CFE FD Model Solutions
Spring 2021

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.

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

Sources:
Case Study;
Corporate Finance, Fourth Edition, Chapters 18, 22 and 27;
Hurdle Rates, Cost of Capital Structure: CFO Spotlight;
Damodaran on Valuation, Chapter 15;
Creating Value Through Best-In-Class Capital Allocation; International Financial Statement Analysis, Chapters. 7 and 16;
Handbook of Corporate Finance, Ch 10;
Cost and Benefit of Reinsurance; Securitization, Insurance, and Reinsurance; and Corporate Restructuring and Value Creation

Commentary on Question:
Parts of the question asked for recommendations. The best candidates gave a recommendation and justified their recommendation. Candidates making multiple recommendations did not receive full credit.

Solution:
(a)   Recommend a cost of capital rate to use for the pet and travel expansion project. Justify your recommendation.

   Commentary on Question:
   Below is an example of an acceptable answer. It is also acceptable to say that this project is unlike any other for Blue Ocean and use a competitor's cost of capital as long as that recommendation is justified.

1. Continued

I recommend using the WACC. It is equal to
WACC = (equity/[equity + debt]) * equity cost of capital + (debt/[equity + debt]) * debt cost of capital * (1 - tax rate)
WACC = (60%) * 14% + (40%) * 8% * (1 - 20%)
WACC = 10.96%

RPPC requires that "return on its economic capital must exceed the cost of the capital acquired to fund that risk. Blue Ocean's hurdle rate is 12%. We should use a cost of capital risk of the project.

Since Blue Ocean is part of RPPC, it is reasonable to assume that RPPC would provide the capital so we should use RPPC's WAAC.

(b) Explain four reasons that the cost of capital rate of Blue Ocean's competitors might be different than what you recommended in (a).

Commentary on Question:
The question asks for four reasons. The first four reasons were accepted. Additional answers were not accepted. Below are four examples of acceptable answers. There are other responses that may get full credit.

1) Competitors may have different balances of debt and equity that would likely result in different costs of capital
2) Financially distressed firms may have to use higher costs of capital because capital suppliers are wary
3) Smaller firms may have a higher cost of capital because they don't have ready access to capital
4) Foreign firms may have a different tax rate that affects the cost of capital

(c) Explain two non-financial factors that could have an impact on the cost of capital rate Blue Ocean ultimately uses for the expansion project.

Commentary on Question:
There are several acceptable responses, below are two of them.

1) Because of the potential for agency conflicts through management compensation, the firm's managers may have some impact on the ultimate cost of capital rate that is used
2) RPPC rules around risk appetite and payback period of no greater than 10 years will impact Blue Ocean's flexibility. All the steps Blue Ocean must go through with RPPC are lengthy and complicated. All this might have an impact on the type of capital deployed for the project and thus the cost of capital rate.

1. **Continued**

(d)   Recommend how Blue Ocean should finance its pet and travel expansion project. Justify your recommendation.

Commentary on Question:
This is one response that could get full credit. Other response can receive full credit as long as a recommendation and justification are given.

I recommend financing the expansion with long-term debt or bonds. The project is an expansion rather than a new market; therefore Blue Ocean needs some up-front funds for things like marketing but the majority of the capital need is to finance reserves. The cashflows from the expansion should be steady and predictable. That lines up well with using debt financing.

(e)

(i)   Explain how Blue Ocean can use reinsurance to mitigate agency conflict between policyholders and shareholders.

(ii)   Explain how Blue Ocean would view reinsurance if it were a mutual company.

(iii)   Evaluate the effectiveness of securitization compared to reinsurance for pet insurance and travel insurance.

(i)   The agency problem arises because policyholders are interested in the ultimate viability of the enterprise, but shareholders want a return on their investment. Money spent reducing policyholder risk could instead go to shareholders. Stockholders are the ultimate risk bearers or residual claimants if the business (expansion project) fails. Raising new capital for an insurance enterprise is costly because of the information asymmetries between firms and the capital markets. Reinsurance has fewer information problems. Reinsurance reduces insolvency risk by stabilizing loss experience, limiting liabilities and protecting against catastrophes. This would allow Blue Ocean to hold lower levels of capital and still have the same insolvency risk. Lower capital levels would improve returns to shareholders while not increasing the policyholder's risk.

(ii)   There is no agency conflict here as the policyholders are the shareholders. However, mutual ownership restricts access to capital markets so perhaps reinsurance would be a good alternative source of capital for the expansion.

1. Continued

    (iii)   Both securitization and reinsurance can assist as a source of capital for a new line of business. Reinsurance is efficient for diversifying relatively small, symmetrical, and statistically independent risks. Securitization is better for risks that are correlated and would need lots of capital to cover the variance. Pet and travel insurance are subject to a high number of relatively small and uncorrelated claims. Therefore, reinsurance is more effective for assisting in the growth of this business. Conversely, one could argue that pet and travel insurance are relatively new and niche products so deep reinsurance markets may not exist so securitization may be the only way to go if one had to use one of the two.

(f)   Critique the capital Blue Ocean is holding with respect to its minimum regulatory capital requirement.

RPPC has a stated desire to "maintain a strong capital position" among its companies, that exceeds minimum regulatory capital requirements. Blue Ocean's required capital is stated as 99% VaR - 95% Var (Case Study Section 5.4.3).

Both RPPC's and Blue Ocean's internal requirements are quite strong/high
Holding more capital than required increases the firm's safety margin
- May reduce borrowing costs
- Could be looked upon favorably by rating agencies/analysts and, in turn, customers
- Might be a requirement as part of some debt covenant
- Holding additional capital could also be viewed as inefficient
- Might induce management to underinvest in the type of projects they need to move the company forward
- Could reduce the attention given to risk measurement

Blue Ocean is holding more than the minimum regulatory requirement so it is not in violation of any laws

2. **Learning Objectives:**
    4.   The candidate will understand the application of quantitative methods with a risk management focus to business problems.

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

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

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

F-148-20: A Guide to Risk Measures, Capital Allocation & Related Decision Support Issues

Case Study

Commentary on Question:
Commentary listed underneath question component.

Solution:
(a)   Describe the four characteristics of a coherent risk measure.

    Commentary on Question:
    Candidates generally did well for this part and were able to list and describe the 4 characteristics of a coherent risk measure.

    The 4 characteristics of a coherent risk measure are:

    Sub-additivity: Risk(A+B) <= Risk(A) + Risk (B)
    Combining 2 portfolios should not create more risk

    Monotonicity: Risk(A) < = Risk(B) if A>B for any given period
    If a portfolio is always worth more than another portfolio, it cannot be riskier.

    Positive homogeneity: Risk(kA) = kRisk(A), for any constant k
    Scaling a portfolio by a constant will change the risk by the same proportion.

    Translation in variance: Risk(A+k) = Risk(A) + k, for any constant k
    Adding a risk free portfolio to an existing portfolio creates no change in risk.

2. **Continued**

(b)

    (i)   Determine the 5% VaR for the following portfolios.

             I. IULF – Fixed Rate Account
             II. IULV – Indexed Account
             III. IUL product consisting of both fixed and indexed accounts
             IV. Current UL portfolio

    (ii)   Assess the appropriateness of the selected measure to quantify the risk in the proposed product.

Commentary on Question:
Most candidates were able to list the 5% VaR and justify its appropriateness as a risk measure in this case.

    (i)

I. IULF – Fixed Rate Account	-18.32
II. IULV – Indexed Account	-27.44
III. IUL product consisting of both fixed and indexed accounts	-8.18
IV. Current UL portfolio	-10.20

    (ii)   5% VaR is not very appropriate to understand the impact of guarantees provided in the products. It focuses only on a single point of the distribution which ignores the tail after the point, therefore the information regarding the tail of the distribution is not captured. And it is not a coherent risk measure since it fails the sub-additivity condition.

(c)

    (i)   Calculate the economic capital allocation for each of the three portfolios using Shapley values to reflect the diversification benefit. Show your work.

    (ii)   Explain two advantages and two limitations of using Shapley values.

