CFE FD Model Solutions
Spring 2023

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) Assess the impact of business strategies including acquisitions, divestitures, and/or restructurings, etc. on value creation.

Sources:

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

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

Case study

Commentary on Question:

The primary goal is to understand how a company optimizes its corporate finance decisions based on its business objectives, and compares methods to determine the value of a business or project, including the impact on investment options.

The secondary goal is to examine how the weighted average cost of capital (WACC) is determined and other elements affecting the value of a project.

Solution:

(a) Critique the use of RPPC's WACC for both alternatives.

Commentary on Question:

This question was looking for the candidates' ability to display an understanding of things that may influence what WACC is most appropriate to use, such as debt-to-equity differences and underlying risk differences of projects.

1. Continued

When considering the WACC to use for these alternatives, the following should be considered:

- *Will the leverage of this project or similar projects in the same industry differ from that of RPPC?*
- *The two alternatives' risks will be different from RPPC's risk. Both alternatives are entering a new segment of the market which Darwin/RPPC has no experience. Additionally, Additionally, one of the options has a very low chance of success.*

Each project and line of business can bring with it different risks. By using the WACC of RPPC, we are assuming that the risk and leverage of Acquiring TL Life Company (Alternative I) and Project Amplify match those of the firm. An issue with this approach is that the positive earnings results on Project Amplify (Alternative II) are less likely than on the Alternative 1. The amount of debt financing to support the risk profile of these two products should not be identical.

One might consider calculating the WACC by comparing the unlevered cost of capital of a single-division firm that has similar business risks, such as Snappy.

Depending on other factors, the WACC may not be the ideal method. For example APV would be preferred if the debt-equity ratio is not constant over time.

(b)

(i) Calculate the NPV for each of the two alternatives using RPPC's WACC. Show your work.

(ii) Recommend which alternative Darwin should choose based on NPV. Justify your recommendation.

Commentary on Question:
This question evaluated the candidates' ability to properly calculate the WACC and NPV. Candidates generally did well in calculating the WACC, but there were often timing errors in calculating the NPV. Years 6+ presented a challenge to candidates.

(i) WACC = (60% * 14%) + (40% * 8%) * (1-20%) = 10.96%

Alternative I NPV: -80m + 2m / (1.1096) + 4m / (1.1096)^2 + 6m / (1.1096)^3 + 8m / (1.1096)^4 + 10m/(1.1096)^5 + 10m/.1096/(1.1096)^5 = -5.089m

Alternative II NPV: -20m + .3*2m / (1.1096) + .3*4m / (1.1096)^2 + .3*6m / (1.1096)^3 + .3*8m / (1.1096)^4 + .3*10m/(1.1096)^5 + .3*10m/.1096/(1.1096)^5 = 2.473m

1. Continued

(ii) Based on the NPV result, Alternative II should be chosen.

(c)

(i) Calculate the value of the option, using a decision tree. Show your work.

(ii) Describe two factors that could affect the value of the option you have calculated in (i).

Commentary on Question:
Part C proved to be challenging for candidates. The additional calculations led to several errors such as: incorrect signs on the tree, missing expenses in year 2, negative values of the option being calculated, issues with discounting, and not comparing the value with the option to the value without the option.

The second part of the question attempted to understand if the candidate could identify items that influenced the value of the option. Often the candidates supplied answers that would improve the value of the project, but it didn't improve the value of the option (value with option minus value without option).

(i) Project NPV = .3*NPV Success + .7*NPV Failure

NPV Failure = -10m + 0m (no investment in the second year if failure)

NPV Success = -10m + (2m-10m)/ 1.1096 + 4m/1.1096^2 + 6m / (1.1096)^3 + *8m / (1.1096)^4 + *10m/(1.1096)^5 + *10m/.1096/(1.1096)^5 = 55.898m

Project NPV = .3*55.898 + .7*-10m = 9.769m
Value of option = 9.769m – 2.473m [from (b) (i)] = 7.296m

(ii) If the success rate of the project goes up, the value of the option decreases. If the success rate of the project goes down, the option becomes more valuable. The additional information is worth more when there is less certainty.

The value of waiting can influence the value of the option. If the decision point were an extra year out for example, there would be more information on the success rate and projected stream of profits.

1. Continued

Others include: The amount of volatility in the projected earnings; The WACC used to determine the NPV of the option; Are there other options in the future if they make this investment? If Project Amplify is successful, is there an option to expand by deploying more capital later? Increase the marketing spend and headcount to accommodate additional sales; Is it imperative that the pilot has 10m of investment? Or can you learn the same information (likelihood for success or failure) with a smaller pilot that is less expensive? The amount being paid up from vs. deferred will impact the value of the option.

(d) Explain four important factors (other than NPV) that could influence Darwin's decision to move forward with either TP Life or Project Amplify, or neither.

Commentary on Question:
For the most part, candidates scored well on section d and were able to identify other factors that could influence the decision. Some candidates lost points for listing and not explaining the factors. Other candidates lost points for being hyper-focused on particular items that were redundant.

Synergies: Will the acquisition have any synergies that improve the overall financial picture of the combined company? Does the acquisition bring new talent and knowledge to the table that could help Darwin in other places?

Leverage Capacity: Can Darwin acquire additional funding? If not, Project Amplify (Alternative II) has a much cheaper entry cost.

