

# **Institute of Actuaries of India**

## **Subject ST5 – Finance and Investment A**

### **May 2015 Examinations**

#### **INDICATIVE SOLUTIONS**

##### **Introduction**

The indicative solution has been written by the Examiners with the aim of helping candidates. The solutions given are only indicative. It is realized that there could be other points as valid answers and examiner have given credit for any alternative approach or interpretation which they consider to be reasonable.

**Solution 1 :**

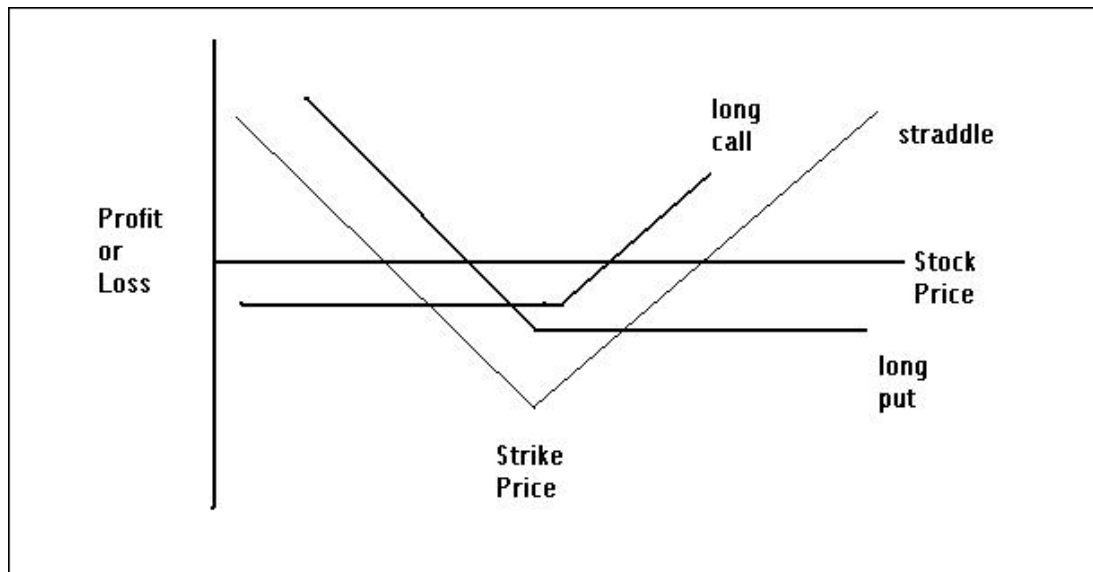
- (i) A Bermudan swaption is a swaption where the owner has the right to enter into the underlying swap either on the swaption's expiry date or on a number of other predefined exercise dates before that expiry date. [1]
- (ii) The prices do not look sensible when seen in relation to each other. Given all other characteristics being same, the American Option should be costliest since it provides the maximum flexibility in terms of exercising the option. Followed by Bermudan and the least costly should be the European Option. [2]
- (iii) *Arbitrage* is generally described as a *risk-free* trading profit. More accurately, an arbitrage opportunity exists if either:
- An investor can make a deal that would give her or him an immediate profit, with no risk of future loss.
  - An investor can make a deal that has zero initial cost, no risk of future loss, and a non-zero probability of a future profit. [1]
- (iv) If American Option is correctly priced then it means that Bermudan Option is overpriced. The investor can go long on the American swaption and simultaneously short an equal quantity of the Bermudan swaption to create a market neutral position. The position can be reversed when the prices correct making an arbitrage profit in the process.

Bermudan options are generally exotic options and liquidity can be a major constraint in entering the suggested trade. The difference in prices looks pretty high and it is highly unlikely that such an arbitrage opportunity will be available if the liquidity is good. Nothing has been mentioned about when the last trade happened for each of the swaption. It is highly probable that the last traded price of the Bermudan swaption is not really reflecting the fair price if a well informed buyer and seller are going to strike a deal now. [3]

[7 Marks]

**Solution 2 :**

- (i) Considering the fact that the beta is close to 1 the CIO can construct an at the money long straddle on NIFTY. This involves buying equal quantity (quantity depending on the portfolio size) of at the money call and puts of the same strike and same time to expiry. If there is a sufficiently large move in either direction, a significant profit will result.