Commentary on Question:
Some candidates were able to list the 0.05 percentile capital requirement from the table but very few candidates completed the entire calculation correctly, partial credit was given for interim steps of the calculation.

2.   Continued

(i)

Capital Requirement: .05 percentile from table

IULF	18.32
IULV	27.44
UL	10.20
IULF + IULV	8.18
UL + IULV	7.45
UL + IULF	23.47
IULF + IULV + UL	16.66

	"2nd in" calculations			
IULF	(19.26)	(IULF + IULV) - IULV	13.27	(IULF + UL) - UL
IULV	(10.14)	(IULV + IULF) - IULF	(2.75)	(IULV + UL) - UL
UL	5.15	(UL + IULF) - IULF	(19.99)	(UL + IULV) - IULV

	Last in calculations	
IULF	9.21	(IULF + IULV + UL)-(IULV+UL)
IULV	(6.81)	(IULF + IULV + UL)-(IULF+UL)
UL	8.49	(IULF + IULV + UL)-(IULF+IULV)

	1st in	Average 2nd in	Last in	Average
IULF	18.32	(3.00)	9.21	8.18
IULV	27.44	(6.44)	(6.81)	4.73
UL	10.20	(7.42)	8.49	3.76
Total	**55.96**	**(16.86)**	**10.89**	**16.66**

(ii)

Advantages:

Sharpley values are a natural extension of more simple, easy to calculate, independent 1st in and marginal last in approaches. It overcomes limitations of these 2 approaches by balancing penalties on highly correlated portfolios and rewards on those that give rise to an overall diversification effect. Since the risk measure is coherent, the allocation method will be coherent.

Limitations:

The allocation method is computationally challenging. And if one portfolio was split into two sub-portfolios, the Shapely values for the 4 portfolios will be different.

2.   Continued

(d)   Critique the use of stochastic models for management decision making purposes regarding the IUL product launch.

Commentary on Question:
Most candidates received partial points for this question, but very rare full credits were given. Some candidates did not link the critiques of the model with the IUL product launch. Response must relate to the impact of the (stochastic) models on the decision making for the IUL launch. Other Case Study references to Darwin's IUL launch may be acceptable. Below are examples of acceptable answers.

It's difficult to decide today without referring to a model at some point. Many factors contribute to this - available information is increasing exponentially, clients expect more customized products and services, regulations are requesting new quantitative angles of analysis, the importance of speed and accuracy. Models are now part of the whole insurance value-chain from the marketing targeting process to the accounting and prudential disclosures. Decisions today are hardly made without referring at some point to (stochastic) models.

For the IUL product, it would be difficult to accomplish the following without the use of a stochastic model: assess the likelihood of meeting the aggressive 3-yr UL sales growth targets, highlight the risks in down scenarios that could breach the risk appetite, assess performance of IR floor for fixed account, assess performance of cap for indexed account, and assess hedge strategies.

Standardized models are less entity-specific and less relevant for an entity's decision-making process. Limited diversity of software products - ESG is offered by only a few firms. Challenging the model is also necessary to achieve a sound decision.

Management needs to understand how well the models reflect the IUL product features - 2 investment account choices, separate investment segments, caps and floors on returns, IUL product's interest rate risk given the long liability duration.

The decision is not necessarily what the model says. Decision-making often includes qualitative, political considerations; diverging views on certain parameters (probabilities of scenarios, assumptions, dynamic laws, and decision criteria used in the models). The different knowledge, experience and technical skills of the C-suite guarantee the quality of the decision, perhaps more than the precision of the model. Models enlighten a decision; the decision-maker's responsibility is to pick the outcome that best fits the forecast and objectives.

2.   Continued

Kaladin's decision should consider not only the model results, but also the company forecast and objectives. The probability of scenarios, dynamic laws, decision criteria, short cuts.

Limits to the realism of insurance stochastic models to duplicate the decision-making process include: all scenarios have the same probability, simulation of management and policyholder intertwined behaviors in extreme scenarios, and the complexity of the stochastic models (data quality, precision of behavior assumptions, quality of event generator, biases/mistakes)

The scenario set used for stochastic modelling of expected distributable earnings on the UL portfolio assumes that each scenario has the same probability ($1/n$, n being the total number of scenarios). The calibration of the ESG is therefore instrumental to the outputs of the model, and there are many different calibrations that could 'pass' the calibration targets test and be considered as fit for running the model. Smith should ensure that the calibration is acceptable for the most important features of the IUL product (breaches of cap and floor on investment returns, long term interest rate scenarios for IUL long liability duration) and assess the probabilities of the scenarios used. Assumptions should represent Darwin's views of the future. Any concerns should be summarized and reported to Kaladin.

In addition, Smith should review the impact of IUL dynamic policyholder behavior assumptions in extreme scenarios and opine whether these results make sense.

3. **Learning Objectives:**

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

Learning Outcomes:

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

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

Sources:

Managing Business Process Flows, Anupindi, R., Chopra, S. and Deshmukh, S., 3rd Edition, 2012
*   Chapter 1: Products, Processes and Performance
*   Chapter 2: Operations Strategy and Management

Enterprise Risk Management Models, Olsen and Wu, Chapter 1

Case study

Commentary on Question:
Candidates should
*   *Understand product space, functional strategies, and the process view (input-process-output) on product development process and how apply those concepts for insurance operations and*
*   *Understand supply chain risk management, set supply chain risk management process and identify internal and external supply chain risks*

Solution:
(a)

(i)   Identify the four dimensions of key product attributes.

(ii)   Describe an example for each dimension in (i) that Darwin should consider in its venture with Snappy.

Commentary on Question:
Answers for (ii) *cannot be generic and should be relevant to Darwin's situation and the key points. In addition, answers for* (ii) *below are more detailed to illustrate all possible answers*

3. Continued

(i) The four components of competitive product space (i.e., four dimensions of product attributes) are:
- Product Cost;
- Process Flow Time (or Product Response Time);
- Product Flexibility (or Product Variety); and
- Product Quality

(ii) Regarding product cost, customers will look for cheaper prices especially with more competitors coming into the market. Several issues Darwin should consider as follows:
- Darwin Life should work with Snappy Life develop underwriting standards for products to be sold through the internet (those can be accepted automatically and those need further review or be rejected). Darwin needs to realize the UW standard will be different from what they have traditionally been used for term life. Based on the UW standards, then assumptions for mortality and morbidity can be set.
- In addition, sales, lapse, expenses, and investment earned rates should be also determined based on the new product's feature, e.g., discussion of the effect of sales and lapse assumptions based on the sensitivity analysis provided in Exhibit C or investment discussion related to Darwin's thinking on expanding to more high yield bonds
- The cost of building the internet platform. How much Darwin can utilize Snappy's existing platform and experience?
- Darwin and Snappy are very different in capital position. Snappy RBC ratio is likely to drop significantly with increasing sales, while Darwin is at a stronger capital position. How to determine the new company's capital requirement is also a key assumption for cost. Balances among profitability target (including risk appetite and capital requirements), sales volume, and competitive premium scale of products and channel conflict should be considered in the product cost components.

Regarding process flow time (or product response time), customers will expect immediate decision and fast turn-around time. New product to market time will also likely need to be much shorter
- Darwin needs to consider the IT infrastructure efficiency and speed and the overall online process design to ensure a speedy customer experience. Possibly leverage Snappy's existing process with improvements.
- Darwin Life should have clear picture on the role and responsibility in ideal generation, product design, pricing, approval, underwriting, competitive analysis, and launch into the web and time needed to make products available to market.
- Darwin Life should also consider the process and timing of making Term, Whole Life, and Wealth Management products available.

3. **Continued**

Regarding process flexibility (or product variety), the range of products can be offered to customers with existing products in mind
- Can Darwin Life provide a variety of the product selection suitable for the consumers (including riders and benefits) using a certain algorithm that can be constructed by Snappy Life (with Darwin Life's review and input)?
- Will products available based on consumer's life cycle e.g., the variety of Term, Whole Life, and Wealth Management products?
- Should Darwin offer all types of products online given its product lineup?

