why Paper Cups?	1	2
Big Straw	3	3
Small Dairy	2	1

4. Continued

ii) QRS Tea and Big Straw are low risk because tea and straws have plenty of supply (no shortage risk) and Frenz has multiple sources (no risk of supplier going out of business).
XYZ Coffee Grower has a moderate risk of an absolute coffee bean shortage, but a low risk of supplier default.
Espresso sales represent the largest revenue stream for Frenz stores.
External events such as extreme weather, political and economic conditions could impact Frenz's ability to obtain enough coffee to supply their stores.
Frenz works with several major growers and distributors, so not dependent on one source.
XYZ's low risk of supplier default prevents XYZ from being a level 1 priority.

Why Paper Cups? has significant short-term absolute shortage risks for Frenz's custom paper cups, as well as a moderate risk of company default.
If the absolute shortage risk were higher, WPC would be a level 1 risk.
However, individual stores were able to adapt and get through the prior cup shortage,

Small Dairy: an absolute shortage (moderate risk locally) or supplier default would affect significant revenues for Frenz. The risk of Small Dairy going under are surprisingly high despite a long term partnership with Frenz

(d) Recommend an appropriate mitigation strategy for Frenz to consider for each supplier.

QRS Tea and Big Straw require no mitigation efforts at this time because they are low risk in both categories.
XYZ Coffee Grower: Since coffee is a storable good, Frenz should build up inventory of stored coffee while supply is more bountiful, ideally in a centralized area to keep costs down or more locally in each store.
Why Paper Cups?: Frenz should consider partnering with a second source for paper cups to spread the
risk of supplier default. Similar to storing coffee, Frenz could consider storing extra paper cups at each store
Small Dairy: Frenz could work with Small Dairy to pre-pay or otherwise provide liquidity in the short-term to help it avoid default. Consider more suppliers.

5. Learning Objectives:

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

Learning Outcomes:

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

(4b) Evaluate model risks and processes

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

(ii) Assess processes for vetting models

Sources:

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

Commentary on Question:

This question tests candidates' knowledge of evaluation techniques for predictive analytics. For full points, the candidates need to be able to calculate the metrics as well as explain the different concepts and the implications of the results.

Solution:

(a)

(i) Explain the false negatives and true positives in the confusion matrix above.

(ii) Explain how recall and precision have been calculated above.

Commentary on Question:

Most candidates got most of the answer. Many did not discuss the multinomial aspect of the confusion matrix.

(i) True positives are on the diagonal. This is where the model correctly predicted a risk classification. Horizontal row elements (excluding the diagonal) reflect the distribution of the false negatives (i.e. they are positive target features for that target level but the model has put them in a different category). This is where for a given risk classification, there are data points that should have been given that risk classification but were categorized elsewhere.

(ii) The recall is calculated across the row for each target level, showing the # of times the model picked the true positive targets for the row's target level. This measures for each risk classification, how often the model was able to pick out the data points that belong to that classification.

5. Continued

The precision is calculated for each column reflecting a target level and measures for each target level, how often the prediction of a positive target level is correct. This measures, for each risk classification, how often the model is correct when it predicts that the data point belongs to that classification.

(b)

(i) Calculate the accuracy and average class accuracy. Show your work.

(ii) Evaluate each of the performance measures in (i) vs a 79% ROC index.

Commentary on Question:
While there were candidates that got full points, there were several candidates that mistook full underwriting as part of the accelerated underwriting platform. Some credit was given for the arithmetic form of average class accuracy where harmonic mean would have been a better metric given the imbalance in the data. Many candidates did not explain well how to interpret the results vs the ROC.

accuracy = 83% average class accuracy = 88% using harmonic mean

The ROC index is the better measure as it is robust to class imbalance or skew in the data set. Most (80%) of the datapoints in the AUW platform is in the first 2 rate classification. The ROC index measures the ability to distinguish between classes (vs detecting the positive class). You can see this with the average class accuracy at 88%, which is high given that most data points are in rate classifications with lower recall. This is because each rate classification is given equal weight. Accuracy is closer to the ROC index as it captures all the misclassifications but only when there is one threshold where ROC index measures accuracy across different thresholds.

(c) Using the mortality slippage cost table provided in the Excel tab Q5_c:

(i) Construct the gain/loss matrix of the misclassifications. Show your work.

