

**INSTITUTE OF ACTUARIES OF INDIA**

**SUBJECT CA1 –Paper II**

**MAY 2009 EXAMINATION**

**INDICATIVE SOLUTION**

## Q1. Definitions

- a) Duration: The duration is the mean term of the payments from a stock where each term is weighted by the present value of that payment.

$$\text{Duration} = \frac{\sum PV \times t}{\sum PV}$$

where

t is measured in years

PV is the present value of the payment at time t calculated at the gross redemption yield

- b) Volatility: It is the sensitivity of the market price of an investment. For fixed interest bonds, it is the rate of change in the dirty price (P) of the bond for a change in the GRY (y). For equity, standard deviation of returns over a specified period, usually one year.

$$V = - \frac{1}{P} \frac{dP}{dy}$$

- c) Embedded Value: It is the expected value to shareholders on a prescribed basis of the future profit stream from a company's existing business together with the value of any net assets separately attributable to shareholders.
- d) Waiting period (in sickness benefits): is the period beginning at the policy inception during which the policyholder is not allowed to make a claim. [Period from onset of sickness to time when benefit starts to be paid]

**[6]**

## Q2 The main factors in managing a successful project are

1. a clear definition of the aim of the project reflecting customer needs
2. full planning
3. thorough risk analysis
4. regular monitoring of developments
5. measurement of performance and quality standards
6. thorough testing at all stages
7. care in managing different strands of the project to ensure that there are no delays in one part which depends on the outcome of another (critical path analysis)
8. appropriate pacing so that right things are done at the right time
9. stable but challenging relationships with external suppliers
10. a supportive environment
11. excellent communications between those involved
12. positive conflict management, using conflicts as a source of ideas & a tool for development
13. a schedule of what needs to be considered at each milestone review point
14. clear documentation & audits of changes

**[7]**

## Q 3. The company should do a preliminary market research covering:

- what is the competition like (product types, market share, premium rates, etc)
- average claim frequency and average claim size
- risk profile of the policyholders
- relevant regulations/ legislations & its impact
- any solvency, capital requirements
- general economic outlook
- any opportunity to cross- sell to existing customers

Factors/ Risks to keep in mind at the time of product design & pricing:

- to set premium rates to achieve certain profit criteria and/ or market share
- various risks have to be clearly identified, analysed and mitigated
- lack of data for vintage cars, making it difficult to assess the likely claims experience
- the company should use industry data or take reinsurer's assistance
- Model to be developed to determine which rating factors are likely to be significant (age, sex, type of the vintage car) this may be different from the current set of rating factors
- the expected volume of business will be less as it is a niche market
- well targeted advertisement to reduce the risk of insufficient sales
- how the competitors will respond to a new entrant and the risks associated with that
- model should test the impact of various assumptions on the profitability of this product as well as the whole business
- sensitivity & scenario testing should be carried out in order to understand the likely range of results
- it is important to carefully monitor the actual Vs expected experience for all the assumptions once the company starts writing this business
- there should be a quick mechanism to feed back any market information into changing our strategy, product or price etc.

Only 19 bullets so need more marks or points. Suggest points are actually quite detailed in factors/risks so worth

[10]

Q4)

(i) Critical illness rates

- The rates should reflect the future critical illness experience of those taking out the policy
- which is a problem as the company has no past data
- Even there would not be much industry data (as the change in regulation is new)
- Reinsures also may not have useful data pertaining to this market, but may have data relating to similar markets
- It will be important to look at the critical illness along with the underwriting norms, morbidity characteristics, etc
- policy wordings and definitions of the illnesses will also impact the rates
- there might be national population statistics on the incidence of various illnesses
- Getting an accurate incidence rate will be difficult
- Need to add a big margin to the best estimate of the incidence rates as the uncertainty is high
- Yet it is important to be competitive
- As it is a Unit linked contract, it should have the ability to review charges