Another strategy to directly profit from volatility is to take a long position in index vix futures. The vix futures are a proxy to the volatility of the market which is calculated from the implied volatility of the index call and put options. [6]

(ii)

- The liabilities of the company could need better matching in terms of regular cash flows so bonds are better suited
- The liabilities of the company could be more guaranteed and hence equities volatility is not appropriate if liabilities do not move in line with the equity market
- Regulatory requirement mandating a particular asset mix
- AA expects the bonds to outperform stocks

[3]

(iii) Advantages:

- The costs can be reduced for large switches if the fee payable to the arranging bank is less than the dealing charges on equities and bonds.
- Swaps maybe available for a longer duration than the usually available liquid bonds and help in better ALM
- OTC products – customizable to company's requirements
- There may be advantages if the bonds to be purchased are illiquid in nature. Direct market transactions can push up the prices of such bonds.
- The exposure can be structured in the desired manner in terms of duration. There can be more customisation for the exact need.
- Swap deals can be completed quickly and reversed at short notice. The investment manager can then make changes slowly in the cash market and hence gets time to act in the best manner.
- Tax liability on direct cash market transactions may be avoided.

**Disadvantages:**

- Since swaps are OTC products and customised, there are counterparty credit risks.
- It may be possible to arrange swaps using only some bonds and equity indices which may not be appropriate for the concerned company's portfolio.
- Managing the reporting and operational risk etc of a portfolio comprising derivatives is not easy. The Company may not have required expertise at all levels.

[5]

[14 Marks]

**Solution 3 :**

- (i) The bank effectively has the put option offered to them, so the value can be calculated for this put option.

Here:

K = 25, volatility = 30%, T = 5 yrs

St = 500 / (2/5%) = 500/40 Cr shares = 12.5 per share

Rfr = 15%/2 = 7.5%

Using Black Scholes Formula, put option value per share = Rs 6.65.

So expected value = 6.65 \* 2 Cr shares = 13.3 Cr. Further the company has been offered an upfront discount as well of Rs 2.5 per share. So overall value of offer = 13.3 + 2.5\*2 = 18.3 Cr.

Buyback price: The Company expects 15% growth in its valuation pa. So it expects its market price to reach  $12.5 * 1.15^5 = 25.14$  in 5 years. So by setting the strike price at 25, it is expecting that the option may not be very valuable.

[8]

- (ii) Negotiation points.

- Give a larger upfront discount – greater than 2.5 Rs currently.
- Give a American style or Bermudan style option
- Increase the strike price – it is consistent with only 15% growth, make it more attractive.
- Give a larger shareholding.

[2]

[10 Marks]

**Solution 4 :**

- (i) Put-call parity is a theoretical relationship between the price of a call option and a put option on a share. The options involved have the same exercise price and exercise date.

**Derivation**

Consider two portfolios:

- **A: one call option plus cash of  $Ke^{-r(T-t)}$ .**
- **B: one put option plus one share.**

**Portfolio A**

The value of Portfolio A at the expiry date is given by:

$ST - K + K = ST$  if  $ST > K$  (ie the call option is exercised).  
and  $0 + K = K$  if  $ST \leq K$  (ie the call expires worthless).

**Portfolio B**

On expiry the value of Portfolio B is:

$0 + ST = ST$  if  $ST > K$  (ie the put expires worthless).  
And  $K - ST + ST = K$  if  $ST \leq K$  (ie the put option is exercised).

Thus, the values at expiry are the same for both portfolios:  $\max \{K, ST\}$ , regardless of the share price at that time.

Since the value of both portfolios is same at expiry it must be the same at starting also (at any time  $t < T$ ) since they cannot be exercised before expiry.

$$C_t + K \exp(-r(T-t)) = p_t + S_t$$

This relationship is called put –call parity

**Assumptions**

Both options are European options and have identical expiry date and exercise price.

Non dividend paying options

No arbitrage.

There is a constant and known risk free rate of return

[8]

(ii) Applying put call parity for a non-dividend paying stock

$$P + S_T = C + X e^{-RT}$$

$$\text{LHS} \rightarrow 7.5 + 346 = 353.5$$

$$\text{RHS} \rightarrow 12 + 340 e^{(-0.1 \times 24/365)} = 349.77$$

If the company is non-dividend paying it is an arbitrage opportunity that can be exploited.

