# Actuarial Society of India

## Examinations

## November 2005

## ST5 – Finance and Investment A

## Indicative Solutions

**Q.1)**

Securitisation is the issue of securities, usually bonds which are serviced and repaid exclusively out of a defined element of future cashflow owned by the issuer. **[0.5]**

Securitisation therefore converts a portfolio of often unmarketable assets into a structured financial instrument which is then negotiable. **[0.5]**

The bondholders have no claim on any other cashflow or assets of the issuer **[0.5]**

Securitisations are set up in such a way that the underlying assets and their associated future cashflows are expected to comfortably cover the interest and capital payments of the asset-backed security with ample margin to spare. **[1]**

The key requirement for an asset to be used as the basis of a securitization is that it generates a reasonably predictable income stream. **[0.5]**

Examples of asset classes used are:

- Residential and commercial mortgage-backed securities – where the payments are collateralized on the interest and capital payments made under the mortgages used to buy property **[1]**
- Credit card receivables – collateralized on the payments made by credit card holders **[0.5]**
- Collateralized loan, bond and debt obligations – collateralized on existing bank loans and bond **[1]**
- Student loans **[0.5]**
- Future profits from in-force business (in the case of a life insurer) **[0.5]**

**Q.2)**

**i)**

Global funds – these try to profit from taking a view on economic change around the world, in particular changes in interest rates and exchange rates **[1]**

These funds will take a combination of long and short positions that reflect the hedge fund manager's views on how macroeconomic factors such as the levels of international asset markets, interest rates and currencies will move **[1]**

The funds may also borrow or use derivatives to speculate on the fund manager's views **[0.5]**

These views will depend on economic trends globally and major international events **[0.5]**

Event Driven funds – these trade the securities of companies in reorganization and/or bankruptcy or companies involved in a merger or acquisition **[1]**

The aim is to profit from share price movements resulting from anticipated corporate events e.g. mergers and acquisitions **[0.5]**

The risk that merger or acquisition does not go ahead is referred to as deal risk and is generally uncorrelated to overall market movements **[0.5]**

Market-Neutral funds – these simultaneously enter into long as well as short positions, so as to have no net exposure to overall market movements **[0.5]**

These funds invest to exploit pricing inefficiencies in the markets to make stock selection profits **[0.5]**

The extent of market-neutrality varies between funds. Funds may be beta neutral and/or currency neutral. They may also be neutral in some more stringent ways e.g. by equity sector or size of company**.** **[0.5]**

**ii)**

The exact ranking would depend on the precise strategy a particular fund was executing, but a typical order in descending order of risk would be:

- Global
- Event driven
- Market neutral

**[1]**

Global funds tend to be most risky as there is generally greater scope for profits (or losses) by taking positions on whole sectors of the markets rather than on individual stocks.

**[1]**

Both event driven and market neutral funds attempt to profit from anomalously priced stocks. Market neutral funds will tend to be less risk as by definition they are structured to be insensitive to movements in the overall level of the market.

**[1]**

**Q.3)**

**i)**

For any given term the expected default loss is given by:

value of Treasury bond – value of corporate bond **[1]**

This assumes that:

- The higher yield on corporate binds is entirely due to compensation for possible default losses **[0.5]**
- The two bonds are otherwise very similar – i.e. similar term and coupon **[0.5]**

**ii)**

Strip each bond into its coupon and principal payments, and treat each as a series of zero coupon bonds. The present value of each equivalent zero coupon bond is then:

| Year | 1 | 2 | 3 |
|---|---|---|---|
| Company Bond | 6/1.08 = 5.556 | $6/1.08^2 = 5.144$ | $106/1.08^3 = 84.146$ |
| Government Bond | 6/1.07 = 5.607 | $6/1.07^2 = 5.241$ | $106/1.07^3 = 86.528$ |

**[2 marks for the complete table above]**

So the cumulative percentage expected default losses to the end of each year are:

Year 1 (5.607 – 5.556) / 5.607 = 0.9096%
Year 2 (5.241 - 5.144) / 5.241 = 1.8508%
Year 3 (86.528 – 84.146) / 86.528 = 2.7529%

**[1]**

The expected percentage losses due to default within each year are thus:
Year 1 0.9096%
Year 2 1.8508 – 0.9096 = 0.9412%
Year 3 2.7529 – 1.8508 = 0.9021%

**[1]**

So the absolute expected default loss within Year 3 is equal to 0.9021% of the PV of the payments in Year 3 i.e.

