

INSTITUTE OF ACTUARIES OF INDIA

SUBJECT CA1 –Paper I

MAY 2009 EXAMINATION

INDICATIVE SOLUTION

1)

- Members of the scheme.
- spouse and other dependants
- prospective members (for example explanatory wording for scheme booklets)
- the scheme sponsor (for example an employer)
- the scheme trustees
- auditors of the sponsor of the benefit scheme
- regulators
- Investment fund managers.

[4]

2)

Asset modelling requires a balance to be struck between realism and simplicity. A set of attributes for a “good” model includes:

- *Representativeness* – the model mimics the behavior of real-world financial assets.
- *Economic interpretation* – the behavior of assets within the model should be consistent with generally accepted economic principles. In particular, we would expect the generated results to be arbitrage-free.
- *Parsimony* – models should be as simple as possible, while retaining the most important features of the problem.
- *Transparency* – the workings of the basic model should be easy to appreciate and communicate.
- *Evolution* – the model should be capable of development and refinement.
- *Implementation tools* – a range of methods of implementation should be available to facilitate testing, parameterisation and focus of results. These might include analytical calculations, historical back-tests, scenario analysis, tree-building techniques and Monte Carlo simulation.

[4]

3)

a) Key characteristics of money market instruments

- highly marketable, short-term, liquid and stable capital values.

b)

- The liabilities of a life co are primarily long term. However, there are short-term liabilities involved too such as expenses of day to day management, annuity payments, surrender and maturity outgo etc. The fund might therefore wish to hold money market instruments to help it meet these shorter-term liabilities without having to sell long-term assets at unattractive prices.
- Money market instruments may have tax advantages over other asset classes.
- Some economic conditions may make cash temporarily attractive :
 - generally rising interest rates which will depress both bond and equity markets
 - the start of a recession if it is thought that equity markets will suffer from lower growth and bonds might suffer from an increase in the government’s deficit and hence high bond supply
 - In times of high inflation, such assets might offer a very good nominal return.
- Cash may be held due to heavy inflow in excess of out flow and is awaiting investment.

c)

- Liabilities of life insurance companies are usually long term and money market instruments may not satisfy ALM considerations of a life co
- Money market instruments would normally give lower return than fixed interest securities and growth assets though they are less volatile
- Policyholder brochure or illustrations might limit excessive exposure to money market instruments

[7]

4)

a) American options can be exercised on any day before expiry. European options can be exercised only on the expiry date itself.

American options give the holder additional possibilities, without additional obligations. Thus they should be priced no lower than an otherwise equivalent European option.

In some circumstances American and European options will have the same price as each other because early exercise will never be worthwhile (eg it is never worth early exercising an American call option on a non-dividend paying asset). American options may be worth slightly more in other circumstances, although often the margin will be quite small.

b)

(i) A loss of Rs1.20 $(-3.2 + 50 - 48)$

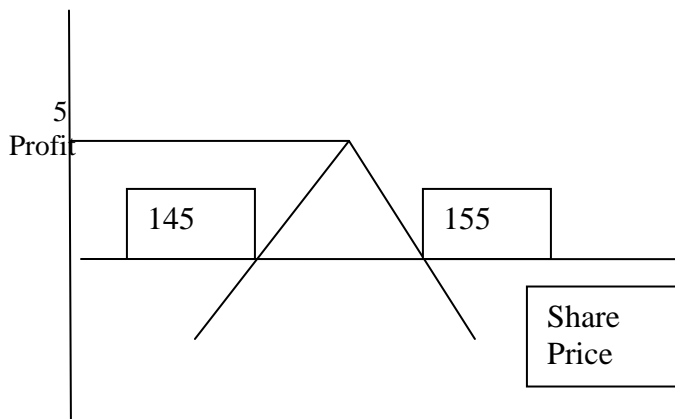
(ii) A profit of Rs 10 $(-10+200-180)$

(iii) Payoff= $-\max(F-150)-\max(150-F)$

Where F is the future price

Profit = 5-payoff

Where $F < 150$ it is, $F-145$ and where $F > 150$ it is $155-F$ and at $F=150$ it is Rs 5

**[6]**

5)

a) Sources of risk include:

