

CFE FD Model Solutions

Fall 2015

1. Learning Objectives:

2. The candidate will understand how an enterprise's structure and policies allow its management to prioritize and select among projects or business activities that are competing for scarce capital resources.

Learning Outcomes:

- (2a) Evaluate how the legal form of an organization, corporate governance and/or compensation dynamics impact decision-making on projects or business activities.
- (2b) Explain how short term factors impact the capital (financing) needs.
- (2f) Assess the impact of behavioral factors in capital budgeting approaches and structure policies.

Sources:

F-126-15 Fan, Titman & Twite, An International Comparison of Capital Structure and Debt Maturity Choices

Jonathan Berk and Peter Demarzo, Corporate Finance, Third Edition, Ch 26: Working Capital

Commentary on Question:

This question tested candidates' understanding of institutional environmental factors impact on capital structures, working capital management, and short-term financial planning. Successful candidates could apply their understanding of institutional environmental factors to the case study and use the financial metrics to make a business decision.

Solution:

- (a) Describe three institutional environmental factors that might influence the capital structure of companies in Vietombia.

Commentary on Question:

Candidates did moderately well on this question. Many candidates were able to list and describe two of the three factors, and almost all candidates discussed level of corruption/legal system. Successful candidates related the factors back to companies that were highly leveraged and financed through short-term debt, as well as Vietombia's specific environment.

1. Continued

Some candidates attempted to list different aspects of corruption/legal system as unique factors, but credit was only given once for corruption.

- 1) **Level of corruption/Legal system:** Vietombia is an unstable country with a corrupt government and weak laws, so financial instruments that allow insiders less discretion and are contractually easier to interpret are likely to dominate. Therefore, Vietombia companies are influenced by the corruption and legal system to use short-term debt.
- 2) **Taxation system:** Specific treatment of interest and dividend payments can influence a firm's capital structure. Countries with a classical tax system (interest payments are tax-deductible) will use more debt. Vietombia could have a classical tax system, which is common in many Asian countries, influencing Vietombia companies to be highly leveraged.
- 3) **Preferences of capital suppliers:** Firms in countries with a larger banking sector use short term financing because banks tend to have short-term liabilities. The banking system in Vietombia is slowly modernizing and engaging mostly in domestic thrift activity, influencing the companies in Vietombia to use short-term debt.

(b)

- (i) Describe the costs and benefits of holding inventory.
- (ii) Describe the costs and benefits of holding cash.

Commentary on Question:

Candidates did very well on this question. Almost all candidates were able to describe the costs and benefits of holding inventory and cash. Successful candidates described two costs and two benefits of both inventory and cash.

- (i) **Costs of holding inventory:**
 - cost of inventory itself amortized over the period being analyzed (acquisition cost)
 - cost of storing the inventory (carrying cost)

Benefits of holding inventory:

- avoid stock-out situations, when a firm runs out of goods and loses sales
- firms hold inventory to match customer demand (e.g. seasonal demand) that might not line-up with the most efficient 'production' cycle

1. Continued

(ii) **Costs of holding cash:**

- opportunity cost of holding cash when it can be invested for a higher return
- holding excess cash has a tax disadvantage

Benefits of holding cash:

- meet day to day needs
- compensate for the uncertainty associated with its cash flow

- (c) Explain two reasons why Frenz might hold relatively less cash than companies based in Vietombia.

Commentary on Question:

Candidates did moderately well on this question. Successful candidates gave reasons related to Frenz's opportunities or enterprise structure. Some candidates discussed Vietombia environmental factors instead of Frenz, but no credit was given for these responses.

- 1) Risky firms tend to hold a relatively high percentage of assets as cash. Frenz is a stable company and would be considered less risky than companies based in Vietombia, a developing country, and therefore might hold less cash.
- 2) Firms with easy access to capital markets (for which the transaction costs of raising cash are lower) tend to hold less cash. Frenz, which is incorporated in Belgium, has greater access to capital markets compared to companies based in Vietombia (a developing nation), and therefore might hold less cash.

- (d)

- (i) Calculate Frenz's accounts receivable days using 2012 year-end data.
- (ii) Calculate Frenz's accounts payable days using 2012 year-end data.
- (iii) Assess whether Frenz should manage its account payables and account receivables differently if it expands into Vietombia.

Commentary on Question:

Candidates did moderately well on this question. Many candidates were able to calculate the account receivable/payable days, but few candidates were able to assess the results. Successful candidates recommended a decision based on the results and trade credit terms provided. Many candidates discussed the cash conversion cycle, but no credit was given.

1. Continued

- (i) Account receivable days = Account receivables / average daily sales

Account receivables from the case study = 60

Total revenue from the case study = 1,166

Average daily sales = total revenue / 365 = 1,166 / 365 = 3.195

Account receivable days = 60 / 3.195 = 18.8 days

- (ii) Account payable days = Account payables / average daily costs of goods sold

Account payables from the case study = 24

Cost of goods sold from the case study = 495

Average daily cost of goods sold = costs of goods sold / 365 = 495 / 365 = 1.356

Account payable days = 24 / 1.356 = 17.7 days

- (iii) **Account Payables:** Frenz should change its account payable management if it expands into Vietombia. Frenz' 2012 account payable days was 17.7 days and Vietombia companies use trade credit on terms 2/10, Net 30. This means Frenz would forego the 2% discount by paying after 10 days, which Frenz might not want to do. If Frenz decides to forego the discount, then Frenz should defer payment to near the end of the credit term (day 30), instead of making payments on average in the middle of the term.

Account receivables: Frenz does not have to change accounts receivable management when operating in Vietombia. Credit terms in Vietombia are 2/10, Net 30, Vietombian companies will likely want to take advantage of the 2% discount by paying by day 10 or waiting until day 30. I.e. the 18.8 A/R days might change, but as of right now Frenz does not have to change its management.

2. Learning Objectives:

3. The candidate will understand how and when to apply various stochastic techniques to situations which have uncertain financial outcomes.
4. The candidate should understand how and when to apply various advance techniques to evaluate risk or uncertainty in any business enterprise especially non-insurance organizations.

Learning Outcomes:

- (3b) Assess the appropriateness of a given stochastic simulation technique to quantify various market risk exposures.
- (3d) Assess the strengths and weaknesses of the calibration techniques for a given stochastic model.
- (3f) Explain the differences and implications of the use of P-measure and Q-measure for risk assessment.
- (4d) Explain how to quantify risk when there is limited data.

Sources:

Ferrara & Nezzamodini, Interest Rate Swap – Exposed

Jonathan Berk and Peter Demarzo, Corporate Finance, Third Edition, Ch 30 Risk Management

Commentary on Question:

This question tested candidates' understanding of hedging currency exchange risk along with the concept of arrow securities and risk neutral pricing.

Solution:

- (a)
 - (i) Describe a currency swap that BJT could execute to reduce this currency exchange risk.
 - (ii) Select the type of swap counterparty that would be most advantageous to BJT. Defend your selection.

Commentary on Question:

Candidates did well on this question. Successful candidates on part (i) were able to state the currencies involved, which side of the swap was the fixed leg, and explain how the swap helped BJT's exchange rate problems. Credit was given for alternate hedging vehicles, such as futures or forwards, if the derivatives solved BJT's exchange rate problems. Successful candidates on part (ii) listed reasons why the centralized counterparty (CCP) was the best option and related it to what BJT wants to accomplish.

2. Continued

(i) BJT wants to pay fixed dollars (Canadian/US) for its raw materials, since the end product sold to customers is priced in dollars. BJT should enter into a swap that lets them pay fixed dollars and receive Malaysian currency. This swap would reduce the currency exchange risk associated with purchasing raw materials in Malaysia.

(ii) The swap counterparty that would be most advantageous to BJT is a centralized counterparty (CCP). Advantages include:

- increases transparency of information: pricing, volume, counterparty exposure
- simplifies management of counterparty risk and collateral
- easily perform multilateral netting to diversify credit and market risk
- better pricing because more transparent and more competition from market makers

BJT wants to hedge its currency risk associated with purchasing materials in Malaysia at the best price without introducing significant swap counterparty risk.

(b)

(i) Calculate the price of protection that would pay BJT \$100 million if the cost of rubber is between 10% and 15% higher at the end of the year. Show your work.

(ii) Determine the risk neutral probability of the cost of rubber being more than 10% higher at the end of the year.

Commentary on Question:

Candidates did poorly on this question. Some candidates recognized the four states, but incorrectly applied the discount rate in part (i). No candidates explicitly discussed arrow securities being risk neutral probabilities, but a few did apply the concept correctly.

