

Institute of Actuaries of India

Subject CA1 – Paper I

Core Applications Concepts

May 2008 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.

1.**(i) *Investment and risk characteristics***

Investment characteristics

High expected returns, relative to, say, fixed-interest bonds

A real asset, albeit with a lag due to rent reviews. If the review periods are property is more closer to a fixed-interest investment). Frequent review periods offer low inflation risk

Large unit size, which is generally indivisible

Unmarketable

Each property is unique

Security depends on quality of tenant

Valuation is difficult, subjective and expensive

Expensive to buy, sell and manage

Usually offers a high level of income, which increases through time (likely to be in the shape of a step function)

Risk characteristics

Riskier income stream than that of fixed-interest bonds, possibly less risky than equities

Main risks include void risk (due to depreciation and obsolescence), variability of market values and income, lack of marketability

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2.**(i) Why analyze claims data**

There are many possibilities, including:

- reviewing premium rates and setting rates for new or amended products
- policy valuation purposes estimating the cost of outstanding claims to set reserves
- comparing actual claims run off against previous estimates
- assessing the relative profitability of different blocks of business
- monitoring the adequacy and use of reinsurance
- monitoring the company's solvency position
- financial planning.

(ii) Why analyze expenses

A general insurance company analyses expenses in order to allocate expense costs correctly between the different classes and rating groups in the portfolio.

This enables the insurance company to:

- measure the past performance of each insurance class
- determine the expenses loadings for premium rating
- spot any inefficient areas of the business before cost cutting exercises
- conduct a financial planning exercise
- analyse its sources of surplus.

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3.

(i) Outline any 3 theories which explains the shape of the yield curve.

(ii) Explain why a corporate bond might have a higher yield than a government bond of the same duration.

(a) Expectations theory describes the shape of the yield curve as being determined by economic factors, which drive the market's expectations for future short term interest rates.

(b) Liquidity preference theory: Investors require a greater return to encourage them to commit funds for a longer period so yields should be higher than expected for long-dated stocks.

(c) Inflation risk premium: Inflation risk is greater in the long term so yields should be higher than expected for long-dated stocks.

(d) Market segmentation / preferred habitat theory: Yields at each term are determined by supply and demand from investors with liabilities of that term, so yields on short and long bonds may therefore move somewhat independently.

(ii) The yield of any fixed interest security is a function of the price. The price will be influenced by the laws of supply and demand. In a perfect market with purchasers who are not influenced by sentiment there are some objective reasons for yield differences.

In general, government bonds provide the most secure and marketable fixed interest investment in a particular currency, and in developed economies they are risk free. Investors will require a higher yield on other forms of debt. The size of the yield margin depends on both the credit (default) risk and the marketability of the corporate bond issue.

A particular bond may have high credit risk: due to a low credit rating (specific risk) or due to high credit spreads in the relevant sector (systematic risk).

It may have low marketability due to small issue size or because it is infrequently traded. The issue may have features that make it particularly desirable/undesirable to certain classes of investor, for example a high coupon might attract institutional investors. Investors are concerned with post-tax returns, so different tax treatment between government and corporate bonds are reflected in the yield.

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4.

The reasons why life insurance companies need capital are to:

- fund the strain from writing new business which may be significant if the products are back end loaded
- attract new business as financial strength may be significant in determining new Business levels (if considered important by individuals and their advisers)
- enable the company to invest more freely (in the pursuit of higher expected returns)
- provide the capital required to achieve its strategic aims, eg, undertake other major new ventures, acquire another company
- provide the capital required to fund overheads and development costs of organic expansion, such as computer hardware and software, product development and exceptional expenses
- smooth reported profits
- improve the solvency position of the balance sheet (especially in a time of increasingly stringent supervisory solvency requirements)
- cover the general day-to-day risks to which the company is exposed, such as: policy guarantees eg guaranteed annuity options, guaranteed maturity values
- persistency and expense risks including the effects of inflation
- operational risks
- mortality risks, especially increasing longevity, ie claims volatility.

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5.

(i) Marketability is the ability to trade an asset at a given price in given volumes. It essentially relates to the ease of trading. For example how long it takes to deal and at what cost.

Liquidity is about how close to cash an asset is. It measures how soon the asset will turn into cash without being marketed. For example a seven-day fixed term deposit at a clearing bank might be completely un-marketable, because the deposit cannot be transferred or assigned. It is however extremely liquid. If market conditions change, liquidity is a measure of how the capital value moves. Liquid assets tend to have stable market values.