0.009021 x 86.528 = 0.7806 **[0.5]**
which as a percentage of the total value of the government bond is equal to:

[0.7806 / (5.607+5.241+86.528)] x 100% = 0.802% **[0.5]**

**iii)**

The above might be an overestimate because comparisons of actual default losses based on historical data with expected default losses calculated from bond prices in this way typically reveal a systematic overprovision for default losses in bond prices.

**[1]**

This means that even after taking account of the impact of defaults investors can expect significantly higher returns from investing in corporate bonds than from investing in treasury bonds

**[0.5]**

This could:

- Be due to investors making allowances for future default losses that are much worse than those experienced during the historical reporting period **[0.5]**
- Be due to the impact of lower corporate bond liquidity on bond prices **[0.5]**
- Partly be compensation for the risk of higher defaults **[0.5]**

This will be the case if bond investors are risk averse, which is probably the case in practice **[0.5]**

**Q.4)**

**i)**

(+) An attractive share incentive scheme can help attract and retain quality management as part of the overall remuneration package. **[0.5]**

(+) Such a package encourages managers to act in shareholders interests, this is in line with good corporate governance **[0.5]**

(+) It may be more tax-efficient to offer share options than additional salary or other benefits **[0.5]**

(-) It is difficult to devise a package with enough downside risk to the management **[0.5]**

(-) Management may focus on actions to increase short-term value, rather than on improving the company's long-term prospects. This can be to the detriment of all stakeholders. (in the extreme case management may act to artificially increase the share price)

**[0.5]**

(-) The option is not appropriate if the shares are tightly held by a few investors, or not listed and restrictions need to be imposed on when management may sell shares **[0.5]**

**ii)**

The directors' primary aim is to ensure the solvent trading and long-term future of the company **[0.5]**

In addition, they need to demonstrate good corporate governance by acting in the best interests of the stakeholders rather than in their own interest. Stakeholders include shareholders, employees, customers and suppliers. **[0.5]**

Good governance will be demonstrated by:

- Seeking to improve shareholder value, and acting in the best interests of shareholders in times of takeover, merger or share issue **[0.5]**
- Ensuring the solvent operation of the business to ensure the long term financial and career prospects of employees **[0.5]**
- not seeking to make excessive profits from customers (this is particularly a risk in the case of monopolies). **[0.5]**
- Paying appropriate recompense to suppliers, this is particularly a risk where monopolies operate. **[0.5]**

The directors need to ensure that they comply with all legislation and should be open and honest in their dealings with all parties. **[0.5]**

The directors will be responsible for:

- ensuring timely accounts are produced in line with regulation and give a true and fair view of the performance of the company **[0.5]**
- choosing appropriately skilled and experienced management to run the company **[0.5]**
- setting the dividend levels, balancing the need to return money to shareholders against the need to reinvest for the long term interests of the business **[0.5]**

Non-executive directors are likely to have responsibility for appointing new board members and for setting the remuneration packages of executive directors. **[0.5]**

Non-executive directors are likely to have a key role in the audit committee checking the operation of the company and its finances **[0.5]**

**Q.5)**

**i)** By definition the duration of a 4-year zero-coupon bond must be 4 years **[0.5]**

In addition, the annual effective spot rate offered by the zero coupon bond is equal to:

$$i = e^{0.0562} - 1 = 0.05781$$ **[0.5]**

The modified duration of the bond is therefore:

$$D = \frac{\text{Duration}}{1+i} = \frac{4}{1.05781} = 3.7814 \text{ years}$$ **[1]**

**ii)** The current price of the bond is given by:

$$B_0 = 100\, e^{4S_4} = 100e^{4x0.0562} = 79.868\%$$ **[1]**

So the forward price of the bond at the strike date of the option is given by:

$$F_0 = B_0 e^{S_1} = 79.868e^{0.0511} = 84.055\%$$ **[1]**

The initial forward yield of the bond $y_0$ can therefore be found from:

$$100 = F_0 (1+y_0)^3 = 84.055(1+y_0)^3 = 0.05961$$ **[1]**

This yield must be compounded annually in order to use it in the relationship between the price and the yield volatilities below.