(i) There are four states of the world for the cost of rubber at the end of the year:

- State 1: raw material price is down 3% or more
- State 2: raw material price change is between -3% and 10%
- State 3: raw material price is up between 10% and 15%
- State 4: raw material price is up 15% or more

2. Continued

Arrow securities are risk neutral probabilities and the four states make-up the entire universe. The price of protection is the arrow security price multiplied by the amount of protection (\$100 million). The arrow security of each state is:

- A1: from the question \$6 million / \$100 million = \$0.06
- A2: 85% probability of being in state 2 = \$0.85
- A3: **unknown**
- A4: from the case study \$5 million / \$100 million = \$0.05

The sum of the arrow securities equal \$1.

Universe of arrow securities = \$1 = \$0.06 + \$0.85 + A3 + \$0.05

$A3 = \$1 - \$0.06 - \$0.85 - \$0.05 = \$0.04$

Price of protection if the cost of rubber is between 10% and 15% next year is $\$0.04 \times \$100 \text{ million} = \$4 \text{ million}$

- (ii) Arrow securities can be used to determine risk neutral probabilities. All states must add up to \$1. The arrow security price of protection for the cost of rubber being more than 10% is the sum of states A3 and A4:
 $A3 + A4 = \$0.04 + \$0.05 = \$0.09$ or as a probability 9%

However, this is the probability at time1, discounting back to time 0

$$9\% / (1 + 2\%) = 0.088 = 8.8\%$$

The risk neutral probability of the cost of rubber being more than 10% at the end of the year is 8.8%.

3. Learning Objectives:

2. The candidate will understand how an enterprise's structure and policies allow its management to prioritize and select among projects or business activities that are competing for scarce capital resources.

Learning Outcomes:

- (2d) Evaluate the capital efficiency of using reinsurance or securitizations for a given risk.
- (2e) Design a risk management plan to optimize the risk reward trade off of capital employed.

Sources:

F-113-14 Trainer & Cummins, Securitization, Insurance, and Reinsurance

Jonathan Berk and Peter Demarzo, Corporate Finance, Third Edition, Ch 30 Risk Management

Commentary on Question:

Candidates should have a solid grasp of the duration calculation, the use and limitation of duration matching techniques, as well as the use of swaps to manage the portfolio duration.

Solution:

- (a)
 - (i) Calculate Darwin's sensitivity to interest rates as of December 31, 2014, using duration.
 - (ii) Describe the impact of a 1% change in interest rates on Darwin's economic surplus, measured as the market value of assets minus the market value of liabilities, as of December 31, 2014.

Commentary on Question:

In general, most candidates were able to do the duration calculation; however, about half of the candidates used book value as opposed to market value in the duration calculation. Some candidates stopped at the asset duration calculation and only received partial credit. Full points were granted for part (ii) if the directional change (in percentage format or in dollar format) was consistent with the calculation in part (i).

3. Continued

- (i) Duration of Assets (DA): must determine MV of assets by applying MV/BV ratio:

Assets	BV	MV/BV	MV	Duration
Bonds	6,133,380,000	1.08	6,624,050,400	10
Mortgages	3,066,690,000	1.04	3,189,357,600	6
Cash	1,022,230,000	1.00	1,022,230,000	0
Total Assets	10,222,300,000		10,835,638,000	7.88

$$DA = (6,624,050,400 * 10 + 3,189,357,600 * 6 + 1,022,230,000 * 0) / 10,835,638,000 = 7.88 \text{ years}$$

Liabilities MV	Duration
10,000,000,000	8.0

$$\text{Surplus} = MVA - MVL = 10,835,638,000 - 10,000,000,000 = 835,638,000$$

$$\text{Duration of surplus} = 10,835,638 / 835,638 * 7.88 - 10,000,000 / 835,638 * 8.0 = 6.4 \text{ years}$$

- (ii) Based on the result, if interest rates rise by 1%, Darwin's surplus will DECREASE by 6.4%. Or if interest rates decrease by 1%, the surplus will INCREASE by 6.4%.
- (b) Determine whether the following techniques will be effective in reducing Darwin's exposure to interest rate risk. Support your answers.
- (i) Rebalancing its asset portfolio
 - (ii) Entering an interest rate swap
 - (iii) Entering an excess of loss reinsurance arrangement for its term insurance business

Commentary on Question:

To receive full credit for this part, candidates needed to relate their answers to duration management. Candidates did well on this part in general.

- (i) Yes
Reduce duration of assets by sell bond/mortgage and hold cash, etc.

3. Continued

- (ii) Yes
Use interest rate swaps to shorten asset duration. Enter into a swap that will increase in value when interest rises, hence receiving floating and pay fixed rate.
 - (iii) No
Term insurance exposure is not correlated with interest rates, so reinsurance payout will not be correlated with interest rates.
- (c) Evaluate the effectiveness of each technique in part (b) in protecting Darwin's economic surplus under this stress test.

Commentary on Question:

Most candidates received partial credit on this part but very few received full credit. Some candidates forgot to comment on the protection against credit spreads change and thus received partial credit. Candidates that only described how interest rate swaps work in general didn't receive credit for (ii) below.

(i) Asset rebalance Will NOT work

As interest rates change, the market values of the securities and cash flows change as well, which in turn alters the WEIGHTS used when computing the duration. Hence, maintaining a duration-neutral portfolio will require CONSTANT ADJUSTMENT as interest rate change.

A duration-neutral portfolio is only protected against interest rate changes that affect ALL YIELDS IDENTICALLY. It offers protection in the case of PARALLEL up or down movements in the yield curve.

If the assets have different credit risks, duration-based hedging will not protect against fluctuations in the relative CREDIT SPREADS of the assets. If the portfolio is rebalanced into all risk free cash flows, the portfolio would not be impacted by changing credit spreads.

(ii) Next year interest rates increase: the swap will increase in value and offset the reduction in surplus due to the rate increases.

The swap will not protect against changes in credit spreads.

(iii) Still not effective.

- (d) Design an interest rate hedge to immunize Darwin's economic surplus.

3. Continued

Commentary on Question:

Very few candidates were able to answer this question. Partial credit was given to candidates who provided the correct formula in calculating the amount to exchange.

$$\text{Amount to Exchange} = (\text{Change in Portfolio Duration} \times \text{Portfolio Value}) / (\text{Change in Asset Duration}) = (6.4 \times 835,638) / (6.5 - 0.5) = 891,347$$

The company should enter a 10-year swap with the notional amount of 891,347. Because Darwin needs to decrease its equity duration, it should pay fixed and receive floating interest rates, as this swap will increase in value if interest rate increases, to offset the decrease in surplus value due to interest rate increase.

The above answer assumes using a 6 month zero coupon bond. Candidates could instead use a one-year zero coupon bond, which will change the answer, but still receive full credit.

4. Learning Objectives:

2. The candidate will understand how an enterprise's structure and policies allow its management to prioritize and select among projects or business activities that are competing for scarce capital resources especially when opposing factors are key decision criteria.
4. The candidate will understand how to critique the appropriateness of advanced risk assessment methods for a given situation.

Learning Outcomes:

- (2b) Explain how short term factors impact the capital (financing) needs.
- (4c) Assess the efficacy of risk margins used by a business enterprise when examining its various risk exposures.

Sources:

Hubbard, How to Measure Anything, Ch 9

Commentary on Question:

This question was testing the candidates' ability to apply statistical concepts utilizing small amounts of observable data by applying a one-sided t-distribution to calculate sufficient capital needs.

Solution:

- (a)
 - (i) State which sampling method was used by Able Energy.
 - (ii) Contrast the effectiveness of Able Energy's method versus spot sampling.

Commentary on Question:

Some candidates said this was Cluster sampling, but this is incorrect because cluster sampling segregates a large group of data into smaller sub-groups before randomly selecting from these sub-groups. This could have been appropriate if the question had asked for ways to estimate number of rainy days in a year and the method could be appropriate by classifying certain days/weeks/months as "rainy, dry, etc." and then randomly selecting from that group.

Some candidates alluded to the "rule of 7" in part b, when asked to evaluate the two years' worth of data, and received partial credit for part a.

- (i) Population Proportion sampling.

4. Continued

- (ii) Population Proportion sampling measures a people, process, or things constantly throughout a period of time. Spot sampling takes random snapshots and would not be appropriate because if it's observed to not rain at a particular time or geographic location it could have rained at a separate time that day. In general, this is not a large enough sample size as it fails the test that: $p \cdot n > 7$ and $(1-p) \cdot n > 7$.
- (b)
 - (i) Calculate the standard deviation of the number of rainy days.
 - (ii) Estimate the maximum number of rainy days with 97.5% likelihood.
 - (iii) Evaluate whether this is an appropriate sample size to estimate likelihoods. Support your evaluation.

