CFE FD Model Solutions
Spring 2025

1. **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.

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

Sources:

Implementing Enterprise Risk Management from Methods to Applications, Chapters 16 and 19

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Assess each of the following based on a risk-based performance management framework:

I. Darwin's goal is to improve its ability to better manage capital and return. CRS advises that three underlying themes are important to support this goal: capital productivity, capital protection, capital adequacy.

II. CRS argues that risk-adjusted return on capital (RAROC) addresses the trade-off between capital productivity and capital adequacy.

III. CRS indicates economic capital is typically calculated with a top-down approach.

Commentary on Question:

Part I: Risk based performance management supports the following three themes: Capital Productivity, Capital Efficiency, and Capital Adequacy. Capital productivity is how much return is achieved on risks. Capital adequacy is how much capital is needed to support risks. Capital efficiency is how much return was achieved on capital.

1. Continued

Part II: RAROC answers the question, "how much return was achieved on capital?" Using RAROC, performance is measured by capital efficiency, or to what degree management allocates capital to the highest risk-adjusted return opportunity. However, CRS is correct that capital productivity and capital adequacy are important components of risk-based performance management.

Part III: The calculation of an organization's economic capital is generally done bottom-up (not top-down): economic capital is calculated separately for each type of risk and then aggregated, taking into account the effects of diversification, to come up with the overall economic capital for the entire enterprise.

(b)

(i) Describe why the VA RAROC may not meet Gabriela's expectation.

(ii) Explain potential implications if Darwin uses the VA RAROC to evaluate the IUL product.

Commentary on Question:
Candidates generally did well on part (i) and recognized the differences in the products' respective risks. Candidates generally did not receive full credit for part (ii), mostly comparing the VA RAROC to the IUL RAROC, and not considering Darwin's cost of capital.

(i) Darwin's VA product has guaranteed lifetime income withdrawal benefits and guaranteed death benefits with extended guaranteed periods and unique funds that may be difficult to effectively hedge. This would increase the amount of economic capital Darwin needs to hold and therefore decrease the RAROC metric. Additionally, VA profits may currently be high due to market performance, but this current experience may not persist. A lower return will decrease the RAROC.

(ii) If the VA RAROC > Darwin's cost of capital: Darwin may be holding the new IUL product to too high of a standard. If the IUL RAROC < VA RAROC, but > Darwin's cost of capital, Darwin may dismiss the product even though it can add value.

If the VA RAROC < Darwin's cost of capital: Darwin may be setting too low of a standard. If the IUL RAROC > VA RAROC, but < Darwin's cost of capital, Darwin may sell a product that destroys value.

(c) Outline a response, using the RAROC metric, to three of Gabriela's questions regarding the IUL product in her email to Aaliyah. (Case Study section 6.7.1.)

1. Continued

Commentary on Question:
Candidates were who able to connect the RAROC metric to the concerns generally did well; however, many candidates did not reference the RAROC metric as directed and answered the question more broadly. Those candidates did not receive full credit.

In response to the CEO's second concern: Increasing the guarantees on the fixed account and increasing the cap for the indexed account would lead to a lower risk-adjusted return (numerator) and higher economic capital (denominator).

In response to the CEO's third concern: High yield bonds would lead to higher risk-adjusted return (numerator) and also to higher economic capital (denominator).

In response to the CEO's fifth concern: Pursuing a long liability duration would lead to a higher economic capital amount (denominator).

2. 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 drive decision making, behavior and performance evaluation.

(3b) Assess and recommend methods used to allocate costs and how these methods impact perceived performance.

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

Sources:

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

Zimmerman, Accounting for Decision Making and Control 10th Ed, Ch 5: Responsibility Accounting and Transfer Pricing

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

Zimmerman, Accounting for Decision Making and Control 10th Ed, Ch 9: Absorption Cost Systems

F-155-21: Product Costing In Service Organizations

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

Commentary on Question:

In general, most candidates understood the concepts well. Most candidates were able to score full mark or close to full mark.

Solution:

(a) Explain why a traditional cost structure to allocate overhead is not appropriate for Darwin.