Regarding product quality,
- Does product coverage meet customer expectation?
- Is price vs. service provided reasonable, comparing to both other online competitors and Darwin's own products distributed through agency?
- From customer service perspective, would Darwin be able to keep its current call center track record, or it needs to develop new service capacity
- Survey should be collected from the customers on suitability, ease of using the system, customer experience of the sale process, after sale, and on-going services.

(b)

(i) Identify three primary functions for most organizations.

(ii) Explain what DEF needs to consider as it develops a functional strategy for each function in (i).

(i) Three main functional strategies include: marketing, operations, and finance. [Note: *Sales and IT are other acceptable answers*.]

(ii) Marketing:
- Market research: Since DEF is new, it should conduct market research of the size and competition of the target market and branding (through hiring outside consultants or using Snappy Life opinions).
- Role and responsibility: DEF should discuss the role of marketing department. Should marketing department have considerable influence with the actuarial and pricing per Snappy Life current situation?

Operations:
- Design of process flow: DEF should design an internal driven process from underwriting, policy issue, admin, premium collection, policyholders service, claim adjudication, and payment of claim.

3. **Continued**

-   Channel conflict and value-added: DEF should consider any potential of the channel conflicts with Darwin and Snappy. The sale of Term and Whole Life can be through Insurtech easily. When it comes to Wealth Management, can Darwin Life current sale force play a role.
-   Data security: Even though, Snappy Life is expert in web sales, but its CFO is not sure if the company is sufficiently protected from cyber-risk. Darwin also has no technology infrastructure around the management of data privacy. This will be a major issue for DEF.

Finance:
-   Financial resources: DEF is to obtain financial resource to support the product, track product performance and report profitability and related capital requirements.
-   Funding impact: Darwin Life should consider what is the impact to its funding need, capital requirements, investment policies, etc.
-   Ownership structure and shareholder agreement: Snappy Life is in a weaker capital position, the agreement should be reached regarding DEF ownership, the financial well-being of DEF, performance standards (net income, risk adjusted return of capital), and capital required (RBC ratios) and risk management policies of the company. Darwin has its own set of explicit requirements on IRR requirement, capital requirement etc., Would DEF adopt Darwin's standard or a modified one?

(c)

(i) Identify the five elements of the process of transforming input into output for DEF.

(ii) Recommend how Darwin should apply the five elements in (i) to work with Snappy on product development. Justify your recommendation.

Commentary on Question:
Answers for (ii) *should be relevant to the case study and be justified for full credit.*

(i) The five elements of the process of transforming input into output for DEF include:
-   Input and Output (or Product Information Input and Product Launch and Feedback)
-   Flow Units (or Information Flow in each Activity)
-   Network of activities and buffers (or Milestone of the Activity)
-   Resources
-   Information   Structure

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3. Continued

(ii) Regarding input and output,
- It includes all tangible (documentation) and intangible (time) items.
- Darwin Life can apply its current procedure with modifications on how to have underwriting procedure, application form, product options, premiums scale and premium collection available in the web. Snappy Life can help from this aspect.
- Input items include product proposal, pricing assumptions, pricing model, profitability target, underwriting guideline, marketing intelligence, etc.
- Output items include final products available to the market, marketing materials, etc.

Regarding flow units,
- It includes the required production from each critical path. Darwin Life can use it current process with the modification per Snappy life input.
- Typical flow units from each critical path include, for example,
  • Product sponsored committee: Product approval documentation
  • Market intelligence team: Competitor information, product feature, premium scale
  • Product development team: Product features documents, product filing document, profitability, premium rates, web-page flow, product offer decision tree, etc.
  • Assumption and model committee: Approved pricing assumptions and pricing model version
  • Understanding team: Understanding questionnaire and rating algorithms
  • Product filing team: Product filing document and approved states
  • Web team: web design algorithms and flow charts
  • Admin team: Insurance policy, billing options, changes.

Regarding network of activities and buffers,
- It simply connects the unit flow described in the second element and determine its sequent
- It required Darwin and Snappy Life to work together to agree upon the process

Regarding resource,
- Darwin Life should consider the form of resources (initial investment, future capital and funding, shared service, independent staff, etc.) to put into the joint venture
- It includes manpower and capital

Regarding information structure,
- What information is needed and is available for whom in order to perform activities or make decisions. For example, customer information, market data, competitor experience, regulatory and technology relate information etc.

3. **Continued**

(d) Propose two examples each of appropriate financial, internal, and external measures for DEF. Justify your answers.

Commentary on Question:
Answers must be relevant to the case study for credit.

Financial measures include
- Absolute performance (e.g., revenue, costs, P&L, B/S, etc.) and IRR as required by Darwin;
- Performance relative to asset utilization (e.g., ROE, ROI, etc.), for example, IRR RAROC as required by Darwin; and
- Survival strength (Solvency ratio, liquidity, cash flow, etc.), for example, if the capital position will satisfy Darwin's requirement.

Internal measures include:
- Controllable indicators linked to external and financial measures;
- Sales quality (vs. expected) Snappy's system is biased towards accepting more risks, need to make sure the new company DEF doesn't have same issue;
- Policy acceptance ratio (vs. expected);
- Customer response (call center, on-line chat wait time, issue resolution, Darwin has good service now, a human can answer phone within 4 rings 95% of the time, they should strive to the same standard no matter what service platform will be);
- Customer ratio; and
- Legal compliance (data security is an issue for both Darwin and Snappy, they need to make sure they comply the minimum legal requirement plus other requirements for insurance products).

External measures include
- Customer expectation;
- Customer satisfaction (Per CS 8.3, new competitors are entering the market in the internet platform, cannot compete on price alone, so customer satisfaction is important);
- Competitive position;
- Product cost;
- Product variation;
- Product quality (coverage);
- Product services; and
- Actual vs. expected.

(e) Apply the supply chain risk management process to the risk of an IT breakdown within DEF.

3. **Continued**

The supply chain risk management process is similar with the general risk management process. It includes:
- Risk analysis and identification;
- Risk assessment and evaluation (or Risk examination);
- Selection of appropriate risk management strategy (or individualize most adequate option to manage risk);
- Implementation; and
- Risk monitoring /mitigation. working on adding content for IT breakdown and Pandemic specific answers

Management process on IT breakdown includes:
- Risk identification: Identify what systems can fail, what are the consequences (for example: data breaches cause loss of sensitive client and company information, platform failure so client can't access the website);
- Risk assessment and evaluation: Evaluate the probability of the risk even happening. Consider both Darwin and Snappy have inadequate data security, the probability will be higher than peers. Darwin and Snappy needs to calculate the cost of the loss (including reputational loss) and the cost of implementing better IT security;
- Selection of appropriate strategy: Darwin and Snappy needs to decide the significance of the risk and if they would spend money to mitigate the risks or accept of cost of incurring the risk. And if decide to mitigate, which strategy to go;
- Implementation: If decide to mitigate, implement appropriate hardware and software, establish appropriate process and protocol; and
- Risk monitoring: Establish process to perform ongoing monitoring of IT related failures and establish proper process and response plan.

4.   **Learning Objectives:**
1.   The candidate will understand how a company optimizes its corporate finance decisions based on its business objectives.

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

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

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

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

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

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

Jonathan Berk and Peter Demarzo, Corporate Finance, Fourth Edition, Ch 28: M&A (pages 962-978)

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

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

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

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

4. **Continued**

Commentary on Question:
This question test candidates on Section 1 – LOs 1a & 1d the cost of capital to use for some project and how to finance it. The candidates generally struggled in part c) and f). In parts a) and b), most candidates did generally well and were able to calculate the NPV for two alternatives of the expansion project; and made correction financial decision based on the NPV calculation.

In part c), many candidates struggled. This part tests the candidate's knowledge utilization from the learning objectives 4b and 4c. Most candidates only stated the simple statistics without stating concerns/comments about the accuracy of the model/graph/numbers. Quite a few candidates did not state enough observations with respect to the stochastic output. We expected multiple observations with respect to the stochastic output; and comments displaying some concern for the accuracy of the numbers/model/graph.

