

# **Institute of Actuaries of India**

## **Subject ST4 – Pension & Other Employee Benefits**

### **May 2013 Examination**

#### **INDICATIVE SOLUTIONS**

##### **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.

**Solution 1 :-****(i) Ceilings and Threshold :-**

- Both benefits and contributions may have either;
  - A limit below which benefits/contributions are not paid (threshold)
  - A limit above which benefits/contributions are not paid (ceiling)
- If the financing of State pension is not to be redistributive or regressive, an important point is that benefits and contributions should have the same threshold and ceiling.
- The advantage of a threshold is that, regardless of the level of benefits, people who cannot afford to can be excluded from contributing. If this threshold also applies to benefits, then these people will also not receive the benefits.
- Placing an upper limit on benefits and not on contributions will allow the State to redistribute resources, although this would be inappropriate if a correspondence between contributions and benefits is desired. Also it may be viewed as unfair by those required to pay higher contributions for no additional benefits.
- Conversely it is possible, although unlikely to act progressively and redistribute in favour of the higher paid, if contributions are subject to a ceiling but benefits are not.

(6)

**(ii) Definitions of Fertility Rates and methods of calculation :-**

- Age specific Fertility rates could be expressed in terms of ratio of numbers of live births to either the number of males at each age or number of females at each age.
- However normally the fertility rates are related to female population that generate births and expressed as age-specific rates. A commonly used measure is Total Fertility Rate (TFR) which the sum of age-specific fertility rates over child bearing ages, say 15 – 49 years.
- TFR can be calculated on “period” basis that is at a given point in time and summed up for all ages at that point in time.
- TFR can also be calculated on “cohort” basis i.e. age-specific rates for women all born in a specified period of time i.e. cohort and then summed up.
- Crude Fertility Rate is the number of live births per 1000 of female’s population.
- Crude Fertility Rates could be age related where in the denominator is counted out of numbers within a given age band.
- The Crude Fertility rate calculated on cohort basis and corresponding TFR will then give average number of children expected to be born to a woman during her child bearing years assuming she survives throughout the period.

(7)

**[Total 13 Marks]****Solution 2 :-****i) List of further information from the Finance Director**

- What commitments, if any, were there with regards to future pension rights when the company was bought?
- Does the employer want to provide any pension benefits?
- What is employer’s attitude to employees?
- Paternalistic culture may make generous defined benefit more likely.
- What benefits were employees previously entitled to?
- What options do they have in relation to these past rights?
- Do the company wish to maintain the pension benefits that applied when the employees were employed by ARMA?
- What will happen to any accrued benefits in the ARMA scheme?

- Who are the company's competitors and what benefits do they provide?
- Will ARIMA need competitive pension benefits to attract and retain staff?
- How much budget is available for pension benefits?
- Would the FD prefer to target the budget towards any specific class or group of people?
- Will employees be required to contribute?
- What is FD's attitude to risk and potential variable costs in the future?
- What is financial size of ARIMA and turnover to gauge relative importance of pension arrangements?
- What is future plan for company in terms of growth and acquisitions?
- What is current and future age and salary profile likely to be?
- Are there different classes to be treated differently e.g. would senior management require a separate arrangement?
- How much, if any, resource is available for administration and how much involvement does the company want?
- Are there unions who are likely to press for a certain type of arrangement? (8)

ii) **Relative risks of defined contribution and final salary arrangement**

*Company's perspective*

- For DC scheme employer knows exactly what it will be contributing.
- Financial risks are transferred to employee.
- May not provide competitive benefits.
- May not target contributions where employer wants to target
- If inappropriate DC investment choices made by employees, this may rebound on employer
- Significant employee education and support will be necessary to avoid future problems.
- Final salary costs are unknown in advance and will vary with experience
- Legislation can introduce conditions that make final salary scheme become a financial burden on the employer.
- Final salary schemes are likely to require more involvement in company administration time but can be more flexible in terms of the timing of any funding requirements, e.g. redundancy exercises.