Commentary on Question:

Some candidates did not correctly calculate the standard deviation in part i by not recognizing the divisor should be $n-1$ instead of n . Another common mistake was to use the standard normal, rather than a t , distribution. For candidates that recognized a t -distribution was necessary, very few used the 95% with 1 degree of freedom which is appropriate for a 97.5% upper-bound test with two observations, since the values supplied in the Case Study were for a two-tail test.

- (i) The number of rainy days were 77 and 81. The sample variance is:
$$\frac{1}{n-1} * [(77 - 79)^2 + (81 - 79)^2] = 8$$

Taking the square root, the answer is 2.83.
 - (ii) This is equal to: $79 + 12.71 * 2.83 = 115$
 - (iii) This is not an appropriate sample size to estimate the number of rainy days for any particular year. However, the t -statistic can account for the wide variation of results and potentially provide some actionable information, even if more observations would ideally be available.
- (c) Demonstrate that the proposed amount is sufficient with 97.5% certainty for 2014-2018. Show your work

4. Continued

Commentary on Question:

*Most candidates were able to calculate the standard deviation, although some did not use $n-1$ as the denominator. A few candidates tried to calculate the standard deviation by manually summing the $(x-\text{mean})^2$ over the 10 years, not recognizing the data was provided at the beginning of the question. Better candidates attempted to calculate the amount of revenue lost and received partial credit, even if they could not complete the entire calculation. A common mistake was using ~ 100 as the number of days to protect against, rather than the **excess** days over the expected number with 97.5% confidence.*

The sample variance for the 11 years' of data is calculated as:

$$\frac{1}{n-1} \sum (x - \mu)^2 = 60.76$$

Taking the square root, this is 7.8.

Now, the standard deviation needs to be multiplied by a t-statistic with 10 degrees of freedom for a 95% confidence level, since the values supplied in the Case Study were for a two-tail distribution. This is:

$$2.23 * 7.8 = 17.4 \text{ days.}$$

The expected yearly lost revenue is $\$0.20 * \# \text{ of Homes} * \text{KwH generated per home}$. Per day, this is divided by 365. To calculate whether 10% of target capital is sufficient, the daily lost revenue * 17.4 days needs to be less than 10% of target capital.

For 2014, this is equal to: $(17.4 / 365) * (\$0.20 * 1200 \text{ homes} * 9000 \text{ KwH}) = \sim \$102,970$. 10% of target capital for 2014 would be $\$216,000$ so this is sufficient.

Repeat this calculation for subsequent years using the pro-forma number of homes and KwH generated per home.

- (d) Identify four reasons why a publicly traded company might be reluctant to pay out excess capital.

Commentary on Question:

Candidates overall did very well on this question. There were a number of other answers not included below which received full credit.

4. Continued

There are a number of reasons companies may not want to pay out dividends:

- Companies do not want to commit to dividends they cannot maintain
- Holding the capital can reduce liquidity distress or to target higher ratings
- There could be tax disadvantages
- A better use could be a share buyback to increase the market value of shares
- Best interest to grow the firm over the long term via investing in positive NPV projects rather than releasing

5. Learning Objectives:

4. The candidate should understand how and when to apply various advance techniques to evaluate risk or uncertainty in any business enterprise especially non-insurance organizations.

Learning Outcomes:

- (4d) Explain how to quantify risk when there is limited data.
- (4f) Quantify the probability of risks taken in a given business or project, their outcome as losses/gains, and their potential impact on Employed Capital.

Sources:

Hubbard, How to Measure Anything, Ch 4

Hubbard, How to Measure Anything, Ch 7

Commentary on Question:

This question tested the application of the requirements for a decision and value of information under the given scenarios.

Solution:

- (a) Explain why Empryss may not be able to make an effective decision pertaining to each of the three statements.

Commentary on Question:

For this analysis part, most candidates were not successful at analyzing and applying the requirements for a decision to the three situations described. Only a few candidates recognized the key factors missing from the situations for effective decision making. For I and II, in order to receive full credit, the candidates needed to note that measuring the question being asked actually destroys value, because it is an excess cost.

I. Under Applied Information Economics, for an object to be worth measuring, there must be a negative risk of making an incorrect decision. The weakness with this statement is that there is no downside risk to make one decision versus the other. Any resources spent on measuring the impact would just be an excess cost destroying value, as both choices create the same result.

II. The weakness with this statement is that the decision-maker is asking for the value of something that is not a realistic alternative to do without. Human Resources and Payroll are required for any company, so measuring the "value" of HR is an unnecessary exercise. Any resources spent on the measurement are just an excess cost.

5. Continued

III. The weakness with this statement is that the modeling and research/measuring has begun before the possible decisions/outcomes have been considered. Under AIE, the decision that would be affected must be defined, including at what point the decision would change, to help focus the measurement effort.

- (b) Determine the Expected Value of Information of performing the field study.

Commentary on Question:

For this knowledge utilization part, very few candidates were able to properly set up and carry the calculation through to the end to obtain close to full credit. Most candidates got partial marks for calculating the expected impact to PV for each project, but were not able to properly select the projects with and without the field study, and thus were not able to measure the value of information. A common mistake was to calculate the differences between the impact to PV with and without the field study respectively for each project, and use those as the value of information. Another common mistake was to only use the expected value of failure in the calculation of value of information. Also, when subtracting the actual gain/loss without the field study to get the value of information, one needed to use the "true" (after the field study) probability for projects A & D.

Project A:

$$\begin{aligned} \text{- Current Assumptions} &= (20\% * -10,000,000) + (80\% * 7,500,000) - \\ & \quad 2,000,000 = \$2,000,000 \\ \text{- True Assumptions} &= (35\% * -10,000,000) + (65\% * 7,500,000) - \\ & \quad 2,000,000 = -\$625,000 \end{aligned}$$

Project B:

$$\begin{aligned} \text{- Current Assumptions} &= (10\% * -750,000) + (90\% * 1,200,000) - 500,000 = \\ & \quad \$505,000 \\ \text{- True Assumptions} &= (40\% * -750,000) + (60\% * 1,200,000) - 500,000 = \\ & \quad -\$80,000 \end{aligned}$$

Project C:

$$\begin{aligned} \text{- Current Assumptions} &= (40\% * -2,000,000) + (60\% * 4,000,000) - \\ & \quad 2,500,000 = -\$900,000 \\ \text{- True Assumptions} &= (10\% * -2,000,000) + (90\% * 4,000,000) - \\ & \quad 2,500,000 = \$900,000 \end{aligned}$$

Project D:

$$\begin{aligned} \text{- Current Assumptions} &= (13\% * -9,000,000) + (87\% * 3,000,000) - 750,000 \\ & \quad = \$690,000 \\ \text{- True Assumptions} &= (27\% * -9,000,000) + (73\% * 3,000,000) - 750,000 \\ & \quad = -\$990,000 \end{aligned}$$

Project E:

$$\begin{aligned} \text{- Current Assumptions} &= (20\% * -4,350,000) + (80\% * 2,000,000) - \\ & \quad 1,500,000 = -\$770,000 \end{aligned}$$

5. Continued

$$\begin{aligned} \text{- True Assumptions} &= (40\% * -4,350,000) + (60\% * 2,000,000) - \\ &1,500,000 = -\$2,040,000 \end{aligned}$$

Empryss would select Projects A and D without doing the field study, since this combination has the largest expected value created ($\$2\text{M} + 0.69\text{M} = \2.69M), and the projects cost $\$2\text{M} + \$0.75\text{M} < \$3\text{M}$.

Project C will be selected with field study, since it has the largest actual value created ($\$0.9\text{M}$), and the project and field study cost $\$2.5\text{M} + \$0.5\text{M} = \$3\text{M}$.

Expected Value of Information is the difference in the Gain/Loss with and without the Field Study:

$$\begin{aligned} [\text{Actual Gain Loss with Field Study}] &= \$900,000 - \$500,000 = \$400,000 \\ &(\text{since project C is selected and the field study costs } \$500,000) \end{aligned}$$

$$\begin{aligned} [\text{Actual Gain Loss without Field Study}] &= (-\$625,000) + (-\$990,000) = - \\ &\$1,615,000 \\ &(\text{since projects A and D are selected}) \end{aligned}$$

$$\text{Expected Value of Information} = \$400,000 - (-\$1,615,000) = \$2,015,000$$

6. Learning Objectives:

1. The candidate will understand how a business funds its activities with considerations for its business model, and the cost and constraints of the sources of capital.

Learning Outcomes:

- (1a) Identify and critique the available sources of funding to start or grow a business entity. Describe the steps to procuring capital funding (treasury function).