Traditional cost methods, such as variable cost methods, aim to allocate expenses

With traditional cost methods, the resulting product costs may not reflect the resources used to produce them.
Darwin offers a broad array of competitive products with customization for specific distribution channels

2. Continued

Darwin offers a range of products, varying in complexity: traditional life, UL, variable annuities, group annuities, individual fixed annuities, etc.

Darwin distributes products through various channels: agents, banks, direct marketing channels
Arbitrary cost allocation does not accurately reflect the economics underlying the production function, particularly in organizations which produce a diverse range of products that vary in terms of their complexity and output.

ABC is most appropriate in complex and highly diversified organizations that have high support overheads and operate in highly competitive environments. These features characterize many life insurance companies.

(b).i Explain 2 considerations for Darwin in determining the granularity of its cost attribution.

The degree of cost attribution granularity is dependent upon the sophistication of accounting information required from the ABC system.

An ABC system at an overly detailed level will inhibit the efficiency and cost-effectiveness (add additional points for product differentiator vs. cost leader, and how Darwin's products fit into that framework)

Also consider: Cost and complexity of implementing ABC Impact on behavior

(b).ii Describe 2 activities which will be difficult for Darwin to allocate, given its business profile.

Corporate initiatives like hiring CRS to develop capital management system

Cryptocurrency and Fintech research

The life insurance company will have difficulties of allocating the cost of computer resources, such as actuarial modeling, data analysis, AI driven marketing research Home office expense
ABC system will not be able to trace some overheads, like corp fn and directors' expenses to particular products

The system will have difficulties of allocating restructure/reorganization cost to products

(b).iii Explain 2 benefits to Darwin of implementing an ABC system.

2. Continued

ABC can perform an important strategic planning role, in providing information for product mix and pricing decisions for Darwin

ABC can also inform Darwin management with information which enables them to better understand profitability of products such as the IVA product with wide ranging costs including hedging, funds management, etc.

ABC can identify non-value-add activities

(c).i See attached excel

(c).ii See attached excel

(c).iii See attached excel

3. Learning Objectives:

4. The candidate will understand the application methods and techniques to business problems for an organization.

Learning Outcomes:

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

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

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

Sources:

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

Nested Stochastic Modeling for Insurance Companies (excl Appendix)

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

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

F-139-19: How to Improve the Quality of Stress Tests through Backtesting (excl appendices)

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Explain the backtesting process Darwin Life would have taken to produce the table above.

Commentary on Question:

Candidates are expected to explain the backtesting process, some candidates only provided the definition of MAE and MED and was granted only partial marks. In general, most candidates did good in the part.

3. Continued

The analysis uses the MAE (mean absolute error) and the MED (mean error in direction) to quantify the size and direction of the gaps

- MAE measures the average absolute difference in the prediction of the model vs actual results
- MED (Mean error in direction) measures the direction and size of over (when MED is positive) or under-estimation (when MED is negative) of the predictions.

The first step in this analysis is to determine if the stress test scenarios were adequate, by substituting in the actual macro environment conditions in the models. If there is still MAE after using actual macro environment conditions,
(a) the difference in MAE between using the stress test scenarios and actual macro environment conditions quantifies the portion of the MAE from the insufficient adversity in the stress test scenarios.
(b) The difference in MAE and MED can also inform on underlying size and likely cause of errors when looking at different market periods.

With the use of actual macro-environment, the next step is to isolate the source of the errors in each of the liability and asset models. Determining the MAE from different periods with different market conditions (in this case, 3Q and 4Q 2023) will also help narrow in to the source of the errors.

(b) Interpret the MAE and MED results shown above.

Commentary on Question:
Main point in this question is that the macroeconomic prediction error can be eliminated in the back testing by using the actual (ex-post) values of macroeconomic variables. Candidates are expected to touch on the main point, and supplement with analysis on the MAE and MED results. Most candidates received partial marks in this part of the question.

The size of the MAEs and MEDs are large relative to Darwin Life's P/L for variable annuities (VA). MED is positive, indicating the models have been over-estimating the P/L. 4Q had larger MAE and MED than 3Q, which could be the result of the macro environment being farther from the stress test scenarios.

