

Institute of Actuaries of India

Subject ST5 – Finance and Investment A

October 2015 Examination

INDICATIVE SOLUTION

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: You work as an analyst in a mutual fund

i)

- Bootstrapping involves finding the zero-coupon yields recursively.
- Having first determined the zero-coupon yield for the bond with the shortest outstanding term, we then use that information to determine the spot yield for the next shortest bond and so on.
- Yields in between are calculated using linear interpolation.
- The technique implicitly assumes that bond markets are arbitrage-free.

(4)

ii)

- Calculate the annual return of Sensex for every year from 1980 to 2014.
- Select 10 years at random (with repetition) to represent a simulation of the returns for the next 10 years
- Calculate the average return
- Repeat the 2nd and 3rd steps say 10,000 times
- Plot a distribution (bar chart) of the calculated averages against the frequency of occurrence to arrive at the frequency distribution of returns

(5)

[9 Marks]**Solution 2:**

Following points needs to be explained

- Tough to estimate the unrealized gain fairly and accurately
- How to pay the tax –may have the tax liability but no cash to pay for it
- People rushing to realise gains – markets may plummet
- Treatment of unlisted assets
- What about if there is subsequent losses. Need to provide tax rebate on unrealized losses or refund the tax. This may lead to cash flow issues for government depending on size of economy.
- Impact on dividend policy
- Impact on investor behaviour, FII's exit as tax regime unfavourable.
- Tax planning
- International comparisons
- Impact on currency and possible currency crisis

[10 Marks]**Solution 3:**

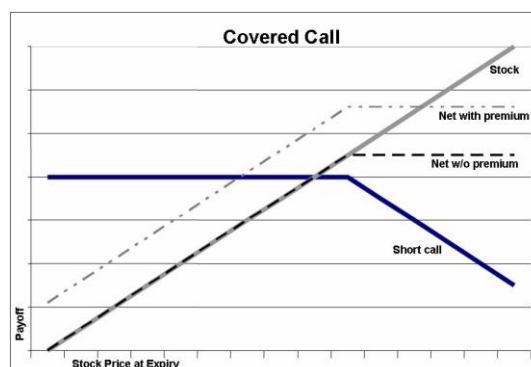
i) Index has remained pretty flat over last two years. Chances of out of money call option expiring worthless is pretty high if same trend continues. The fund can then pocket the premium which adds to return.

- The fund has written call options and the position suffers if the stock moves up. But since the fund owns the underlying security you are covering your position by selling the stock at a price which is higher than current market price.
- So in effect you either get the premium or you are able to sell the stock at a price higher than today which makes the strategy attractive.

(3)

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ii)



(3)

iii)

- Is taking derivative positions allowed as per the current mandate? If yes then to what extent.
- What has been the implied volatility? A flat index over 2 years would probably mean implied volatility is also on the lower side. This would mean that the call options premiums may not that good from a writer's perspective. A jump in implied volatility after taking the short position can be detrimental to the portfolio.
- Index has been flat over last 2 years doesn't mean that the same trend will continue in the future too. While it is right that it helps you to sell the stocks at a price higher than current price the big problem here is that upside is capped. In case of a significant up move the capped return would mean that the fund under performs the index.
- You may want to hold certain stocks for long term. This strategy may force you to sell some stocks when you really don't want to or book losses on the derivative position in case of up move. This can lead to crystallisation of profits. Tax implication of these needs to be considered.
- Are peer funds also adopting a similar strategy? Risk of being an outlier.
- Cash flow impact of margin calls
- Would clients who have entrusted their funds with a long term mandate prefer to see derivative positions in their portfolio? Equating non-hedging derivative positions with speculation.

(7)

[13 Marks]

Soultion 4:

i)

- A measure of short-term market movements
- Providing a history of market movements and levels
- As a tool for estimating future movements in the market, based on past trends
- As a benchmark against which to assess the investment performance of portfolios
- Valuing a notional portfolio
- Analysing sub-sectors of the market
- As a basis for index funds that track the particular market
- To provide the basis for the creation of derivative instruments relating to the market or a sub-section of the market
- If it is a government bond index

- A standard against which yields on other fixed interest investments can be assessed
- Approximate valuation of a fixed interest portfolio
- Providing a picture of general yield structures of fixed interest investments
- Comparison to be made with yields on ordinary shares as a measure of the yield gap between bonds and equities

(6)

ii)

