

Institute of Actuaries of India

Subject ST5 – Finance and Investment A

November 2010 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.

Q1:

i)

a) **Myopic Loss Aversion:** This is similar to prospect theory, but considers repeated choices rather than a single gamble. Research suggests that investors are less risk-averse when faced with a multi-period series of gambles, and that frequency of choice/length of reporting period will also be influential.

(b) **Prospect Theory:** Prospect theory is a theory of how people make decisions when faced with risk and uncertainty. It replaces conventional risk-averse/risk-seeking decreasing marginal utility theory based on total wealth with a concept of value defined in terms of gains and losses relative to a reference point. This generates utility curves with a point of inflexion at the chosen reference point.

(c) **Estimating Probabilities:** Issues (other than anchoring) which might affect probability estimates include:

Dislike of “negative” events – the “valence” of an outcome (the degree to which it is considered as negative or positive) has an enormous influence on the probability estimates of its likely occurrence.

Representative heuristics – people find more probable which they find easier to imagine. As the amount of detail increases, its apparent likelihood may increase (although the true probability can only decrease steadily).

Availability – people are influenced by the ease at which something can be brought to mind. This can lead to more biased judgments when examples of one event are inherently more difficult to imagine than examples of another.

ii)

Three techniques to identify a policy switch:

Volatility and duration: Calculations of volatility or duration together with forecasts for changes in yield at different points along the yield curve can be used to estimate percentage changes in value and so determine the area of the market which will give the best returns, if forecasts prove accurate.

Reinvestment Rates: Consider two bonds A&B, the latter having a longer term to maturity. Knowing yields to maturity, it is possible to compute a rate at which the proceeds of the first bond would have to be re-invested, up to the maturity of the second bond to match its total return. If this re-investment rate is particularly high, it may be considered unattainable, leading to the conclusion Bond B offers better value. It is useful to select representative bonds along the curve, calculate the series of reinvestment rates, and identify areas which appear cheap/or dear in relation to neighbouring areas.

Spot rates and forward rates: Derive spot/and or forward rates from the yield curve. This may reveal oddities in the term structure of interest rates which may give rise to a policy switch opportunity.

iii)

Limitations of classical immunization theory:

1. The theory relies upon small changes in interest rates. The fund may not be protected against large changes.
2. The theory assumes a flat yield curve and requires the same change in interest rates at all terms. In practice, the yield curve does change shape from time to time.
3. In practice, the portfolio must be rearranged every day to maintain the correct balance of:
 - Equal discounted mean term
 - Greater spread of asset proceeds
4. Assets of suitably long discounted mean term may not exist.
5. The timing of asset proceeds and liability outgo may not be known.

[8]

Q2:

i)

Term	Zero Rate	Discount Factor (dt)
1	0.038	0.963391137
2	0.029	0.944428861
3	0.027	0.923184851
4	0.026	0.902423834
5	0.025	0.883854288

	Fixed Rate	Notional (£m)
Swap A	0.0315	100
Swap B	0.026	120

Swap A

Value (Fixed) = $0.0315 \cdot (d1 + d2 + d3) + d3 = 1.012362$

Value Floating = 1

Net value = $100 \cdot (1.012362 - 1) = \text{£}1.23615\text{m}$

Swap B

Value (Floating) = $1 \cdot d2 = 0.944429$

Value (Fixed) = $0.026 \cdot (d3 + d4 + d5) + d5 = 0.9543$

Net value = $120 \cdot (0.944429 - 0.9543) = \text{£}-1.18458\text{m}$

Total value of swaps to Banco = $A + B = 1.23615 - 1.18458 = \text{£}0.051575\text{m}$

ii)

a) The life insurer will only have credit exposure on a swap which has a positive value to the life insurer. In this situation, if the bank defaults, the insurer loses the positive value of that particular swap.

b)

Collateral: Using some pre-agreed formula, the swap positions will be valued or marked to market at pre-agreed intervals (note that illiquid hedges may be difficult to value). If the total value moves in favour of the insurer, then the investment bank will post collateral (e.g cash or government bonds) to the insurer. This will act as security against the insurer's exposure to the bank.

Netting: The insurer could make the following agreement with the bank. If the bank defaults on its outstanding obligations to the insurer (i.e swap positions which have negative value to the bank), then it must default on all of the swap positions with the insurer. Therefore, this could reduce potential losses to the insurer if the bank defaults.

Downgrade (credit) triggers: A clause stating that if the credit rating of the bank falls below a certain level (say Baa), then the insurer has the option to close out the swap positions at their market value (using a pre-agreed formula).