Sources:

F-123-15 Graham & Harvey (Duke University), How Do CFOs Make Capital Budgeting and Capital Structure Decisions?

F-129-15 Villamil (University of Illinois), The Modigliani-Miller Theorem

Jonathan Berk and Peter Demarzo, Corporate Finance, Third Edition, Ch 23: Raising Equity

Jonathan Berk and Peter Demarzo, Corporate Finance, Third Edition, Ch 24: Debt Financing

Commentary on Question:

This question tested candidates understanding of the costs and benefits of raising capital through debt or equity, and their ability to apply the concepts to a real-world scenario.

Solution:

- (a) Calculate the post-money valuation of Olive after selling shares to Angel Investors.

Commentary on Question:

This comprehension part tests the concept of post-money valuation. Candidates did moderately well on this part. The common error was failure to apply the \$2 share price to 10 million Series A shares.

Post-firm valuation is the value of the whole firm (existing plus new shares) at the funding round price.

Total shares outstanding = 10million + 5million = 15million.

Post-money value of the firm = 15million shares * \$2/share = \$30 million.

- (b) Calculate the post-money valuation of Olive after the Series C IPO.

6. Continued

Commentary on Question:

This comprehension part tests the understanding of auction IPOs and post-money valuation. Most candidates were able to accumulate the number of shares bid from highest offering price to derive the final offer price. A few candidates erroneously used \$3.75 as offer price.

At price \$4.00, the company has received bids for a total of 6.25 million shares, which exceeds the offering of 5 million shares. Hence, the final offer price is \$4.00 per share.

Total shares outstanding: original 15million + 5million = 20million.

Post-money value of the firm = 20 million shares * \$4/share = \$80 million.

(c)

- (i) Critique Magenta's suggestion.
- (ii) Critique your CFO's statement.

Commentary on Question:

In general, candidates disagree with the two statements. However, very few candidates provided a complete critique on this analysis part.

For part (i), in order to receive full credit, candidates needed to accurately explain the negative market reaction and to relate it to Olive's situation. Most candidates were able to identify the negative market reaction, but very few candidates could describe the linkage to Olive.

For part (ii), candidates needed to explain that the CFO is citing the MM proposition and why MM proposition do not hold in the real world. Most candidates recognized that the CFO is citing the MM proposition, but some did not fully describe why it does not hold in the real world.

- (i) Magenta's suggestion is not valid. Market often reacts negatively to an equity offering based on the premise that managers avoid issuing equity when the company is undervalued in order to protect the existing shareholders. Thus, investors rationally interpret management decisions to raise equity as a sign that the firm is over-valued. This negative market reaction imposes information cost to the existing shareholders as the earnings per share is diluted.

6. Continued

For smaller and start-up firms like Olive, this information cost is large particularly, as investors are greatly uncertain about the prospects and the intention of the management. Hence, the decision of issuing equity could eventually cause a dilution of shareholder equity and be very costly.

- (ii) The CFO was citing the MM proposition concerning the invariance of the firm value to its capital structure. This is only valid when financial markets are perfect and there is no tax or bankruptcy cost.

In the real world, issuing debt may benefit the firm due to the preferable tax treatment for debt, but on the other hand, also exposes the firm to significant costs if the firm goes bankrupt.

The real world also has asymmetric information issues. The capital structure, or the debt-equity ratio of a firm conveys the firm's profitability information. One example is the assumption that a seasoned equity offering signals to the market that the firm is over-valued.

- (d) Recommend the better alternative, a SEO or convertible bonds, for raising the \$40 million. Justify your answer.

Commentary on Question:

Most candidates were able to make a correct recommendation, but failed to provide a full critique on this knowledge utilization part. In order to receive full credit, candidates needed to 1) support with the negatives of an SEO and the positives of convertible bonds; 2) relate to Olive's situation in that it is unknown to outside investors and will have high growth opportunities in the near future; 3) make a recommendation.

Most candidates failed to provide the downside of an SEO, and very few candidates linked convertible bond features (insensitivity to information disparity and the option to convert) to Olive's situation. A few candidates had an incorrect description of a convertible bond.

Recommendation: Convertible bond.

For SEO, investors will rationally interpret management decisions to raise equity as a sign that the firm is over-valued. The information cost for a relatively unknown company like Olive is high and the decision of issuing equity could eventually cause a dilution of shareholder equity and be very costly.

Convertible debt is an alternative solution in raising capital, which gives the bondholder an option to convert each bond into a fixed number of shares of common stock.

6. Continued

Compared to issuing equity, convertible debt is an inexpensive way to issue "delayed" common stock especially when the firm is concerned with under-valued stocks. In particular, for Olive with such high growth value, management is facing specifically high information cost for issuing under-valued equity.

Also for smaller companies like Olive, outside investors are usually more uncertain of the riskiness of the firm. Convertible debts' insensitivity to information disparity tends to attract such outside investors.

Since Olive has several possible investments in the near future and is facing significant growth opportunities, the conversion features of convertible effectively give management the option to retire debt and get an equity injection.

7. Learning Objectives:

3. The candidate will understand how and when to apply various stochastic techniques to situations which have uncertain financial outcomes.
5. The candidate will understand how to identify and recommend appropriate risk assessment and monitoring techniques for financial risk management.

Learning Outcomes:

- (3b) Assess the appropriateness of a given stochastic simulation technique to quantify various market risk exposures.
- (3g) Recommend the use of techniques to reduce the computational demand when applying stochastic methodology.
- (5a) Evaluate the methods and processes for measuring and monitoring market risk positions.
- (5b) Describe the types of models and the sources of model risk.
- (5c) Assess the methods and process for quantifying and managing model risk within any business enterprise.

Sources:

Korn, Monte Carlo Methods and Models in Finance and Insurance, Ch 5, Sections 5.1-5.6 (background), 5.7-5.9, 5.11, 5.14-5.19

Korn, Monte Carlo Methods and Models in Finance and Insurance, Ch 8

Hubbard, How to Measure Anything, Ch 7

Dowd, Measuring Market Risk 2nd ed, Ch 16

Commentary on Question:

Commentary listed underneath question component.

Solution:

- (a)
 - (i) Calculate the three-month 95% VaR as of June 30, 2015, for the AirLift feature, based on the results of the prior eighteen months, assuming monthly results are independent. Show your work.
 - (ii) Calculate the transaction cost savings, as basis points of fund value per month, needed to break even, assuming that 5% of fund value is paid when an AirLift payout occurs. Show your work.

7. Continued

Commentary on Question:

Candidates did very poorly on this analysis question. The majority of candidates did not read the question carefully enough and failed to assume monthly results were independent as was directed. Many also did not recognize that they were just supposed to use the discrete dataset and instead tried to interpolate or something similar.

- (i) There are 6 months of negative returns out of the 18 months. So there is a $1/3$ probability of a negative alpha in any given month. The probability of 3 negative alphas is $(1/3)^3 = 1/27 < 5\%$. Therefore, VaR for AirLift is 0 as of June 30, 2015.
 - (ii) Expected loss in the three-month period is $1/27 * 5\%$
Transaction cost savings expressed in basis points (bps) is $3 * x / 10000$
Setting these quantities equal:
 $(1/27) * 5\% = 3 * x / 10000$
 $(1/27) * 5\% * 10000 / 3 = x$
 $6.17 = x$
The transaction cost savings is 6bps
- (b)
- (i) Describe two shortcomings of modeling equity returns with a lognormal model.
 - (ii) Assess whether these shortcomings are likely to have a material effect on Alice's analysis.

Commentary on Question:

Candidates did moderately well on part (i). Many candidates were able to mention one shortcoming in part (i) related to normality of return distribution, while a few scored on dependency of return series. For part (ii), most candidates were not able to provide sufficient support of whether the shortcomings are material. Full marks were awarded for sufficient support of either stating material or immaterial.

- (i) The lognormal model assumes that log-returns are normally distributed, but historical equity returns are skewed and have fatter tails than a normal distribution.

The lognormal model assumes the returns are independent from one another, but historical equity return time series exhibit some autocorrelation.

7. Continued

- (ii) These shortcomings are unlikely to have a material effect, because Humilis returns and the benchmark index returns are expected to be highly correlated, such that the shortcomings of the lognormal model are likely to offset each other when considering the ratio of returns.
- (c)
 - (i) State whether Bob's model is equivalent to Alice's model. Justify your answer.
 - (ii) Describe a mis-specified relationship due to Bob's calibration method.
 - (iii) Describe a problem in Bob's calibration method.

Commentary on Question:

Candidates did poorly on this question. Many candidates did not perform deduction in part (i) to determine that the two models are equivalent. A number of candidates were able to point out the discrepancy between monthly and daily alpha, however many failed to mention the missing relationship of autocorrelation.