Risk Tolerance: There are several risk items to consider such as will the addition of this online channel increase the risks that must be accounted for such as cyber? Is Darwin comfortable in deploying so much capital with a low probability of success?

Corporate Strategy: Either of these projects will take a great deal of organizational bandwidth. Does this align with the company's long-term strategy? Would they be better off investing in a product line like the new IUL they have been considering?.

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 4th Ed, Ch. 11 Financial Reporting Quality.

Commentary on Question:

Most candidates did demonstrate some basic understanding of financial reporting vs earnings quality in part (a). However overall performance in part (b) and (c) were poor. Partial credit was awarded to sound answers applicable to SEA and with justifications.

Solution:

(a)

(i) Contrast high-quality financial reporting and high-quality earnings.

(ii) Explain how financial reporting quality and earnings quality are related.

Commentary on Question:

Most candidates were able to score some marks on this question. Many candidates mixed up their answers in part (i) vs (ii), however credits were still awarded if their statements are correct. In part (i), the question was asking about the differences between high-quality financial reporting vs earnings (i.e., how are they different from definition). Part (ii) was specifically asking about their relationships (i.e,. how do they interact with each other).

(i) Financial reporting quality and the quality of reported results are related.

High-quality financial reporting conforms to the GAAP of the jurisdiction, as well as provides decision-useful information which is 1) relevant and 2) fairly/faithfully represents the economic reality of the company's activities during the reporting period and financial condition at the end of the period.

2. Continued

On the other hand, high-quality earnings result from activities the company will likely be able to sustain and provide sufficient return on the company's investment.

(ii) The relationship between financial reporting quality and earnings quality can be viewed as a matrix or as 4 cases. Financial reporting quality can be high or low. Earnings quality can also be high or low.

High reporting quality is a prerequisite for analyzing earnings quality and valuation.

High reporting quality enables assessment. High earnings quality increases company value, whereas low earnings quality decreases company value.

Low reporting quality impedes assessment of earnings quality and impedes valuation. If reporting quality is low, the information provided is of little use in assessing company performance, or making investment and other decisions.

(b)

(i) Determine where on the quality spectrum SEA's financial reports fall, based only on the financial statements in the case study. Justify your response.

(ii) Determine where on the quality spectrum SEA's financial reports fall, using the new exhibit and disclosure. Justify your response.

(iii) Critique management's decision to include this new exhibit.

Commentary on Question:
Most candidates did poorly on this question. Many did not understand what the "quality spectrum" exactly refers to; specifically, not basing their answers off the key elements of financial reporting and earnings quality. There were also a fair number of candidates who thought "more is better" in part (ii)(iii) without solid justifications, who received few marks.

(i) As reported SEA's financial statements fall on the quality spectrum either in the first or second spot.

They appear to be decision-useful and prepared faithfully under GAAP of the jurisdiction. No Notes or statement of cash-flows are presented. Earnings quality has declined the last two years. There do not appear to be any biased choices, but we also do not have any notes or financial disclosure to analyze.

2. Continued

The key question is whether the results are sustainable. The following factors call into question the sustainability of SEA's results: 1) non-passenger (other) revenue has declined 1% per year; 2) net income and operating income have decreased 49% and 41% respectively over the last two years; 3) over the last two years, passenger revenue has ticked up 6%, but aircraft maintenance only increased 1.5% suggesting there may be some deferred maintenance accumulating.

Absent additional information, we can conclude SEA's financial reporting is decision-useful, but don't know if it is sustainable.

(ii) The new exhibit is a non-GAAP exhibit, with little additional disclosure. It appears to be presented as prominently as GAAP compliant exhibit, which suggests the exhibit could reflect biased choices. The new exhibit restates fuel costs, reducing 2020 fuel costs by 3% and 2021 fuel costs by 15%. The new exhibit also restates other operating expenses, reducing them 1% per year, rather than showing the true 3% per year increase. Both of these reduce expenses and increase net income (aggressive choices).

Since the old exhibit is left unchanged, there doesn't appear to be earnings management, either real or in the accounting choices, but the new presentation does appear to show aggressive results.

Non-GAAP exhibits limit comparability across companies and time periods. The adjustments companies make to prepare non-GAAP exhibits are ad hoc and can differ significantly.

(iii) As mentioned in (ii), the new exhibit reflects aggressive choices. In the future, fuel costs may not increase as much as they have in the last two years, but to reduce them to appear to grow with general inflation misrepresents actual financial performance in the reporting period. The adjustment to other expenses appears to decrease those expenses to make them consistent with the change in non-passenger revenue. Similar to fuel costs, this change misrepresents expenses, overstating financial performance in the reporting period. It would have been more appropriate for SEA's management to publish pro forma projected financial results showing more moderate increases in fuel prices and to "right size" other expenses if they truly are expected to increase proportionately with non-passenger revenue.

2. Continued

(c)

(i) Explain four possible motivations that might lead SEA management to issue low-quality financial reports.

(ii) Propose, for each motivation in (i), additional disclosures that would help the user of financial statements to assess whether SEA's management acted on that motivation.

Commentary on Question:
Full marks were only awarded only if explanations were tied to SEA circumstances from the case study. The motivations that do not apply to SEA, (for example, beating analyst forecasts is not applicable since SEA is a privately held company), received no credit.

(i) Possible motivations that are applicable to SEA include:

1. Managers might manipulate financial reports to increase the firms value prior to being purchased by another firm. From the case study, we are told that SEA might be an acquisition target or strategic partner for one of the RPPC companies.

