Actuarial Society of India

EXAMINATIONS

June 2005

CA11 – Assets

Indicative Solution

1.

- The investor may want to diversify its shareholdings across a range of different investment managers in order to avoid the risk that one or more of them performs badly. [1½]

- The investors may want to diversify its shareholding across a range of different investment markets and sectors, and sees investing in a range of investment trusts as a convenient means by which to achieve this aim. [1½]

- The company may use investment trusts for more specialist investments where it has no expertise itself. A range of trusts will therefore be required if the investor wishes to invest in a number of different specialist areas. [1]

- If it is a very small investor it may decide that a range of investment trusts is a sensible alternative to having its own investment department (unlikely). [1]

[Total 5]

2.

a) 20 years index-linked government bond: high risk because the market value is volatile.
b) Shares in AAA rated corporate: high risk because the market value is volatile.
c) Conventional one week call deposit with one year to redemption: very low risk.
d) Revolving one week call deposit with a well-known clearing bank: low risk, but more risk than (c) because reinvestment rates may vary.
e) Shares in a small, specialist mining company : very high risk.
f) One year sterling Eurobond issue by major German company: very low risk if sterling returns required
g) Put options in a major food retailer: very high risk
h) Call options on the FTSE 100 Index: very high risk
i) One year term deposit in dollars with Citibank: high risk because currencies can fluctuate.
j) One year term deposit with a well-known clearing bank: very low risk.

[10 x ½ =5]

3.

a. **Identifying the risks**

Make a high lever preliminary risk analysis to confirm that the project does not obviously have such a high risk profile that it is not worth analyzing further – eg there is a high profitability that the project will fail completely losing all of the initial investment. [1]

Hold a brainstorming session of project experts and senior internal and external experts who are used to thinking strategically about the long term. [½]

The aim will be:

- To identify project risks, both likely and unlikely [½]
- To discuss these risks and their interdependency [½]
- To attempt to place a broad initial evaluation of each risk, both for frequency of occurrence and probable consequences if it does occur. [½]
- To generate initial mitigation options and discuss them briefly. [½]

Carry out a desktop analysis to supplement the results from the brainstorming session. This will involve identifying further risk and mitigation options, researching similar projects undertaken by the sponsor or others in the past (including overseas experiences), and obtaining the considered opinions of experts. [1]

Carefully set out all the identified risks in a risk register, with cross-references to other risks where there is interdependency. High levels of correlation between individual risks will lead to a higher overall variance of the investment returns from the project, as the individual risks are less likely to cancel each other out. [1]

Maximum [5]

b. **Calculation of expected NPV**

Toll revenues

Use the midpoints of each range, so that the expected toll revenue if the bridge is a success(denoted *a1*) is 45 in each of years 3 to 5, whereas if it is a failure (denoted *a2*), the revenue is 25 in each of these years.

Weather

Denote the state good weather by b1. In this case, the cost in Year 2 is zero. Denote the state bad weather by b2. In this case, the cost in year 2 is 20 (assuming no strikes)

Strikes

If there are no strikes, which we denote by state *C1*, the costs are as noted under weather. If there are strikes, which we denote by state *c2*, then the costs are increased to 60 in year 1, and either 0 (good weather) or 24 (bad weather) in year 2.

An outcome or state of the world is thus denoted by a string of three co-ordinates, and the probabilities, cashflows and NPVs associated with each possible state of the world are summarized in the table below.

State of the world	Probability	Cashflows in each year	Net present value @ 10%
a1,b1,c1	1/6	-50,0,45,45,45	51.74
a1,b2,c1	1/4	-50,-20,45,45,45	33.55
a1,b1,c2	1/6	-60,0,45,45,45	41.73
a1,b2,c2	1/12	-60,-24,45,45,45	19.92
a2,b1,c1	1/12	-50,0,25,25,25	6.52
a2,b2,c1	1/8	-50,-20,25,25,25	-11.66
a2,b1,c2	1/12	-60,0,25,25,25	-3.48
a2,b2,c2	1/24	-60,-20,25,25,25	-25.30

[5 marks for a correct table]

Thus, the expected NPV is given by:

$$\frac{1}{6}\times 51.74+\frac{1}{4}\times 33.55+....+\frac{1}{24}\times -25.30=23.4$$

[1]

The expected NPV is positive, suggesting that the project should be undertaken.

[1]

The NPV for the different states of the world is positive with a probability of ¾.