[8]

Q3:

a)

The regulation of financial markets is very important to maintain confidence in financial system and due to asymmetry of information, expertise and negotiating strength between provider and customers.

Therefore, the main areas that need attention of financial regulators are:

- 1) Information asymmetry: Information asymmetry can be reduced or mitigated by requirements for a service provider to disclose full information regarding products and about itself in an understandable form.
- 2) Conflict of interest: Knowledge held by service provider about third party should be restricted by inside trading regulations and by applying “Chinese walls” or separation of functions techniques.
- 3) Negotiation: Weakness of an individual in negotiating a deal with a large institution should be addressed by applying price controls, giving customers time to terminate a deal within a certain period like cooling off period.
- 4) Capital Adequacy: Rules governing sufficient capital to cover liabilities so as to protect customers and to reduce systematic risks.
- 5) Competence and integrity: To ensure competency and integrity of financial practitioners and managers.
- 6) Compensation/protection Schemes: Some kind of investors protection or compensation mechanism to compensate investors in case of default or systemic failure.

b)

Corporate governance refers to the high level framework within which managerial decisions are made in a company.

A Board of Directors (BoD) is responsible for the governance of a company. Typically a BoD consists of:

- Executive directors
- Non-executive (independent) directors

A good corporate governance means that a company should be governed in a way so as to meet the appropriate requirements of all the stakeholders, like shareholders, employees, customers, suppliers etc.

In current times, it is important to have good corporate governance mechanism so as to avoid agency problems due to separation of management from ownership.

[8]**Q4:****a) Trustee Proposal:**

The trustees are required to act in the interest of scheme members.

- The accounting practice in India, AS15 (Revised) requires assets to be considered at market value and prescribes government bond yield for discounting of liability cash-flows.
- Strategic asset allocation should reflect liability profile eg term and nature of the assets with respect to liability cash-flows.
- Equities are typically used to match long term salary related liabilities, mainly for active members, but are very volatile in nature.

- Bonds are typically used to match fixed liabilities and are normally less volatile.
- Inflation linked liabilities are generally matched by index-linked bonds.
- Strategic asset allocation should not be influenced by some current events, rather it is a long term view.
- As country's accounting policy requires government bond yield for discounting, investing in corporate bond fund will not be exact match.
- Investing in the corporate bond fund will bring in additional credit and spread risks.
- As the scheme is final salary linked, moving to corporate bond fund will also break the link with salary inflation.
- As the other half of the portfolio is in traditional superannuation fund, it is also invested primarily in fixed interest bonds, therefore after the switch, almost 100% of the portfolio will be in fixed interest bonds, therefore no matching for annuities based on final salary which are inflation linked in payments.
- The traditional fund is valued at book value, while the liabilities will be at fair value based on current yield, it also introduces volatility in P&L.

b) Main points to consider:

- Exit load on equity fund and entry load on corporate bonds fund.
- Bonds profile (rating, tenure) of corporate bonds fund.
- Is this a temporary or permanent switch.
- If temporary, do derivatives overlay will be cheaper than exiting and entering funds.
- If derivative overlay is cheaper, will it cause any reporting problem.
- If permanent, how to match the liability cash-flows if the asset cash-flows are not real in nature.

[10]

Q5:

- As ABC is a well reputed and well company in its field, it is expected that XYZ is also well known company as current market capitalization of both the companies are almost similar, in fact XYZ is a bit higher. Therefore, it is expected that future profitability of the combined entity can be easily projected.
- It is expected that lots of synergies can be released through the merger, like operating costs related to office space, premises etc. Merger can bring economy of scale in many areas.
- Merger will also remove one of the competitors and hence may result in increase in the price of services.
- Merger will also incur some costs and will also take some time and therefore will consume management time also.
- A cost benefit analysis needs to be done after considering all the costs and benefits.
- The market capitalization of XYZ is higher than ABC though its revenues are lower. Before making a bid, it is important to ascertain the reasons for this.
- After considering all these factors, impact on ROE needs to be calculated.

- Funding for the bid needs to be considered. As market capitalization of XYZ is slightly more than ABC, ABC may not be in position to make an all cash-out bid with its accrued profits.
- To make an all cash bid, option of leveraged finance or any other finance option needs to be considered.
- Instead of a cash bid, shareholders of two companies might agree to swap shares in a new combined entity.
- Any other rival company can also make a counter bid for XYZ. If this happens, cost of acquisition may increase. ABC must factor in this scenario before making a bid of acquisition.
- ABC must also do some human resource planning before making a bid. Transition period before the formation of a combined entity may witness many top management and other employees of ABC/XYZ resigning and moving to other competitors.