(ii) expense assumptions

- Need to set charges by estimating the expected expenses to be incurred in writing and administering the product
- starting point would be any recently conducted expense investigation for a similar product
- modify for any specific aspects which might be significantly different like underwriting or claims administration
- it might be difficult to get any industry data
- company's fixed expenses need to be appropriately allocated to this product
- prepare an expense model for a projected new business over a period of time and spread the overheads over that period to get the per policy expense assumptions
- expense model will throw up some expense assumptions expressed as percentage of premium, sum assured or fund

- Direct sales expenses like commission will need to be set in line with that for similar products & the market. The actual levels will be taken in the pricing
- Need to allow for expense inflation
- expected inflation can be estimated by looking at the yield differential between fixed & index linked bonds.
- again due to the ability to vary future charges, inflation assumption may not be critical

## (iii) Investment assumptions

- Will not be a very critical assumption
- because it is essentially a risk product with very little provisions
- Also due UL design the investment risk will be fully bourn by the policyholder
- there will be some risk to the company as there would be fund management charges, but will be very small in absolute size
- different growth rates needs to be assumed for unit and non-unit fund
- need to take the likely investment mix for the above
- and what would be the investment returns currently and in the future needs to be taken

**[14]**

## Q5.

## (i) A good model will:

- be valid, rigorous and well documented
- reflect the risk profile of the business being modeled
- allow for all the significant features of the business being modeled
- have appropriate input parameters and parameter values, taking into account any special features of the provider and the economic & the business environment
- easy to communicate
- should exhibit sensible joint behavior of model variables
- capable of independent output verification
- not be overly complex
- not be time consuming to run
- be capable of development and refinement
- be capable of being implemented in a range of ways

## (ii) (a) pricing a 3% guaranteed growth at maturity on a product

- stochastic model will be more appropriate
- change in economic scenario will have a significant impact on the pricing
- effect of various changes in economic scenarios will have different level & quantum of impact on the product profitability
- wider range of economic scenario can be tested and benefit from the quality of results

## (b) repricing term assurance rates due to mortality improvement trends

- deterministic model may be more appropriate
- because it is normally self evident which direction of movement in mortality rates would give rise to what financial results
- change in mortality rates is expected to be smooth and gradual in a certain direction.
- the fluctuation is not erratic and random

**[9]**

## Q6.

- investment return on assets held
- the amount of future contributions
- salary growth
- expenses of the contract
- future inflation
- any legislative constraints on the assumptions

- amount/value of current fund
- current age, normal retirement date
- the annuity rate that will apply at retirement including allowance for payment options such as
  - inclusion of a spouse's pension
  - having an escalating pension
  - age of the spouse at retirement (if spouse pension opted)
  - different frequencies of pension payment
  - fixed term or payable for life
  - guaranteed minimum period of pension payment
  - the proportion of fund that will be taken as cash at retirement

**[7]**

Q7.

(i) purposes of allocating expenses are:

- to determine the expense loading for premiums
- determining the expense loading for calculating provisions
- understanding the profitability of a particular product
- analyzing sources of surplus
- analyzing areas of inefficiency within the organization
- financial planning
- cashflow management, to ensure that liquid funds are available to pay the expenses

(ii)

a) computer cost

How to allocate

- should be spread over the future expected lifetimes
- then allocated to departments in proportion to usage
- computer running costs could be treated as general overheads
- or charged out to direct operational departments based on departmental usage

b) Investment cost

- expenses directly related to an investment transaction could be added to the purchase price or deducted from the sales proceeds
- other investment costs are usually subdivided by asset class and allowed for by a reduction in yield for each class

c) Property costs

- by charging a notional rent to each department
- in proportion to the floor space occupied
- then allocated to different cells in proportion to the department's salary costs

**[13]**

Q8. Investigation may be undertaken to-

- ascertain the profitability of the current premium rates
- ascertain the profitability of any proposed new premium rates
- analyze segment-wise profitability of both current and proposed premium rates
- to compare current rates (actual claim ratios) with expected rates
- compare with the competitors rates
- review the suitability of the current rating structure
- assess the effect of lapse rates
- assess the impact of cover changes, new perils included, any perils excluded, change in excess, etc
- assess the extent of cross- subsidy
- assess impact of policy excesses

**[5]**

Q9.