But it is highly unlikely that such an opportunity exists in a large cap stock in a market where depth of the derivative market is reasonable. The more plausible scenario is that the company has declared a dividend and ex-dividend date falls somewhere between 2<sup>nd</sup> March and 26<sup>th</sup> March. The **present value** of the dividend should account for the difference between the left and right side of put call parity equation rather than an arbitrage opportunity.

The put call parity equation here is

$$P + S_T = C + D + X e^{-RT}$$

where D is the present value of the dividends expected during the life of the option. [7]

[15 Marks]

**Solution 5 :**

Equity mix =  $645/1029.5 = 62.7\%$

Debt mix = 32.5%

Cash mix = 4.8%

Benchmark equity mix: 50%

Benchmark debt mix: 50%

Significant outperformance compared to benchmark driven mainly by the stock selection. Sector selection positive since movement away from debt into equity provided above than average return but cash holding detrimental to sector selection profit.

Stock selection positive for debt and equity both; debt extremely high

Actual equity yield of  $10/645 = 1.6\%$  lower than benchmark yield of c3.5%. This suggests that fund manager's style is probably towards high capital growth stocks rather than high income stocks.

Debt benchmark yield = 4%. Actual yield = 6%. This suggests a portfolio of probably lower credit rating corporate bonds since the debt outperformance is also very high

Fund manager should be asked to comment on the following:

- Reasons for investing in cash – does the mandate allow it?
- Are the debt stock purchased within credit risk tolerance?
- Why are cash returns of 2% lower compared to repo rate?

[8 Marks]

**Solution 6 :**

ALM Steps:

- Define the objective: Assessment of the possibility of shortfall at maturity of the fund value and guaranteed value
- Set up the model: Create a model with relevant cash flows and all assumptions required.
- Consider the asset mix – is it variable or fixed? Should it vary by the scenario of investment return?
- Determine the variables that need to be analysed stochastically - here investment returns for each asset class.
- Create (or attain) scenarios of the investment return into the future – typically 1000 or 5000 or 10000.

- Run the model multiple times for all the scenarios and capture the shortfall (if any) under each scenario.
- Whether any management action needs to be allowed – like portfolio rebalancing, counter cyclical etc?
- Rank the shortfalls and take a 95% worst value and set that as the reserve (or 99% or any other)
- Or set the average of the shortfalls as the extra reserve.
- Consider whether a discounted value needs to be set as the reserve or undiscounted can be held for prudence.
- Run iterations with different management actions if required. **[5 marks]**

### **Solution 7 :**

The following factors to be considered

#### **Data**

- New company – just 3 years data available. Traditional sources of data like stock exchange filings, corporate databases not available. Three years data may be obtained from registrar of companies. But the entire scope of operations changing very fast and the relevance of 3 years data for future projections may be also not much.
- Some information may be available from press but the information could just be headline numbers and may also not be authenticated by the company
- Traditional data analysis like using accounting ratios holds little value
- No access to Management at the time of making the report as the mandate given is to prepare a report based on available information. So first hand information not available at the time of making the report
- Since ABC is a global asset management company the company's network can be used to gain information from in house analysts and analysts at brokerages who cover the sector in developed countries where the industry is more mature.

#### **Business analysis**

- The first step of valuation is to understand the business. What is the business model? Is it just going to be a market place? Will it outsource logistics or will it start its own logistics company? Does it have plans to start selling its own goods? Commission structure vis-a-vis its peers. Going online, checking out a few vendors and talking to vendors may provide some valuable information about the business. You may also order a few goods online and see how the process works.
- Quality of management – difficult to assess as this is a start up. If the senior management comprises industry veterans then their past track record at companies where they worked maybe considered. But if it is started by young people under 30 as a start up analysis of quality of management is difficult

- Rapid scaling up and management bandwidth to manage the scale up of the company will be difficult to analyse
- Low barriers to entry – business at a nascent stage and many players likely to enter. Business nature based on trends in developed countries is such that only a few winners will finally emerge (like Amazon in US) and many start ups will bite the dust. Sustenance analysis is key to the investment thesis. Evolution of this model in developed countries maybe studied to identify the traits of the companies which finally succeeded
- Completely new business model. There may not be taxation laws and other regulations pertaining to this business model which may soon come to force. How it will affect the company and industry will be very critical. The general discussions happening about the topic in financial press is critical to understand the possible turn of events.