[½]

The most critical of the three risks facing the project is that of low tolls, which has the greatest impact upon the expected NPV and hence the success of the project.

[1]

The NPV is always positive if the toll revenue is high. [½]

Bad weather is probably the next most important risk, as two of the three negative results – the two worst results in fact – arise when the weather is bad. In fact, bad weather reduces the expected NPV by an amount equal to either 18 or 22 (compared to the result that would otherwise arise in its absence). Conversely, a strike reduces the expected NPV by either 10 or about 14. [1]

[Total 10]

c. **The financial consequences of risk mitigation**

The result of adopting a particular option ought to be to reduce the downward volatility of the NPVs but in addition it normally either:

- Increase the expected NPV, or
- Decrease the expected NPV [1]

In the former case, the mitigation option is beneficial and should be built in to the project. Risk has been reduced and expected return increased. Consequently the project has been unambiguously made more attractive. [1]

In the second, and more normal, case, judgment will have to be exercised on whether the mitigation option in question should be adopted. In this more usual case, risk has been reduced at the expense of a reduction in expected return. Such judgments would be made having regard to the views of the sponsor and the prospective lenders and investors. [1]

[Total 3]

[Grand total 16]

4.

i. **Immunisation** : Ensuring that the discounted mean term of assets equals that of the liabilities and that the spread of the assets is greater than the spread of the liabilities. This means that a uniform change in interest rates will cause the reinvestment rate and capital value on assets to move in opposite directions so that a fund does not make a loss. [1]

ii. **Inflation risk premium**: the difference between the yield on a fixed income bond and the sum of the guaranteed real yield and the expected inflation rate on a similar index-linked bond. It is required as compensation for the uncertainty in the real return on the bond by investors with index-linked liabilities. Under the inflation risk premium theory the yield curve will tend to slope upwards because investors need a higher yield to compensate them for holding longer-dated stocks which are more vulnerable to inflation risk than shorter dated stocks. [1]

iii. **Run-off basis** : A valuation basis that assumes an insurer will cease to write new business, and continue in operation purely to pay claims for previously written policies. Typically expenses and reinsurance arrangements change after an insurer ceases to write new business. [1]

iv. **Terminal funding**: An arrangement whereby a payment to meet the value of a benefit is made only at or about the time when the benefit is due to commence.

[1]

v. **Return on capital employed (ROCE)**: Profit before interest and tax divided by capital employed, expressed as a percentage. An indicator of a company's efficiency in generating profit from its asset base. [1]

[Total 5]

5.

a. Market segmentation theory says that yields at each term to redemption are determined by supply and demand from investors with liabilities of that term. [1]

The concept of market segmentation is based on two fundamental ideas:

1. Different investors have different needs. In particular, they have liabilities of different terms. Therefore different investors are active at different terms of the yield curve. [1]

2. Price is a function of supply and demand. Yields are simply a function of price – hence supply and demand determine yields. [1]

b. If life offices sold a large amount of annuity business, there would be extra demand for stocks with medium and long terms. The yields of these should fall (as prices rise). The yield curve at these terms should fall. [2]

c. The expected return on a long term investment does not necessarily have to be equal to the expected return from a series of short term investments. There are other factors affecting investment decisions other than maximizing return. For example, a life office with a fixed monetary liability in, say, ten years, will want a medium term stock to match the liability, even if other stocks look better value according to the expectations theory.

Another way to explain this is to say that expectations theory is not the only determinant of the level and shape of the yield curve. [3]

[Total 8]

6.

a. **Merits of the current investment policy**

<u>Advantages</u>

The property companies and investment trusts provide expert management

[½]

This is particularly true in property investment (which needs great expertise) and overseas equity investment in the more unusual regions. [½]

Investing in property companies may give some exposure to gains from development activities or to particularly large properties. This may cease to be the case if the fund shifts to direct property investment. [1]

Some of the practical problems of overseas investment (eg different accounting practices, language, time zones) are avoided, or at least passed on to someone else. [½]

Diversification within the overseas/ property markets will be greater than if the institution invests directly. [½]

This may be particularly useful for property, where large unit sizes could make diversification difficult for a property fund of "only" Rs.20 crore. [½]

Particularly with property, the current policy of investment in quoted shares should give greater marketability than direct investment. [½]

Currently the institution may be benefiting from any gearing in the investment trusts or property companies. [½]

Property companies and investment trusts can both stand at a discount to their net asset values. So the assets, and the resulting income stream, may be enjoyed cheaply. [½]