[7]

Q6:

i)

- The company needs to decide the optimal hedge ratio for their currency exposure. They must also decide how to hedge the currency exposure.
- Assuming the liabilities are all denominated in the currency of country X, the overseas investments represent a potential asset liability mismatch risk. The more the currency risk is hedged, the more stable the earnings/financial position of the company.
- However, unhedged currency exposure may be seen as a separate asset class that could diversify investment return, though this depends on correlations within the portfolio.
- Risk appetite of the company – the company may prefer large hedge ratios. The company is unlikely to want to speculate on currencies. Any ALM guidelines/risk policies will be useful when deciding the extent of hedging.
- Exchange rates – examine past (and future projected) volatility and correlations in the relevant currency pairs (country X vs relevant overseas currency). More volatile currency pairs indicate greater need for hedging. Weak correlations between currency pairs could create an overall offset that lowers the required hedge ratio.
- The size of the overseas exposure (in absolute terms and/or in relation to the entire asset portfolio) should be large enough to justify the costs of hedging.
- Rebalancing - Frequent rebalancing of the hedge may increase transaction costs and reduce potential gains from the hedging. Could set a tolerance around optimal hedge ratio, so that positions will need to be monitored and rebalanced to stay within limits.
- Instruments – Company likely to use OTC currency forwards and OTC currency swaps for FX hedging. Swaps/Forwards have zero initial cost, but remove possibility of profits from favourable currency movements.
- If the term of derivative contracts is less than term of overseas investment, company may need to rollover contracts at unknown rate to match term of overseas investments – this causes residual FX risk.
- A range of assets seems to be held overseas, so will need more information on exact asset holdings. It will be difficult to accurately hedge foreign currency risk in uncertain exposures (e.g equity portfolios). Bond cashflows (coupons/redemptions) are more certain (but this depends on credit quality of bonds) and the FX risk may be easier to hedge.
- Operational issues – Any proposed hedging instruments should be within the company's investment guidelines/approved derivative classes. Proper controls will be needed to ensure managers use currency derivatives within agreed guidelines. Any OTC instruments used for currency hedging will have credit risk that needs to be managed.
- Reporting – hedge transactions need to be adequately reported and accounted for. The economic effect of the hedges needs to be visible to stakeholders in accounts etc.
- Regulations in country X (current and forthcoming) may influence currency hedging strategy.

ii)

- Physical – as no derivatives are being used, the switch is conducted via physical sales/purchases in equity shares.
- Costs – significant transaction costs (stamp duty, broker commission, bid/offer spreads) and administration costs (custodian) will be incurred. Research costs will be incurred when deciding which stocks to buy/sell.
- A large transaction seems to be considered by the company. The costs of market impact may be material. The switch may need to be conducted over an extended period. The process may be lengthened if smaller shares are involved.
- Manager selections – will need to select which managers in country X should sell the equities. Will need to select which managers should buy the overseas equities in Y and Z.
- Research – need to research which shares should be purchased in Y and Z, and which shares should be sold in country X. This requires time, skill and expertise. Any poor selections could result in sub-optimal equity portfolios.
- Delays – Company could be out of the market for an extended period of time i.e country X shares are sold, but the cash is not immediately re-invested in Y and Z. This is due to settlement delays from selling equities in X. Delays will also be encountered when converting this cash into the currencies in Y and Z to purchase the new shares. Any unfavourable market moves/currency moves in this period could result in losses.
- Tax liabilities may be crystallized when shares in country X are sold.

[15]

Q7:

i)

- Shares in private equity investments are not freely available for trade and thus the index is not necessarily investable.
- Price data is difficult to obtain at frequent/regular intervals.
- Market value of unquoted investment is only known when it is sold.
- Deals may be treated with a degree of confidentiality.
- Companies may not have obvious comparators that can be used as a proxy
- Consequently any estimation of values is subjective and expensive.
- Private equity investments are unlikely to pay dividends, so any yield on the index will not reflect the universe of companies but the actions of just a few companies.

[4]

Q8

i)

- Increase in correlation spreads the losses further up the CDO tranches towards senior.
- This has the impact of reducing the value of the senior tranches and hence (assuming no change in default probability) increasing the value of the junior tranches.

ii)

- The securitisation can be structured as a CMO [Collateralised Mortgage Obligation] whereby the MBS is issued in several tranches. The first tranche accepts all of the early repayments [prepayments] from the mortgage owners thereby insulating the other CMO tranches from the impact of prepayment. When the first tranche is paid off, the prepayments tend to impact the second tranche and so on.
- Thus in a CMO each tranche can be targeted at investors with specific maturity requirements.