- The selection process can probably begin with the constituents of a broad based index like say CNX 500 as the selection universe.
- The quantitative parameters that a company should satisfy in order to be considered for the index should be pre-determined. The following metrics may be considered as proxy for quality
 - ROE or ROCE
 - Debt to Equity Ratio or interest coverage ratio
 - Financial performance over last say 5 years (in terms of growth in EBITDA or PAT)
- Following exclusion criteria may also be considered
 - Free float say more than 25%
 - Non-negative net worth (after adjusting for goodwill if any) etc.
 - Dividend track record – say uninterrupted over last 3 years
 - Companies which have made losses in any of the last 3 years
- Once the parameters are decided then the next step is to zero in on weights for each parameter
- A quality score (say q) is arrived at for all the companies in the universe that are considered for being a part of the index after the exclusion criteria based on the weights for each parameter
- Top 30 stocks based on q score is taken as the constituents of the index to start with
- It can be an equal-weighted index or free float weighted index or MCAP weighted index
- It is preferable to have it as a Total Return Index
- The value of the index as on a particular date selected (day on which funds are transferred to the new fund house) may be rescaled to say 100
- Corporate actions need to be adjusted using say a chain linking method
- The index maybe revised say on an annual basis
- Details of benchmark may or may not be shared with the fund manager depending on the Management's policy

(11)

[17 Marks]**Solution 5:**

i)

- Contango Market is a commodity futures market where the futures price normally exceeds the spot price. This is usually because the cost of carry (the financing cost of holding the underlying commodity, plus storage costs) is positive and future price = spot price + cost of carry.
- Future price = spot price + cost of carry – convenience yield.

- A situation when the convenience yield is higher than the cost of carry making the futures price lower than the spot price is known as backwardation.

(2)

ii)

- The customer uses the chemical to manufacture a leading detergent brand which is a consumer product
- It is likely that the customer is facing quite a bit of volatility in prices of the raw material and it is difficult to readjust the consumer product price up or down regularly like a commodity
- The customer would probably prefer more stability in the pricing of raw materials so that he can plan other cost heads in a better manner. This can make operations more predictable.

(3)

iii)

- The raw material and finished product for ABC are both commodities and they keep fluctuating while the spread between the prices is probably much less volatile
- If ABC agrees to the supply arrangement then it is exposed to significant volatility on the raw material front.
- Say ABC enters into the agreement and then the price of raw material goes up sharply then ABC may end up making severe losses. Hence ABC has to go in for a hedging programme to negate the effect of one sided exposure to commodity price volatility.

(3)

iv)

- The intended hedging programme of the CFO works if company takes a long position in futures and rolls it over rather than going short.
- A long term fixed price supply arrangement of the product is akin to going short on the product
- This needs to be negated by taking an equivalent long position in the futures equivalent to the quantity of product supply committed
- As and when the product is supplied to the customer equivalent quantity of futures need to be unwound so that the open futures position at any point of time will be equal to the quantity remaining to be supplied under the supply arrangement
- If the price of the raw material and finished product go down you make a loss on the long future position but a gain on the physical supply and vice versa
- Since only near month futures are available the open position towards the expiry of the futures needs to be rolled over to next month

(5)

v)

- Usually far month futures trade at a premium to near month futures as they need to reflect cost of carry
- In this case the cost of carry is negative. This would mean that upon expiry the company would be selling the near month futures and buying the far month future which is at a discount to the near month future

- So each rollover leads to a gain equivalent to open position quantity multiplied by the discount of far month future to near month future. Hence CFO feels that the deal is lucrative.

(3)

vi)

- Hedging is possible if company goes long on futures rather than short as suggested by CFO but the strategy is fraught with risks
- Highlight the lack of expertise of the company in entering into the deal
- Futures trading in chemical X have recently started. What if the exchange finds that the required volumes are not to their expectations and discontinue it. Company will be exposed to a massive unhedged exposure
- What is the position limit imposed by the exchange? Will the exposure required by ABC lead to any of the limits being breached as the exposure needed by ABC (three years supply) can be sizeable
- Is the future at a discount to spot sustainable? On what volumes is the past trend observed? What is the reason for the unusual trend witnessed? Negative cost of carry is not a usual phenomenon. Is it prudent to assume it for the next three years?
- With ABC taking a position where during a rollover there is a high buying for far month and high selling in near month will the position of discount reverse to one of premium? If that is the case the rollover will come at a cost. Has this cost been considered in pricing?
- There is a serious ALM issue here as the company is hedging a long term liability using short term financial instrument. The problems associated with ALM mismatch needs to be elaborated.
- The exit clause in the contract needs to be analysed. If the price of chemical X falls sharply and the customer reneges his contract or renegotiates the price downwards what will be the consequences.

(7)

[23 Marks]**Solution 6:**

(i)

a. **Company**

- **Market risk**
 - This is the risk of unpredictable falls in the value of its surplus of assets over liability due to unpredictable changes in the market values of the assets in which it is invested.
 - As the annuity amounts are fixed at outset, the fall in value of the assets needs to be closely monitored.
- **Liquidity risk**
 - This is the risk of not having sufficient cash to meet annuity payouts and other operational needs at all times.
 - It is related to market risk in as much as the liquidity of the overall portfolio needs to be taken into account in portfolio selection.
- **Credit risk**
 - This is the risk that a counterparty to whom the insurance company has loaned money (eg a bond issuer or a swap counterparty) may default on their legal obligations to make capital and interest payments.