(ii) Analyze the components of the gain/loss.

(iii) Evaluate the overall performance of the revised AUW platform.

5. Continued

Commentary on Question:
Except for a very small number of candidates, most did not fully arrive at the gain/loss matrix of misclassifications. However, most did get some credit for getting one or more elements of the calculation: (a) mortality slippage (b) gain of the policy (c) retention impact of misclass to lower rate class (30% one class, 0% if more than 1 class) and (d) loss due to some policies going to competition. About half of the candidates did not understand that the mortality slippage matrix is a matrix of losses. In analyzing the components of gain/loss, many candidates also just described the matrix, vs analyze where most of the impact of gain/loss were. Taking into account the numeric result the candidate got, credit was given where the evaluation is reasonable and took into account the accuracy of the platform and the gain/loss result.

c-(i)

Gain/loss matrix — Prediction using revised AUW platform

Profit matrix	('000)	NT Risk Class 1	NT Risk Class 2	NT Risk Class 3	Tob Risk Class 1	Tob Risk Class 2			
	NT Risk Class 1		148	-45					
	NT Risk Class 2	-326		67					
Target=	NT Risk Class 3		-18						
Original AUW	Tob Risk Class 1								
Platform	Tob Risk Class 2								
	Rated		-24	-46	-36	-62	-168		
	Decline			-35	-63	-53	-151	-319	
		-325.606	107.0465	-59.4816	-99.2706	-114.8	-492.111		

c-(ii)
Most of the loss is coming from 2 sources:

(1) the false positive of an NT Risk Class 2 being classified instead as NT Risk Class 1, resulting in mortality loss. This is offset but not fully by the false negative of an NT Risk Class 1 being classified as an NT Risk Class 2, resulting in a gain for those applicants who stayed, but a loss of profit on those who went to the competition.
(2) there will be a loss when an application that was rated or declined end up being issued at a better risk class, i.e false negatives. The sum of those losses, even when the number of false negatives is small, can accumulate to a large loss number, in this case $319,000, about 65% of the total loss

c-(iii) This model would be considered a strong model with an ROC index of 79%. However, the profit/loss evaluation would indicate that the cost is too high where there are performance gaps. That is, the precision and recall of the classification of NT Risk Class 1 and Risk Class 2 needs to be better and the classification of rated and declines into other classifications need to be minimized.

6. 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.

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

Sources:

Robinson et al., International Financial Statement Analysis 4th Ed, Ch. 9 Income Taxes

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

Commentary on Question:

The goals of this question are to examine candidates' ability to

- *Intrepret the financial statement deferred tax disclosure related disclosure and utilize new information to update the disclosure.*
- *Determine if deferred tax assets or libabilities should be extablished*
- *Select the most appropriate financial statement analysis formula to analyze the company's performance and recommend if there are any areas to look into further*

Solution:

(a)

(i) Explain why the amounts of the deferred tax assets and liabilities displayed in the balance sheet are different from Note 7.

(ii) Calculate the TBD elements in the table in Excel. Show your work.

Commentary on Question:

The question is to make candidates understand the composition of financial statement note related to deferred tax assets and liabilities. Be aware of if there is an update of accounting standard related to deferred tax disclosure. The note may be modified.

6. Continued

(i) According to the accounting standards, the deferred tax assets and liabilities of foreign owned entities should be net out in the balance sheet display. Meanwhile, the deferred tax assets and liabilities from all entities are shown in full in the Note 7.

(ii) The computations are as follows:

- Step 1: Calculated the net change of deferred tax assets and liabilities between 2023F and 2022A
  Deferred Income Tax = (deferred tax assets 2023F - deferred tax assets 2022A) - (deferred tax liabilities 2023F - deferred tax liabilities 2022A)
  Deferred Income Tax = (160 - 175) - (360 - 290) = -85 or (85)
- Step 2: Derive income tax (expense) recovery
  Income Tax (Expense) Recovery = current income tax 2023F + deferred income tax 2023F
  Income Tax (Expense) Recovery = 60 + (85) = (25)
- Step 3: Compute adjustment
  Adjustment = income tax (expense) recovery 2023F - income taxes before the adjustment to tax basis 2023F
  Adjustment = (25) - (31.5) = 6.5
- Step 4: Derive income tax (expense) recovery
  Income Tax (Expense) Recovery = Income Taxes before the adjustment to tax Basis + Adjustment = (31.5) + 6.5 = (25)
- Step 5: Compute effective tax rate
  Effective tax rate = income tax (expense) recovery / income before taxes
  Effective tax rate = (25) / 150 = -16.67%

[See Excel worksheet for more detailed]

(b) Analyze the impact to the deferred taxes/liabilities for each of these items.