- Credit risk- The risk that a borrower is unable or unwilling to make payments required under the mortgage agreement.
- If they do default, then there is the risk that the value of the property doesn't cover the loan.
- Liquidity risk- Unable to dispose of the house when liquidity is required- as property is an ill-liquid asset
- Asset and liability mis-match- The risk of short term liabilities and long term assets or vice versa.
- Concentration risk- Risk of over exposure to housing sector
- Pricing Risk- The mortgage defaults have been priced inadequately
- Expense risk- Asset management costs is higher than expected

- Business Risk- Lower business volumes than expected
 - Reputational Risk- Re-possession of property might lead to loss of reputation , political risk- as property is always a political issue
- b) Regulatory framework should consider issues -
- Accounting and reporting standards-Valuation of such assets – Method and parameters for financial accounting purposes to ensure true and fair view is presented and there is consistency across cos in reporting such investments.
 - Maximum loan that should be offered (as a percentage of value of property) to ensure adequate security on default
 - Allowance for additional solvency capital for credit risk on such assets
 - How much exposure as a percentage of total asset base to avoid concentration risk
 - Which class of fund s should be allowed to invest in such fund- free assets, assets backing solvency, proprietary funds, unit linked funds,
 - How should such assets be values for purpose of solvency
 - Classification of mortgages based on credit quality- security offered, loan duration, fixed/floating loans
 - Recommend stress tests and the ability of company to withstand stress situations
 - Disclosures that should be made to concerned policyholders/financial statements/solvency statement

[10]

6)

- a) The risk premium is the amount of premium required to cover claims expected for a risk. When calculating the risk premium the main issue will be –
- Data is adequate as experience is available for 10 years. However, a period of 10 years may be long considering new technological innovations in motor cars
 - The recent data may not be large in volume and hence not credible
 - Relevance of data is an issue as past experience may not be reflective of future experience
 - a. The type of vehicles in future might be different from that in the past
 - b. In future costs of replacement may go up/down, incidence rates might go up with increase in consumer awareness, changes in consumer laws
 - Data quality may be poor and unreliable, hence not adequate to do an investigation
- b) An actual premium charged would be based on the theoretical risk premium but would additionally allow for:
- a. any differences between the basis used to determine the expected cost and the basis used to set future provisions for the liabilities (provision for adverse deviations)
 - b. expenses including commission
 - c. Profit Margins
 - d. contingency loadings, allowance for tail events
 - e. investment income
 - f. Allowance for inflation on claims and expenses
 - g. the cost of the capital
 - h. Shareholder taxed
 - i. reinsurance costs

- j. profit sharing/experience rating
- k. Company's decision to have a loss leader product

[8]

7)

- a) Circumstances under which market value may not always be suitable-
 - Valuation of assets cannot be looked in isolations and needs to be consistent with methods of valuation of liabilities. If liabilities are valued using methods other than Market Value then Market value is not suitable for valuation of assets.
 - Market values are volatile (fluctuation in prices) are an issue when ensuring consistency with valuation of liabilities.
 - The market value depends on the circumstances surrounding the transaction. A market value requires a willing buyer and a willing seller. When either the buyer or the seller is not willing the market price will be distorted, for example when there is the forced sale of a large volume of assets.
 - There may be no market in the assets concerned, and thus no market value may be available.
 - Accounting or other regulations may require another value e.g. book value or amortised book value to be used.
- b)
 - Book value: historic book value is the price originally paid for the asset. Written up or written down book value is historic book value adjusted periodically for movements in value.
 - Smoothed market value: where market values are available they can be smoothed (for example by taking some form of moving average over a specified period) to remove daily fluctuations. Smoothing would be over a short period — days or weeks.
 - Discounted cash flow: this method involves discounting the expected future cashflows from an investment. It has the advantage of being easily made consistent with the basis used to value an investor's liabilities. However, it relies on the assessment of a suitable discount rate, which is straightforward where the assets are government guaranteed fixed interest stocks but is less so otherwise. Assumptions are needed for default rates and where cash flows are uncertain, such as for equities, property and inflation linked securities, further assumptions have to be made.
- c)
 - Book value is often used for fixed assets in published accounts. Companies other than financial product providers often use book value (written down if necessary) for all accounting purposes.
 - Smoothed market value: This method can be used where markets are volatile, in particular where values are driven by sentiment rather than underlying fundamentals.
 - Discounted cash flow: this method is most commonly used when the cash flows from assets and liabilities are certain and they can be discounted at the same interest rate. It is the most straightforward tool where it is necessary to compare asset and liability values.