*Employees' perspective*

- In a final salary scheme employee is likely to know in real terms the level of benefit they will receive.
- Financial risk is with the employer.
- Final salary scheme may be attractive in periods of high inflation or rapid promotion.
- In a money purchase scheme employee benefits from good experience and suffers from bad experience e.g. investment returns, annuity rates.
- Employees may appreciate one type of arrangement more than other depending upon their understanding/knowledge of pensions.
- Employees have more flexibility in the type of benefits they may take from a money purchase scheme.

(7)

[Total 15 Marks]

**Solution 3 :-****i) Reason for deficit arising**

- Prudence of assumptions
- Liability on other measures
- Nature and term of liabilities...
- ... in particular, how long is appropriate period to restore funding
- Investment strategy
- ... in particular, degree to which assets match liabilities

(2)

**ii) Determining status of sponsor**

- No specific measures to distinguish between the two
- Trustees need to decide...
- seeking advice from actuaries on nature of liabilities and
- credit risk specialists on the sponsor's finances

***About the sponsor***

- Need to assess its ability and willingness to pay sufficient contributions
- To meet benefit payments as they fall due
- 50 Lakhs could be regarded as loan to sponsor
- Consider size of deficit relative to size of employer
- its assets (which could be realised to repay the "loan" if required)
- its earnings (which can be used to meet regular "repayments" to the scheme)
- Extent to which it is legally obliged to fund the deficit (if any)
- Particularly if scheme were discontinued
- Consider other company debt (how much / ranking of scheme)
- Consider if parent company who would make good any shortfall

***About the scheme***

- Size of liabilities (is the scheme 50% or 90% funded?)
- Ongoing cost of accrual or current contributions (is Rs.50 lakhs one year's contribution or over certain number of years)

***Various ways to assess credit risk (i.e. ability to pay).***

- Business outlook
- Financial metrics
- Implied market default risk
- Credit ratings
- Other risk-based measures e.g. levies
- Probability of default using Merton-type model
- Independent business review

***Assess willingness to pay by considering***

- Past practice if deficits have arisen before
- FD's attitude / plans

(8)

**[Total 10 Marks]**

**Solution 4 :-****i) SCR calculations**

PUM with control period of:

1 year:  $SCR = 285/1,810 = 15.7\%$ .

2 years:  $SCR = (285+278)/(1,810+1,745) = 15.8\%$ .

3 years:  $SCR = (285+278+272)/(1,810+1,745+1,659) = 16.0\%$

AAM:  $SCR = PUSCR$  with 3 year control period = 16.0%. (Note all members leave scheme after 3 years) **(4)**

**ii) MCR calculations:**

Surplus = 2,719 – 2,568 = 151

Reduction in contribution rate =  $151/(1,810+1,745+1,659) = 2.9\%$ .

Since all members retire from the scheme by the end of third year we assume surplus will be spread over 3 years. So the contribution rates calculated above will be reduced by 2.9% to arrive at the MCR.

**(2)****iii) Relative pros and cons:*****Projected Unit Method*****Advantages**

- The benefits will be secure as long as the contribution rate is adjusted to deal with ageing over the inter-valuation period, e.g. by use of a control period.
- Charge appropriate to company profit at the appropriate time.
- The above will be broadly achieved over the inter-valuation period if a control period equal to 3 years is used but then the contribution rate will be higher than necessary in the first year or so and less than necessary in the later part of the control period.

**Disadvantages**

- Lack of stability/realistic measure of long term cost
- The contribution rate will tend to increase over time as the membership ages so the contribution rate calculated at each valuation will not give a realistic measure of the long term contribution rate required.
- The above is because it costs more to provide the pension for an older member than a younger member.
- There's less time to benefit from the excess of investment return over salary progression

***Attained Age Method*****Advantages**

- The benefits will be secure.
- The contribution rate is designed to build up a surplus in the early years (which will offset the increasing standard contribution rate in later years)
- Stability/realistic measure of long term cost
- The contribution rate will be stable if assumptions are realised.
- It gives a realistic measure of the required outflow over the period of members' service.