In part d) and e), the candidates generally did well except e) ii. Several candidates forgot the definition of the profitability index.

In part f), this is a summary of the summary results from prior parts. Most candidates forgot to evaluate the results of prior methodology; or they failed to discuss the limitation or concerns. Several candidates did not provide adequate support for their position in order to justify their recommendations.

Solution:
(a)

     (i)   Calculate the Net Present Value (NPV) for each of the two alternatives of the product expansion project. Show your work.

     (ii)   Recommend which alternative BJT should select based on your calculation in (i). Justify your recommendation.

     Commentary on Question:
     Recommendations should be justified for full credit.

     (i)
     Under the option to buy TNT.

         First need to calculate the WACC for the project

         r(WACC) = [equity/(equity + debt)] x r(equity = [debt/(equity + debt)] x r(debt) x (1 - tax rate)

         Since BJT is a member of RPPC, it makes sense to use RPPC's info for the WACC

4.   Continued

$$= 0.6 \times 14\% + 0.4 \times 8\% \times (1 - 20\%)$$

$$= 0.1096 \text{ or } 10.96\%$$

Value of the project is just future cashflows discounted at the WACC

Value = 10.0 / 10.96% = 91.24

NPV = value less the cost of buying TNT

NPV = 91.24 - 100 = -$8.76 million

Under the option to build its own plant.

We can use the same WACC for the project as calculated in part a)

Value of the project is just future cashflows discounted at the WACC

However, we need to account for the 2-year delay in getting the plant built and running
value = $1/(1+ 10.96\%)^2 * 12/10.96\%$

value = 88.93

NPV = value less the cost of building the plant

NPV = 88.93 - 85 = $3.93 million

(ii)
Generally, we should follow the course of action that leads to the highest NPV

There were a lot of simplifying assumptions that went into the NPV calculations that perhaps should be reviewed

The NPV for the project to buy TNT is negative
The NPV for the project to built their own plant is positive

So, with respect to these calculations BJT should build their own tire plant since that gives the best result

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4. **Continued**

(b)   Calculate the value of the option for BJT to reduce staff. Show your work.

Redoing our work from part a) ii, if BJT is successful 2/3 of the time it earns $15M but the other 1/3 it earns 0

Value if successful $= 15 / 10.96\% = 136.86$

Value if unsuccessful $= 0 / 10.96\% = 0$

Applying the probability of success, value $= 2/3$ x $136.86 + 1/3$ x $0 = 91.24$

NPV $= 91.24 - 100 = -\$8.76$ million   same answer as part a)

Now to account for the option from the labor union to cut staffing

Value if successful $= 15 / 10.96\% = 136.86$

Value if unsuccessful has cashflows of 0, (0 -6), 3, 3, 3, 3, …

$= 0(10.96)^{-1} + -6(1.1096)^{-2} + (3 / 0.1096)$ x $(1.1096)^{-2} = 17.36$

Applying the probability of success, value $= 2/3$ x $136.86 + 1/3$ x $17.36 = 97.03$

NPV $= 97.03 - 100 = -\$2.97$ million

The value of the "option" to reduce the scale of the project is the NPV (with option) - NPV (w/o option)

Option value $= -2.97 - -8.76 = \$5.79M$

So the option to scale back the plant has value but not enough to make the NPV of buying the TNT plant positive

(c)   Analyze the results of WC's stochastic model.

Commentary on Question:
Below are examples of acceptable answers.

The output covers a reasonable number of sample runs so we should be able to get a good read of the profitability

4. **Continued**

With 10,000 simulations, we can be pretty sure our results will not be impacted by random sampling error

From this output, we can also get a feel for the average profitability and the variability around that profitability

Average profitability is 0.27 million so that is good that it is positive, the variance in results looks small
The extreme percentiles tell us how bad/good things could be

The graph of results looks like they are somewhat normally distributed. The extremes (up and down) are tails.

Both the maximum loss and the maximum gain are about $3 million. BJT's maximum risk won't be devastating.

Those extremes can be viewed as a "stress test" quantifying how bad things could be for BJA
We can use the output to go back and analyze the scenarios that gave rise to the results. This would help to refine our understanding of the success factors for the expansion.
We can rerun the model to see what factors are most important and we could do sensitivity testing around those factors with this model.

Based on the graph of results, it appears that the model may have some errors. These should be reviewed.

Small discrepancies are often good warning signs of larger problems with a model

The median listed in the chart is a small positive (0.2432) but on the graph, it looks like the median is negative

Var(50) should equal the median but they have opposite signs

Also on the chart, the maximum value is listed as 2.9268 but the graph clearly has values at 4
There is a "flat spot" on the graph which may indicate that some correlation parameters are not working in the model

4.   Continued

(d)   Describe three shortfalls of using a stochastic model for decision making.

Commentary on Question:
Below are examples of acceptable answers. However, on the exam only the first three written by the candidate were accepted.

- Stochastic models are more difficult to use and explain than some other methods
- These models are computationally complex
- Not the best for modeling optionality and early exercise options
- Could require a lot of customization in order to simulate the problem at hand
- Modeled process will necessarily be discrete while the true process is continuous
- Have to be able to specify the nature of the dependence/correlation between variables without making the problem incalculable (increasing the dimensions too much)

(e)   Using your information from part (a)

(i)   Calculate the highest hurdle rate that would allow BJT to accept the expansion project under the alternative to buy TNT. Show your work.

(ii)   Calculate the profitability index value for BJT's expansion project under the alternative to build its own plant. Show your work.

(iii) Recommend which alternative Blue Jay Tire should select based on the above rules of thumb. Justify your recommendation.

Commentary on Question:
Candidates could receive full credit for other recommendations if that recommendation is supported by their calculations.

(i) Calculate the highest hurdle rate that would allow BJT to accept the expansion project under the option to buy TNT. Show your work.

Hurdle rate is just the discount rate where the NPV is zero
Solving for hurdle rate: value $= 100 = 10 / x$
Therefore $x = 10\%$

4. **Continued**

(ii) Calculate the profitability index value for BJT's expansion project under the alternative to build its own plant. Show your work.

Profitability Index = NPV / Initial Investment
From part a) the NPV = $3.93M
Profitability Index = 3.93 / 85 = 0.046

(iii) Recommend which alternative Blue Jay Tire should select based on the above rules of thumb. Justify your recommendation.

Hurdle rate just changes the discount rate until the NPV becomes zero; then use the hurdle rate to evaluate the project and its financing

Invest if the profitability index is > 0 or higher if you also have the option to delay the investment
Applying these rules-of-thumb validated what we knew by calculating the NPVs.

So, building their own tire plant still gives BJT the best outcome

(f) Recommend a course of action for BJT including your summary of results. Justify your recommendation.

We evaluated the BJT expansion plan under a few different methodologies. Each provided useful information for the ultimate decision.

The simplest method was a rule-of-thumb criteria which would support building our own plant
If BJT has (or can access within RPPC) significant cash, that would reduce its cost of funding the project perhaps making it more profitable

Evaluating cash flows from the options under a NPV method added more support for building our own plant

The NPV is based on a lot of assumptions perhaps it would look even better under more favorable assumptions

Options to delay are always valuable. You buy time to get more information. Similarly, the option to reduce scale if things didn't work out according to our initial assumptions was also valuable.

4. **Continued**

The stochastic simulation showed that if we built our own plant, break-even was highly likely and that the potential for a large loss was remote. Although, the stochastic simulation results also pointed out the need to refine our models and assumptions to be sure they are correct and that we understand what they are doing.

We also need to consider that financial projections may not drive the ultimate decision. Synergies either through cost reductions or increased revenues may be enough to offset the NPV deficiencies

This is a new area for BJT and may be the most effective way to acquire the expertise, even with negative financials.

I recommend that we continue to move forward with the expansion by building our own plant. Most of the metrics showed that this would be profitable and that the downside risks were neither catastrophic nor likely. BJT should continue to refine its assumptions and models as the project progresses.

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.

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

Sources:
Robinson et al., International Financial Statement Analysis, Ch. 16 Multinational Operations

Case Study

Commentary on Question:
This question required candidates perform a translation of foreign currency financial statements. Candidates were also asked to assess and recommend actions to mitigate the impact of foreign exchange volatility on consolidated financials.