Commentary on Question:
The candidates should determinate if there is a temporary or permanent difference for tax purpose. If there is a temporary difference, then the impact is increase (or decrease) of deferred tax assets or deferred tax liabilities. If there is a permanent difference, then there is no impact to deferred tax assets or liabilities. In addition, a recoverability for deferred tax assets has to be conducted on a regular basis. The answers are based on the accounting principles as of the exam date.

(i) There is no impact to deferred tax assets. If the valuation allowance is "more than likely or not" (US GAAP) or "Probably" (IFRS), then deferred tax assets would be reduced.

6. Continued

(ii) It is a temporary difference with asset carrying amount larger than tax based carrying amount. It results in an increase of deferred tax liability of (10 - 2) * 21% = 1.68 million.

(iii) There are two possible answers:
- If the assets are classified as going through P&L: There is a temporary difference. The carrying amount is smaller than tax-basis, deferred tax assets will be increased by 14 * 21% = 2.94 million.
- If the change is not going through P&L: There is a permanent difference, thus no impact to deferred tax impacts.

(iv) Change of accounting policy only affect equity (net of tax). There is a permanent difference. Thus, there is no impact to deferred tax assets or liabilities.

(v) Write-down of goodwill will not be considered as a tax event. Thus, it is a permanent difference so, no change of deferred tax assets

(c)

(i) Recommend a quantifiable financial ratio for each of I-II above. Justify your recommendation.

(ii) Calculate each ratio you recommended in (i) for each of 2021, 2022 and 2023. Show your work.

(iii) Interpret the results in (ii).

Commentary on Question:
For activity ratio, using inventory turnover or receivable turnover or numbers related to receivable/inventory is a preferred choice. For liquidity ratio, using quick ratio, current ratio, or cash ratio is a preferred choice. Other than that only reduced points would be given.

[See Excel worksheet for more detailed]

(d) Describe two potential follow-up items for the 2023 forecast that should be examined further based on your recommendations in part (c).

Commentary on Question:
For each ratio, factors of the affecting the ratio should be asked. In addition, change of macro environment and competitors' intelligence should be look into also. One of the sampled solutions is listed in the model solution

6. Continued

(i) Aircraft fuel turnover (AFT) increased significantly in 2023 requires further analysis into the following areas:

- Sale increase resulted in significant increase on cost of aircraft fuel sold increase.
- Company expects fuel price to drop in the future. Thus, holding the inventory at the low level.
- Company experienced larger than expected profit, thus, keep the ending inventory low to lower the profit

Meanwhile, turnover ratio for other competitors for better comparison

(ii) Cash Ratio (CR) decreased significantly in 2023 requires further analysis into the following areas:

- Cash level may be due to significant increase in property & equipment, BJA can review the cash purchase of the property & equipment.
- Account receivable also increased, BJA should look into the collection process if there are any potential delay.

Meanwhile, CR of competitors should be collected for better

7. Learning Objectives:

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

Learning Outcomes:

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

(1c) Assess the impact of business strategies including acquisitions, divestitures, and/or restructurings.

Sources:

F-158-F23: Hurdle Rate – Definition and Example

F-160-F23: Why private equity sees life and annuities as an enticing form of permanent capital

Jonathan Berk and Peter Demarzo, Corporate Finance, Fifth Edition, Ch 28: Mergers and Acquisitions

Commentary on Question:

In general, question 7 seemed difficult for candidates. In part (b), many candidates were able to calculate the acquisition price, but did not evaluate the proposed acquisition price. In part(d), most candidates failed to comment on Epoch's life and annuity business lines.

Solution:

(a) Describe how BGPEF would view an acquisition of Epoch with regards to each of the following:

(i) Capital

(ii) Economies of scale

(iii) Vertical integration

Commentary on Question:

Candidates did not answer well for the economies of scale and vertical integration. Most candidates failed to recognize that vertical integration is not applicable here.