And the modified duration of the forward bond is then found as:

$$D = \frac{\text{Duration}}{1+y0} = \frac{3}{1.05961} = 2.8312 \text{ years}$$ **[1]**

We can now find the forward price volatility $\sigma$ of the bond from:
$\sigma = D\, y_0\, \sigma_y$

**[0.5]**

where $\sigma_y$ is the current forward yield volatility of the bond. Thus:
$\sigma = 2.8312 \times 0.05961 \times 0.16 = 0.02700$

**[0.5]**

So the price of the 1-year European put option on the zero-coupon bond is found from
$Put = P(0,1)\,[X\Phi(-d_2) - F0\Phi(-d_1)]$
With

$d_1 = [\ln(84.055/85) + (0.02700^2 \times ½)] / 0.02700 \times 1^{0.5} = -0.40057$

**[0.5]**

$d_2 = d1 - \sigma\, T^{0.5} = -0.40057 - 0.02700 \times 1^{0.5} = -0/42757$

**[0.5]**

So

$\Phi(-d_1) = 0.65563$ **[0.5]**
$\Phi(-d_2) = 0.66552$ **[0.5]**

The out option price is therefore given by

$Put = P(0,1)\,[X\Phi(-d_2) - F0\Phi(-d_1)]$

$= e^{-0.0511} \times [85 \times 0.66552 - 84.089 \times 0.65563]$
$= 1.39$

**[1]**

**Q.6)**

A long position in a short-term interest rate future effectively fixes a minimum rate at which the investor is able to lend over the future term of the short-term interest rate underlying the future. **[1]**

This is because by going long, the investor has an option to go long in an interest rate future and so effectively lend over the future period based on a fixed contract price. **[0.5]**

Suppose that the actual contract price at the strike date turns out to be higher than the strike price, i.e. the short term future interest rate turns out to be lower than that corresponding to the strike price. In this instance, the investor will exercise its option to lend at a strike rate that exceeds the current future interest rate, in order to make a profit.
**[1]**

Conversely, suppose that the actual contract price at the strike date is lower than the strike price, i.e. the short-term future interest rate turns out to be higher than that corresponding to the strike price. In this case the investor will not exercise its option to lend at a strike rate that is less than the current future interest rate. **[1]**

The downside of this strategy is that money has to be found to fund the option premium. **[0.5]**

One way of funding this is by selling a put option on a short-term interest rate future. **[0.5]**

This will generate the put option premium for the investor, but at the cost of fixing a maximum interest rate at which they are able to lend over the future period**.** **[0.5]**

This is for the following reason. Suppose that the actual contract price at the strike date turns out to be higher than the strike price, i.e. the short-term interest rate turns out to be lower than the corresponding strike price. Then the putholder willl let their option to sell the interest rate contract (i.e. borrow) at a strike rate that exceeds the current future interest rate expire worthless. **[1]**

Conversely, suppose that the actual contract price at the strike date is lower than the strike price, i.e. the short-term future interest rate turns out to be higher than that corresponding to the strike price. In this case the putholder will exercise their option to lend at a fixed strike rate that is less than the current future interest rate. **[1]**

**Q.7)** Company B clearly has a worse credit rating than company A because it pays a higher rate of interest than company A in both fixed and floating markets.