[4]

Q9

- The announcement of the takeover has caused X's share price to jump up (evidenced by the activity on Nov 11th 2010). The hedge fund seems to have reacted quite late and may have acquired the stock just below the closing price e.g Rs10.75. The hope is that the takeover happens, and the hedge fund can tender its shares in X at Rs11 to company Y, thereby profiting from the increase. The leverage employed by the hedge fund will amplify this return.
- The hedge fund would make extra profit if the final takeover price exceeded Rs11 (e.g due to a bidding war)
- If the hedge fund had reacted earlier, it would have probably been able to buy the stock at a much cheaper price. This would have resulted in higher upside potential and lower downside risk.
- The principal risk is that the merger may not happen (for reasons outlined below) and X's share price could easily fall back to pre-announcement levels. In this situation, the losses to the hedge fund could be considerable, and would be amplified by the leverage in its' position.
- The merger may not happen - it may not be accepted by X's shareholders, or may not be permitted by anti-monopoly regulators.
- In addition, company Y may choose to terminate its offer if the merger becomes unviable e.g interest rates may increase, thereby increasing the cost of its debt finance.
- Even if the merger happens, it may be delayed and take much longer than a few months to complete. This means the hedge fund's annualized return may be lower than expected.
- The merger may happen at a price much less than Rs11. For the hedge fund, this would mean a lower return than anticipated, and could even result in a loss.

[4]**Q10:**

i)

- Hedging
- Income Enhancement
- Trading or speculation
- Arbitrage
- Portfolio Management

ii)

a)

Company could buy European Call option on Sensex index, which expires in 1 year, with strike price equal to 18530 (=109% current index level).

If index finishes above 18530, company exercises option and receives excess above the strike price. This offsets the loan repayments it has to make when the index exceeds 18530. The net effect is to limit the company's liability to a 9% increase in the index.

If index finishes below 18530, then company does not exercise the option.

To finance the cost of the call option, the insurer could sell a European Put option on the Sensex, which expires in 1 year, with strike price equal to the current index value. Therefore, the insurer would not benefit on the loan if the index declines, because any gains on the loan are offset by losses on the short p

b)

Company could sell European Put option on Sensex index which expires in 1 year, with strike price equal to 13600 (=80% of current index level.)

If index finishes below 13600, the option is exercised by the purchaser and company must sell the index for 13600. This offsets the gains (or savings) the company makes on the loan when the index falls below 13600. The net effect is to limit the company's gain to a 20% decrease in the index.

If index finishes above 13600, then the purchaser will not exercise the option against the company.

iii)

Two methods (variants of put call parity)Method 1

Buy a 5 year OTC European Call Option based on FTSE 100 Index. This provides the upside.

Buy a 5 year Zero coupon bond equal to the value of the capital guarantee

Method 2

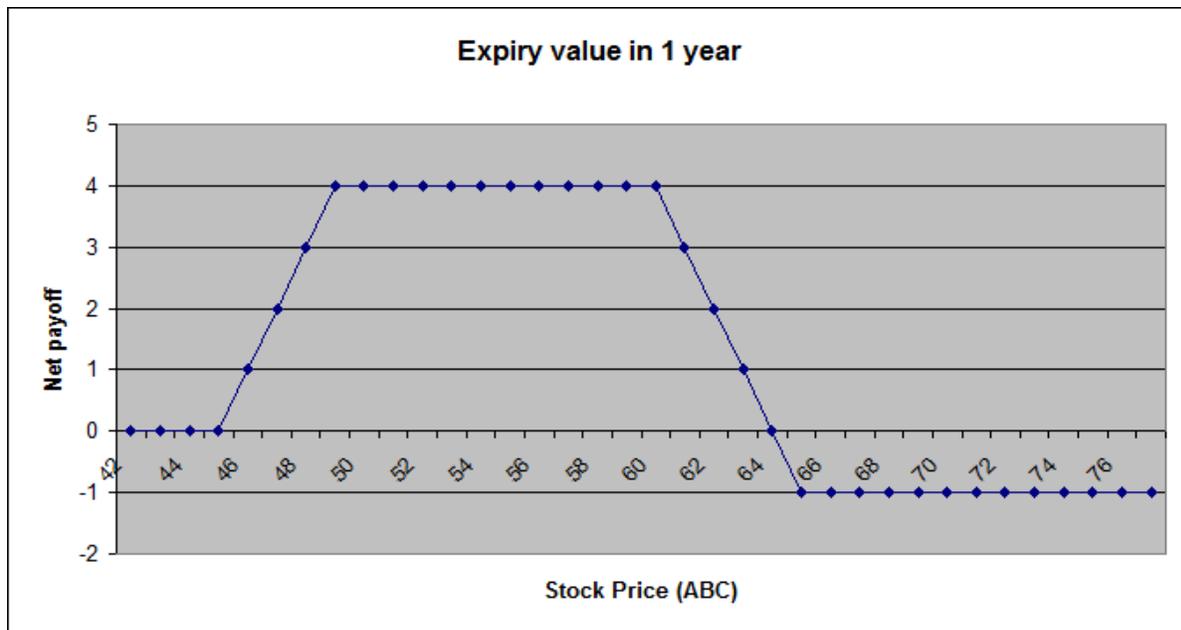
Buy a Portfolio of equities tracking performance of FTSE 100 (or use a suitable forward contract/futures contract on the FTSE100)