In the first step of the analysis where the stress test scenarios are replaced by the actual macro conditions environments, both MAE and MED came down significantly but did not eliminate the errors. This confirms that the scenarios in the stress tests were not sufficiently adverse and by a large extent, given that the remaining MAE is less than half after substitution of actual macro environment conditions. 4Q MAE and MED came down more significantly than 3Q MAE and MED, signifying that most of the errors are

3. Continued

coming from the stressed scenarios needing to go much farther in the tail, specifically on interest rates.

With the use of actual macro-environment, the next step is to isolate the source of the errors in the liability and asset models

- The MAE on liability model is insignificant, signifying adequacy.
- The MAE on the interest rate hedging performance is very high in 4Q, signifying inadequacy of hedging in the severe drop interest rate environment.

- The MAE for equity market risk hedging performance is high in 3Q and 4Q.
- Some of the MAE is likely due to high level of volatility in the equity market environment as seen in sharp drop in 3Q and sharp rise in 4Q

It is also likely that the hedging is not capturing the convexity in the tails of a variable annuity. Darwin Life's VA guarantees have generally been more modest than the industry, but Darwin is hedging a lot less than most of the industry as Darwin Life only hedges delta and 50% rho. With volatility high, this type of hedging is playing catchup with the very fast market movements seen in the macro- economic conditions, resulting in losses.

(c) Recommend two changes to the stress testing process. Justify your recommendation.

Commentary on Question:
Candidates are expected to answer on at least two changes below to receive full credits. Candidates did well in this section overall.

(a) The Risk models need to capture more of the fat or heavy tails, especially on the negative side. Normal distribution does not have enough skewness or kurtosis as is apparent from the Rosenblatt transformation which had a heavy presence in the lowest percentile of the uniform distribution.

(b) Stress test scenarios need to go further in the tail. As shown in the attribution of the MAE and MED, the scenario set is insufficient in capturing the stress of even recent events. Darwin could set up new stress test scenarios that include historical events of a fast moving market going through significant spikes/drops, much like the 2nd half of 2023.
Stress tests based on historical events should be of the same order of magnitude as the worst case in history. Stylized scenarios of rare events in the 1-2 standard deviation capturing market movement shifts and changes in prices could also be used to capture more extreme events.

3. Continued

(c) Stress test scenarios could also be more dynamic. As current conditions become more extreme for longer, these stress test scenarios should move towards more extreme conditions in both directions as corrections or ongoing conditions could occur. 3Q MAE was already large and signifying tail conditions. 4Q macro environment moved in the opposite and larger direction. And MED was indicating over-estimation of P/L. In 3Q, Darwin could have already been analyzing potential outcomes and for sources of model issues.
Note: Liability models do not need changing. The MAE after using actual macro-environment, was insignificant. So should not come up.

(d) Hedging strategies need to be re-visited and re-designed to offset more of the greeks. The second half of 2023 was one of increased volatility in the macro environment that Darwin could not keep up with in its hedging. The extreme movements in short time period of both interest rate and equity markets resulted in large MAEs and fairly large MEDs. The MAE on interest rate hedging is very high in 4Q, signifying inadequacy of protection from the sharp movement down in interest rates. The MAE on equity market risk hedging is high in both quarters, also signifying lack of protection from volatility in equity market movements (both up and down). In this type of macro-environment conditions, if Darwin had hedged more fully (i.e. some level of gamma, vega, cross-greeks, and much more of rho) as part of its hedging strategy, it could have mitigated much of the losses.

(f) Risk models and stress tests should be regularly validated thru backtesting to ensure that the forecasting models remain adequate given market conditions and consistent with assumptions and liability structures and asset strategies. Recent past years covered both calmer periods and periods of market shifts (even if not as extreme as the second half of 2023), allowing validation of the models through a broad range of environments. If Darwin Life had a more regular and more timely (e.g. annually vs 3 years) cadence of model validation and backtesting, Darwin could have recognized the need to adjust its models and hedging strategies earlier.

(d)

(i) Recommend three actions for Darwin to reduce the time and/or cost of performing nested stochastic calculations. Justify your recommendation.

(ii) Describe the tradeoff between runtime and accuracy from Darwin's perspective.

Commentary on Question:
Candidates are expected to recommend actions specific to Darwin to receive grading points. Very general answers that are not applicable to Darwin were not granted full points.