A key feature of the rates offered to companies A and B is that the difference between the two fixed rates is greater than the difference between the two floating rates. Company B pays 1.4% per annum more than company A in fixed rate markets and only 0.5% per annum more than company A in floating rate markets. Company B appears to have a comparative advantage in floating rate markets whereas company A appears to have a competitive advantage in fixed rate markets. Note that B's comparative advantage in floating rate markets does not imply that B pays less than A in this market. It means that the extra amount that B pays over the amount paid by A is less in this market. In other words, A pays more less in fixed rate markets and B pays less more in floating rate markets. It is this apparent anomaly that can lead to a swap being negotiated. **[1]**

Company A borrows fixed rate funds at 12.0% per annum. Company B borrows floating rate funds at LIBOR plus 0.6% per annum. They then enter into a swap agreement to ensure that A ends up with floating rate funds and B ends up with fixed rate funds.

**[0.5]**

The total apparent gain in this type of interest rate swap agreement is always (a – b), where "a" is the difference between the interest rates facing the two companies in fixed rate markets, and "b" is the difference between the interest rates facing the two companies in floating rate markets. In this case, "a" = 13.4 – 12.0 = 1.4, and "b" = 0.6 – 0.1 = 0.5. The total gain, ignoring the intermediary, is 1.4 – 0.5 = 0.9. After allowing for the intermediary's profit, the total gain will be 0.9 – 0.1 = 0.8.

**[1]**

A swap that has to be equally attractive to both companies, after paying the intermediary, could be:

Company A has three sets of interest-rate cash flows:
- it pays 12% to outside lenders
- it receives 12.3% per annum from the B via the intermediary
- it pays LIBOR to B.

The net effect of the three cash flows is that A pays LIBOR minus 0.3% per annum. This is 0.4% less than it would pay if it went directly to floating rate markets.

**[1]**

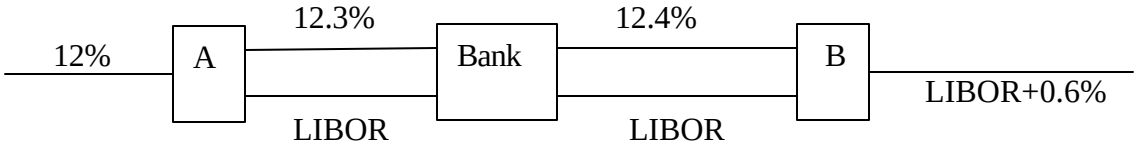
Company B also has three sets of interest rate cash flows:
- it pays LIBOR plus 0.6% to outside lenders
- it receives LIBOR from A
- it pays 12.4% to the intermediary (who in turn pays 12.3% to A)

The net effect of the three cash flows is that B pays 13% per annum. This is 0.4% less than it would pay if it went directly to fixed rate markets.

**[1]**

The intermediary made 0.1%. **[0.5]**

In diagram, this can be expressed as




**[1]**

**Q.8)**

**a)**

The construction of suitable property indices requires knowledge of market values of the constituents of the indices at frequent intervals. **[1]**

There are a number of problems in obtaining such information for property:

- each property is unique **[0.5]**
- the market value of a property is only known for certain when the property changes hands **[0.5]**
- estimation of value is a subjective and expensive process **[0.5]**
- valuations will be carried out at different points in time **[0.5]**
- sales of certain types of investment property are relatively infrequent **[0.5]**
- the prices agreed between buyers and sellers of properties are normally treated with a degree of confidentiality **[0.5]**

The performance can be benchmarked against two main types of index

- Portfolio-based indices **[0.5]**
  - These are mainly used for performance measurement **[0.5]**
  - These measure rental values, capital values or total returns of actual rented properties. Different indices of this type will give different results because of the underlying portfolio of properties will vary in size, regional spread and sector weighting. **[1]**
- Barometer indices **[0.5]**
  - These aim to track movements in the property market at large by estimating the maximum full rentals of a number of hypothetical rack-rented properties. **[0.5]**
  - The main use is in highlighting short-term changes in the level of the market in terms of rents and yields **[0.5]**
  - This type of index is unsuitable for portfolio performance measurement since an investor could not closely match its movement with an actual portfolio of property holdings. **[0.5]**