Valuation of the institution's investments in property company shares is simpler and more objective than the subjective valuation of different property investments. [½]

Disadvantages

The biggest drawback is that the fund does not have direct control over all the underlying assets. [½]

It also has to pay management fees through the investment trust and property companies. This will reduce its investment return. [½]

A fund of this size is likely to be able to invest more cheaply itself. [½]

Gearing and any discount to net asset value may work against the institution, in particular they give unwanted volatility. [½]

Property shares do not give the diversification away from equities that direct property investment would offer. [½]

[Maximum 8]

b) **Range of assets if it were to invest directly**

Property

Sectors: offices, shops, industrial and possibly residential. A fund of this size could invest in a mixture of all these, although it would not gain exposure to large offices in a capital city, or major financial centre, which can be very expensive. [1]

Locations: it could have a mixture of capital city and regional property. Overseas property is a possibility. [½]

Tenure: it could consider freehold and leasehold investments. [½]

Overseas

Types: mainly equities, but it could have some fixed-interest exposure in the main overseas markets, eg USA, UK, Germany and Japan. [1]

Country and currency: it will want some exposure in each of the main areas (North America, Europe – both inside and outside of the Euro currency zone – Japan, the rest of the Pacific basin). [½]

Industry: it will want to diversify as much as possible, particularly into any industries that are not available domestically. [½]

[Total 4]

7.

a. The expected return is taken to be the gross redemption yield (GRY). Equating the expected return with the required return:

GRY = required risk-free real yield + expected inflation + inflation risk premium

We can now use this relationship to decide whether government bonds are cheap or dear. For example, we might believe that future inflation will average 2½% pa and we might require an inflation risk premium of 1% pa to cover the risk of higher inflation eroding our real returns. Now, if we know that we can earn a risk free real return of 2% pa on index-linked government bonds, then conventional government bonds will be cheap to us if there gross redemption yields exceed 5½% pa. [3]

b. The required nominal return from conventional bonds is 5½%(2% + 2½% + 1%). The GRY is only 5%. Therefore the investor would prefer index-linked. [3]

8.

a. Counterparty risk is the risk that a counterparty will not honour its obligations. If the default occurs before the date when settlement of the underlying transaction is due, the party who has been let down will be exposed to the risk of having to bear any costs of replacing or canceling the deal.

Credit risk arises when a party pays away cash or delivers assets before the counterparty is known to have performed their part of the deal.

The term credit risk is sometimes also used to describe the risk associated with any kind of credit-linked event. This could include:

- Changes to credit quality (up or down)
- Variations in credit spreads in the market

[2]

b. Credit rating factors

The agency's rating will reflect the government's willingness and ability to meet its debt obligations on time and in full. [1]

It will therefore be based on the current levels of national debt and government fiscal deficit as a percentage of national income. [1]

The future trends in this will also be considered – eg by looking at fiscal projections (government tax revenues and spending plans), prospects for economic growth and demographics. [½]

The current position and outlook in respect of the country's foreign currency reserves, balance of trade and exchange rate will also be considered. [½]

The rating agency will also take into account the country's relationships with the rest of the world, its history of debt repayment – eg has it ever come close to failing to meet its payment obligations in the past – and the degree of political stability.

[1]

[Total 4]

c. When security is taken in support of a lending (or other) transaction it is important to make sure that:

- It can be enforced against the appropriate party(s) in the relevant jurisdiction(s) without involving disproportionate costs or liabilities [½]
- If it is necessary for the security to be "registered", this is done within the time period allowed for that purpose [½]

- The security documents themselves are put in a safe place with coples available for ease of reference. [½]

Where market risk is a factor, an important discipline is revaluing the security at market value on a regular basis. [½]

[Total 2]

[Grand total 8]

9. Potential benefits

- high return (1)
- exposure to a strong dollar and /or strong US equity market (½)
- a degree of diversification from the UK stock market (½)
- a (roughly) real or super-real investment (½)
- limited down-side risk (a maximum loss of £2,000 per warrant) (½)

When profitable

It will be worthwhile to exercise if the £/$ exchange rate at the exercise date is less than £1=$1.33 (ie a depreciation of just over 10% over 3 years). At this exchange rate the $60,000 minimum exercise value exceeds the exercise price. (1)

The overall break-even point requires a slightly lower exchange rate to cover the initial £2,000 cost. (1)