2. Managers may be motivated to issue low quality financial reports to mask poor performance. SEA's financial performance has been in decline, so masking poor or worsening behavior is a possible motivation.

3. Managers frequently have incentives to meet or beat market expectations, e.g. as in manager forecasts. This is especially true if manager compensation is linked to increases in SEA reported earnings/performance.

4. Managers might be concerned that working for a company that performs poorly will limit their future career opportunities. SEA's financial performance has been in decline, therefore managers' future career opportunities could have been impacted.

5. Whether out of concerns for career opportunities or to influence compensation (like hitting a bonus trigger), managers might make accounting choices to delay revenue (in periods of strong performance) or inflate revenue (in periods of marginal performance).

6. Managers might inflate earnings or other metrics to avoid debt covenants. SEA has long-term debt on their books, so avoiding debt covenants is a reasonable motivation.

2. Continued

(ii) Additional disclosures include:

1. A statement of cash flows would help us value the company and better ascertain financial performance based on cash flows.

2. Notes that include information related to manager compensation and financial incentives.

3. Notes that discuss any material debt covenants.

4. Notes sharing information about senior leaders, e.g. bios might shed light on which managers would be more or less concerned about the implication for future career opportunities.

(d) Describe the two conditions in addition to motivation that typically exist when companies issue low-quality financial reports.

Commentary on Question:
This question was done quite well. Partial credits were awarded to other reasonable answers as well.

The two conditions that typically exist when low-quality financial results are issued are:

1. Opportunity can result from weak internal controls, an ineffective board of directors, or accounting standards that allow for divergent choices or have minimal consequences for inappropriate choices.

2. Rationalization is a reflection of company culture and the ability of the individuals making choices to justify the choice to him- or herself.

3. Learning Objectives:

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

Learning Outcomes:

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

Sources:

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

Commentary on Question:

This question tests the candidate's ability to evaluate strategies and make effective business process decisions. In order to perform well, candidates needed to understand the various types of graphs in the source material and be able to apply them to the BJT case study.

Solution:

(a) Identify the type of strategic fit approach BJT is pursuing with its expansion into non-road tires. Justify your response.

Commentary on Question:

Candidates struggled with this question. Most candidates did not recognize that strategic fit can be achieved using either a market-driven strategy or process-driven strategy.

The type of strategic fit approach BJT is pursuing is a market-driven strategy.

A market-driven strategy is when a firm starts with key competitive priorities and then develops processes to support them. BJT is starting with their key competitive priorities (increasing product variety), and it is now evaluating 2 possible approaches (developing its own capabilities or buying a company that is already in the market) to support this competitive priority.

(b)

(i) Explain what the current position 0 and all three potential positions 1-3 represent on the product-process matrix.

(ii) Recommend which position(s) on the product-process matrix would be best for BJT. Justify your recommendation.

Commentary on Question:

To receive full credit for part (i), candidates needed to explain why positions 1 and 2 result in high costs.

3. Continued

(i) The current position (0) and position 3 are on the diagonal of the product-process matrix. Any position on the diagonal of the product-process matrix represents an effective match between the desired process flexibility and product variety.

Any off-diagonal positions represent a mismatch that can result in unnecessarily high costs. The position above the diagonal (1) represents a mismatch that causes opportunity costs. The position below the diagonal (2) represents a mismatch that causes out-of-pocket costs.

(ii) Either of the positions on the diagonal are best since they both represent an effective product-process match between the desired process flexibility and product variety.

(c) Describe the information that this graph provides for the following in relationship to the two possible approaches to expansion:

(i) Positions 1 and 2.

(ii) The dotted line.

(iii) The arrows between positions 0 and 1, and 0 and 2

Commentary on Question:
For part (i), many candidates did not identify that position 1 represents acquiring TNT and position 2 represents building its own plant.

(i) Position 1 is buying a company that is already in the market and position 2 is developing its own capability. Position 2 must be developing its own capability since the case study mentions that this plant would be more efficient to run, resulting in higher profits per year.

(ii) The dotted line represents the operations frontier. This is the smallest curve that contains all current industry positions, and thus represents the current best practices of world-class firms. Firms on the operations frontier have superior performance along the desired product attributes (highest operational effectiveness).

(iii) The arrows represent strategic positioning, which is the direction of improvement in operational effectiveness from the current position. Reducing the distance of the current position to the current operations frontier along the direction of improvement means that the operational effectiveness has been improved.

3. Continued

(d)

(i) Evaluate BJT's capacity to become more operationally efficient by reaching position 3.

(ii) Explain BJT's ability to reach position 4.

Commentary on Question:
For part (ii), many candidates did not explain that the operations frontier can shift outward in the future.

(i) A position on the operations frontier (position 3) represents the highest operational effectiveness in the industry, meaning that this is the ideal position to be in. The firm's current position (position 0) does not represent the highest operational effectiveness. It is theoretically possible for BJT to reach position 3.

At BJT's current position, they do not face any trade-offs - they can improve along multiple dimensions (in this case, process flexibility and cost efficiency) simultaneously. Since the operations frontier is concave, any point on the frontier represents a trade-off - to increase performance along one product dimension, one must give up some performance along the other.

(ii) Since the operations frontier (position 3) represents the highest possible performance (operational effectiveness), it is not possible for the firm to currently be outside of the operations frontier (position 4).