3. Continued

Candidates did well in part (i) of the question. For part (ii), most candidates realized that running more scenarios may increase accuracy at the cost of longer run time and vice versa. Very few candidates took a further step to analyze the tradeoff from Darwin's perspective. Most candidates received partial credits in the second part of this question.

(i) Optimal allocation of resources within inner loop - only perform inner loop if market drops more than 20%;
Optimal allocation of resources within inner loop - perform inner loops less frequently (like every 5 years);
Replace inner loops with approximations - preprocessed inner loops;
Replace inner loops with curve fitting techniques - polynomials or table lookups;
Reduce the number of cells on the liability extract in the inner loop (recluster or regroup) reduce the number of scenarios from 1000 to 100

(ii) **Reasons to prioritize accuracy:**

- Size of company - mid size so can afford to perform more calculations for accuracy
- Risk management is important to Darwin
- VA is a significant block with higher relative expected growth
- New VA products have much richer benefits by extending the guaranteed period and offering unique funds that have outperformed the market (presumably higher risk funds)
- The capital risk appetite will require some more accurate runs to determine if this is satisfied in future years.

Reasons to prioritize runtime:

- Technology resources have been devoted to new sales and not in force management.
- The additional reserve only comes into play in large market drops, so reduced runtime and less accuracy may be sufficient until market drops are extreme.

4. 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.

Sources:

Koller, Goedhart, and Wessels, Valuation: Measuring and Managing the Value of Companies, Seventh Edition, Ch 33: Target Capital Structure section only (p641-651)

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

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

Case study

Commentary on Question:

This question is designed to assess candidates' understanding of debt and equity financing, interest coverage, and reinsurance. Additionally, it evaluates their ability to analyze how debt influences interest coverage and why this is significant for a company's financial health.

Candidates are expected to apply insights from the provided readings to the companies featured in the case study.

Solution:

(a) Contrast the benefits of using equity vs. using debt in Darwin's financing of the acquisition.

Commentary on Question:

The question is to make candidates discuss the benefits from equity financing and debt financing. Reasonable explanations for both options will receive full points.

4. Continued

Solution:
Equity financing
- Provides managers with greater flexibility to navigate unexpected downturns and
- Allows the exploitation of unforeseen opportunities, such as acquisitions.

Debt financing (more debt)
- Offers higher efficiency through tax benefits and
- Strengthens management discipline over investment spending.

(b) Calculate the interest coverage ratio in 2023 for each of the following. Show your work.

(i) Darwin before the acquisition.

(ii) Darwin and Snappy combined, assuming no new debt.

(iii) Darwin and Snappy combined, assuming $100M of new debt using the expected cost of debt of Darwin's parent company, RPPC.

Commentary on Question:
The question is to have candidates compute the interest coverage ratio. In general, candidates did well for this question.

Solution:
(i) Darwin interest coverage (2023) = Darwin EBIT / Darwin interest expenses = $209,420 / $18,000 = 11.6344

(ii) Darwin and Snappy combined interest coverage, assuming no new debt (2023) = Darwin and Snappy combined EBIT / Darwin and Snappy combined interest expenses = ($209,430 + $3,781) / $18,000 = 11.8445

(iii) Darwin and Snappy combined interest coverage, assuming $100 million debt (2023) / Darwin and Snappy combined interest expenses with additional interest expenses from debt = ($209,430 + $3,781) / ($18,000 + 8% * $100,000,000 / 1,000) = 8.2000

(c) Explain why Darwin would care about the interest coverage ratio.

Commentary on Question:
Candidates should highlight that rating agencies and regulators are likely to pay close attention to the interest coverage ratio. Reasonable explanations will be acceptable.

4. Continued

Solution:
Changes in interest coverage ratio can impact the way regulators view the strength of the company. Credit rating could increase/decrease depending on these changes.

(d)

(i) Explain one general benefit of each reinsurance option.

(ii) Recommend if either reinsurance option is a good solution for the additional product risks Darwin would acquire from Snappy. Justify your recommendation.

Commentary on Question:
Candidates should explain the benefits from captive insurance and financial insurance, the determine what kind of reinsurance option is suitable for additional product risks.