- (i) From Bob's model:
 $1 + \alpha = (1 + \text{Humilis return}) / (1 + \text{index return})$
 $\ln(1 + \alpha) = \ln((1 + \text{Humilis return}) / (1 + \text{index return}))$
 $\ln(1 + \alpha) = \ln(1 + \text{Humilis return}) - \ln(1 + \text{index return})$

$\ln(1 + \alpha)$ on the left hand side is normally distributed according to Bob. Both terms on the right hand side are normally distributed, as per Alice's approach, hence the sum of 2 normally distributed variables are also normally distributed.

Bob's and Alice's models are equivalent.

- (ii) Bob's lognormal model for monthly alpha assumes that each day's and each month's alpha is independent, but inspection of the 18-month history shows a strong indication of autocorrelation, a relationship which is missing in Bob's model.
- (iii) The historical data corresponds to a different fund manager, however, you are the new fund manager, who would have a significant impact on actively managed funds, so calibrating to data under a different manager is inappropriate.
- (d) Describe a potential model risk specific to Charlie's modeling approach.

7. Continued

Commentary on Question:

Candidates did moderately well on this question. The key to answer this question is to understand the high complexity of a Heston model. A candidate would be awarded full marks for each risk mentioned and well explained below.

Implementation risk - There are several methods for avoiding negative volatilities when projecting returns in a Heston Model, and each could produce a materially different final answer depending on what method is chosen.

Incorrect calibration – 120 months of return data are not enough to confidently set the many parameters of the model. Given the amount of data, a simpler model may be needed.

- (e) Explain how endogenous model risk may result in higher transaction costs from the AirLift feature.

Commentary on Question:

Candidates did poorly on this question. Many candidates were not able to explain the mechanism of how the AirLift feature impacts trading strategy of fund managers, and why transaction costs are higher.

The presence of the AirLift feature is likely to change trading behavior.

Risk of the fund, measured by VaR, would significantly increase a few months after missing the benchmark. Then the fund manager may make large trades to track the benchmark much more closely for the rest of the 3rd month, preserving the positive alpha while increasing transaction costs. On the other hand, if the fund is trailing the benchmark, the fund manager may alter the trading strategy in a last-ditch effort to beat the benchmark before the end of the 3rd month, resulting in higher transaction costs.

- (f) Explain the advantages and disadvantages of using a competition to reduce model risk.

Commentary on Question:

Candidates did very well on this knowledge utilization question. If a candidate did not get full credit for their answer, it was typically because they did not provide enough support or rationale for their answer.

Advantages: Competition helps to reduce several aspects of model risk. Having multiple, independent models makes it easier to discover implementation and programming errors, and the varying approaches that may occur allow the risks of misspecified models, processes, and relationships to be directly addressed.

7. Continued

Disadvantages: Competition is not likely to help with data issues, as the modelers will share the same data, and it does not help with whether the models are answering the correct question. It may also reduce collaboration between teams as they are attempting to do better than the others.

8. Learning Objectives:

2. The candidate will understand how an enterprise's structure and policies allow its management to prioritize and select among projects or business activities that are competing for scarce capital resources.

Learning Outcomes:

- (2a) Evaluate how the legal form of an organization, corporate governance and/or compensation dynamics impact decision-making on projects or business activities.
- (2c) Recommend an optimal capital structure and how to implement it for a given business or strategy

Sources:

F-128-15 Atkeson & Cole, A Dynamic Theory of Optimal Capital Structure and Executive Compensation

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

Jonathan Berk and Peter Demarzo, Corporate Finance, Third Edition, Ch 29 Corporate Governance

Commentary on Question:

The question tested candidates understanding of optimal capital structure and optimal management compensation. The question required candidates to identify how capital structure interacts with compensation, the motivation of managers, and how to set compensation structures in order to get desired results. Some answers seemed short or were unfinished. This hinted that candidates did not manage their time and did not leave enough time to complete this final question of the morning session.

Solution:

- (a) Explain two frictions faced by GSC in determining optimal capital structure and management compensation.

Commentary on Question:

Candidates did okay on this retrieval section. Most were able to identify agency friction and the tradeoff between outside investors and management. Fewer identified the cost of attaining information. While the question was written with the intent of having capital structure related to compensation, it was determined that the wording was not explicit enough, so full credit was given if each of these aspects were addressed independently.

8. Continued

Agency Friction – managers make decisions based on their best interest, instead of what is best for the firm. Different capital structures desire different risk levels. If the compensation does not reflect the risk tolerance of the capital structure, there will be friction.

Information Friction – there is an asymmetric availability of information about the performance of the firm. Managers know more than outside investors.

- (b) Describe how the frictions in part (a) evolve, from the perspective of outside investors, during the following periods:
- (i) The beginning of a production process
 - (ii) The middle and end of a production process

Commentary on Question:

Candidates did not do well on this comprehension question. Providing simple descriptions of the frictions was not enough to get full credit. The candidate must relate the friction to the time period of the production process. Few were able to identify that the information friction is higher in the early stages of the production process. This is most likely because few identified that this is one of key frictions in part (a). Most were able to identify how one of the frictions changed in the later stages, but few mentioned the changes to both frictions.

- (i) Early in the production process there are major information frictions. Managers have private information about the firm then what is disclosed to external investors. The investors would have to pay a cost to monitor the firm to reduce the asymmetry.
- (ii) In the middle and late stages of the production process, the output of the firm is revealed to the outside investors and the information friction greatly diminishes.

While the information friction diminishes in the end stage of the process the agency friction is greatly increased. The firm's manager can divert unused resources to providing themselves with private benefits, instead of these resources being paid out to investors.

The candidate could have also discussed the impacts of bond covenants on agency friction and how they can reduce them in the later stages.

8. Continued

- (c) Recommend which compensation package GSC should offer Smith to ensure she remains productive. Support your answer.

Commentary on Question:

Candidates did very poorly on this analysis question. No credit was given if the wrong compensation package was chosen, even with explanation for the choice. It was for this reason that most candidates did not receive credit for their answer. Although, most did attempt to defend their choice.

Because of her numerous outside opportunities, while being a successful and highly sought after executive, Smith's compensation package should be Package 1. This package has the smaller golden parachute payment. The more limited the outside opportunities of the manager, the larger their payment should be.

Managers such as Smith will have many job offers with equal or greater compensation. If a large golden parachute payment is provided, the manager will have incentive take risk or work to get the firm to merge or be acquired in order to trigger the payment. Once they are terminated from the merger/acquisition, they will then be able to easily find new employment. These decisions may not be in the best interests of GSC, but would be in Smith's. Smaller compensation packages, such as 1, provide less incentive for risky merger/acquisition decisions.

- (d) Recommend changes to Smith's compensation package to better align her interests with those of the new outside investors. Support your recommendations.

Commentary on Question:

Candidates did well on this knowledge utilization question. Candidates did not need to answer part (c) correctly in order to receive full credit for part (d), providing they gave adequate explanation of the changes. Simply saying that the package should encourage solvency was not acceptable. Relating the solvency to the interest of debtholders was required.

Given that 80% of the product initiative is financed with debt, the firm should align the majority of Smith's compensation with those of debtholders. However, since 20% of the product initiative is financed with equity, the Smith might still have some exposure tied to the firm's stock price.

To align with the stockholders, an ownership viewpoint should be given with the compensation package. This could be achieved with stock or stock options.

To align with the debtholders, a majority of the compensation should have a solvency viewpoint. Potential solutions are tying the bonus to product performance or to rolling multi-year earnings results.

9. Learning Objectives:

3. The candidate will understand how and when to apply various stochastic techniques to situations which have uncertain financial outcomes.
4. The candidate should understand how and when to apply various advance techniques to evaluate risk or uncertainty in any business enterprise especially non-insurance organizations.

Learning Outcomes:

- (3a) Explain the mathematical foundation of stochastic simulation.
- (3e) Interpret the results of a given application of stochastic modelling and the impact of the chosen calibration process used.
- (4d) Explain how to quantify risk when there is limited data.

Sources:

Korn, Monte Carlo Methods and Models in Finance and Insurance, Ch 3, Sections 3.1, 3.2, 3.3.1, and 3.3.2 to p72

Korn, Monte Carlo Methods and Models in Finance and Insurance, Ch 8

Hubbard, How to Measure Anything, Ch 5

Commentary on Question:

Candidates did well on part (b) and (d) but very few candidates answered part (a) or (c) correctly.

Solution:

- (a) Describe the steps of the Monte Carlo Simulation to model the one-year loss distribution using 1,000 simulations.