## Disadvantages

- Charge not appropriate to company profit at the appropriate time.
- The contribution rate is higher than necessary in the early years and too low in late years.
- Build-up of surplus may cause pressure for benefit improvement or a statutory surplus even.

(6)

[Total 12 Marks]

**Solution 5 :-****i) Main reasons for performing a valuation of a final salary pension scheme:**

- It may be required under the terms of the scheme's trust deed and rules
- To recommend a future contribution rate
- To assess funding level — on-going
- On discontinuance
- Statutory valuation requirement
- Accounting for pensions
- If a bulk transfer is taking place/sale agreement
- Legal requirement e.g. for actuarial statement, surplus regulations
- debt on employer
- To investigate benefit changes

(2)

**ii) Valuation process steps**

- Recognize the valuation objective
- Collect data —
  - scheme documentation/rules/benefit structure
  - asset data/membership data
  - data relating to the future operation of the scheme
  - Details of previous actuarial advice, actuarial factors, actuarial reports
- Determine funding method — ensure consistency between assets and liabilities
- Determine funding assumptions — for assets and liabilities
- Data checks — e.g. reconciliation of number of members, missing data, consistency random spot checks
- Determine the value of the assets using the chosen method and assumptions
- Determine the value of the liabilities using the chosen method and assumptions
- Perform analysis of surplus
- Perform analysis of future service funding rate
- Produce valuation report setting out method, assumptions and results
- Cash flow projections/sensitivity analysis
- Discuss results with trustees/employers

(5)

**iii) General terms for analysis of the experience of the pension scheme:**

- Size of scheme
- Consider whether to analyse using old or new valuation basis
- Typically only analyse the major sources (salary, investment, etc.) although mortality can be important for large mature schemes
- Group data appropriately allowing for the size of the schemes e.g. for mortality — calculate for each age band the no. of deaths/no. of exposed to risk
- Consider members in force throughout the inter valuation period — cohorts

- Salary growth — divide current salary levels by those applicable for the same individuals at the last valuation — appropriate to perform analysis of total salaries for age groups
  - Allow for assumed salary inflation including general inflation
  - Analyse promotion/age-related increases separately
  - Similarly for withdrawal and early retirements
  - Investment performance — compare actual against expected by accumulating cash flow/assets at start by expected return and comparing with actual assets
- (4)

iv) **How are the results to be used**

- Results should be used “with care”
  - Useful check on method and assumptions and data
  - Helps identify sources of surplus/shortfall
  - Help understand how to achieve the desired level of prudence in the basis
  - Unlikely to change economic assumptions Statistical assumptions — builds up a “bigger picture” and may justify adjusting some assumptions.
  - Depends on significance of results e.g. for mature schemes pensioner mortality in material.
- (2)

[Total 13 Marks]

**Solution 6 :-**

i)

Longevity is a key risk as longer life expectancy means increased liabilities as pensions paid for longer. It has a bigger impact when real returns are low. Over the recent past life expectancy has improved at a faster rate than previously seen and expectation is that it will continue to improve at these rates at least in the medium term.

(2)

iii) **Determination of post-retirement mortality assumptions:**

- Recently industry standard table probably based on insured lives have been used because occupational pension scheme tables have not been available.
- For the majority of pension schemes, industry standard tables are used with appropriate adjustment to reflect the individual scheme experience.
- As the pension scheme is large enough it should be possible to derive its own base table or at least make —more accurately adjustments to an industry standard table.
- Or adjust the tables used by other schemes in the same sector.
- Adjustments can be expressed as +/- years to age or % adjustment to mortality rates based on location, occupation, amount of pension, postcode as proxy for the impact a member’s socio-economic class has on their life expectancy.
- For allowance for recent experience updation of the chosen base table to account for the time elapsed between the exposure periods. For future improvements trends may be difficult to identify. However, for suitable allowance of future improvement, test the sensitivity of these assumptions to understand risks involved.

(3)

[Total 5 Marks]

**Solution 7 :-**

The sponsor will assess the following point before taking a decision of insurance.