(i) The life and annuity-heavy balance sheet of Epoch is a form of Permanent capital. Permanent capital allows investors/managers to save time on fundraising and offers the flexibility to invest in times when other forms of capital are scarce.

7. Continued

(ii) BGPEF can leverage Epoch's balance sheet of long-term investment horizon to achieve the investment proficiency.

(iii) Vertical integration is not relevant in this scenario since BGPEG has no insurance presence and is not a supplier or customer of Epoch.

(b) Assess the proposed acquisition price. Show your work.

Commentary on Question:
To receive full mark, candidate must evaluate the proposed price and note that the premium paid is advantageous for BGPEF. Some candidates incorrectly assumed cashflow occur at the end of year.

Premium = 24m = (1350m - 1110m) * 0.1
PV synergies = 27.2m = 9.5m + 9.5m/1.05 + 9.5m/(1.05^2), since cash flow occur at the beginning of the year

The valuation does not match the value of the synergies for BGPEF. Present value of synergies is higher than premium paid. The deal as structured is advantageous for BGPEF.

(c)

(i) Explain which opportunities BGPEF would pursue given its criteria.

(ii) Critique BGPEF's criteria.

Commentary on Question:
Most candidates did well on part (i). For part (ii), many candidates noted IRR ignores the amount of value added but failed to comment on other flaws.

(i) BGPEF would accept opportunities 2 and 3 and decline opportunity 1 because the former have 10yr IRR > 15% and the latter does not meet this threshold.

(ii) Using a hurdle rate is an appropriate and objective method to assess whether a project provides adequate returns for the company.

However, using IRR only as the hurdle rate for investments may favor short term investments over long-term ones.
Not having different hurdle rates for different projects, or assigning a risk premium, can lead to taking on riskier investments.
The 10-year time horizon for cash flows may be too short as it ignores impacts of longer-term projects/investments (which may be positive or negative).

7. Continued

(d) Rank each opportunity, ignoring BGPEF's specific criteria and considering the application to Epoch. Justify your ranking.

Commentary on Question:
Many candidates did not link the ranking to Epoch's business lines and focused solely on IRR and/or NPV, which resulted in partial marks.

Project 1 should be the first project to fund (if BGPEF has the budget to do so). It is fully relevant to all product lines of Epoch and will add value to its insurance operations. Even though it does not meet BGPEF's hurdle rate requirement, it has the highest NPV by far of the 3 projects, and the 30-year IRR is very high as well.

Project 2 should be the second project. It is fully relevant to the Life insurance business of Epoch and exceeds BGPEF's hurdle rate requirements. It also generates the second highest NPV.

Project 3 should only be undertaken if there is additional budget for it. The investment performance project is not as relevant to the core product lines of Epoch (life and variable annuities). While it has the highest IRR by far, it also has much smaller cash flows than the other 2 projects.

8. Learning Objectives:

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

Learning Outcomes:

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

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

Sources:

Dowd, Measuring Market Risk 2nd ed, Ch 9 Applications of Stochastic Risk Measurement Methods

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

Commentary on Question:

Candidates' performance on Question 8 was mixed. Most candidates demonstrated some basic understanding of model risks and their management. However, many struggled on part (b)(ii) and (d)(ii). Some also barely answered the later parts of the question.

Solution:

(a)

(i) Describe two common sources of model risk that should be considered when adapting the existing model for use with the new product.

(ii) Propose two risk management approaches to mitigate the risks identified in part (i).

Commentary on Question:

Many candidates did not receive full marks because their answers were generic and not tied to the context of the question, which is using the existing model for a new product.

(i) Incorrect model application - this model risk arises when a model that is suitable for one purpose is misused for another purpose; in the case of using a simple annuity model for equity-linked annuity pricing, if the model owner did not properly adapt the model to include a dependency of equity performance, the model would be misapplied.

8. Continued

Incorrect calibration - this model risk arises when parameters to the model are estimated inappropriately, either due to date that is out of date, incorrect sample periods, or non-relevant data. E.g., if the model owner used simple annuity policyholder behavior to set the lapse rate for the equity-linked annuity product, the new product pricing model would be incorrectly calibrated.

(ii) To address the risk of incorrect model application, the model owner should simply be aware of model risk. The owner should be aware of the strengths and weaknesses of adapting an existing simple annuity model as opposed to building a complex equity-linked annuity model from first-principles or other approaches.