Solution:

(i) Captive reinsurance can be utilized to support redundant reserves through more cost-effective capital sources and by reducing counterparty credit exposure, albeit at the cost of financial and operational leverage.

Financial reinsurance can influence the balance sheet, income statement, solvency margin ratio, and other financial metrics. If more debt is issued for a transaction, financial reinsurance might be employed to enhance the interest coverage ratio.

(ii) While neither option (captive nor financial reinsurance) may be ideal, traditional reinsurance emerges as the preferred alternative. For Darwin, the focus is not on capital or financial metrics but rather on managing product risk. Snappy's higher sales growth projections come with significant volatility, as evidenced by its failure to meet the initial risk appetite statement.

Traditional reinsurance can mitigate the volatility risk associated with IVAs and provide a safeguard against the product and insurance risks inherent in Darwin's existing life business as well as the recently acquired Snappy Term/WL business.

5. 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 the unusual or questionable accounting practices and analyze their impact on the quality of key financial metrics.

(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. 6 Financial Analysis Techniques

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

Robinson et al., International Financial Statement Analysis 4th Ed, Ch. 11 Financial Reporting Quality

Case Study

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a)

(i) Calculate Frenz's Inventory Turnover and Net Profit Margin. Show your work.

(ii) Assess the sustainability of Frenz's earnings using the metrics calculated in part (i).

Commentary on Question:

A number of candidates did not comment on the lower cost of sales and lower operating costs relative to sales, both of which were important contributors to the improved profitability.

5. Continued

(i)

Inventory Turnover

	2026	2025	2024	2023	2022	2021
Inventory	14,660	12,999	11,518	10,198	8,739	6,934
Cost of Sales	55,381	49,368	43,992	48,631	60,165	31,145
Ave. Inventory	13,830	12,259	10,858	9,469	7,837	
Turnover	4.0	4.0	4.1	5.1	7.7	

Net Profit Margin

	2026	2025	2024	2023	2022	2021
Net Income	130,668	111,321	94,319	71,488	42,092	62,741
Sales	626,696	568,306	515,482	461,802	412,632	378,654
Margin	20.9%	19.6%	18.3%	15.5%	10.2%	

(ii)

- The decreasing inventory turnover indicated that Frenz has become more efficient in managing inventory costs or has changed its inventory accounting method, resulting in a relatively lower cost of sales. It is projected that the inventory ratio will stabilize from 2024 and onward, reflecting continued improvement in inventory costs.
- The net profit margin continues to grow, driven by net income increasing at a faster rate than revenue. This trend can be attributed, in part, to lower inventory costs as mentioned above.
- Additionally, the lower operating costs relative to sales, as noted in the case study, contribute further to the increasing profit margin.

(b) Calculate the following financial items in each year given the revised projection in the table above:

I. Account Receivable

II. Total Assets

Show your work.

Commentary on Question:
Many candidates failed to calculate the correct tax rate based on Frenz Exhibit B Income Statement. Most didn't recognize that account receivable is a balance sheet item and needs to consider the accumulative impacts of the revised depreciation schedule. Very few candidates were able to calculate the revised account receivable and total assets.

5. Continued

See Excel. The model solution captures the financial impacts of account receivables and total assets. It is also acceptable for candidates to present the revised balances of these two items, as long as the adjustments are clearly stated and supported by relevant calculations.

(c)

(i) Explain the aggregate effect of the change to the depreciation schedule on each of the following financial statements:

I. Income statement

II. Cash flow statement

Justify your answer.

(ii) Describe two potential issues that impact Frenz's reporting quality.

Commentary on Question:
Candidates were expected to identify all impacted accounting items on income statement and balance sheet respectively including the quantified dollar impacts of the changes. Many candidates did not fully outline the scope of the adjustments or provide the expected quantitative analysis, resulting in lower scores.

(i) See Excel

(ii)
- Deferred tax assets should not be included in Account Receivable. If there are deferred tax assets, they should be presented separately on the balance sheet in accordance with IFRS disclosure requirements. Similarly, deferred tax liabilities should not be included in Accounts Payable. Any deferred tax liabilities must also be shown separately on the balance sheet to ensure compliance with IFRS standards.
- Long term investment term is vague. Accounting items related to goodwill or long-term depreciable assets should be clearly disclosed and classified appropriately to provide transparency and align with accounting standards.