(ii) a) The fund will hold unquoted shares, which will by their nature have low marketability. The capital values of the shares will probably be volatile given the nature of the companies. Hence there will be low liquidity. There will be no quoted market value and the values used for many purposes could be quite stable, which means the fund appears to have lower volatility. Any actual transactions, especially large trades, will lead to a revaluation. The new value could differ a lot from the previous revaluation, which means that the fund could be very volatile.

(b) Guaranteed return fund

The investment is short term with a guarantee and so the assets held should have low volatility i.e. be liquid. A combination of assets could achieve this aim. There is no guarantee in respect of early redemption (or possibly any option of early redemption). Hence assets do not need to be marketable (early redemption penalties could apply to cover any risk). Having assets with lower marketability implies that a higher guaranteed return can be offered.

(c) Bond fund

The fund aims to generate profits by trading and so it will hold marketable assets (in general). It could deal in large blocks of bonds, particularly as an intermediary between a seller and an ultimate buyer. One of the ways to make profits is to switch between bonds that have different volatilities. So at any given time, the bonds held will have varying liquidity features and this makeup could vary over time.

(d) Motor insurer

The bulk of the liabilities will be short term and cash-like in nature. The assets to match will therefore need to be liquid and if outgo is uncertain, marketability will be needed to provide reliable cash flows. There could be some longer term more real liabilities for personal injury claims. Assets to back these liabilities could have less marketability and liquidity to hopefully provide higher returns. If the insurer has strong positive cash flow from premium income or large free reserves, it could hold assets with lower marketability and liquidity.

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6.

(i) Relationship

Assuming an efficient market and equating expected and required returns:

$d + g = \text{required risk-free real yield} + \text{expected inflation} + \text{equity risk premium}$

where:

d is the income stream, ie the dividend yield

g is the expected capital gain, ie the expected annual growth in dividends

(ii) Prolonged recession

At the start of a prolonged recession we can expect the following:

- During a recession, inflation is likely to be very low. The absolute value of economic growth is negative, and inflation will reflect this lack of economic activity. There will certainly be little or no demand-pull inflation.
- Long-term real dividend growth and absolute dividend growth in equities will be zero or may become negative too.

- Dividends are often maintained through recessions, even though the profits are falling. Some companies who have over-stretched themselves during the growth years may, however, have to cut back the dividend in anticipation of negative growth. Many companies may reduce their payout ratio in order to generate enough cash internally to survive.
- The equity risk premium reflects the additional return required to justify holding assets with additional risk. The risk involved in holding equities will arguably increase during a recession. The chances of company failure will rise when profits growth is harder to achieve.
- Cash flow problems may force many companies into receivership and default. Also the volatility of dividend income and earnings may increase in an uncertain environment. The equity risk premium should increase to account for that too.
- On the other hand the risk-free real rate of return may fall because investors prefer risk-free investments in uncertain times .
- As a result of all this, the equity dividend yield is likely to increase.

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7.

(i) Investment indices can be used:

- as a measure of short-term market movements;
- to provide 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;
- to value a notional portfolio;
- to analyze sub-sectors of the market;
- as a basis for index funds which track a particular market;
- to provide the basis for the creation of derivative instruments relating to the market or a subsection of the market.

(ii) Government bond indices can be used:

- As a standard against which yields on other fixed interest investments can be assessed;
- For an approximate valuation of a fixed interest portfolio;
- To provide a picture of general yield structures of fixed interest investments;
- Yield indices allow comparison to be made with yields on ordinary shares as a measure of the yield gap between bonds and equities.
- Comparison of yields on fixed interest and index-linked government bonds indicates the market's view of future inflation.
- Comparison of short term yield and long term yield indicates the market's expectation of future interest rates

(iii) There are many items you could mention. The following is an illustrative list:

- Purpose of the index – this will help to establish answers to the issues below
- Constituent shares and the basis for inclusion/exclusion of shares – *eg* all stocks,
- largest n stocks by market capitalization, constituents fixed at a point in time
- Frequency of calculation – *eg* continuously, daily, monthly
- Method of construction of index – *eg* weighted or un-weighted
- Price data to use (*eg* mid-market prices) and source of the data
- Method for dealing with changes in the constituents – should a change in the constituents result in a change in the value of the index?
- Treatment of income – *eg* should the index try to reflect the total return on the
- constituent shares (including dividends) or just changes in the capital values?

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8.

The general principles of investment are that:

A provider should select investments that are appropriate to the nature, term and currency of the liabilities and the provider's appetite for risk. Subject to the above, the investments should also be selected so as to maximize the overall return on the assets, where overall return includes both income and capital. To the extent that the company does not follow these principles it opens itself to risk.