***Assessing the value of insurance***

In deciding whether or not to insure a particular benefit, the scheme managers should consider the following:

- Is insurance available?
- How certain is the cost of the benefit? If it is certain, then all the scheme needs to do is pay the cost. If it is uncertain, how much is it likely to vary?
- If the cost is uncertain, how serious is it for the scheme if the cost is larger than expected? If the consequences are serious, the scheme is much more likely to insure than if the result of an excess cost is minor.
- If insurance is available, how expensive is it? The relevant cost comparison here is of the insurance premium versus the expected cost of the benefit, together with the perceived value of the reduction in volatility.
- The additional cost of insurance can then be assessed against the reduction in risk to assist the decision on the merits or otherwise of the use of insurance.

***Liquidity constraints***

In addition to the relative costs and the variability of those costs, the liquidity risk of insuring annuities should be considered before making a decision. As mentioned, the purchase of annuities may cause liquidity problems. The purchase of cover for death-in-service lump sums will, however, remove a potentially significant liquidity risk. Liquidity risk will be particularly important for a scheme that is immature or small.

***Investment constraints***

In planning in advance for the purchase of annuities, allowance should be made for the risks of disinvesting at an inappropriate time. This risk can be reduced by the holding of assets that match those underlying the purchase price of annuities.

***Impact on the valuation method***

If a scheme switches from insuring benefits to not insuring them care will need to be taken as the valuation methods may then require the need for a reserve to be held where one would not have been held before. This is particularly true of dependants' benefits.

***Availability of additional services at competitive prices.***

Another factor to note in assessing the relative additional costs of insurance is that the insurer may offer very competitive terms for administration, actuarial services and other insurance products. This increases the financial advantage to many small schemes of obtaining insurance.

***Variability of benefit outgo.***

Another factor to note in assessing the advantage of insurance is flexibility and the form of benefit provided by the insurer. Whether it would include discretionary benefit or not?

[Total 6 Marks]



**Solution 8 :-****i) Asset liability Modeling**

- The model projects forward the financial progress of the scheme for a given investment policy.
- The trustees can look at the possible impact on the financial strength of the scheme under differing investment strategies.
- In particular the trustees will be interested in the discontinuance position as they will not want to adopt a strategy which will lead to the scheme being unable to meet its accrued liabilities.
- In addition the trustees will get an indication of the ongoing funding levels and the contributions which they will need to obtain from the company.
- An optimisation process can be adopted which will derive the “best” investment strategy for a given level of risk.
- For the trustees this could mean ensuring the discontinuance funding position (however defined) does not fall below a prescribed level.
- The trustees should consider the appropriate measure risk, e.g. the probability of the measured item falling below a certain level is x%.
- The model can also produce information for the trustees on cash flow requirements so they can manage the investments more appropriately.

(4)

**ii) Limitations:**

- Model uses historical data, which may not be valid, to derive future returns.
- Results may be sensitive to small changes in assumptions
- The model will include some simplifications
- The results may only be valid for a limited time horizon
- Results will provide an insight rather than a true optimization tool
- Level of risk depends on attitude of employer/trustees
- There will need to be a compromise between the trustees and company
- May be difficult for trustees to understand.
- The model may not adequately model practical aspects

(4)

**[Total 8 Marks]****Solution 9 :-****i) Difference between Funding valuation and Discontinuance Valuation:*****Funding Valuation***

- Usually assumes the scheme will be continuing.
- Primary purpose is to provide advice about the future level of contributions.
- There is no single correct way to ensure that a pension scheme will provide the promised benefits
- The objectives of the valuation also include:
  - Comparing assets & liabilities to assess the degree of security for the benefits
  - To review the financial progress of the Scheme since the previous Valuation
  - To determine an appropriate investment policy
- It is common for the valuation assumptions to be relatively cautious
- It is important that the valuation of assets & liabilities are consistent

***Discontinuance Valuation***

- The purpose is to assess how secure the members’ accrued benefits would be if the scheme had to be terminated at the valuation date
- Usually assessed by considering the position if all benefits could be secured by purchase of insurance policies.