It is only possible to reach position 4 in the future if the operations frontier shifts outward. The operation frontier can shift outward due to technology and management practice advancements.

4. Learning Objectives:

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

Learning Outcomes:

(3a) Assess how managerial accounting can impact decision making.

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

(3c) Assess how managerial accounting can impact behavior and performance evaluation in organizations.

Sources:

Zimmerman, Accounting for Decision Making and Control 10th Ed, Ch 7: Cost Allocation: Theory

F-156-21: ABC and Life Insurance Industry

Case Study

Commentary on Question:

This question is testing the understanding of cost allocation and its implication on Life Insurance companies. This is a case study-based question, so it is important to apply cost allocation theory to this specific case. It is important to look at the specific verbs of the questions ("Describe," "Explain" etc.).

Solution:

(a)

(i) Describe the three primary reasons companies allocate fixed costs to individual cost centers.

(ii) Explain which reason is most relevant to Snappy.

(i) The three primary reasons companies allocate fixed costs to individual cost centers are:

a. External Reporting/Taxes: Accounting rules require that inventory be stated at cost, including indirect manufacturing costs.
b. Cost Based Reimbursement: Depending upon the type of contract, reimbursements require cost-based allocation.
c. Decision Making and Control: Cost allocations are an important part of an organization's budget system, product pricing and performance evaluation processes.

4. Continued

(ii) As a domestic life insurance company, among the three reasons, the decision making, and control is most relevant for allocating fixed costs.

(b)

(i) Assess if each of the approaches, I-IV, is an insulating or noninsulating allocation method. Justify your response.

(ii) Describe one advantage and one disadvantage of noninsulating allocation systems with regards to management behavior and performance.

Commentary on Question:
It is important to look at the verbs the question is using. It is not enough to simply state whether the approaches are insulating or non-insulating.

(i) The different cost allocation approaches and the types are below:

a. Even allocation across lines of business is an insulating allocation approach. The business performance of any line of business would not affect the cost allocated to other lines of business.
b. Allocation by employee count can be either insulating or non-insulating allocation depending upon the nature of businesses. If the number of employees tends to scale up with sales, this would be a non-insulating allocation. If the number of employees is relatively fixed, independent of business performance, this would be an insulating allocation.
c. Allocation by policy count is a non-insulating cost allocation approach. The number of policies sold by individual lines of businesses affects total costs generated and the costs allocated to other lines of businesses.
d. Allocation by face amount is a non-insulating cost allocation approach. The face amount of policies sold by individual lines of businesses affects total costs generated and the costs allocated to other lines of businesses.

(ii) The primary disadvantage of a non-insulating cost allocation method is that it distorts the performance measure of one division by tying it to another division's performance. For Snappy Life, for example, if sales for the Whole Life group are down, this would increase the amount of costs that are allocated to the other two divisions, lowering their total profitability.

4. Continued

The primary advantage of non-insulating methods is that the overall volatility in cost is absorbed by the individual lines of business. Non-insulating methods act like shock absorbers to the new or growing lines of businesses. For example, if a company wants to move into the SPWL line of business it will require upfront capital costs. But under the non-insulating method this cost will automatically shift to the other lines of business to avoid punishing a growing line of business that is strategically important to the company.

(c)

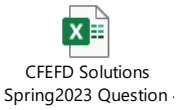
(i) Determine the profitability percentage for each line of business before allocation of fixed costs. Show your work.

(ii) Determine which line of business benefits most from each of the four proposed allocation approaches, I-IV. Justify your response.

(iii) Determine which allocation Veltro would prefer. Justify your response.

Commentary on Question:
This is a spreadsheet calculation question. Setting up the solution steps is important to respond to all parts correctly.

Please refer to the spreadsheet model solution.



(d) Identify a shared cost from Snappy that Corrie has not identified for cost allocation. Justify your response.

Commentary on Question:
There can be multiple answers to this question. Candidate should clearly identify a shared cost and not a cost that are or can be attributable to a specific line.

A shared cost that is missing from the CFO's analysis would be related to marketing/advertising expenses. Since the marketing/advertising is done at a company level, we need to allocate this overhead expense to specific lines.

(e) After reviewing the ABC alternatives proposed by Corrie, Veltro states “ABC is all too complicated for just allocating costs. Use face amount to allocate the fixed costs instead! At the end of the year, the product line with the highest profitability percentage will receive an additional year-end bonus, which will be excluded from the profitability percentage calculation.”

Critique Veltro’s statement.

4. Continued

Commentary on Question:
"Critique" is the keyword here. The candidates should identify both pros and cons of a statement if applicable.

The specific critique on Veltro's each statement are shown below:

a. "ABC is all too complicated for just allocating costs."
   It is true that Activity Based Costing requires many data input and tracking. Implementation of ABC can be complicated and expensive exercise.
   But for life insurance companies, ABC is an appropriate costing mechanism for understanding cost tracking, profitability management, product design and budgeting.

b. "Use face amount to allocate the fixed costs instead!"
   Using face amount to allocate fixed costs is a non-insulating cost allocation approach. This is not the right approach for cost allocation as it will incentivize the managers of lines of businesses to sell smaller sell smaller face amount policies, which ultimately lowers total gross premiums and total net income.

c. "At the end of the year, the product line with the highest profitability percentage will receive an additional year-end bonus, which will be excluded from the profitability percentage calculation."