[10]

8)

a)

(i) Risks avoided by the individual-

- There is some savings for long term nursing care. He has offset the risk partially.
- Investment risk

Risks accepted by individual-

- Lump sum benefit might be inadequate to pay for long term nursing care benefits due to inflation risk and increase in longevity
- Default risk
- Risks of claim being declined if contract words are not clear
- The contingent event may never happen (poor value for money)

Risks transferred to insurance company-

- Investment and expense risk
- Pricing risk- as the price charged for the benefit might in reality turn out to be lower than the benefit due to mis-estimation of incidence rates

(ii)

Risks avoided by the individual

- Future investment and re-investment risk of regular premiums as the annuity payment is guaranteed
- Longevity risk- as annuity is payable for life
- Definition of ADD- contract un-ambiguous and hence the risk of declined risk is reduced

Risks accepted by individual-

- Inadequacy of annuity payments to meet cost of nursing care due to –inflation risk
- Poor value for money of insured event does not occur
- Default risk

Risks transferred to insurance company-

- Investment and expense risk
- Pricing risk- as the price charged for the benefit might in reality turn out to be lower than the benefit due to mis-estimation of incidence rates

(iii)

Risks avoided by the individual

- All risk-inflation risk, longevity risk, investment risk passed to insurer

Risks accepted by individual-

- Poor value for money if insured event does not occur
- Default risk
- Risks that claims may be declined if contract words are ambiguous

Risks transferred to insurance company-

- Investment, expense risk, longevity risk
- Price charged for the benefit might in reality turn out to be lower than the outgo due to mis-estimation of incidence rates

b) **Policy pays a lump sum at the point of claim.**

- The company needs to determine the probability of need for nursing home at each age., set of transfer probabilities between sickness to death, sickness or recovery etc. .
- Needs to consider whether there is need to allow for anti-selection in initial years
- Decide on margins for adverse deviation required. The margins will depend on the level of data available, reliability etc, Considering the definition “need for nursing care” unambiguous company need to allow for margins due to increase in unanticipated claims

Policy pays a fixed at point of claim

- Longevity risk – is this case it will be rates for “disability annuity” and hence would be different from normal annuitants table
- The definition of event is more clear than in case above (ADD vs. need for nursing care). Hence Margins required might be less than in case above

A single premium insurance policy that will cover the full cost of nursing home fees

- In addition to incidence rates company also needs to make assumptions on the cost of nursing home care, and the inflation of the cost both before and after payment commences needs to be taken into account. Appropriate margins need to be included. for the loose definition of the insured event and incidence rates, escalation costs.

[10]

9)

(i) Merits of the current investment policy

Advantages

- The property companies and mutual fund provide expert management. This is particularly true in property investment (which needs great expertise) and overseas equity investment in the more unusual regions.
- 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.
- 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.
- Diversification within the overseas/property markets will be greater than if the institution invests directly. This may be particularly useful for property, where large unit sizes could make diversification difficult for a property fund
- Particularly with property, the current policy of investment in quoted shares should give greater marketability than direct investment.
- Property companies can both stand at a discount to their net asset values. So the assets, and the resulting income stream, may be enjoyed cheaply.
- Valuation of the institution’s investments in property company shares is simpler and more objective than the subjective valuation of direct property investments.
- Property shares do not give the diversification away from equities that direct property investment would offer.

Disadvantages

The biggest drawback is that the fund does not have direct control over all the underlying assets. It also has to pay management fees to mutual fund. These will reduce its investment return.

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

(ii) 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 of these, although it would not gain exposure to large offices in a capital city, or major financial centre, which can be very expensive.
- Locations: it could have a mixture of capital city and regional property. Overseas property is a possibility.
- Tenure: it could consider freehold and leasehold investments.

Overseas

- Type of asset- fixed-interest exposure in the main overseas markets, eg USA, UK, Germany and Japan, equities in developed/developing and under developed markets/
- Country and currency: (North America, Europe, Japan, the rest of the Pacific basin).
- Industry: it will want to diversify as much as possible, particularly into any industries that are not available domestically.

[11]

10)

{Information ratio was outside the core reading and so allowance was made for this in the marking of the examination}

- a) Risk is most commonly measured as a *tracking error* from a given benchmark. It can be measured on a *forward-looking(prospective)* basis or a *backward-looking(retrospective)* basis.

The prospective measure is the forward-looking tracking error – an estimate of the standard deviation of returns (relative to the benchmark) that the portfolio might experience in the future if its current structure were to remain unaltered. This measure is derived by quantitative modeling techniques and depends on assumptions including:

- the likely future volatility of individual stocks or markets relative to the benchmark
- correlations between different stocks and/or markets. .