- Credit risk due to default and risk due to rating downgrade which can affect ALM.
- Currency risk – if foreign assets are also being held
- ALM risk – if assets matching liability is not available and mismatch is there and later interest rates fall.
- Operational risk - the risk of loss due to fraud or mismanagement within the fund management organisation itself.
- Relative performance risk – the risk of under-performing other life insurance Companies.

(4)

b. Policyholder

- Inflation risk rendering chosen annuity inadequate
- Company risk – company becoming insolvent or getting acquired and guarantee is not kept.

(2)

(ii)

- An overall market risk control guideline for the main fund could be based on a Value at Risk (VaR) measure, eg “a reduction in the statutory free assets of 10% over a one-year period must have a probability of less than 95%”.
- To ensure that the VaR limit is not breached fund managers might be given a benchmark asset distribution reflecting the liabilities for this business
- Permitted ranges would then be established within which managers have freedom to depart from the benchmark. These could be set either as a load difference (eg limiting corporate bonds to below 10% of the total portfolio) or a load ratio.
- Techniques that can be used for identifying and measuring liquidity risk include the cash budgeting / short-term financial planning techniques.
- Liquidity gap analysis may also be carried out. Liquidity gap or net liquid assets are defined as the difference between the level of liquid assets and volatile liabilities.
- A more rigorous approach is duration analysis. This involves the concept of liquidity duration or liquidity risk elasticity (LRE), where the impact of changes in market conditions is considered. The process consists of two steps:
 - Calculate the present value of assets and liabilities using the “cost of funds” rate as the discount rate.
 - Measure the change in the market value of the institution’s equity (LRE) from a change in the cost of funds.
 - If the LRE is zero, the institution has zero liquidity risk (by this measure).
 - If the LRE is sharply negative, it will pay the institution to shorten the maturity of its assets and lengthen the maturity of its liabilities, thereby increasing liquidity.
- The creditworthiness of counterparties can be controlled by placing limits on the credit ratings (as published by the major rating agencies) with which the insurance

company may deal, eg no investment in bonds with a “BBB” rating or lower.

- It can also be controlled in derivatives transactions by dealing on a recognised exchange with a central clearing house which stands as counterparty to all deals, rather than over the-counter.
- Limits should be placed on the credit exposure to any single counterparty. In applying this type of guideline the insurance company will need to allow for the particular relationships between different companies within the same group.
- Credit derivatives such as credit default swaps could also be used to limit the credit exposure to particular borrowers.
- With good management practices including having established and documented chains of reporting and responsibility, Operational risk could be controlled.
- An example of this could be separation of “front office” and “back office” functions

(8)

(iii)

- Ensure security by maintaining solvency coverage (in some cases allowing for planned future contributions to the fund).
- Aim to generate long-term investment returns above the risk-free rate so as to reduce the size of required future contributions.
- The first of these objectives will encourage hedging of liabilities and holding low risk assets.
- Whereas the second of these objectives will encourage holding more risky assets in pursuit of excess returns (and reducing hedging activity where there is a cost to hedging).

(4)

iv)

- Liability hedging is where the assets are chosen in such a way as to perform in the same way as the liabilities.
- The liability in this case will change with the change in WPI
- WPI linked bond would be helpful to hedge the liabilities.
- So that the coupon and principal proceeds from the bond portfolio can be used to meet the obligation to make the payments.
- However, such a longer duration bond may not be available.
- If the longer duration bonds are not available then it will require reinvestment thus exposing to reinvestment risk.
- Due to “gaps” between bond maturities (particularly at longer durations), there may be a need to reinvest or disinvest bonds prior to maturity, and the hedge may therefore be imperfect.
- If the tax status of the government bonds worsens, this will mean the assets are likely to be insufficient to meet the liability payments.
- The use of such bonds may result in credit risk.
- Alternatively, combinations of inflation swap and inflation-linked swap can be structured.
- Interest rate and inflation swap markets may have longer maturities available than bond markets.

- These would have the added advantage of having greater liquidity and lower transaction costs.
- Swaps permit hedging to be achieved without full asset cover being required, as they are a contract for difference rather than a funded asset.
- The bespoke nature of a swap means that closing out a swap position is more complex than selling a bond.
- However, in a liquid market closing out a swap may in fact have lower transaction costs than selling a government bond.
- If the swaps are subject to collateralisation (to mitigate credit risk), then this will require the movement and investment of collateral on a daily or weekly basis.
- Such arrangements are subject to counterparty risk, if the counterparty bank defaults.
- To hedge longevity risk, longevity bond or longevity swap could be purchased.

(10)

[28 Marks]