**a)**

Advantages

- The trustees are answerable to the scheme sponsors and members, whose are interested in knowing the investment returns of the fund. **[0.5]**

- Regular monitoring of performance helps the trustees understand the risks being taken by the managers, asset liability management, see whether performance is in line with other similar funds and encourage healthy competition between the two managers. **[1]**

Disadvantages

- By monitoring managers quarterly, although a portfolio's composition may change by only a modest amount over a quarterly period, the cumulative effect on the composition of the portfolio over a series of quarterly periods could be significant. **[1]**
- For example, more risky stocks may be incorporated into the portfolio that do not immediately show up in the portfolio's estimated standard deviation of returns. **[0.5]**
- A particular investment performance measurement system may not be appropriate for a particular investment manager, who may therefore be treated unfairly even if he is inherently successful. **[1]**

Examples are

- A manager may be skilled in selecting good stocks amongst those which the market views as risky **[0.5]**
- A manager may be skilled at selecting stocks that may currently have low values but ultimately are likely to generate higher returns in the long run **[0.5]**

- By using market values to measure performance, the system relies on the efficiency of the market. **[0.5]**
- Thus, a manager's views and strategy may be entirely sensible, but the consequent investment performance may not be if the market acts "irrationally". **[0.5]**
- Also, market prices are determined by the average investor – but the pension scheme is likely to have a very different tax treatment from the average investor. **[0.5]**
- Measuring performance quarterly may encourage short term focus on investment returns. This may lead to myopic loss aversion and hence be detrimental to the achievement of the pension fund's long term objectives. **[1]**

**b)**

i) We first need to calculate the ß's of the two investment managers using

$ß_i = Cov(R_i, R_m) / V_m$

Treynor risk adjusted performance measure formula is

$$T = (R_p - r_f) / ß_p$$ **[1]**

Jensen risk adjusted performance measure formula is

$$J = R_p - [r_f + ß_p * (R_M - r_f)]$$ **[1]**

$ß_1 = (0.9*0.20*0.25)/(0.25^2) = 0.72$

$ß_2 = (0.7*0.40*0.25)/(0.25^2) = 1.12$

For Manager 1,

Treynor Measure = (0.22 – 0.12) / 0.72 = 0.14 **[0.5]**

Jensen Measure = 0.22 – (0.12 + 0.72 *(0.25 – 0.12)) = 0.0064 **[0.5]**

For Manager 2,

Treynor Measure = (0.30 – 0.12) / 1.12 = 0.16 **[0.5]**

Jensen Measure = 0.30 – (0.12 + 1.12 *(0.25 – 0.12)) = 0.0344 **[0.5]**

ii) The risk adjusted measures are positive for both managers, indicating that each has generated excess risk-adjusted returns. **[0.25]**
Manager 2 has produced larger absolute out-performance according to both measures **[0.5]**
The use of Jensen measure is inappropriate because the two managers have incurred differing levels of systematic risk, as indicated by different betas. **[0.25]**
Jensen measure is suitable for comparisons only where both managers have taken the same level of systematic risk because it considers absolute risk adjusted out performance relative to the security market line. **[0.25]**
Treynor measure is a more suitable measure as it measures proportional risk adjusted out performance relative to the security market line. **[0.25]**
Manager 2 has performed slightly better on Treynor's measure but the results for the two managers are too close to draw any firm conclusion. **[0.5]**

**Q.9)**

**a)** The top down approach involves a structured decision-making process which starts by considering the asset allocation at the highest level i.e. between different asset classes. **[0.5]**
A long term benchmark or strategic allocation of assets between countries and the main asset categories is decided. This decision is taken after using asset liability modeling or risk budgeting or similar approach that reflects the investment objectives. **[0.5]**
Decide on the short term tactical split of investments between countries and the main asset categories is decided. This decision is taken based on fundamental, quantitative and technical analyses. **[0.5]**
Having done the above, decide upon sector split, reflecting macroeconomic and industry specific factors. **[0.5]**
Within each sector decide which stocks are best value. **[0.5]**