   Adding a bonus to the product line with the highest profitability percentage may not be the right approach. The business lines which require less capital will automatically see highest profitability and there will be unhealthy competition among talent pool to get into the business line. Instead, each business line should have different targets and the LOB that beats the target by highest percentage point can get an additional bonus.
   Also excluding the additional bonus from profitability calculation is not appropriate. It should be part of the cost of the specific business line.

5. Learning Objectives:

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

Learning Outcomes:

(4b) Evaluate model risks and processes

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

(ii) Assess processes for vetting models

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

Sources:

F-131-16: Heavy Models, Light Models and Proxy Models

Commentary on Question:

This question was looking to test a general understanding of proxy models and their behaviors when compared to heavy models. Candidates generally had a good understanding of the purpose of proxy models, but struggled to demonstrate an understanding of the application, specifically with regard to scenario accuracy as it pertains to solvency capital requirements.

Solution:

(a) Describe one advantage and one disadvantage of stochastic models.

Advantage: Stochastic models are detailed and thorough.

Disadvantage: Stochastic models are relatively slow. The number of scenarios that can be run in one valuation exercise are limited by computational power.

(b)

(i) Compare and contrast the three proxy formulas across the following:

I. Formula structure
II. Regression versus interpolation
III. Optimization

(ii) Recommend a proxy formula that will satisfy management's preference. Justify your recommendation.

5. Continued

(i) Replicating Polynomials:
- Determining Formula Structure: Choice and number of nomials
- Regression, Interpolation or Both: Both Possible
- Optimized Components, Whole, or Both: Both Possible

Replicating Portfolios:
- Determining Formula Structure: Choice of assets
- Regression, Interpolation or Both: Regression
- Optimized Components, Whole, or Both: Optimized Whole

Commutation Functions:
- Determining Formula Structure: Choice and number of commutators
- Regression, Interpolation or Both: Both Possible
- Optimized Components, Whole, or Both: Optimized Whole

(ii) Replicating Polynomial proxy formula is recommended. This is the only proxy formula being considered that can be optimized at the component level, which is management's preference. Replicating Portfolios and Commutation Functions can only be optimized at the whole formula level.

(c) Your manager, the head of ERM, says, "A proxy model mimics the key behaviors in the heavy model, so we can rely on all the results of your proxy model at the scenario level going forward."

Critique your manager's statement.

Commentary on Question:
Candidates generally performed fairly on this question. Most candidates recognized that a good proxy model does in fact mimic the key behaviors of a heavy model, but are not necessarily accurate at the scenario level. Candidates who received full points on this question recognized that the purpose of the proxy model is to calculate solvency capital requirements, which relies on accuracy at the left tail, and scenario accuracy is not a requirement in this calculation.

A good proxy model does mimic the key behaviors of a heavy model, but the loss in complexity is accompanied by a loss in the ability to reproduce some of the other behaviors, as a proxy model is a less complex version of a heavy model. Key behaviors may just be related to the models purpose (e.g., capturing a certain portion of the distribution of results, such as the tail or expected value).

5. Continued

Not all proxy models are accurate at the scenario level, but are still useful in capital management in creating a proxy full distribution from which percentile results can be drawn. A model does not need to be accurate at the scenario level for it to provide an accurate description of the capital distribution/accurate assessment of required capital.

(d)

(i) Calculate the 1-in-200 VaR of the calibration scenarios. Show your work.

(ii) Calculate the 95th Percentile Error of the proxy model. Show your work.

(i) The 1-in-200 VaR is the calibration model result of the 5th scenario of the 1,000 scenarios, ranked from smallest to largest. The 5th smallest result is -42MM.

(ii) The 95th Percentile Error of the proxy model is the ratio of (1) the difference between the VaR(95) for the proxy model vs the calibration model, and (2) the absolute value of the VaR(95) of the calibration model.

VaR(95) Scenario = 1000 * (1 - 95%) = 50th scenario

VaR(95) Calibration = 50th scenario of heavy model results ranked from smallest to largest, or -4.4727MM
VaR(95) Proxy = 50th scenario of proxy model results ranked from smallest to largest, or -4.4754MM
Difference = -4.4754M – -4.4727MM = -0.0027MM
95th Percentile Error = -0.0027MM / absolute value of -4.4727MM = -0.06%

(e) Assess the appropriateness of the fit of the proxy model.

Commentary on Question:
Candidates generally performed poorly on this question. Candidates who did well recognized that the proxy model was intended to determine solvency capital requirements, which is a left-tail calculation, specifically at the VaR(99.5) level, however any reasonable quantitative justification was given full points. Candidates who did well on this question also recognized that a proxy model must be ranked before comparing to the heavy model when determining appropriateness of the fit of the proxy model, as a proxy model will not mimic the heavy model on a scenario level. There was no single right answer required to attain full points.

5. Continued

The purpose of the proxy model is to calculate the solvency capital requirements, so the fit of the proxy model should be examined at the left tail when determining the appropriateness of the fit of the proxy model.

The right tail is not a good fit. The proxy model produces an error of over 20% in the upper 10% of the results. However, the right tail is not a consideration for the solvency capital calculation, and this does not mean the proxy model is not a good fit.

At the 99.5th percentile, the proxy model produces an error of only 0.04%, which is quite small, so it is a good fit for the purpose of mimicking a solvency capital model.