Solution:
(a)   Explain four considerations relevant to Big Ben when determining its functional currency.

Commentary on Question:
Candidates generally did well on part a. To receive full credit, candidates had to include one of the factors noted in the text as having greater weight when determining the functional currently (see factor 1 below). Answers not shown below received full credit if mentioned in the text and relevant to Big Ben.

Factors relevant to Big Ben when determining its functional currency include:
1. The currency that mainly influences sales prices for goods and services for Big Ben. This could include the competitive forces or regulatory environment of the countries in which Big Ben provides its asset management, commercial banking, or investment banking services.
2. The currency Big Ben's employees are paid in, deposits are denominated in, or other business expenses are incurred in.
3. The currency of the country where the majority of Big Ben's operations take place, such as retail branch locations.
4. The currency used to accept payments and deposits from customers.

5. Continued

(b) Calculate Big Ben's 2019 foreign currency Cumulative Translation Adjustment that should be included on RPPC's 2019 financial statements, including AOCI and Retained Earnings. Show your work.

Commentary on Question:
Candidates struggled on part b. Partial credit was awarded where elements of the calculation were correct.

RPPC's functional and presentation currencies are the Euro, as they are a conglomerate headquartered in Europe. Big Ben's functional currency is likely the Pound (based on the considerations in part a). Thus, the current rate method should be used.

All items used to calculate Big Ben's net income in GBP are translated at the average exchange rate in 2019 (1.18 EUR per GBP). Big Ben's 2019 dividend (22 GBP) is translated at the exchange rate on the declaration date (1.13 EUR per GBP).

2019 net income: (-37) + change in AOCI (-23) is -60 * (1.18) = -71 EUR
2019 retained earnings: -71 - (22 * 1.13) = -96 EUR

Big Ben's 2019 assets and liabilities are translated to Euros at the 2019 year-end exchange rate. Big Ben's 2019 stockholder's equity balances are translated at historical exchange rates.
> Assets: 42,988 * (1.1) = 47,287 EUR
> Liabilities: 41,236 * (1.1) = 45,360 EUR
> Capital: 1,143 * (1.25) = 1,429 EUR

Total retained earnings including AOCI at EOY 2019 are 609 GBP (513 + 96), which includes the 2019 retained earnings. The 2019 retained earnings are equal to -82 GBP (net income + change in AOCI less dividend). The pre-2019 retained earnings are 691 GBP (609 EOY less -82 during 2019). The pre-2019 retained earnings are translated at 1.21 EUR per GBP.

pre-2019 Retained Earnings = 691 * (1.21) = 836 EUR
2019 Retained Earnings = -96 EUR (from above)
Total Retained Earnings = 740 EUR

Using the values above, the 2019 balance sheet translation adjustment is 242 EUR (47,287 - 45,360 - 1,429 - 740).

Note: there is no translation adjustment on the income statement with the current rate method.

5. **Continued**

(c)   Assess the directional impact of 2019 currency movements on the following if management were to determine that Big Ben's functional currency is EUR:

  (i)   Big Ben's translated assets

  (ii)   Big Ben's translated revenues

  (iii)   Big Ben's translated net income

  (iv)   Big Ben's income statement and/or balance sheet foreign currency translations

Show your work.

Commentary on Question:
Candidate performance was mixed on part c. Candidates were expected to provide the directional impact with explanation for each item. Many candidates received partial credit for providing the correct directional impact, but few candidates correctly supported their answers.

Big Ben and RPPC would have the same functional currency, so the temporal method should be used to translate Big Ben's financial statements into RPPC's consolidated statements.

Assets are translated at the current or historical exchange rate under the temporal method. Given that the Pound weakened versus the Euro in 2019, the translated assets would decrease in Euros.

All revenue is translated at the average exchange rate in 2019. The weakening Pound will result in lower translated revenue to Euros.

Big Ben has a net monetary liability exposure at EOY 2019. See below. Thus, the weaker Pound will result in a higher translated net income.

  Assets Translated at Current Rate = 39,076 = 42,988 – 3,407 – 28 – 234 – 243 (exclude Other Assets, Equity Method Investments, DTA, Goodwill/Intangibles)

  Liabilities Translated at Current Rate = 41,223 = 41,236 – 13 (exclude deferred tax liability)

The weakening Pound combined with the net monetary liability exposure will create a negative translation gain from Big Ben. There is no translation adjustment under the temporal method.

5. **Continued**

(d) Recommend three specific actions to decrease foreign exchange volatility on RPPC's financial statements assuming Big Ben's functional currency is EUR. Justify your recommendation.

Commentary on Question
Few candidates were able to provide three specific actions to decrease foreign exchange volatility. To receive full credit, the action must be connected to RPPC and/or Big Ben. Many candidates simply listed different currency hedging techniques (e.g. swaps, options, futures) without any explanation, which received minimal credit.

Big Ben and RPPC have the same functional currency (Euro), so the temporal translation method will be used.
- Big Ben could hedge their Fx volatility using futures. For example, a futures contract may allow them to exchange Pounds for Euros at a future date, so currency fluctuations have limited impact on consolidated net income.
- Under the temporal method, long-term debt is translated at current exchange rates, while equity is not. Thus, RPPC could issue debt at the holding company level and use it to repay long-term debt in Big Ben to reduce Fx volatility. Note that Big Ben has a net liability exposure based on part c, so they should look to increase cash/short term investments and/or decrease liabilities.
- Big Ben could incur a large enough volume of trading liabilities in Euros to net out its exposure to Pounds.

(e) Explain how investors can objectively compare RPPC's financial results to its competitors despite foreign exchange volatility.

Commentary on Question:
Most candidates did poorly on part e. Most commonly, candidates recommended comparing financial ratios, which still may be exposed to Fx volatility when the numerator and denominator come from financial statements subject to different translation methods and levels of Fx risk.

Investors could compare RPPC's financial results to its competitors by using the disclosures required under IFRS and GAAP to adjust net income or other financial metrics, so the impact of foreign exchange volatility and translation adjustments are included or excluded consistently across companies (often referred to as "clean surplus accounting").

6.   **Learning Objectives:**
5.   The candidate will understand advanced techniques to evaluate and manage non-hedgeable risks in financial and non-financial organizations.

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

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

Sources:
F-138-20: A Framework for Board Oversight of Enterprise Risk, CPA Canada

F-143-19: Managing Supply Chain Disruptions, sections 2-5

Olsen and Wu, Enterprise Risk Management Models, Ch. 4

Case Study

Commentary on Question:
Commentary listed underneath question component.

Solution:
(a)   Define supply chain disruption.

   Commentary on Question:
   Many candidates did well on this part by defining the basic concept, though many didn't mention of negative consequences/impacts or of causing confusion/disorder or any similar impact to get full credit.

   A supply chain disruption can be defined as any occurrence which has negative consequences for regular supply chain operations and hence, causes some degree of "confusion/disorder" with the Supply Chain.

(b)   Describe two disruptions that the global pandemic may cause to BJT's supply chain.

6. **Continued**

> **Commentary on Question**:
> *To get full credit the answers needed to be specific to BJT and classifying supply chain based on the type of disruptions by adopting the flow and process method, examining each of nodes/arcs. A supply chain likely encounters disruptions caused by change in quantity, lead time, quality and technology as illustrated below. Any two of these would be fine as the question required. Many candidates did well in this question with answer involving general reasoning, however, couldn't use the theoretical concept well as below.*

> (1) Quantity: Reduced finished goods due to reduction in raw material from Malaysia used to manufacture tires that were severely impacted by a global pandemic. Reduced workers in Tire factories (or possible factories closure) due to social distancing reduces production quantity.
> (2) Lead time: delay of raw material from Malaysia to production factories in Canada. Delay of finished products shipment to US from its factories in Canada due to limited capacity at Us-Canada customs.
> (3) Quality: any reasonable answer that contributes to Blue Jay Tire's product quality is also acceptable.
> (4) Technology: Ill-equipped Blue Jay Tire online store cannot support the increase in online orders. Online virtual assistance is also badly built.