A manager investing in value stocks chooses stocks that offer good fundamental value using certain traditional measures. **[0.5]**
These measures are typically:

A high book value to market price ratio
High dividend, earnings and cashflow yields
A high sales to market price ratio **[1]**

A passive investment strategy is one in which an initial investment portfolio is constructed and subsequently managed passively. The constituents of the portfolio are changed only in reaction to some other event external to the portfolio, such as a change in the investment objectives of the investor or in an external benchmark. **[1]**

Under a passive strategy, the aim is often to match or track some external benchmark such as

The liabilities of the investor – actuarial matching or liability hedging
The asset allocation of the investor's peer group – commercial matching
An investment index – index tracking **[1.5]**

Alternatively, the fund might decide to invest in a particular asset category without explicit reference to an external benchmark. **[0.5]**

**b)**

i) Manager P

Actual closing fund value = Rs. 10020 Mn

Closing fund value as per All Stock Index =
(750 * 1902 / 2115) + (250 * 2847 / 3046) + (75 * 1902 / 2084) + (25 * 2847 / 2982) = Rs. 10004.5 Mn **[1.5]**

Closing fund value as per manager's sector split and index stock return =
(770 * 1902 / 2115) + (230 * 2847 / 3046) + (100 * 1902 / 2084)
= Rs. 9986.9 Mn **[1.5]**

Manager Q

Actual closing fund value = Rs. 10500 Mn

Closing fund value as per All Stock Index =
(750 * 1902 / 2115) + (250 * 2847 / 3046) + (112.5 * 1902 / 2084) + (37.5 * 2847 / 2982) = Rs. 10472.8 Mn **[1.5]**

Closing fund value as per manager's sector split and index stock return =
(600 * 1902 / 2115) + (400 * 2847 / 3046) + (150 * 2847 / 2982)
= Rs. 10561.2 Mn **[1.5]**

ii) Manager P lost Rs. 17.6 Mn (i.e. 9986.9 – 10004.5) compared with the company's benchmark of the All Stock Index. The manager however gained Rs. 33.1 Mn (10020 – 9986.9) through stock selection skills. **[1]**

Manager Q gained Rs. 88.4 Mn (10561.2 – 10472.8) compared with the company's benchmark of the All Stock Index. The manager however lost Rs. 61.2 Mn (10500 – 10561.2) through stock selection skills. **[1]**

These results give an impression that P was better at stock selection where as Q was better compared with the index. **[0.5]**

Both have however performed differently from the index or through stock selection only by a small amount, over a short period of time. **[1]**

We need data over a much longer time period to draw any reliable conclusions. **[0.5]**

**Q.10)**

**a)** VaR is an attempt to provide a single measure for senior management summarizing the total risk in a portfolio of financial assets. It can be measured either in absolute terms or relative to a benchmark. **[1]**

It is calculated either on a forward looking basis or a backward looking basis. **[0.5]**

It is useful in assessing the

- potential losses on a portfolio **[0.5]**
- over a given future time period **[0.5]**
- with a given degree of confidence **[0.5]**

An example of its use is that in calculating a bank's capital regulators could set capital requirements such that, say the required capital is three times the 10-day 99% VaR. **[0.5]**

**b)**

Standard deviation of daily changes in the value of the position is 2% of 100 mn = 2,000,000 **[0.5]**

Assuming that changes on successive days are independent, the standard deviation of the change over a 10-day period would be v10 times the change over a one-day period. **[0.5]**

The standard deviation of the change in value of Infosys portfolio over a 10-day period is therefore 2,000,000 v10 = 6,324,555. **[1]**

It is customary in VaR calculations to assume that the expected change in the price of a market variable over the time period considered is zero. **[0.5]**

We thus have that the change in the value of the portfolio of Infosys shares over a 10-day period has a standard deviation of Rs. 6,324,555 and a mean of zero. **[0.5]**

Assuming that the change is normally distributed, the 10-day 99% VaR for the portfolio is

2.33 * 6,324,555 = Rs. 14,736,214

where 2.33 is the normal distribution value for 99%. **[1]**

**********