	Calibration in $MM	Proxy In $MM	Error in $MM	Error as a %	Scenario Selected	Percentile
VaR(99.5)	(42.007)	(41.990)	0.017	0.04%	5	99.5%
VaR(10)	52.342	66.447	14.105	26.95%	900	10.0%

(f)

(i) Calculate the Combined Non-Linearity Surface of the stress test. Show your work.

(ii) Determine the number of heavy lift calculations required to calibrate the formulas of each of the potential risk factor pairings. Show your work.

(i) The non-linearity surface is equal to the difference of the combined stress test impact and the sum of the individual parts.

5 + 2 + 4 + 2.5 + Non-Linearity Surface = 15

13.5 + Non-Linearity Surface = 15

Non-Linearity Surface = 1.5

(ii) For n risks, there are n * (n-1) / 2 risk pairings

There are 4 coefficients to determine (c1, c2, c3, and c4)

5. Continued

There are 4 risks (interest rate, mortality, lapse, and credit spread), so there are 4 * 3 / 2 = 6 risk pairings

6 risk pairings * 4 coefficients = 24 heavy life calculations needed to calibrate the formulas

6. 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:

F-157-23: CFO Forum: Market Consistent Embedded Value Basis for Conclusions

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Explain two other reasons why RPPC might benefit from adopting an MCEV framework.

Commentary on Question:

Candidates were generally successful in this portion of the question.

any 2 from the following

(1) RPPC can understand their business better as MCEV focuses on expected values and the drivers of change for those values and the risks associated with realization of those values

(2) RPPC can understand better the effectiveness of the management of their inforce thru the renewals with MCEV and the prospects of the company with New Business Value

(3) improved disclosures improve transparency for external users allowing them to understand the (i)impact of events, experience, decisions on expected value of business during period (ii) main risks and drivers of realization of value (iv) management's view of business and interpretation of MCEV Principles

(4) eliminates diversity of approaches in the marketplace, bringing consistency with other companies allowing external users to make valid comparisons

(5) allows RPPC to reconcile the covered businesses with other accounting statements so covered business can be put in context with entire group, which gives external users a better view of the entire group

(b) Describe four considerations for the treatment of financial options and guarantees under an MCEV framework.

Commentary on Question:

Most candidates failed to identify the correct financial options and guarantees considerations in the MCEV framework.

6. Continued

Any 4 of the following
(1) MCEV requires recognition of time value of guarantees. Time value = stochastic valuation of PVFP (PV of future CF expected to emerge from assets backing the liab) – deterministic PVFP. This should be based on economic variables valued in line with prices of similar cash flows traded in the capital market
(2) future volatility in economic variables is key factor of value of financial guarantees. These guarantees have asymetric impact on shareholders which MCEV neutralizes. Future excess returns over reference rate is not recognized. Volatility can increase the value of financial guarantees causing a decrease in MCEV
(3) Consistency of valuation of whole contract is needed to avoid discontinuities as contract moves in and out of the money. Stochastic valuation of option like features considered suitable.
(4) Noneconomic assumptions should be consistent with historical experience and consistent with the scenario economic environment
(5) use reference rate to value assets. For assumptions that depend on market performance, assume historical market experience in line with reference rate and that all market participants are in the same environment. Market participants include all who could offer alternative products.
(6) Model non-hedgeable risks within projections, for ex dynamic lapse
(7) Reflect management discretion in crediting rates/bonus, other management levers reflecting any guarantees and considering PH behavior. Model the choices management and PH make, considering the market conditions at that time and the path taken to get there but not of the future.
(8) use reference rates in liability valuation . Reference rates are proxy for risk free rates, generally the swap yield curve for the given currency. where liabilities are not liquid, can also include a liquidity premium.

(c) Determine two design features or operation issues that exist within each of the following Darwin product lines that may negatively influence MCEV

(i) Variable Annuities

(ii) Universal Life with Secondary Guarantees

Commentary on Question:
Candidates are expected to describe two design features in the list below to receive full credit. Most candidates received partial credits on this part. Some candidates failed to recognize the design features/operation issues with financial risks.

6. Continued

A. variable annuities with guarantees. Any 2

(1) MCEV results can be volatile and can go negative when risk free rate are low and/or implied volatility is high. Guarantees within VAs have high sensitivity to changes in financial markets. These products have financial options and guarantees that MCEV requires valuing stochastically, reflecting implied volatility and risk-free rate. liquidity premium can be added to discount rate, where appropriate, in this case after contract value goes to zero and there no longer is any liquidity in the liability. The greatly longer guarantee that Darwin Life recently added to enhance the product will further increase the MCEV sensitivity.

(2) Guarantees within VA have a high non-hedgeable risk in the dynamic lapse and utilization behavior that the VA industry has seen which has to be reflected within the liability valuation. The assumption needs to be consistent with historical experience and consistent with the economic environment implied by the projection. As well, MCEV Principles require consistency of assumptions with other measurement basis. Darwin Life does not currently have consistent assumption setting process and only has the static policyholder behavior assumption shared across functions.

(3) An operational non-hedgeable risk that would need to be reflected is basis risk. This cost would be reflected in residual nonhedgeable risks and bring down the MCEV.

(4) Darwin Life has not fully hedged its guarantee, only hedging 90% of liability delta and 50% rho. This will show up negatively n the MCEV valuation as the liability will reflect liability moving fully with the cpaital market and the assets will not.