Assuming 10 year bonds yields 3% pa a fully passive strategy will require the company to invest

$P/(1+0.03)^{10} = \text{Rs } 74.45$ P in zero coupon bonds. The proposed investment strategy is active as it is proposed to invest only 60% in 10 year bonds. This exposes the company to volatilities of the equity markets. Out of Rs 100, Rs 60 invested in bonds will grow to Rs 80.63 at the end of 10 years. The balance has to be met good by the equity investments. The risk that company faces is that Rs 40 originally invested in ordinary shares will depreciate in value by more than 50% at the end of 10 years in which case the guarantee will bite. Worst case scenario will be fall in equity markets combined with a credit default.

There is also the mortality risk that needs to be charged for since the death benefit is return of premium. This will need to be modeled since the cost will vary with performance of equities and bonds during the ten year period.

The appropriateness of the investment policy will depend on –

- Risk appetite of the company and availability of free assets- - Greater the level of mismatch greater will be level of risk to the company. If the company is risk averse or is sitting on low free assets it should follow a passive investment strategy with exposure to high quality bonds to reduce the risk of credit default.

- Volume of business- If the product will be available for sale for limited period the monies collected should enable the company to suitably diversify across bond class (across companies, sector). If the amount of money collected is small the company should look at investing in Collective investment vehicles which will reduce concentration risk.
- It is proposed to follow a static 60/40 equity and bond split- Towards policy maturity it might be more appropriate to shift equity investments towards MM instruments to ensure that the portfolio is not impacted by equity market volatilities towards maturity.
- The proposed strategy will not offer any protection on death claims as the death benefit will be higher of the SP or Fund Value.

Alternative strategy

- It could follow a passive strategy wherein it can first match the guarantee then consider investing in equities. It can reduce credit risks by investing in sovereign bonds. It can invest in overseas bonds or bonds issued by supra national bodies if the returns are attractive. It can however, expose itself to exchange risk which can be hedged. It can also consider investing in high risk Corporate bonds (and thus gaining from credit spreads) if it sees attractive opportunities. It can hedge against credit defaults if the costs are attractive
- It can continue with its aggressive style of investment management provided it also consider hedging its equity portfolio against adverse fall. This will enable the company to take higher risk but will also entail a cost. The one issue may be non availability of hedging opportunities.

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9.

(i) If the employee leaves within 2 years, they get nothing. Potential recruits don't know if they will stay long at the company - this is not necessarily in an employee's control.

The benefits are based on average of salary received during last 5 years before separation. This is not as attractive as a final salary scheme.

Death Benefit is not attractive and appears low as it is only 2 times average annual salary

(ii) 4 changes that may make it attractive to new entrants

- Remove/reduce the 2-year nil benefit period. This will be perceived as highly valuable and the cost may not be very high even if there are fairly large exits.
- Introduce some form of revaluation so that benefits are based on final drawn salary rather than average salary. For new employees the salary increase might be rapid during initial

years and the benefits can be defined relative to final salary. The cost could be higher and the employer can examine passing the costs to employees in some form.

- Higher death benefits. Meets employee's immediate concerns, so high perceived value, at relatively small cost as cost of life cover is not that significant.
- Offer some form of defined contribution benefits. Benefit value can be more obvious to new and younger employees. Need to consider the impact of possible significant changes in structure on administration costs.

(iii) Cutting the nil benefit period is likely to be of such low cost that the employer would accept the increased contributions (if any). This will only affect existing employees with less than 2 years' service, and the new benefit would probably be extended to them.

Increasing death benefits say from 2 to 4 times salary would also be of low cost. These costs might also be accepted by the employer, and extended to existing employees. Greater increases in death benefits would be more costly.

The obvious route to improving benefits without adding to employer costs is to increase the employee contribution rate. Employment legislation might make this difficult for existing employees, so the changed terms could only apply to new joiners, who pay a higher contribution rate.

Recent recruits may be dissatisfied at not being offered the improved benefits. Offering an option to existing employees might be anti-selective — those expecting to benefit from the option would be prepared to pay the higher contributions.

If neither employee nor employer contributions change then the effect must be to provide more to an employee who leaves and less to an employee who stays for a longer period, which would mean reducing the retirement benefits in some way. Any such change would be adverse on existing employees and may not be possible as it would be a worsening in their terms of employment, unless they agreed to it.

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10.

The government of a certain country is proposing to pass legislation creating a National Fund for payment of minimum wages for 12 months to employees made redundant in modernization of private textile factories. When an employee is made redundant monthly benefit equivalent to his last drawn monthly salary will be paid from the Fund for 12 months. The Fund will be financed by levies on private textile companies at a rate to be fixed by the Government and revised every year, if needed. The Fund is expected to be in place and active for a period of 8 years after which it is proposed to be wound up. The Government will make an initial corpus contribution of Rs 100 million to the Fund.