### **Valuation**

- In all probabilities the company will be making significant losses at the start up stage. Traditional valuation metrics like P/E, EV/EBITDA, Dividend Yield or DCF may hold little value
- Valuations at which private equity players may have taken stake in similar companies will be a starting point. Since most companies would be making losses or just meagre profits other metrics may have to be used say Price to Sales, Price to Gross Merchandise Value and so on to enable some comparison. Risk of assumption of efficient markets and greater fool theory
- The evolution of this industry in mature economies will be good case in point how the players progressed over the years, how long it took for the main players to be profitable, proportion of survivors, valuations then and now and so on
- Interaction with industry experts (sector analysts in developed countries, retired employees of successful online companies who have served in senior management in these countries) may throw some light on where to start. Global contacts of the company may be used for this purpose

It needs to be clearly mentioned that the report will definitely lack a lot of details and it can at best be used only as a starting point for further analysis. **[15 Marks]**

### **Solution 8 :**

#### **(i) Rationale for the move**

- XYZ is a one product commodity company totally dependent on crude oil and its performance can be very volatile depending on the fluctuations in crude oil prices. Merger with Mesa will create an entity which is more diversified as dependence on a single commodity will not be there for XYZ. Mesa will also benefit from diversification as another commodity is added to the basket which will reduce earnings volatility
- Mesa has a high debt to equity ratio and its earnings are currently just sufficient to cover interest. Merger with XYZ which has zero debt and surplus cash will lead to a much



stronger balance sheet and more comfortable interest coverage ratio. Chances of a rating upgrade and lower cost of borrowing.

- Ability to repay debt will be higher. Repayment of debt may be seen positively by the market and the combined entity may get a value higher than the sum of parts
- Combined entity will be bigger and more diversified – possibility of a higher valuation/rerating and greater wealth creation for shareholder as bigger funds get attracted to the company
- Mesa already owns 18% of XYZ. Management may feel that since the numbers are not getting fully consolidated in Mesa (as per Indian Accounting norms) the true value of XYZ is not getting reflected in Mesa's valuation. A merger may remove this discrepancy.
- Benefits of economies of scope

[7]

**(ii) Shareholder's opposing the move**

- Agency conflict – should management be doing the diversification for the shareholders or they will do it themselves. The shareholder profile maybe predominantly ones preferring a pure play crude oil exposure which they get in XYZ
- A zero debt company like XYZ can tide through adverse movements in crude oil prices and there is no need for diversification
- If Veda's stake in Mesa is higher then merger swap ratio maybe unfavourable for XYZ's minority shareholders
- XYZ minority shareholders maybe expecting hefty dividend payouts which will not happen in case of merger as cash flows will be diverted for debt repayment
- A merger brings with it a lot of uncertainties and change in management which may lead to loss of focus
- Mesa is not doing very well as is indicated by its income statement and balance sheet and XYZ shareholders don't want it
- If market perceives the merger negatively then there can be value erosion
- Veda's steps maybe deemed as ones taken to maximise the group's value (MESA+XYZ) which may not necessarily be aligned with maximising the value of XYZ which the minority shareholders want

[9]

[16 Marks]

**Solution 9 :**

- a. Stochastic discount factors which can be applied to a series of cash flows under a set of realistic scenarios to produce market-consistent valuations of assets and liabilities. Sometimes referred to as "state-price deflators".
- b. An international bond issued by a company or government, often in a currency other than the currency of the borrower. The bonds are traded internationally through banks, and not in the traditional bond markets

- c. A loan, the servicing or repayment of which is dependent solely on the profitability of the underlying project and not on any other funds/assets potentially in the possession of the borrower. If default happens lender can take over the project along with the assets of the project
- d. A plot of coupon value on the y-axis against term to redemption on the x-axis. For each term, the coupon that would be required for a fixed interest bond of that term to be issued at par is plotted
- e. The annual standardised deviation of the difference between portfolio return and benchmark return.

[10 Marks]

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