With a low sterling exchange rate the warrant is profitable regardless of the performance of the Dow Jones index. (1)

The warrant is even more profitable, for a given exchange rate, to the extent that the Dow Jones averages more than the 5,000 level (ie 60,000 + 12) over the next three years. (1)

Note that the potential profit from a strong performance of the Dow can be eliminated by a weakening of the dollar. (1)

Risks

Mismatching by currency. It is essentially a dollar denominated investment. This is unlikely to match the UK investor's liabilities. (1)

It is also too short term for most of the fund's liabilities. (½)

There is a significant chance of a 100% loss if sterling does not weaken sufficiently or strengthens (particularly if the Dow Jones does not perform well). (1)

There is also an element of credit risk involved in a contract with a foreign merchant bank. (½)

The investment is likely to be almost completely unmarketable. (½)

Maximum { 10 }

10. Value of equity portion:

$$\frac{MV \times D}{d} = \frac{750 \times 0.031 \times 1.02}{0.03}$$

$$= 790.5$$

[2]

Note that this assumes that we are using i = d+g (to give d = 3%) for the valuation (prospective) dividend yield (assuming that the next dividends are due in one year's time).

The actual "current" dividend yield is multiplied by 1.02 to allow for one year's dividend growth. This makes the two yields more consistent, but still ignores the fact that the All Share dividend yield will be, on average, 6 months historic. Alternative assumptions are possible.

Value of bonds portion:

$$250 \times \frac{DV_{bond}}{MV_{bond}} = 250 \times \frac{2.9 \times 2 \times a\overline{|15}^{(2)} + 100v^{15}}{100} @ i = 5\%$$

= 272.6 (rounded)

Total = 106.3 crore

[3]

[Total 5]

{ In the above problem, all a's are to be taken as a two dots .}

11. Ignore costs, tax and voids.

Value of the head lease is the value of the rents from the sub-lease, less the value of the rents payable to the freeholder:

$$15{,}000 \times a\overline{|4} \times a\overline{|10}\frac{j\%}{} - (10{,}000 \times a\overline{|20} + 15{,}000 \times \frac{1.05^{20}}{1.10^{20}} \times a\overline{|20}) \quad \text{at } 10\%$$

Where j is at a rate of interest given by: $(\frac{1.10}{1.05})^4 - 1$

Value = 111,000 (to nearest thousand)

[7]

12. a. Expected returns

- returns from different assets
- allowing for tax

Benchmarks and restrictions

- investment restrictions
- other similar funds
- statutory valuation and solvency

Circumstances of investor

- assets vs liabilities (ie size factors)
- existing portfolio
- risk prepared to take
- objectives

[4]

b. The starting point will be to model the key features of the pension fund's asset proceeds and liability outgo. [½]

Realistic values will be chosen for all the parameters. These include the mean returns, variances of returns and correlations between the returns on the main asset categories (eg domestic equities and government bonds) and also price and salary inflation. [1]

A large number of simulations are then carried out, based on the pension fund's current asset distribution. [½]

The results may be presented/ analysed in a number of ways. For example, the number of times (eg out of 1,000 simulations) in which the fund becomes "insolvent" over a given period (eg 10 years) could be calculated. Alternatively, the value of the fund at the end of the period may be considered on its own. [½]

"Insolvency" may be defined in a number of ways eg insolvency on a statutory basis, or in terms of an ongoing valuation. [½]

Asset liability modeling is likely to include an analysis of how changes to the investment strategy would change the long-term solvency position of the fund. [½]

[Maximum 3]

c.

i. Performing a mean variance optimization without reference to the liabilities – using the ideas behind mean-variance portfolio theory and the capital asset pricing model to determine the investor's optimal portfolio (in terms of the expected return and the variance of portfolio returns). [1]

ii. Basing asset allocations on market capitalizations – this is essentially what index tracking does within each particular asset market. The idea here is likewise that investment performance should broadly track that of the underlying investment market or markets. In this case, however, our asset allocation might reflect the market capitalizations of the bond market, the equity market, the money market and so on. There may be difficulties here both with defining the markets involved and then obtaining estimates of the relevant market capitalizations, eg the "property market", the "overseas equity market". [1]

iii. Shadowing the strategies of other comparable institutional investors – ie instead of tracking the index, aim to match the performance of your competitors. Such commercial matching will reduce the potential for both significant underperformance and over performance compared to your competitors, ie reduce the relative performance risk [1]

[Total 10]