Commentary on Question:

Candidates performed poorly in part (a). A handful of candidates only described a general simulation procedure without demonstrating necessary knowledge to perform an actual simulation. Successful candidates recognized that there are 2 simulations to be done, claims will stop at age 65, and used other information provided in the question to derive the steps to generate a 1-year loss distribution of the LTD portfolio.

9. Continued

For each of the 1,000 simulations,

Step 1: Simulate 5,000 independent random variables $X_i \sim U(0,1)$ where each X_i represents probability of insured i being disabled during the year.

- If $X_i < d_i$, then insured i is disabled.

Step 2: For each insured that is disabled, simulate a second random variable $Y_{t,i} \sim U(0,1)$, where t represents the duration of disability for insured i

- If $Y_{t,i} < Q(t)$, then insured i is off of disability (recovered or died) at duration t .
- If $Y_{t,i} \geq Q(t)$, then the insured i is still disabled at duration t .
 - return to the beginning of step 2 and simulate $Y_{t+1,i}$ until $Y_{t,i} < Q(t)$
 - or until insured i reaches age 65 (termination of LTD benefits under the plan).

Loss is PV of payment b_i for t periods: $b_i * (v + v^2 + \dots + v^t)$

Alternative calculation for step 2:

Step 2: Calculate the survival function $P(t) = 1 - Q(1) - Q(2) - Q(3) - \dots - Q(\text{infinity})$. $P(t) = 0$ if insured i reaches age 65.

- Simulate $Y_i \sim U(0,1)$ and find the smallest t such that Y_i is larger than $P(t)$.
- Disabled duration is equal to t and the loss would be the PV of payment m for t periods:
- Loss is PV of payment b_i for t periods: $m * (v + v^2 + \dots + v^t)$

Step 3: Sum the loss of all insureds to find the loss under this scenario.

Step 4: Repeat steps 1-3 1,000 times to yield the loss distribution of the portfolio.

(b)

- (i) Calculate one-year 99% VaR.
- (ii) Calculate one-year 99% TCE.

Commentary on Question:

Candidates performed very well in part (b). Some candidates provided the 990th record as VaR(99). Full credit was awarded. Also, some candidates provided absolute VaR instead of relative VaR. Both answers receive full credit.

9. Continued

$$\text{VaR}(99) = X(991) = \$96,645$$

$$\text{CTE}(99) = \text{average} [X(991), X(992), \dots, X(1000)] = \$97,736.50$$

- (c) Calculate the 99% confidence interval for the expected one-year loss using the normal distribution.

Commentary on Question:

Part (c) was meant to be a straight forward question but very few candidates received full credit. Common mistakes were

1.) not including the number of simulations in the calculation of the CI. As the number of simulations increases, the range of the confidence interval should decrease.

2.) calculated population variance instead of sample variance.

Formula of sample variance:

$$\sigma_N = \sqrt{\frac{N}{N-1} \left(\frac{1}{N} \sum_{i=1}^N x_i^2 - \bar{x}_N^2 \right)}$$

Substitute with the given information from the problem:

$$\begin{aligned} \sigma_N &= \text{square root of } \{(1000/999) \times (7,910,811,905 - 88,882^2)\} \\ &= 3,288.28 \end{aligned}$$

$$\begin{aligned} \text{So 99\% confidence interval is } & 88,882 \pm 2.575 \times [3,288.28/\text{sqrt}(1,000)] \\ \text{lower bound} &= 88,614 \\ \text{upper bound} &= 89,150 \end{aligned}$$

- (d) Describe two methods of improving your colleague's estimation skills.

Commentary on Question:

Candidates performed well on this question. It is a retrieval question from the course material.

- Repetition and feedback: take several tests in succession, assessing how well the CRO did after each one and attempting to improve his performance in the next one.

9. Continued

- Equivalent bets: for each estimate, use the equivalent bet to test if that range of probability really reflects the CRO's uncertainty.
- Consider potential problems: think of at least two reasons why the CRO should doubt his assessment.
- Avoid anchoring: think of range questions as two separate binary questions of the form "Are you 95% certain that the true value is over/under the lower/upper bound?"
- Reverse the anchoring effect: start with extremely wide ranges and narrow them with the "absurdity test" as the CRO eliminates highly unlikely values.

10. Learning Objectives:

5. The candidate will understand how to identify and recommend appropriate risk assessment and monitoring techniques for financial risk management.

Learning Outcomes:

- (5a) Evaluate the methods and processes for measuring and monitoring market risk positions.
- (5c) Assess the methods and process for quantifying and managing model risk within a financial institution.

Sources:

Dowd, Measuring Market Risk 2nd ed, Ch 12

Hubbard, How to Measure Anything, Ch 7

Commentary on Question:

Commentary listed underneath question component.

Solution:

- (a) Explain the benefits of mapping the new bond to reference instruments.

Commentary on Question:

Candidates in general did well on part (a). More than half the candidates received full credit with two or more correct answers.

Acceptable answer:

1. Inadequate information (or not enough data) since the bond is the first of its type and/or is being issued in an emerging market.
 2. The bond could be closely correlated to other investments in emerging markets in the same region. (or can manage dimensionality of variance-covariance matrix through mapping.)
 3. Avoid rank problems in the variance-covariance matrix since this instrument can be closely correlated to instruments issued in other emerging markets in the same region.
 4. Reduce time needed to carry out risk calculations when a large number of positions are involved.
- (b)
 - (i) Critique the student's proposed reference instruments. Support your critique.
 - (ii) Recommend alternative instruments that can be used as reference instruments.

10. Continued

Commentary on Question:

On part b (i), most candidates were able to identify that the student's recommendation was incorrect. However, many failed to support their decision. A common mistake is to criticize the potential risk mismatch between the bond and the two instruments, instead of the appropriateness of the two instruments as mapping reference instrument.

- (i) The student's proposed reference instruments are not appropriate.

A vanilla interest rate swap is not a basic instrument that can be used for mapping. It can be broken down further in to a fixed-coupon bond and a floating-rate bond.

A forward rate agreement is not a basic instrument that can be used for mapping. It can be broken down further in to a long zero-coupon bond of one maturity and a short zero-coupon bond of a different maturity.

- (ii) 1. FX positions
2. Zero Coupon Bonds
3. Sovereign bonds from same region

- (c) Derive equivalent cash flows of reference instruments in the emerging market's currency. Show your work.

Commentary on Question:

Candidates performed poorly in part (c). The calculation is following the example of Table 12.2 from T133-15 Dowd, Measuring Market Risk 2nd ed, Ch 12. Few candidates were able to recognize the method and necessary steps for deriving equivalent cash flow. For candidates who did recognize the method most were not able to carry out all the steps. Partial credit was given for correct intermediate steps. Any possible calculation differences due to rounding were ignored.

Coupon paying bond

Coupon rate 6% Semi-annual coupons
Notional 1,000,000
Maturity 2 yrs

	Ref horizon	Pmt horizon	Pmt horizon	Ref horizon
Time to CF in months	3	7	13	15
Time to CF in years	0.25	0.58	1.08	1.25

10. Continued

Zero Rates

Time to CF in months	3	7	13	15
Observed	4.00%			5.00%
Interpolated		4.3333%	4.8333%	
		4.333% = (5%*(7-3) + 4%*(15-7))/(15-3)		
		4.833% = (5%*(13-3) + 4%*(15-13))/(15-3)		

Interpolated rates with 1bp change in reference rates

Time to CF in months	7	13
Left reference rate	4.3400%	4.8350%
Right reference rate	4.3367%	4.8417%

$$4.3400\% = (5\%*(7-3) + (4\% + 0.0001)*(15-7))/(15-3)$$

$$4.3367\% = ((5\% + 0.0001)*(7-3) + 4\%*(15-7))/(15-3)$$

$$4.8350\% = (5\%*(13-3) + (4\% + 0.0001)*(15-13))/(15-3)$$

$$4.8417\% = ((5\% + 0.0001)*(13-3) + 4\%*(15-13))/(15-3)$$

Impact of 1bp change in reference rates

Time to CF in months	7	13
Left reference rate	0.0067%	0.0017%
Right reference rate	0.0033%	0.0083%

Bond Cash Flows

Time to CF in months	7	13
Coupon	30,000	30,000
Principal		1,000,000
Total	30,000	1,030,000
PV	29,251.17	977,455.70

$$29,251.17 = 30,000 * \text{Exp}(-0.58 * 4.333\%)$$

$$977,455.70 = 1,030,000 * \text{Exp}(-1.08 * 4.833\%)$$

Impact of 1bp change in reference rates on PV cash flows

Time to CF in months	3	7	13	15
Left reference rate		-1.14	-17.65	
Right reference rate		-0.57	-88.24	
Impact on CF at ref date	-18.79			-88.81
Mapped CF	758,996			756,326

$$-1.14 = 30,000 * \text{Exp}(-0.58 * 4.3400\%) - 29,251.17$$

$$-0.57 = 30,000 * \text{Exp}(-0.58 * 4.3367\%) - 29,251.17$$

$$-17.65 = 1,030,000 * \text{Exp}(-1.08 * 4.8350\%) - 977,455.70$$

$$-88.24 = 1,030,000 * \text{Exp}(-1.08 * 4.8417\%) - 977,455.70$$

10. Continued

$$-18.79 = (-1.14) + (-17.65)$$

$$-88.8 = (-0.57) + (-88.24)$$

$$758,996 = (-18.79)/(\text{Exp}(-4\%+0.0001)*0.25)-\text{Exp}(-4\%*0.25))$$

$$756,326 = (-88.81)/(\text{Exp}(-5\%+0.0001)*1.25)-\text{Exp}(-5\%*1.25))$$

The bond has the same sensitivity to changes in the 3 month and 15 month spot rates as cash flows of \$758,996 at 3 months and \$756,326 at 15 months.