To address the risk of model calibration, the owner should take time to identify, evaluate, and check key assumptions. The model owner should explicitly set out key assumptions and evaluate the extent to which the model results depend on the assumptions.

(b)

(i) Critique Lisa's statement on model risk quantification.

(ii) Propose an approach to quantify one potential type of model risk present in the new pricing model.

Commentary on Question:
Many candidates struggled on part (ii). To received full marks, candidates were expected to describe how to explicitly quantify the model risk discussed on part (i). For example, to quantify the parameter risk, one should describe the distribution, its associated parameters and how it can be applied in the new pricing model.

(i) Lisa's statement on model risk is incorrect. Every model has model risk that can be quantified, even if the model is a pricing model using "best estimate" assumptions. Model risk could be quantified related to specific parameters, correlation between parameters, and distribution risk.

(ii) For the equity-linked annuity model, Lisa can quantify the parameter risk associated with the model output, which is the estimated cost of the equity-linked annuity LTC rider. To estimate the model risk, we can assume the rider cost has a normal distribution, with a mean = average rider cost, with a standard deviation based on the number of scenarios run. We can use this to calculate a confidence interval for the rider cost given a specified set of parameters. This confidence interval gives an estimated floor for the model risk, as the normal distribution likely underestimates the heaviness of the tail risk.

8. Continued

(c) Describe two challenges in modeling with a multivariate stochastic process.

Commentary on Question:
Most candidates were able to describe at least one challenge. Full marks were awarded for two reasonable challenges if they were well described.

The first primary challenge in modeling a multivariate stochastic process is that the model is not considered valid unless the owner specifies the dependence between the random processes. This should be modeled using either correlation or a copula-based approach. For the equity-linked annuity model, this will be difficult to develop given the newness of the model.

The second challenge is the issue of computational efficiency. The stochastic modeling required to implement a complex equity-linked annuity model relative to a simple annuity model is substantial. SIC would have to scale up to be able to meet the modeling demands.

(d)

(i) Define the simulation technique.

(ii) Propose a specific approach for modeling the new product's assumptions using the simulation technique.

Commentary on Question:
Most candidates did well in part (i). However, part (ii) was very poorly answered. Majority of candidates only briefly stated a recommended simulation technique without describing how to use such technique for modeling the new product's assumptions in the context of SIC.

(i) Principal component (PCA) simulation simulates the individual components that contribute to the overall estimation of the model output.

Like PCA, scenario simulation focuses on the key components. However, in scenario simulation, the components are limited to a set of discrete states, as opposed to a full continuous distribution.

(ii) Under PCA, Lisa could take the following step-wise approach:
1. For each of the selected assumptions, propose a stochastic process that accurately corresponds to the variable (e.g., mortality might follow a binomial process, with mortality shocks following a transformed beta distribution)
2. Based on preliminary analysis, determine the primary components - for a process with multiple assumptions, the model owner is looking to identify the three to four components that explain the majority of the movement in the rider cost estimate.

8. Continued

3. Define an equation to estimate the rider cost in terms of the principal components
4. Simulate the principal components and derive the corresponding rider cost estimate

Under Scenario Simulation, Lisa could take the following approach:
1. Identify the primary assumptions, which could be all eight assumptions, given that Lisa can more easily sample the states across eight assumptions.
2. For each assumption, establish the set of possible states and the corresponding probability of being in each state
3. Simulate combinations of the states across the assumptions and calculate the corresponding rider cost under each simulated combination.

(e) Compare and contrast a full multivariate approach, principal component simulation, and scenario simulation.

Commentary on Question:
Most candidates were able to comment on computational intensity. To receive full marks, it is expected to elaborate on the specific elements of the simulation techniques (such as scenario simulation would be easier to select states).

PCA's primary benefit against a full multivariate stochastic process is the gain in processing efficiency - there are fewer random variables to work with, which allows the user to focus on more simulations, as opposed to running more scenarios under a single or limited set of starting parameter values.

However, PCA is still more computationally intensive that scenario simulation, and requires more mathematical complexity in defining the distribution around each parameter. Similar to PCA, the Scenario Simulation approach is less computationally intensive. However, given a limited set of states for each assumption, it is also less computationally intensive than PCA.

Another advantage compared to PCA is that it's easier to pick specific states to conduct what if simulations (e.g., picking the extreme mortality state, extreme equity volatility state, etc.).