(c)

    (i)   Recommend two risk management strategies that could help BJT mitigate future global pandemic supply chain disruptions. Justify your answer.

    (ii)   Evaluate the tradeoffs to the recommendations in (i) with respect to BJT's supply chain.

> **Commentary on Question**:
> *The answers below are a few possible risk management strategies, other well-reasoned answers were acceptable. Most of the candidates couldn't explain well, specifically part (ii) of the question.*

> (i) One lesson learned from global pandemic is the importance of burdening supplier choices, local or near-shore sourcing. Given the fact that "85% of the raw material is sourced from Malaysia", Blue Jay Tire's supply chain would turn vulnerable rather quickly during a global pandemic. Therefore, to mitigate supply chain risk, BJT should consider diversifying its supplier choices, may consider multiple geographic locations.
> Furthermore, BJT can also incorporate disruption related metrics in the evaluation of its suppliers to mitigate supplier related risks.
> BJT can automate tire manufacturing processes as much as possible to reduce labor costs, avoid manufacturing hazard to the workers and eliminate disruptions imposed by social distancing during a pandemic.

6. **Continued**

BJT can set up distribution channel so that the finished products are shipped only from the closest manufacturing plants and US-Canada border crossing is minimized. Therefore, delay on shipment would be minimized due to border closure during a pandemic.

A comprehensive global scenario planning should be conducted such that an organization such as BJT becomes connected to their complete supply network to promote end-to-end visibility, collaboration and optimization.

(ii) Automation - there are high upfront costs that would use capital that could otherwise be deployed for strategic initiatives such as expansion into non-road tires.

Distribution channel - there's a trade-off between reliability and robustness. While adding an additional plant will let BJT's distribution be more flexible, the added complexity increases the likelihood failure. BJT would need additional oversight and management of its supply chain if it adds new nodes.

(d) Describe two tools the BJT Board could use to oversee the operational risk from future global pandemic supply chain disruptions.

Commentary on Question:
The following are the required answers; however, other reasonable answers were accepted. However, most of the candidates couldn't get this section well, many digressing from what the question asked.

Capacity constraint analysis
The Board should analyze capacity limitations for any strategy it implements. If BJT chooses to produce tires in both Canada and the US, it needs to determine if the plants can produce the number of tires, it will be expected to produce. It should also identify risks to these production levels and implement plans to mitigate those risks.

Vendor and distribution dependencies
The Board should review critical dependencies and the risks with those. BJT sources its rubber mainly from a single source, so the Board could help review alternative sources of rubber in an effort to diversify its supply and manage the negotiations with the new suppliers.

7. **Learning Objectives:**
1.   The candidate will understand how a company optimizes its corporate finance decisions based on its business objectives.

3.   The candidate will understand how to apply and recommend appropriate ERM framework, principles and strategies to manage, evaluate, analyze and mitigate risk exposures faced by an entity and to ensure operational excellence in any industry.
4.   The candidate will understand the application of quantitative methods with a risk management focus to business problems.

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

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

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

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

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

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

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

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

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

Sources:
F-152-20: Demystifying the Risk Margin Theory Practice and Regulation, (exclude section 3)
Hubbard, How to Measure Anything, Ch 14
Olsen and Wu, Enterprise Risk Management Models, Ch. 5
Olsen and Wu, Enterprise Risk Management Models, Ch. 7

7. Continued

Dowd, Measuring Market Risk 2nd ed, Ch 9 Applications of Stochastic Risk Measurement
Dowd, Measuring Market Risk 2nd ed, Ch 13 Stress Testing Risk
Dowd, Measuring Market Risk 2nd ed, Ch 16 Model Risk
ASB, Proposed ASOP on Modeling, pages 1-10
Kelleher, Mac Namee, and D'Arcy, Fundamentals of Machine Learning for Predictive Analytics, Ch. 8 Evaluations
Case Study

Commentary on Question:
Commentary listed underneath question component.

Solution:
(a)

    (i)   Design a mathematical programming model to optimize Big Ben's allocation to each city.

    (ii)   Explain each component of (i).

    (i)
In this problem we need to optimize the cash flow from the project. The model can be defined as below
Max: $P1\%*f(1)+P2\%*f(2)+P3\%*f(3)$
Subject to: $P1>=20\%$, $P2>=20\%$, $P3>=20\%$, $P1+P2+P3=100\%$

    (ii)
In the model above, P1, P2, and P3 represent the % of allocation in each of the three cities; f(1), f(2) and f(3) represent the total cash amount received from each city.

Total cash amount received from each city = Sum of 20 years loan repayment + government subsidy.

Each year's loan repayment =Max(loan interest + principal due, proceeds from selling excess energy). If the proceeds from selling energy is higher than the interest and principal due, Big Ben receives the full interest + principal payment; otherwise they won't receive full interest + principal payment (just receive the proceeds from selling energy).

(b)   Recommend two additional metrics Big Ben can use to evaluate the Solar Energy Financing opportunity other than the total cash payments received and IRR. Justify your recommendation.

7.   Continued

There are several metrics that can be used to evaluate the financing opportunity. Two other metrics are as below:

1. Net Present Value (NPV): NPV is the most accurate and reliable method for allocating the firm's resources so as to maximize its value. In general, a company should not invest in projects with negative NPV.

2. Hurdle Rate: Hurdle rate is higher than Weighted Average Cost of Capital (WACC) taking into account risk premia and option to wait. Any project with positive NPV using the hurdle rate as the discount rate is worth investing in..

(c)   Analyst X suggests using the model that created deterministic results under Exhibit B and using the assumptions in Exhibit D to project the total cash payments received.

Critique Analyst X's suggestion on building the model.

1. Original model intended purpose: The original model is built to produce financial projections for the loan opportunity for a single location. It doesn't perform projections for multiple locations and calculate the maximum amount that Big Ben can get across all locations. To apply the model results to all 3 cities may not be appropriate. The existing model could be a base but it will need to be modified and improved for current purpose.

2. Assumptions of the original model: The data source for the results in Exhibit 8 could be from a region not even close to the 3 cities in discussion. Energy generation data and consumer consumption data or weather mix data may not be applicable to develop assumptions for this model.

3. Limitations of the model: It is unknown if we have any documentation for the limitations and simplifications done to the original model. We would need to understand first if there is any major limitation and simplification within the current model before it can be improved.

(d)   Recommend which two risk factors should be modelled stochastically. Justify your recommendation.

The risk factors which take random paths are most likely to be modeled stochastically. The two factors which should be modeled stochastically are:

1. Weather: Weather follows random path under normal circumstances.

2. Retail Sales of Energy: Retail sales of energy has a significant random component.

7.   **Continued**

(e)   Explain which risk factors listed in Case Study Section 6.4 may be hedgeable.

The hedgeable risk can be eliminated through trades into a deep liquid market.

For non-hedgeable risks a deep, liquid market does not exist. The risk factors that are hedgeable are

1. Weather: There exists capital market solutions for trading against weather. This risk is somewhat hedgeable.

2. Demand for Electricity: Demand for electricity is highly dependent on weather and we can structure capital market solutions to hedge this risk. This can have high residual or basis risk though.

(f)   Patel says: "These stress tests are excellent! Not only do they cover all identified risks, they illustrate the adverse direction and correct magnitude of impacts. Now we know the events we need to worry about!"

Critique Patel's statement regarding the stress test proposal and results.

Patel is suggesting to use stress test results as if these cover all possible adverse impacts. While the stress results provide great insights to the financial implication, there are several drawbacks of using these as comprehensive results.

1. The stress tests do not cover all identified risks. Big Ben has identified the following risks which are not included in the stress tests: weather, solar panel installation issues, and solar panel equipment failure.

2. Some of the proposed stress tests do not adversely impact the cash payment. An increase in the loan rate should increase (not decrease) Big Ben's cash payment. Similarly, a reduction in personal energy consumption results in a favorable event (more energy to sell), not an adverse event.