- (i) List the parties which will be affected by the imposition of levies, outlining how each is affected.

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- (ii) Discuss the factors the Fund should consider at this point in setting its investment strategy and managing its liabilities.
- (iii) Discuss the risks to the solvency of the fund.
- (iv) Describe ways in which the risks in (iii) can be managed.
- (v) (a) List the potential conflicts of interest that an actuary might face in advising the National Fund on the levies it should charge.
 (b) Comment on how these potential conflicts could be managed.
- Employees of private textile cos who will now be offered some safety net until they get new employment
 - The management of private textile cos which will pay levies. They will now have to set aside money to pay levy and will impact their cash position, investment plans and bottom lines. At the same time it will enable it to implement massive lay off plans
 - Shareholders of private textile cos which will pay the levies. The share price of the cos will be affected by the levies
 - Distinguishing between current cos and those who will still be around in 8 years, who will pay more/less if initial levies turn out too low/high.
 - Government who won't want levies higher than predicted when introducing the legislation.
 - Taxpayers- ultimately the if the levies turns out to be lower than required the Government may impose additional taxes on general public to support the Fund . Taxpayers will be interested to know how the financing will impact them.
 - Customers of private textile companies – ultimately they may be impacted by costs of scheme.
- (ii) Fundamental principles are to invest appropriately to the nature/term/currency of liabilities, and to aim to maximize returns subject to an acceptable level of risk.

Start with an assessment of the expected cash flows of promised benefits, expenses and investment return. These will be uncertain, particularly due to inflation, redundancy levels, and so it will be necessary to assess the impact of these and other risks.

The fund must look at all options the Fund has to mitigate these risks. Ideally, there would be assets that would guarantee payments to match the expected benefit/expense outgo in term and nature (inflation-linked/fixed). High quality bonds give the best match. The assets should have to be adequately marketable so that the assets can be converted to cash as and when required. Sufficient liquid assets are necessary to meet cash flow requirements.

Investigate whether insurance policies are available that could cover some/all of the liabilities. The premium may be cheaper than the reserves it would be necessary to hold.

Almost inevitably, the market value of the target matched portfolio will not equal the value of the assets available. The rules of the Fund should address these situations. If there are excess funds, then consider lowering future levies. If there are insufficient funds, then levies will need to be increased or benefits will need to be reduced or contribution from Govt will need to be increased.

There may be restrictions on what the Fund can invest in.

(iii) Risks to the solvency of the Fund would arise if the assets of the fund are insufficient to cover the future benefits and expenses. This can occur due-

- Greater redundancies/lay off than expected
- Average salaries of those exiting is higher than expected impacting benefit payout
- Salary inflation is higher than expected impacting final out go
- Failure of investment strategy- poor liquidity, credit defaults, lower returns than expected
- Administrative costs of running the scheme higher than expected
- Inability to raise levies in line with experience due to resistance from textile cos with fewer redundancies than expected
- Default on part of cos to pay levies- due to poor financial condition, management fraud,
- Economic down turn which impact the bottom line of cos and their ability to pay up and also resulting in higher redundancies.
- Fraud risk- Bogus claims

(iv) Management of risks

- Prudent asset management in line with expected benefit/expense outgo. Investing in high quality and liquid assets
- Carrying out stress tests to assess the impact of adverse redundancy than expected combined with economic down turn and default in payment of levies. Holding suitable reserves to address worse case scenarios or buying suitable insurance to address stress scenarios
- Limit on benefits- The benefits could be capped off so as to reduce exposure to unexpected increase in salary levels or highly skewed exposures (salary levels may not be same across cos).
- Flexibility to reduce benefits if levies cannot be increased
- Instead of paying 12 months salary can examine giving benefit until the person gets suitable employment in the 12 month period. This would save costs if re employment can be done within 12 months.
- Regular audit of private cos to rule out management frauds or bogus claims

(v) a) Conflicts could arise if the actuary, as well as being an adviser has one or more of the following roles:

- As advisor to existing private textile co;
- As manager of a private textile co;
- As taxpayer;
- As shareholder in private textile cos.

(b) It will be very difficult for Fund to find an actuary who has no such conflicts. The Fund could look for advice outside the country, or appoint an actuary who has fewer conflicts.

If the job was big enough, then the actuary could cease advising other clients or be full-time employee of Fund.

Any potential conflict must be disclosed to all relevant parties. Procedures should be established to prevent information being used in other areas (Chinese walls).

[24]