- the exercise of the option should be financially neutral to the scheme
- Interest rate assumption
  - will need appropriate interest rates for valuing the benefits
  - may consider medium to long term current bond rates
  - for stable factors average rate or valuation rate may be appropriate
  - it is important to review these rates regularly
- mortality assumption
  - should be for those who are likely to exercise this option
  - anti-selection likely, members in poor health or those whose spouse's are in very good health are likely to opt
  - if all members (or most) with spouses opt for this option then no need for any special mortality adjustment required
- factors should vary by age of the member & the spouse
  - average age difference can be assumed with adjustments made incase the age difference is significant
- need to consider if discretionary increases in payment should be taken into account
- external constraints
  - the scheme document might specify something
  - there could some legislation or professional guidance
  - existing industry practice or competitive pressures which be kept in mind before finalizing the factors
- allowance to be made for additional administration costs
- Besides all the above it is important to work out a pragmatic solution for the table of factors
  - as it should be easy to administer and
  - easy for members to understand

**[13]**

Q 10.

- funds could be merged – this could help if some of the regulatory requirements are calculated as an amount per fund or were less onerous for funds above a certain size
- will also result in savings on expenses, leading to lower provisions for future expense outgo
- exchanging inadmissible assets for admissible assets
- assets more closely matched to liabilities, reducing the need for a mismatching reserve
- valuation rate of interest may depend on expected future returns on the assets. Switching assets may change the valuation rate of interest
- the valuation basis may be weakened, reducing the provisions without altering the assets, so improving the solvency position
- however such arbitrary change in valuation basis may not be allowed by the regulations
- profits could be retained in the business, instead of distributing to shareholders/policyholders
- keeping in mind the reasonable expectations of the concerned parties
- if the company sells with profit business, it will be possible to defer the distribution of surplus by paying less regular bonus and more terminal bonus

In a certain country the economy has grown consistently at 5% nominal per annum. Expected inflation in that country is 2.5% per annum. The table below gives information about various investments available to an institutional investor.

Investment	Price	Coupon	Term
Index Linked Government Bond	100.00	1.5%	10
Government Bond	104.11	4.25%	10
Company X Corporate Bond	89.70	6.00%	10
Equity	Price	Dividend	Dividend Cover
Company X Ordinary Shares	50.00	3.00	2.0

- (i) Analyse the expected returns from the different assets.  
(ii) Comment on the relative attractiveness of each

[8]

Q11 IL Gov Bond GRY = 1.5 % real => risk free return.

Gove Bond GRY = 3.75% = 1.5% + 2.5% (expected inflation) -0.25% (inflation risk premium)

Corporate Bond GRY = 7.5% = 1.5% + 2.5% -0.25% + 3.75% (risk premium)

Equity return = d+ g = 11.0% = 1.5 % + 2.5% + 7.0% (risk premium) Assumes div growth in line with economic growth [other assumptions may be valid]

Comments: Gov Bond has negative inflation risk suggesting lower inflation than expected in the near term. Corporate bond gives excellent uplift on gov bond and with div cover at 2 times has low default risk. Equity risk premium higher than historically possibly reflecting same economic condition as gov bond. Div yield of 6% attractive given cover. Other suitable comments should be awarded marks if sensible.

Question distribution

Ques No.	Knowledge	Application	Higher skills	Total
1	6			6
2	7			7
3		5	5	10
4		7	7	14
5	4		5	9
6		7		7
7	4	9		13
8	5			5
9		13		13
10			8	8
11		6	2	8
<b>Total</b>	<b>26</b>	<b>47</b>	<b>27</b>	<b>100</b>

[8]

[Total 100 Marks]

\*\*\*\*\*