(5) This is a fully guaranteed product. The only existing management lever is the ability to pull or make available other underlying funds. Managing the underlying funds can help with the underlying asset volatility and the outcome in adverse economic scenarios. MCEV principles allow the reflection of management discretion on levers available in the product, which would help increase MCEV. But the management lever can only be reflected if it has passed thru appropriate approvals such as SEC and state approvals. In reflecting the management lever, MCEV needs to also consider the market and policyholder reaction to such actions.

B. UL with secondary guarantees (ULSG) Any 2

(1) The MCEV of a ULSG will be negative. MCEV uses risk free rates while the guarantee has an implicit rate guarantee that is higher than the risk-free rates and extends for the lifetime of the policy. This design is needed to be competitive in the ULSG marketplace.

(2) While MCEV principles allow reflection of management discretion in credited rates and even in changing product charges, the policy does not allow changing premium requirements for the secondary guarantee itself. Reflection of available management levers can make the MCEV less negative.

6. Continued

(3) As the ULSG is managed within the UL portfolio, the value of new business and the movement in value of existing business need to consider material interactions between new business and existing business as Darwin Life has the option to cross subsidize between different generations of business and the different blocks of business.
(4) Requires stochastic valuation to value financial guarantees, using risk free rates. can include liquidity premium where the liability becomes illiquid, at the point cash value = 0.
(5) Need to reflect non-hedgeable financial risks such as dynamic lapses.
(6) Non - economic assumptions should reflect historical experience and need to be consistent with the economic environment implied by the projection. And should reflect the best estimate experience for ULSG and not share margins from other products
(7) ULSG as an industry product line does not have credible lapse experience at the very long policy years. MCEV principles requires reflection of this as a cost of residual non-hedgeable risk.
(8) MCEV needs to reflect allowance for a cost of residual non-hedgeable risk due to mortality that would reflect the difference between best estimate and the CTE (conditional tail expectation or the mean of the average of tail distribution)

(d) Explain how each approach, I and II, could be applied effectively to increase MCEV. Recommend the best model to use. Justify your recommendation.

Commentary on Question:
Candidates did poorly on this part. Partial credits. Most of them failed to recognize the cons of the counterparty risk/credit risks from reinsurers, which increase the aggregate business risk in MCEV.

(1) third party reinsurance would remove the reinsured portion from the MCEV calculation but any counterparty risk (or credit risks associated with claims from reinsurers are part of aggregate business risks and should be reflected in MCEV.

(2) Darwin Life needs to increase hedging to be more aligned with the liabilities. In doing so, Darwin Life will be able to reflect the increased hedging in MCEV and this will reduce the negative effect of volatility implicit in not hedging fully. Costs of hedging will offset any positive impact of hedging on MCEV so needs to be balanced.

7. Learning Objectives:

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

Learning Outcomes:

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

Sources:

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

Commentary on Question:

The question is to test candidate's understanding of translating Income Statements / Balance Sheets under different methods and the implications of accounting choices with respect to company's foreign operations.

Solution:

(a)

(i) Describe three appropriate disclosures related to statement translation.

(ii) Identify three considerations for Conglomerate Holdings as it prepares Sunshine Spot Insurance's translated statements.

Commentary on Question:

For a-i, most candidates were able to name one or two appropriate disclosures. To earn maximum scores, the disclosure must be related to translation not company in general.

For a-ii, only a handful of candidates mentioned the accounting method (IFRS vs GAAP).

(i) Any three out of the following list

- Disclose methodology used and reasons for choice where not clear
- In general functional currency is clear, but if not IFRS provides factors to be considered
- Note that current rate method includes currency adjustment that impacts stockholder equity
- Under temporal method translation adjustment impacts net income
- Disclose amount of differences recognized in net income
- Disclose translation adjustments

7. Continued

(ii) Any three out of the following list
- Parent's method of accounting: IFRS or US GAAP
- Foreign company books must be translated into parent's currency
- Possible methods are current rate method and monetary/non-monetary (Temporal) method
- What is functional currency (currency of primary economic environment)

(b) Provide the income statement and balance sheet (including dividend impact) for Sunshine Spot Insurance for 2020, ignoring taxes, as it will appear in the parent's consolidated financial statements under:

(i) The current rate method.

(ii) The temporal method.

Commentary on Question:
Part b-i was done well though a fair number of candidates didn't get capital stock right. Part b-ii was difficult for candidates. Very few candidates correctly calculated translation gain/loss under temporal method.

See Excel attached

(c) Your manager wants to choose the current rate method to reduce volatility.

Critique your manager's suggestion.

Commentary on Question:
Candidates didn't score well. Several candidates argued current rate method created more volatility due to the use of current exchange rates, which received no mark. Partial credit was given to candidates stating that the choice of the translation methodology is dependent on the functional currency of the foreign entity rather than management discretion.

- Methodology is prescribed and should not be a matter for company discretion.
- External audiences need to know that methodology is consistent and transparent.
- There are better ways to reduce volatility than trying to define a method.

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 within any business enterprise.

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

Sources:

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

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

Dowd, Measuring Market Risk 2nd ed, Ch 13 Stress Testing

Dowd, Measuring Market Risk 2nd ed, Ch 15 Back Testing Market Risk Models

F-147-20: Modeling in Life Insurance - A Management Perspective, Chapter 11

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Identify two distinctive features that need to be considered in selecting a suitable stochastic process to model interest rates.