- (d) Recommend whether Awburn should invest in the new bond, based on the above information. Support your recommendation.

Commentary on Question:

Candidates performed poorly in part (d). A common mistake is taking weighted average of VaR and comparing it to the current VaR. Most candidates failed to recognize that one has to know the entire loss distribution of the investment portfolio to recalculate VaR and not simply to take a weighted average. Successful candidates used Expected Opportunity Loss to arrive at the correct recommendation.

	Outcome 1	Outcome 2
Probability	0.6	0.4
Change in VaR if invested	-80000	70000
Change in VaR if not invested	0	0

Expected Opportunity Loss if invest in the bond: = 40% x 70,000 = 28,000

Expected Opportunity Loss if don't invest in bond = 60% x 80,000 = 48,000

EOL if invest < EOL if don't invest, so Awburn should invest in the new bond

Expected decrease in portfolio VaR if new bond investment is added to existing portfolio is higher than the expected increase in portfolio VaR.

- (e) Assess whether Awburn should pay the investment bank for the information. Support your assessment.

Commentary on Question:

Candidates performed poorly in part (e). A common mistake is using either the weighted average VaR reduction or the total VaR reduction to compare with the cost of the information. Successful candidates used their answers in part (d) to support their recommendations.

Awburn should not pay for the more accurate information.

10. Continued

Since most companies in the real world do not hold the \$28,000 of EVPI, but will finance that amount, either through line of credit, issuing bonds or equity, etc. The cost of the extra capital is, therefore, $(r \times \$28,000)$, where r is the cost of capital, and is most certainly smaller than \$25,000.

Alternatively:

Some candidates treated VAR as the actual cost and then compared it to the cost for perfect information. In that case, Auburn should pay for the more accurate information. Full credit was also given for:

The value of the information is higher than its cost.

EVPI = EOL before info

EVPI = \$28,000 from part (d).

Cost of obtaining information = \$25,000

11. Learning Objectives:

1. The candidate will understand how a business enterprise funds its activities with considerations for its business model, and the cost and constraints of the sources of capital.

Learning Outcomes:

- (1a) Identify and critique the available sources of funding to start or grow a business entity. Describe the steps to procuring capital funding (treasury function).
- (1b) Evaluate capital budgeting approaches and structure policy for insurance and non-insurance organizations. Assess whether the risky return from a new project or ongoing business is sufficient to employ investor capital using key factors, market drivers and book drivers (including return on employed capital such as NPV, IRR and payback period).

Sources:

F-121-15 KPMG, Is the Company Using Its Capital Wisely?

F-122-15 Jagannathan, Meier, & Tarhan, The Cross Section of Hurdle Rates for Capital Budgeting

F-125-15 Froot, Risk Management, Capital Budgeting, and Capital Structure Policy for Insurers and Reinsurers

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

Commentary on Question:

Commentary listed underneath question component.

Solution:

- (a) Identify two weaknesses of Chestnut's capital budget allocation process.

Commentary on Question:

Many candidates answered this question correctly. One response that was seen repeatedly was that budgeting should be done more frequently than annually. However, that isn't supported by the reading and was not given full credit.

- Given the new product is one of the biggest initiatives in recent years and is strategically important for the company's future growth, receiving the same budget as last year reflects that the budget allocation process is not aligned with the long term strategy of the company
- Receiving the same budget allocation as last year also shows the budget allocation process is subject to inertia.

11. Continued

- (b)
- (i) Recommend whether Chestnut should launch now or wait one year. Justify your answer.
 - (ii) Describe how a change to each of the four cash flow estimates for the new product could change your recommendation in (i).

Commentary on Question:

Candidates did fairly well on this section. Some thought that just because an option value was positive, Chestnut should wait. For full credit candidates should compare the option value to the NPV of the project and recommended launching the product immediately. Many did not calculate the NPV for comparison.

- (i) This is the value of the delay option

$$V = \frac{2}{(0.1 - 0.02)} = 25M$$

$$V = \frac{2}{(0.1 - 0.02)} = 25M$$

$$PV(K) = \frac{10}{1.03} = 9.7087M$$

$$d_1 = \frac{\ln\left(\frac{23.1818}{9.7087}\right)}{0.3} + \frac{0.3}{2} = 3.0512$$

$$d_2 = 3.0512 - 0.3 = 2.7512$$

$$\begin{aligned} C &= 23.1818 * N(3.0512) - 9.7087 * N(2.7512) \\ &= 23.1818 * 0.9988 - 9.7087 * 0.9970 = 13.4755M \end{aligned}$$

This is the value of launching now.

$$NPV = V - cost = 25 - 10 = 15M$$

The product should be launched now. Since the NPV today is worth more than the value of the option.

11. Continued

(ii)

- Higher volatility will increase uncertainty and the value of information gathered increases over time. The option to wait is more valuable when there is more uncertainty.
- Higher initial cash flow means Chestnut will give up more by waiting, hence it makes more sense to start now instead of waiting.
- Higher initial investment will reduce value for both the invest now and the delay option. *Grader comment: In general it will impact the delay option less due to the time value of money.*
- Higher growth rate will increase value for both the invest now and the delay option. *Grader comment: Even with a full calculation, this was a difficult answer to obtain. Therefore credit was given for a well-reasoned explanation that supported either to invest now or delay.*

(c)

- (i) Identify three possible reasons for Berry's higher hurdle rate.
- (ii) Explain why it may be appropriate for Chestnut to use a lower hurdle rate for evaluating this project.

Commentary on Question:

Most understood the questions and gave good explanations. On part (i) many candidates received partial credit because they referred only to the amount of cash and not the cash to asset ratio. On part (ii) many candidates did not recognize that the project was a strategic investment for Chestnut.

- (i) Identify three possible reasons for Berry's higher hurdle rate.

Reason 1. Berry has the highest growth rate. Firms with high growth prospects may pass up some good, current period projects by using hurdle rates that exceed their WACC. The difference between the hurdle rate and WACC represents the premium associated with the option to wait.

Reason 2. Berry also has the highest cash to asset ratio, which is a proxy for high growth opportunities. High growth opportunities imply a high valuation for the option to wait and will imply a high hurdle rate.

Reason 3. Berry has the highest level of capital constraints. Organizational and managerial constraints are another reason why firms with valuable options to wait would use higher hurdle rates. High-growth firms are likely to have high opportunity costs of not waiting for possible better projects in the future due to limited managerial talent. These firms are likely to place a high value on the option to wait

11. Continued

- (ii) Explain why it may be appropriate for Chestnut to use a lower hurdle rate for evaluating this project.

Chestnut considers the new product as strategic to the company's long term goals. Investing in such a project has the potential to generate additional future cash flows that are currently not incorporated in the valuation of the project. The hurdle rate used for this type of valuation is normally lower.

Chestnut has the lowest growth rate, cash to asset ratio and low capital constraints. All things indicate that Chestnut is not a high growth company. High growth companies put more value on the option to wait and will use higher hurdle rate vs. value firms such as Chestnut.

- (d) In the context of *Risk Management, Capital Budgeting and Capital Structure Policy for Insurers and Reinsurers*:
- (i) Critique the CFO's comment.
- (ii) Critique the Treasurer's comment.

Commentary on Question:

The question specifically pointed to the Risk Management, Capital Budgeting and Capital Structure Policy for Insurers and Reinsurers. Many candidates did not provide responses from that perspective.

- (i) The required incremental rate of return on a new project has three factors.
- The first factor is related to market risk
 - The second factor is related to firm wide risk that comes through the product market channel.
 - The third factor is due to the asymmetry of firm wide payoffs. The size of this factor depends on the covariance of the new project with existing asymmetrically distributed portfolio and the price of asymmetry risk.