3. The magnitude of some impacts are clearly not correct. Stress testing is dependent on the chosen scenario and the judgement, skill, intuition, good sense, and experience of the people carrying out the tests. The negative events that we want to guard against can be hard to predict. Choosing the 'right' scenarios is an important but sometimes difficult task. It can also be very difficult even to identify the risk factors to look at.

4. The proposed stress tests are not the only events Big Ben needs to worry about with the solar financing opportunity. In addition, the stress tests ignore interdependency or correlation among the risk factors. Under tail events, the correlations are likely to increase in adverse manner.

7.   **Continued**

(g)
   (i)   Contrast the two models.

   (ii)   Interpret the results of the two models.

   (iii) Recommend which model Big Ben should pursue. Justify your recommendation.

   (i)
   The analysts are trying to build a predictive model here. From a predictive modeling perspective, Analyst Y used a hold-out test set and avoided the issue of peeking that is apparent in Analyst X's model. Analyst Y used 5 years of data as a training set to develop a machine learning algorithm and 2 years of data to test the prediction performance of the model. Analyst X did not use separate data to train and evaluate the data.

   (ii)
   Analyst X's model appears to perform very well with high R-squared and low mean squared error, but we know nothing about the predictive power of the model. In comparison, Analyst Y's model doesn't seem to perform well, but the model's purpose (predicting weather to estimate cash payment more accurately for the coming month) aligns with the original purpose.

   (iii)
   Since this is a predictive model, Analyst Y's model is the preferred model. She is following the approach of building the model and testing the model in two different datasets. In addition, Analyst Y's model performance (R-squared, MSE) is in acceptable range.

(h)   Explain which assumption or data source Big Ben should invest in for quality improvement.

   Based on the information provided by case study, the utility company's participation rate impacts the financial result greatly. So even a little information gain on utility company decision making can be very helpful. Big Ben should invest in quality improvement of utility participation data.

8. **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.

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

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

Robinson et al., International Financial Statement Analysis, Ch. 13 Income Taxes

Commentary on Question:
This question is asking the candidate to show their ability to analyze the interrelationships between the income statement, cash flow statement, and balance sheet. Most candidates have trouble analyzing the impact of tax accounting. Some candidates entirely omitted this question.

Solution:
(a)　Calculate 2021-2024 cash tax payable, deferred tax payable, and post-tax net income for each line of business if the business is ceded to the subsidiary in Happy Tax Island. Show your work.

Commentary on Question:
Most candidates were able to calculate cash tax payables or were rewarded partials marks for showing their work. However, many candidates had trouble calculating the deferred tax payable.

Change in Tax Reserve = Increase in reserves & S/A Transfers * 0.9

Taxable Income = EBIT + Increase in reserves & S/A Transfers – Interest – Tax

Cash Tax = Taxable Income * 30%

GAAP Tax = (EBIT – Interest) * 30%

Deferred Tax = GAAP Tax – Cash Tax

Post-Tax Net Income = EBIT – Interest – Cash Tax – Deferred Tax

8. **Continued**

Result: VA	2021	2022	2023	2024
Change in Tax reserves	584,325	726,660	934,200	1,318,050
Taxable income	94,925	116,440	153,450	221,350
Cash Tax	28,478	34,932	46,035	66,405
GAAP Tax	9,000	10,710	14,895	22,470
Deferred Tax	-19,478	-24,222	-31,140	-43,935
Post-Tax Net Income	21,000	24,990	34,755	52,430

Result: TL	2021	2022	2023	2024
Change in Tax reserves	46,170	52,470	58,320	64,170
Taxable income	43,030	43,230	43,780	44,830
Cash Tax	12,909	12,969	13,134	13,449
GAAP Tax	11,370	11,220	11,190	11,310
Deferred Tax	-1,539	-1,749	-1,944	-2,139
Post-Tax Net Income	26,530	26,180	26,110	26,390

Result: UL	2021	2022	2023	2024
Change in Tax reserves	137,043	164,340	192,969	221,796
Taxable income	55,047	55,370	52,591	51,784
Cash Tax	16,514	16,611	15,777	15,535
GAAP Tax	11,946	11,133	9,345	8,142
Deferred Tax	-4,568	-5,478	-6,432	-7,393
Post-Tax Net Income	27,874	25,977	21,805	18,998

Result: Term	2021	2022	2023	2024
Change in Tax reserves	10,800	11,880	13,140	13,590
Taxable income	33,300	36,120	38,160	37,710
Cash Tax	9,990	10,836	11,448	11,313
GAAP Tax	9,630	10,440	11,010	10,860
Deferred Tax	-360	-396	-438	-453
Post-Tax Net Income	22,470	24,360	25,690	25,340

Result: Others	2021	2022	2023	2024
Change in Tax reserves	-26,820	-8,010	-9,900	-18,360
Taxable income	48,620	61,610	48,600	39,185
Cash Tax	14,586	18,483	14,580	11,756
GAAP Tax	15,480	18,750	14,910	12,368
Deferred Tax	894	267	330	612
Post-Tax Net Income	36,120	43,750	34,790	28,858

8. Continued

(b)   Recommend which line of business to cede to the subsidiary in Happy Tax Island based on the results in (a). Justify your recommendation.

Commentary on Question:
Candidates did poorly on this question. Most candidate failed to realize that they should compare the cash tax calculated in part a) with the current tax payable for each line of business.

	VA	UL	TL	Term	Others
Current tax payable	10,500	13,900	13,300	11,200	24,400
New tax payable	28,478	16,514	12,909	9,990	14,586
Difference	**-17,978**	**-2,614**	**391**	**1,210**	**9,814**

Based on the above results, ceding the UL and VA block would increase Darwin's time zero tax payable. Since Darwin's preference is to reduce current tax payable, TL, Term, and other LOB are the business that would be preferential. Also, because Darwin only wants to cede one LOB, Darwin should choose the Others LOB to cede as it can result in the biggest savings.

(c)   Construct the 2021-2024 income statement for Darwin if all lines of business are ceded to the subsidiary in Happy Tax Island. (*3 points*) Construct the 2021-2024 income statement for Darwin if all lines of business are ceded to the subsidiary in Happy Tax Island.

Commentary on Question:
Candidates had trouble calculating the new earned rates but were still rewarded partial marks for using the correct formulas for EBIT, tax (30% tax rate) and net income.

8. Continued

Total	2021	2022	2023	2024
REVENUES				
Premium - First Year	1,077,880	1,289,710	1,594,260	2,090,450
Premium - Renewal	293,230	329,160	365,520	401,560
Total Premiums	1,371,110	1,618,870	1,959,780	2,492,010
Net Investment Income = Asset supporting Stat Reserves * New Earn Rate	671,020	693,521	722,742	768,487
Other income	61,150	73,190	85,850	103,940
Total Revenues	2,103,280	2,385,581	2,768,372	3,364,437
BENEFITS AND EXPENSES				
Claims	143,730	168,890	198,370	235,170
Surrender and other benefits	722,420	726,080	791,210	863,940
Increase in reserves & S/A Transfers	835,020	1,052,600	1,320,810	1,776,940
Total Benefits	1,701,170	1,947,570	2,310,390	2,876,050
Field Compensation	119,100	138,800	161,100	193,200
Change in DAC	-75,070	-87,090	-100,330	-120,350
Total Acquisition Costs	44,030	51,710	60,770	72,850
Total Administrative Expenses	84,090	91,700	99,740	107,750
Total Benefits and Expenses	1,829,290	2,090,980	2,470,900	3,056,650
EBIT = Total Revenue – Total Benefit and Expenses	273,990	294,601	297,472	307,787
Interest	18,000	18,000	18,000	7,375
Tax = (EBIT – Interest) * 30%	76,797	82,980	83,841	90,123
Net Income = EBIT – Interest - Tax	179,193	193,621	195,630	210,288
Statutory Reserves	12,299,000	13,160,200	14,280,300	15,856,500
Asset supporting Stat Reserves = Stat Res *105%	12,913,950	13,818,210	14,994,315	16,649,325
Current Investment Income	606,450	624,430	647,770	685,240
Current Earned Rate = Current Investment Income / Asset supporting Stat Reserves	4.70%	4.52%	4.32%	4.12%
New Earn Rate = Current Earned Rate + 50bps	5.20%	5.02%	4.82%	4.62%

(d)   Complete the summary Kaladin requested. Show your work.