Commentary on Question:

Candidates are expected to touch on both stylized factors and term structure to receive full credits. Many candidates answered two of the stylized factors and received half credit.

The types of processes should ideally cover the following stylized factors:
Interest rates are random / stochastic
Interest rates should be non-negative
Interest rates are mean reverting

Additionally, the term structure has to be considered, as most fixed income instruments have payments that occur at regular intervals

8. Continued

(b) Identify two data quality issues indicated by the data summary report provided in Excel.

Commentary on Question:
In general, Candidates did well in this part of the question. Missing values is easy to identify in the ABT provided, irregular cardinality and outliers may not be that obvious. However, candidates are expected to look for these issues therefore should be able to at least discuss that there is a possibility of the data containing outliers and irregular cardinality.

Missing Values:
There are missing values in 3 of the features selected: Competitor rates average, Credited rate not considering GMIR and Remaining time to annuitization.
Out of these, the % of missing values in competitor rates average and remaining time to annuitization are reasonably low. Further investigations in to the distribution of values would be needed to understand whether there are underlying issues with the data in these fields, but the % of missing values do not appear to be a problem.
The % of missing values in credited rate (not considering GMIR) is high. However, the rule of thumb as a threshold for missing values to be problematic is 60%, and the % of missing values in this feature is less than 60%. Further analysis on the distribution of data and undertsanding the reason behind missing values would be needed before determining the usability of this data.

Irregular Cardinality:
Cardinality refers to the number of distinct values present for a feature. A data quality issue arises if the cardinality for a feature is ""irregular"". i.e. does not match what we would expect.
From the ABT, it appears that the cardinality for credited rate is very low. The cardinality of this feature is 67 when the market data (10yr UST rates and S&P Index) to which the credited rate is tied has a cardinality of 120. It may be due to the missing values. Further investigations in to the underlying data is required to confirm whether this would be potential problem and whether this feature would be usable.

Outliers:
Outliers are values that lie far away from the central tendency of a feature.
From the ABT, it appears that the Benefit Base feature may have outliers. The gap between the maximum and the third quartile is much higher than the gaps between the other quartiles. The data appears to be valid, as there are no invalid values as outliers (e.g.: negative values) that show up in the ABT. However further analysis of the underlying data would be required to identify the outliers and investigate the reasons for outliers.

8. Continued

(c) Describe two pros and two cons of using stress testing for this model.

Commentary on Question:
Candidates are expected to describe two pros and two cons in the list below to receive full credit. Most candidates received partial credits on this part.

Stress Testing:
Pros
- Since stress tests are usually unlikely, the data used to estimate VaR will not reveal much information about them. If the stress events are rare, they are likely to fall in the VaR tail region and VaR does not provide any information about the region beyond the value.
- Assumptions that help value non-linear positions in normal times might not be appropriate in stress situations, so a stress test could reveal more than a second-order approximation VaR.
- Stress tests are useful in identifying the consequences of volatility
- Can highlight dependence on correlation assumptions

Cons
- Not straightforward
- Dependent on chosen scenarios and hence on the judgment and experience of the people carrying out the test
- Difficulties in working through scenarios in a consistent and sensible way
- Can run into computational problems
- If risk tolerance is 90% VaR, then you need to make sure that your stress test is sufficient to move the more extreme tail results (likely, but not a given)

(d)

(i) Compare the two models based on backtesting results.

(ii) Recommend the best model to use. Justify your recommendation.

Commentary on Question:
Candidates did poorly on this past of the question. Partial credits were granted to candidates attempted to calculate p-value and use that to derive a conclusion instead of QPS.

(i) For the company model:

n = 1,000
p = (1-α) = 0.10
Expected number of losses = 100
x (number of exceedances) = 122
QPS = 0.2152

8. Continued

QPS with expected number of losses =0.1800

The model performs worse than a model that generates expected number of exceedances.

For the industry model:

n = 500
p = (1-α) = 0.10
Expected number of losses = 50
x (number of exceedances) = 54
QPS = 0.2128
QPS with expected number of losses =0.2000

(ii) The industry model performs worse than a model that generates expected number of exceedances but is still better than the company model as the QPS is less than the company model QPS. Therefore, it is recommended that the industry model be used.

(e) Summarize the key points that you should highlight to the Risk Committee to help them think more broadly about using model results to make decisions.

Commentary on Question:
Candidates did okay in the last part of the exam. Only partial points were granted for general acknowledgement of the risk of letting the model be the decision-maker. Additional points were granted if candidates related to qualitative considerations, assumptions, outcomes/objectives, completeness of the model.

Is the Decision What the Model Says? No.

-Indeed, there are good reasons to challenge the outputs of the model. Collective debates around the model inputs and outputs are absolutely a must, first at the technical level and then at the political decisional level. These discussions often lead to a decision which is different from a simple reading of the direct output of the model
-'Models' outputs do not always have the same weight in decision-making. Is the model capturing the right metrics at the right level of detail?

-In strategic decisions, such as whether or not to buy a Company or an insurance portfolio, a model's outputs feed the battery of quantitative indicators under review, which are looked at in conjunction with qualitative considerations:

8. Continued

-The assumptions used by the model should represent decision-makers' (Risk Committee) views on the future. Do they? Committee should discuss that.

- The models do one thing: they are telling a story, a simple story, understandable, with explicit shortcuts. The decision-maker's responsibility is then to pick the outcome they feels best fit what they are foreseeing vs. what the objectives are.