(d) Recommend two important disclosure practices that Frenz should adopt to comply with IFRS disclosure standards. Justify your recommendation.

Commentary on Question:
Examples of acceptable disclosure responses are below. Justifications should be included.

5. Continued

- Any instances of non-compliance should be clearly disclosed.
- The measurement methods used should be clearly defined and explained.
- Explanations should be relevant and understandable to the intended users of the financial statements.
- All measurements should be reconciled with those presented in accordance with IFRS standards.

6. Learning Objectives:

4. The candidate will understand the application methods and techniques to business problems for an organization.

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, sections 1-5, 7 (excl appendices).
Dowd, Measuring Market Risk 2nd ed, Ch 15 Back Testing Market Risk Models.

Commentary on Question:

The goal of the question is to have the candidate take a common situation (i.e. repurposing and expanding an existing model) and demonstrate their understanding of model risks inherent in this process and how both more complex models and more simplified approaches should work, including simulation and proxy models.

To receive the full marks, the candidate is expected to identify how proxy models are useful for insurers in part (a). In part (b), the candidate should demonstrate an understanding of when and how to appropriately develop a proxy model in a particular situation. In part (c), *the candidate should apply their knowledge of how to perform a hypothesis test.*

Solution:

(a) Describe four common uses of proxy models for insurers.

Commentary on Question:
Most candidates were able to list two to three common uses of proxy models. Many did not differentiate scenario testing from stress testing and only received partial marks.

There are four common uses of proxy models:

1. Daily reporting (this is the use case the VA LTC example would fall in) - a proxy model is often used for frequent reporting for things like capital calculations, reserve estimation, or rider cost reporting, where it is unrealistic to execute the heavy model given the time constraint

6. Continued

2. Stress testing - Proxy models can be used to execute stress tests by changing one single component and assessing the impact on the combined result.

3. Setting limits or appetites - Given that risk appetites are commonly set at a component level (where management has more control over the assumption), proxy models can be used to help set component-specific risk appetites.

4. Scenario testing - Similar to stress testing, but scenario testing focuses on a combination of parameters being changed, likely at a less extreme level.

(b)

(i) Assess if a proxy model is appropriate for ABC to validate its pricing of the 1% rider fee. Justify your response.

(ii) Recommend an approach for each of the following aspects of developing a proxy model to estimate the rider fee. Justify your recommendation.

I. Type of proxy model.

II. Type of required accuracy.

III. Validating the quality of fit.

IV. Calibrating the model.

Commentary on Question:
Candidate performance on this part of the question was mixed. In part (i), an assessment of whether the proxy model is appropriate or not should be stated in order to receive marks. In part (ii), many candidates demonstrated poor understanding of certain model development aspects, especially for II and III.

(i) Yes, a proxy model is appropriate for ABC to use for a number of reasons:

1. The model is a computationally intensive "heavy model" so it is likely not feasible to run on a weekly basis. Therefore, use of a proxy model could achieve the desired efficiency goal.
2. The model will have assumptions / parameters that likely can be turned into a replicating polynomial approach, so it should be feasible to fit a proxy model.
3. Fair for candidates to discuss or question whether the results of such a stripped-down model will be accurate enough for this type of complex calculation.

6. Continued

(ii) The following is the general approach for developing a proxy model to replicate the VA LTC model:

1. Type of proxy model. For replicating a heavy model that involves future cash flows, a replicating polynomial model will likely be the best choice. In this case, the user will solve for the impact that specific parameters have on the outcome of the rider cost, such as mortality, lapse, and equity volatility.

2. Type of required accuracy. ABC must decide to calibrate the model on either distribution accuracy (i.e., accuracy across a complete distribution of scenarios), scenario accuracy (i.e., accuracy at specific scenarios such as the scenario closest to the average rider cost or the 99th percentile scenario), or component accuracy (i.e., accuracy is most important for a specific factor, such as LTC claim incidence). For estimating the daily rider cost, daily updates will tend towards the mean, and since this is not a capital calculation that is concerned with the tail, scenario accuracy of the mean scenario is most appropriate.