- So there is no real subjectivity in the calculations
- All active members will be treated as early leavers with benefits calculated with reference to salary at the valuation date (perhaps with some allowance for increases thereafter)
- Or the scheme could be run as a closed fund adopting an appropriate investment policy to minimise the investment risks

(4)

ii) **Differences between a discounted cash flow funding valuation and a market value approach:**

***Discounted cash flow funding valuation***

- Assets are valued by estimating future income (dividends, rents etc.) and discounting them to give a present day value.
- The discount rate used is consistent with the long term expected investment returns from the assets held (and may bear no relation to current market yields).
- This is often derived by considering the real long-term return on equities relative to the long term expected inflation rate and then making a deduction to reflect the other assets held
- The liabilities are valued using the same long term rate of interest As a result:
  - the valuation of the assets and liabilities is on a consistent basis as the same long term discount rate is being used and market fluctuations in asset values are smoothed

***Market Value Approach***

- The assets are taken at market value to ensure a consistent approach a market value of the liabilities is needed
- There are a number of different approaches to determining a suitable discount rate
- These include: Discounting liabilities at bond yields or allowing for an equity premium to take account of potential higher returns from investments such as equities.

(4)

iii) **Why are different methods used at different times?**

- A market value approach makes more sense in the context of a discontinuance valuation because if the scheme were terminated at the valuation date the actuary would be testing to see if assets held at this point would be sufficient to buy the benefits
- Accounting valuations often require assets to be taken at market values hence the overall valuation basis would be market based
- The discounted cash flow approach produces a reasonably stable contribution rate over the long term.
- Whereas the contribution rate produced by looking at market conditions may not reflect the long term cost of the scheme. Hence a market value approach might also use a long term rate to determine the basic contribution to cover benefit accrual in the future or alternatively it might use a short term rate.
- Depending on the circumstance of the scheme it might be prudent to set a contribution rate for the short term that is higher than the long term average.

(4)

[Total 12 Marks]

**Solution 10 :-*****General factors***

- Conversion factors may be influenced by competition, industry standards or legislative requirements.
- Scheme Trust Deed and Rules may require certain terms.
- If there are no such restrictions, the starting point is usually that the scheme should suffer neither profit nor loss.

***Interest Rates***

- The factors are to remain stable for long periods so the valuation rate of interest or an average rate of return could be used.
- The rate of interest could be chosen to reflect the expected rate of return on the investments (assuming that the scheme is funded) this avoids additional costs to the scheme.
- If the valuation rate of interest is used, care should be taken if this is a conservative one although it may be appropriate to use if the intention is to fund for a surplus which may be used to improve pensioner benefits.
- Or could base premium on expected long term gilt yields.
- When valuation premium could take account of terms of payment guarantee period, frequency of payment etc.)

***Mortality***

- In theory, should consider the mortality of those who are likely to exercise the option.
- Should also consider the uses to which the cash may be put (what is the likely take up of the option?) e.g. are there any tax advantages of taking cash instead of pension? (0.5)
- Could assume that the option will be exercised against the scheme i.e. only be exercised by those members in ill health.
- In practice it may be that all members exercise the option and that standard, valuation, mortality can be used.
- As the factors are required to be stable, a suitable allowance for future expected changes in mortality should be made.
- Does legislation allow male and female factors to be different? If so, does the sponsor want them to be the same?
  - In many societies male and female mortality differs, one sex tends to live longer than the other. The actuarial value of the pension to be commuted will therefore also differ.
  - If the factors are to be different then the factors can more accurately reflect the value of the pension being commuted.
  - If the factors are to be the same need to make assumption about proportion of men/women taking this option can be based on age (mortality tables are) or could decide to use a broad brush approval.

***Other Factors:***

- A stable basis is unlikely to be cost neutral, need to determine the extent to which the sponsor wishes to subsidise/penalise the members exercising the option.
  - Will determine the extent to which the basis needs to be reviewed and the frequency of reviews.
  - For case of administration may use a smooth progression from age to age.

**[Total 6 Marks]**

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