Commentary on Question:
Candidates struggled with this part of the question.

8.   Continued

From part c)

2021 Change in Tax Reserve
= Increase in reserves & S/A Transfers * 0.9
= 835,020 * 0.9
= 751,518

2021 Taxable Income
= EBIT + Increase in reserves & S/A Transfers – Interest – Tax
= 273,990 + 835,020 - 751,518 - 18,000 = 339,492

2021 Cash Tax
= 2021 Taxable Income * 30%
= 101,848

	Net Change	Total cash tax	Comments
Current tax payable	67,000	67,000	
plus inpact due to Change in tax reserve	29,226	96,226	Change = 835,020 (Increase in reserves & S/A Transfers) * 10% * 35%
plus impact due to change in tax rate	-13,746	82,480	Change = 209,420 (EBIT pre-reinsurance)
plus impact due to change in asset base	0	82,480	
plus impact due to change in earned rate	19,371	101,851	Change = (671,020 (new investment income) - 606,450 (old investment income))*30%
Post-reinsurance tax payable	101,851	101,851	
Unexplained		3	Due to rounding in the case study

9. **Learning Objectives:**
5.   The candidate will understand advanced techniques to evaluate and manage non-hedgeable risks in financial and non-financial organizations.

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

Sources:
Hubbard, How to Measure Anything, Ch 9, 11, 13

Commentary on Question:
This question intended to test the application of statistical techniques to a practical business situation, to identify the risks with using these types of techniques in isolation. In general, students performed somewhat poorly on this question, missing the larger business context and instead focusing too much on the "math." Successful answers went beyond just defining the terms in the question to consider the practical implications of repeating the study from a cost and resources perspective.

Solution:
(a)   Assess whether or not the subscription led to increased sales at a 5% significance level.

Commentary on Question:
Students performed fairly well on this portion. Partial credit was awarded for students who set up the approach correctly, even if they ultimately reached the incorrect conclusion due to a calculation error.

Key values for the calculation:

	Sample Size	Average ($k)	Variance ($k)	Sample Var
Test Group	32	99.969	6.917	0.216
Control Group	97	98.947	5.227	0.054
Baseline	129	98.979	5.208	0.040

Sample Variance for each group = Variance / Average (e.g., 6.917 / 99.969)
Sample Variance = 0.216 + 0.054 = 0.270
Sample Standard Deviation = sqrt(0.270) = 0.520
Sales Difference = 99.969 – 98.947 = 1.022
p-value Calculation = Using the Normal Distribution function in Excel, NORM.DIST(0, 1.022, 0.520, 1) = 0.025

Given that the p-value of 0.025 is less than the significance level of 0.05, we conclude that the subscription led to increased sales.

9. Continued

(b) Your manager suggests doing another experiment the following year but with an increased sample size to reduce the uncertainty.

Critique your manager's suggestion.

Commentary on Question:
For this part, full-credit solutions focused on the amount of information that was already gained as part of the first study, as well as the practical business tradeoffs in performing another study, specifically with regards to the cost of another year of the study relative to the likely information gained.

Without any considerations for the cost of the program, the manager is correct that an increased sample size would reduce uncertainty. However, there are greatly diminishing returns to the confidence interval as it relates to sample size, so you'd need a much greater sample size to reduce uncertainty by only a small amount. Additionally, since you knew very little to begin with, even the small sample size provided a wealth of information about the increased productivity from the subscriptions.

Most importantly, performing another study will take an additional year, with another full year of cost, and the additional effort for data collection and analysis. This amount of time and effort is not justifiable for such a small-scale initiative, and the manager should either be comfortable making a decision with the information gained or should look for alternative approaches to gain more information besides reperforming the study.

(c) Evaluate the use of "statistical significance" in determining whether the subscription is a good investment.

Commentary on Question:
Many candidates merely defined "statistical significance," as opposed to evaluating the use of the metric. Full credit answers noted that even a result that is statistically significant can be a potentially neutral/bad business decision.

The measure of statistical significance itself is not really what the decision maker wanted to know in the first place. The manager is trying to answer a fundamentally straightforward question - does the subscription service impact sales enough to offset the cost of the licenses?

Whether a finding is statistically significant isn't the same as determining if uncertainty is less now than it was before the uncertainty reduction. More importantly, statistical significance is not about whether the measure was informative or economically justified.

9.   Continued

For a hypothesis test to be useful in a decision, we need more information than just the p-value. The subscriptions only improved sales by $1,022 per employee. With a cost of $1,000 per subscription, the return is too low compared to the cost (2.2% ROI), even though the improvement was "statistically significant." Given this, the statistical significance of the measure in insufficient on its own to make a business decision.

(d)   You are concerned about using only the experiment to decide whether or not to purchase the subscription for the rest of the sales team. You are looking for a simple rule-of-thumb for decision making. Your co-worker in the Mergers and Acquisitions (M&A) department suggests you use their investment boundary chart and compare it to the ROI of the investment.
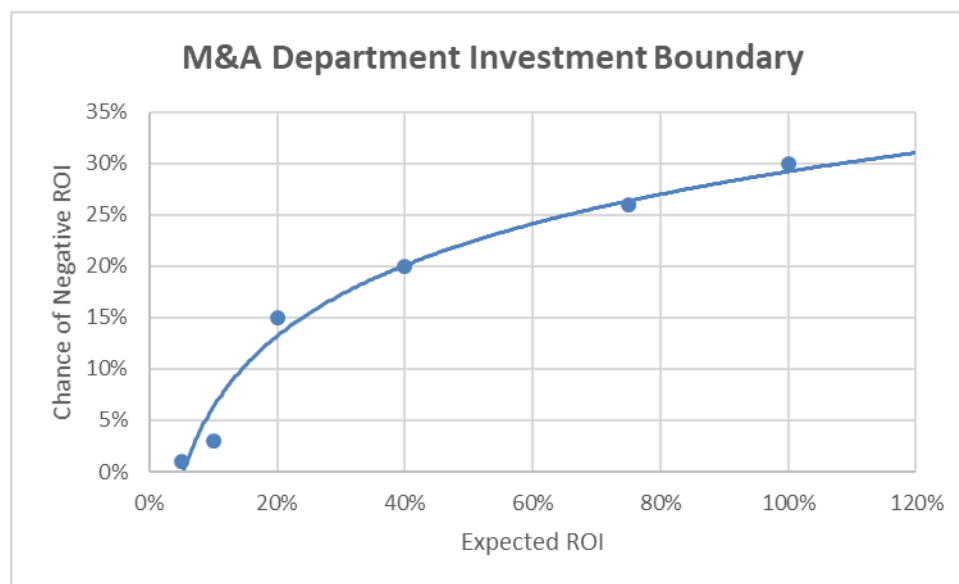
Critique your co-worker's suggestion.

Commentary on Question:
Students scored slightly higher on this and were generally able to articulate both the benefits and drawbacks of using both an investment boundary in general and this specific investment boundary. To receive full credit, students needed to identify both pros and cons of the approach in the context of the subscription service and the previously performed study.

Using an investment boundary is a good way to measure the trade-offs between risk and reward to determine whether an investment's upside is worth the likelihood of loss.

9.   Continued

ABC should be able to simulate the ROI of the subscriptions and compare the expected return to the probability of a negative ROI, using information gained from the previously conducted study. Using this graph, if it's at or below the boundary line, it's a good investment. If it's above, then it's a bad investment.

However, using this specific investment boundary without any modification may be an example of misapplying a model / approach. Companies should have different investment boundaries for investments of different sizes. The remaining investment for the subscriptions is $129k, while the cost of acquiring another company is likely much larger than that.

Using this investment boundary is not a good choice, as it doesn't reflect the size, risk, and return profile of the opportunity being evaluated. It would be better to create an investment boundary for smaller investments (potentially by adjusting the one above) or see if one already exists elsewhere at ABC.