Chestnut is a large insurance company, which tend to have negatively asymmetric payouts-occasional large negative payouts offset by frequent small positive outcomes. The new product would also tend to have negatively distributed outcomes. Due to the covariance, the company may have a higher hurdle rate than what might be expected based on the first two factors alone.

Even if Chestnut actively hedges out the market risk, the third factor may push Chestnut to use a hurdle rate higher than the cost of capital

11. Continued

- (ii) There are opportunity costs of carrying cash and there are also agency concerns. It is not absolutely correct that raising external capital is just the same as funding using internal cash.

The cost of raising external finance is convex. It becomes more costly to raise funds the larger the amount that must be financed externally. The fluctuation in internal cash results in fluctuations in additional cost of raising external funds. Although the company has a decent cash balance, if the project is large, the cost of raising external capital may be high.

If we assume the return of the project is an increasing concave function of the cash commitment, the fluctuation in internal cash results in a fluctuation in investments, lowering the average return on investments.

By having a higher internal cash balance, Chestnut can control the risk of internal funds better. And with lower volatility of internal capital, the cost of raising external funds is likely to be lower.

12. Learning Objectives:

4. The candidate should understand how and when to apply various advance techniques to evaluate risk or uncertainty in any business enterprise especially non-insurance organizations.

Learning Outcomes:

- (4a) Critique models for estimating the long term discount rate. Compare and contrast the approaches for their ability to be calibrated effectively, to provide interpretable results and to give insights on the underpinning asset management strategy

Sources:

Manistre, A Risk Management Tool for Long Liabilities: The Static Control Model

Commentary on Question:

Candidates had a very difficult time with this question. It was based on a fairly theoretical source and was testing candidates' understanding of the different approaches to value and manage the risk in long-term liabilities. Candidates didn't understand the major comparison points between methods and struggled with fairly basic calculations. If candidates didn't prepare for this material/concept then the entire question would be fairly difficult.

Solution:

- (a) Identify the advantages of the Static Control Model versus the Yield Curve Extension Approach.

Commentary on Question:

Candidates struggled to compare the two methods, usually citing one or two characteristics about the Static Control Model, rather than identifying the fact that it provided more realistic hedging strategies because it uses actual market instruments instead of extrapolating the current curve. Some candidates simply stated "more realistic" without any justification.

The yield curve extension method extrapolates the current forward rate curve to predict rates in the future whereas the Static Control Method uses available market instruments to match the hedgeable risks, and uses a total return approach to match the non-hedgeable risks. Therefore, the Static Control Method is more realistic for hedging strategies and it is market consistent.

- (b) Construct a static hedge at time 0 using a monopole strategy for the given long-term liability cash flows beyond 30 years.

Commentary on Question:

Commentary: Candidates did well on this part. The most common error was to mis-read the question and involve a duration component or apply the wrong discount factor from the table.

12. Continued

$V = Z_{30}(K)$ in 30-year zero coupon bonds

$V = (0.3713)(1806) = \$670.57$ zero-coupon 30-year bonds should be purchased.

- (c) Explain whether the static hedge strategy in part (b) is an acceptable risk management strategy. Support your explanation.

Commentary on Question:

Candidates performed poorly on this section. Partial credit was given for candidates realizing it was not an acceptable strategy. Most candidates didn't consider the scenario where if forward rates turn out as predicted, then the results of the hedge would be satisfactory.

This is not an acceptable strategy.

If the forward rate fluctuates randomly around the mean forward rate, the hedge would be acceptable. May need to add margin to discount to provide additional economic capital. If the forward rate drops before it mean reverts, the model will have bias which needs to be removed so it can account for the risk of further rate drops.

- (d) Calculate the gain or loss from the static hedge in part (b) after one year, assuming the new one-year forward rate at duration 30 is 3.94%.

Commentary on Question:

Candidates really struggled with this calculation. They generally used the wrong discount rates from the table and missed the simple formula which uses the difference in the forward rates and the value of the 30-year bond in one year's time. This question was also used to demonstrate that if the rates drop from the predicted mean forward rate, the hedge is clearly not sufficient. Partial credit was given if a candidate was able to realize that there was a loss as the value of the liabilities increased.

$G/L = (f_{30}' - f)KZ_{30}' = (.0394 - .041)(1806)(0.3696) = -\1.068 therefore there was a loss of \$1.07.

- (e) Construct a static hedge at time 0 consisting of an investment in a monopole and a dipole.

Commentary on Question:

This was the hardest section for candidates. Some recognized which instruments to long/short, but couldn't perform the calculations correctly.

Invest \$670.57 in a monopole of 30-year bonds (from part b)

Delta = 30-29 = 1

Duration = 15

12. Continued

$$f = \frac{Z_{29}}{Z_{30}} - 1 = \frac{0.3887}{0.3713} - 1 = 4.69\%$$

Dipole: Take a short position in $KD(1+f)^{-\Delta} / \Delta$ 29 year bonds

$$= (1806)(15)(1.0469)^{-1/1} = \$25,876$$

$$\text{Invest proceeds in the 30-year bonds} = K(1+D/\Delta) = 1806(1+15/1) = \$28,896$$

- (f) Explain whether the hedge strategy in part (e) is an acceptable risk management strategy. Support your explanation.

Commentary on Question:

Most candidates were able to identify that this was still not an acceptable strategy. More than one explanation was generally lacking and so only partial credit was given.

This is not an acceptable risk management strategy.

- The dipole model is not self-financing; has bias
- Convexity mismatch creates costs
- Random movements in the slope of the forward rate curve still creates unhedged risk

- (g) Describe two sources of bias in the dipole model.

Commentary on Question:

Most candidates were able to identify convexity risk, but often lacked the explanation required for full credit in a "Describe" question.

Convexity Bias: Costs that arise from matching the first order sensitivities but not the second order (not gamma-hedged)

Slope of the Forward Curve/Timing Bias: The cost of carry from borrowing at one point, and investing at a neighboring point on the curve.

13. Learning Objectives:

2. The candidate will understand how an enterprise's structure and policies allow its management to prioritize and select among projects or business activities that are competing for scarce capital resources.

Learning Outcomes:

- (2f) Assess the impact of behavioral factors in capital budgeting approaches and structure policies.

Sources:

"Handbook of the Economics of Finance, Vol 2 Part A, 2013, Chapter 5, pp. 357-424"

Jonathan Berk and Peter Demarzo, Corporate Finance, Third Edition, Ch 3: Arbitrage and Financial Decision Making

Commentary on Question:

This question tested candidates' knowledge of corporate finance, particularly focusing on the "market timing and catering" theory and using that as a basis to ask for examples of financial market imperfections and how managers can take advantage of those imperfections. Many candidates were able to correctly identify the "market timing and catering" theory, but struggled on the follow-up questions.

Solution:

- (a)
 - (i) Describe the "market timing and catering" theory of behavioral corporate finance.
 - (ii) List two key building blocks of this theory.
 - (iii) Justify the reasonableness for each key building block provided in (ii) using two examples.

Commentary on Question:

Most candidates were able to give an overview of the "market timing and catering" theory, but many stumbled when trying to identify the building blocks of this theory and thus were not successful in justifying the reasonableness of these building blocks either.

- (i) Managers take care to please irrational investors and take advantage of differences between market prices and fundamental value.
- (ii)
 1. Securities are not informationally efficient.
 2. Managers are "smart" in the sense of being able to distinguish market prices and fundamental value.

13. Continued

- (iii) Securities are not informationally efficient as observed mispricings of similar securities occur in the market. For instance, on-the-run and off-the-run Treasuries often having pricing discrepancies and Siamese twin securities with identical cash flows can trade at different prices. Managers being able to distinguish market prices from fundamental values is evidenced by large returns on insider trading and the ability of managers to manufacture an information advantage by managing earnings
- (b) Recommend possible strategies to preserve excess value for Dark Beige's long-run shareholders.

Commentary on Question:

Many candidates did well on this question, although some failed to realize that the goal of the manager is to maximize value for current long-run shareholders and thus suggested strategies that benefited other groups.

I suggest issuing equity and then using the proceeds to acquire companies that are more fairly valued or investing in other positive NPV projects.

- (c) Describe two arguments that support the CFO's viewpoint.

Commentary on Question:

Most candidates were able to identify at least one argument to support the CFO's viewpoint.

The CFO assumes that markets are informationally efficient and thus prices always reflect true value, which means that there are no opportunities for arbitrage.

Alternatively, the CFO assumes that managers are not able to distinguish market prices from real value and therefore are not able to take advantage of any market mispricings.