3. Quality of fit should ideally be assessed in at least three phases:
   First - a statistical test to assess whether the model is an appropriate representation of the observed data (e.g., Anderson-Darling or Chi-Squared).
   Second - an information criterion test, to see if the model can be reasonable simplified even further (e.g., Akaike Information Criterion).
   Third - a visual test such as a QQ plot to identify goodness of fit trends that are missed via a single metric.

4. Calibration takes place in two broad steps:
   Step 1 - Determine the overall formula structure and which elements to include. The goal of this step is to build an overall model capable of emulating the heavy model.
   Step 2 - Determine the coefficients that best fit each replicating polynomial. The goal of this step is to reproduce a specific data set of rider costs. For a replicating polynomial model, we can calibrate the model using a "least squares" approach and run a regression program to identify the optimal coefficients.

6. Continued

(c)

(i) Complete the summary table in Excel.

(ii) Conduct a one-sided hypothesis test for the model at a significance level of 5%.

(iii) Interpret the results of the one-sided hypothesis test in (ii).

Commentary on Question:
Most candidates were able to score many marks in part (i). A common mistake was not subtracting the data position from the total number of data (250) for VAR at 0.9, 0.95 and 0.99. For parts (ii) and (iii), very few candidates received full marks because hypothesis testing for both upper and lower limits are required.

See Excel.

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:

Koller, Goedhart, and Wessels, Valuation: Measuring and Managing the Value of Companies, Seventh Edition, Ch 22: Leases

Koller, Goedhart, and Wessels, Valuation: Measuring and Managing the Value of Companies, Seventh Edition, Ch 27: Cross-Border Valuation

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Describe two benefits of leasing a plane compared to purchasing a plane.

Commentary on Question:

Most candidates did well, many valid answers were accepted with justifications. Below are some examples.

There will not be a need for large upfront capital to purchase the plane so there is a lower need for further financing that shifts the capital structure of a company away from its target.

It allows for a short-term solution. For example SEA currently sees a need for an additional plane due to growing business needs. If this need disappears in the future, they can end the lease instead of selling the plane afterwards

(b) Describe how to calculate the value of SEA's lease in Euros (EUR) using each of the following:

(i) the spot-rate method

(ii) the forward-rate method

7. Continued

Commentary on Question:
To earn full credit on part (b), Candidates needed to be specific about which currency was projected, what currency CoC was being used to discount, and what exchange rate was used was being used to convert currencies. Full credit was given regardless of which currency the candidate described as being projected, as long as the CoC discounting and exchange rates described were consistent.

Spot Rate method:

- Project SEA's lease payments in Canadian dollars
- Discount the lease payment back to present time with SEA's Canadian WACC
- Convert the PV lease payments to Euros by multiplying by the spot exchange rate to get the value of lease in Euros.

Forward rate method:

- Project SEA's lease payments in Canadian dollars
- Convert the projected lease payments to Euros by using the forward exchange rates
- Discount the lease payment back to present time with RPPC's Euro WACC to get the value of lease in Euros

(c) An executive from RPPC suggests "We can hedge currency risk. However, since cash flows are uncertain, we must add a premium to cost of capital for foreign investment to mitigate the foreign currency risk of acquiring SEA."

Critique the executive's statement.

Commentary on Question:
Many candidates noted that currency risk can be hedged, but most did not note that adding a premium to the cost of capital is not a necessary approach.

- There is no need to add a premium on cost of capital due to currency risk.
- Price fluctuations tend to mitigate currency fluctuations because of purchasing power parity
- Currency risk is also largely diversifiable for companies and shareholders
- Any remaining risk from currency rate changes is best reflected in the cash flow projections for the investment

(d) Explain why the current method is a more appropriate approach in this case than the temporal method or the inflation-adjusted currency method.

7. Continued

Commentary on Question:
Most candidates noted that Canada is not in a hyperinflationary environment, making the temporal and inflation-adjusted methods less appropriate

- Canada is not in a hyperinflationary environment, thus the temporal method and the inflation-adjusted currency methods are less appropriate.
- Canada is experiencing moderate inflation, thus the current method is most appropriate