Prospective tracking error- involves modeling the future experience of the fund based on its current holdings and likely future volatility and correlations to other holdings.

Retrospective looking measures simply measure differences between actual fund performance and benchmark performance and calculate a standard deviation based on this data

- b) The information ratio is *relative return/relative risk*

where:

relative return is the mean difference between the return generated by the fund and the return of the benchmark, *ie* active return

relative risk is the standard deviation of the difference between the return generated by the fund and the return of the benchmark.

It is also known as the active risk and the tracking error.

A positive information ratio indicates that the fund has achieved positive risk-adjusted performance. Both funds have managed this. Fund Z seems to have performed better by this measure as it has a higher information ratio.

The active money position is equal to the amount that the fund has invested in a particular stock less the amount that an index-tracker has invested in that stock (if it is targeting the same benchmark). It represents the bet that the fund is placing on a stock and can be both positive (for stocks that the fund believes will outperform) or negative.

Fund Z looks as if it is taking much greater risks relative to the benchmark, both in terms of the number of active money positions and in terms of the amount of mismatch involved in the active money positions. It therefore seems to be taking a higher-risk position, which the information ratio suggests has paid off even after allowing for the additional risk.

(iii) *Limitations involved in this analysis*

- One year may not be a long enough time period to make inferences about investment performance. The results may be very different over other periods (both longer and shorter). Past performance is not necessarily a good guide to the future.
- The managers of the funds may have had other constraints placed on them, or different objectives.
- Fund A may have a large number of smaller active money positions rather than larger active money positions and the above information is only on large positions (above Rs 1 crore)
- An active money position in a stock with a high beta is more risky than the equivalent active money position in a low-beta stock, hence the figures may be misleading in terms of the risk undertaken.

[14]

11)

a) Adequate income is individual specific- depending on whether he has a spouse other dependents. Adequate pension will depend on his health, other sources of income etc. It should allow him to adequately maintain his standard of living, ensure protection against inflation

To that extent the proposed system suffers from the following drawbacks-

- It provides an annuity for life post age 60 – addresses longevity risk and provides for an income on retirement There is no protection from inflation/
- The annuity is not guaranteed and depends on the rates available rates, hence no certainty on quantum of future income
- It takes time to build a retirement fund in a DC fund. Hence those who retire in the near future the pension might be inadequate
- No investment freedom- he has to mandatorily invest in debt funds whereas at younger ages an individual can afford to take more risks and invest in growth assets

- Annuity start mandatorily from age- he can neither pre-pone/post pone the vesting age- No additional income for ill-health, death benefits etc.
 - There is no guarantee on the fund- the proceeds depend on performance of underlying fund. There is risk of retiring at times when assets prices are unusually depressed 10% contribution might be inadequate for people who especially for those with less than average earnings, or who wish to make provision for their dependants, and is even less likely to be adequate for individuals who do not work a full career, perhaps because of unemployment, or ceasing work to bring up children.
 - The money is not available in case of any other requirement- critical illness,
 - This system gives a pension based on performance of underlying investments and rates available at time of vesting. Pension is not guaranteed though it is for life. Hence it may or may not be adequate.
- b) Other events include-
- Long term care- nursing care are old age
 - To provide fund for marriage/education for children
 - To provide pension/benefits for spouse and dependents
 - To pay off mortgages
 - For leisure activities
 - Critical Illness Benefits
 - Disability benefits
- c)
- In addition to member annuity it could provide an option for spouse/dependent annuity as well
 - Allow for withdrawal from retirement fund before retirement for certain contingencies- medical emergency, marriage/higher education for children
 - Insurance benefits on death/permanent disability
 - Flexibility over the contributions required increase/decrease contributions, contribution holidays
 - Contract out of state pension
 - Flexible retirement age –pre pone/postpone vesting age
 - Income draw down can be considered
- d)
- The investment policy is “one size fits all”. Where as it should allow investors to invest as per their risk appetite and requirements
 - Investment policy is rigid and allows no flexibility to members “customized solutions”
 - A variety of fund should be offered – equity fund, debt fund, property fund, funds which provide protection against down side risk etc.
 - Life Style funds should be offered- which would allow transfer of investments to debt securities towards retirement
 - It should allow members who have long accumulation period to invest in riskier assets.

[16]