Buy a 5 year OTC European Put Option based on FTSE 100 index.

iv)

Preferred Option Strategy is: Buy 1 put (strike = 65), sell 1 put (strike = 60), sell 1 put (strike = 49), Buy 1 put (strike = 45).

Cost : Re 1 (11-8-3+1)

Possible strategies candidates may propose

Strategy number	Strategy	Cost of Options	Profit if stock price = 58 (unchanged)	Payoff when stock price <40
A (award 1 mark)	1 Long put (strike = 65) 1 Short put (strike = 60)	11-8=3	5-3=2	non-negative
B (award 0 marks)	1 Long put (strike = 65) 1 Short put (strike = 60) 1 short put (strike = 49)	11-8-3 = 0	5-0 = 5	Negative
C (award full 3 marks)	1 Long put (strike = 65) 1 Short put (strike = 60) 1 short put (strike = 49) 1 long put (strike = 45)	11-8-3+1=1	5-1 = 4	non-negative

b)

Return from option strategy	:	400%	(4/1)
Return from just buying stock	:	1.72%	(59-58)/(58)
Additional return from option strategy	:	400-1.72 = 398.28%	

[15]

Q11:

1) Different Asset Classes:

1) Domestic assets

- Domestic FI Government bonds
- Domestic inflation index linked Government bonds
- Domestic floating rate Government bonds
- Domestic FI corporate bonds
- Domestic inflation index linked corporate bonds
- Domestic floating rate corporate bonds
- Interest rate swaps
- Inflation swaps
- Credit swaps
- Equities and properties
- Cash investments

2) Overseas assets

3) Currencies futures/swaps

2)

Mismatching risks: It seems based on the available assets, the duration of liabilities cash-flows will be much longer than the duration of domestically available fixed interest and index linked bonds. The insurer can take interest rate and inflation rate swaps overlays to mitigate mismatching risks

Interest rate risk: This risk implies different movements for assets and liabilities with the movement in interest rate. The risk is mitigated by investing in FI bonds and taking interest rate swaps overlay if FI bonds of required tenures are not available.

Inflation risk: Because some of the annuities cash-flows are linked to inflation, high inflation may pose problem for the insurer. The risk is mitigated by investing in index linked bonds and inflation swaps overlay.

Credit risk: This is the risk of default or increase in spread on corporate bonds. As government is running budget surplus, it may not issue government bonds. Therefore, the insurer may be forced to buy corporate bonds since the yield on existing government bonds may drop due to increase in demand.. The credit risk associated with corporate bonds can be mitigated by taking credit swaps overlays.

Risks associated with overseas assets: The insurer can buy overseas assets, but as the Central Bank of the country pursues aggressive monetary policies to help exporters, the domestic currency is expected to depreciate with the time. To mitigate this risk, the insurer needs to take currency futures/swaps on overseas assets besides other risks mitigating avenues on overseas assets like credit swaps etc.

Risk of higher capital requirements: The best assets to keep the capital requirements on lower level are domestic government bonds, but if these are not available at appropriate rates, the insurer will have to buy domestic corporate bonds and also overseas bonds. To keep the risks down, the insurer should also buy proper swaps like credit and currency swaps.

8

3)

LPI liabilities: The RPI linked liability cash-flows can be matched by index linked bonds or inflation swaps, but matching of LPI liability cash-flows pose additional challenge from matching perspective.

ALM on best estimate cash-flows or cash-flows on reserving basis: What liability cash-flows to be considered to be matched by assets cash-flows. Liability cash-flows on reserving basis will be higher than liability cash-flows on pricing basis.

Effect on capital requirement: As country's regulations provide any asset but with very prudent risk margin, the Investment Director will have to balance returns with capital needs.

[17]

[Total Marks 100]
