

# **Institute of Actuaries of India**

Subject ST4 – Pension & other Employee benefits

**November 2012 Examinations**

## **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.

**Ans 1: List of stakeholders:**

1. Employer & group of employers
2. Employees
3. State
4. Trustee
5. Scheme Actuary

**Objectives of the stakeholders**

**Employer & group of employers:**

1. Stable/predictable cost
2. Meet needs of employees
3. Paternalism
4. Good benefits vs. Competitors
5. Flexibility
6. Simple / cheap to administrate
7. Tax benefit
8. Target benefit
9. Flexibility
10. Attractive benefit

**Employees**

1. Security
2. Easy to understand
3. Value for money
4. Protection of defendants
5. Flexibility
6. Tax benefit
7. Maintain standard of leaving after retirement
8. Predictable benefit

**State**

1. Paternalism
2. Encouraging private provision
3. Limit dependency
4. Political goal
5. Macro effect on economy
6. Simple in administration
7. Social inclusion
8. Stable / predictable cost
9. Provide safety net for needy

**Trustees:**

1. Operate within trust law
2. Act in interest of all
3. Security of accrued benefit
4. Maintain confidentiality
5. Invest asset prudently
6. Monitor the benefits , contribution and investments
7. Use specialist advice
8. Work independently

9. Not profit from duties
10. Proper administration of accounts, records and benefit calculation

**Scheme Actuary:**

1. Act in interest of all
2. Avoid conflict of interest
3. Suitable assumption setting
4. Follow the professional code of standard
5. Design of simple and suitable scheme
6. Proper administration
7. Scheme should Full fill the need of all stakeholders
8. Minimizing of all the risk related to scheme. -

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**Ans 2:**

The Company may face the following risks:

1. New scheme may not perceive attractive to new employees. However, they will consider that the future accrual of the benefit for existing employees is also based on the rule by which they are getting benefits.
2. Difficult to administrate for existing employee, as two different account need to be maintain for same employee. One account for accrued benefit as per defined benefit rules and another for future accrual of benefit as per defined contribution rules
3. Now company need to operate two schemes, defined benefit and defined contribution. So company will face all the risk related to both schemes.

Defined benefit Risk	Defined contribution Risk
Risk of in adequate funds	Unpredictable benefits
Risk of illiquid of asset	Investment risk , inflation and market value risk lead to Inadequate benefit
Risk of increasing / unpredictable cost	Guarantee risks when purchasing the benefit such as annuities
Risk of surplus of fund and unable to use excess of fund for other purpose, i.e. higher opportunity cost.	the contributions are not made due to the financial circumstances of the sponsor.
Risk of failing to meet members need	the contributions are linked to an inflationary factor, thereby introducing an inflationary risk.
Investment risk , inflation and market value risk lead to higher contribution than expected	Risk of in adequate benefit at retirement.

3. Other common risk , faced by company due to both type of scheme:
  - a. Incorrect benefit calculation and benefit payment
  - b. Higher than expected administration cost
  - c. fines due to non compliance with legislation
  - d. Loss of fund due to fraud
  - e. inappropriate advice due to incompetence, lack of integrity, use of unsuitable model and error in data.
  - f. Risk of bad return on investment, low income generation by asset, higher opportunity cost, asset liability mismatching, reinvestment risk and default risk.

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Ans 3:

**Monitoring the strength of the sponsor covenant**

- Review any financial information available, for example the sponsor's published accounts.
- Monitor the level of any risk-based levies, for example risk-based premiums to a central discontinuance fund.
- Maintain regular contact with the finance director and board of the sponsoring company.
- Require that the sponsor informs the trustees of any actions it takes or is intending to take that could materially impact on the strength of the covenant.
- Ensure the strength of the covenant is regularly monitored by qualified professionals

**Actions for trustees**

- Change the investment strategy to bonds to limit future risk of mismatching liabilities.
- Invest in assets that pay out on sponsor default, eg derivatives including credit default swaps.
- Consider alternatives to cash payments by sponsor, for example a charge on the sponsor's fixed assets.
- Require ratchets to be in place, so if the financial position of the sponsor improves then the contributions to the scheme increase to reflect this improvement.
- Require contingent contributions, so the deficit needs to be made up more quickly if the scheme's financial position worsens.

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Ans 4

- 4.(i) Prospective funding methods aim is to target a stable level of contribution which can be adjusted appropriately when experience does not follow expectation.

Accrued funding methods aim is to target a stable level of funding with standard contribution rate set to maintain this target from year to year with adjustments being made when experience does not meet expectations.

Prospective funding methods:

1. Attained Age method (AAM)
2. Entry Age method (EAM)

Accrued funding methods:

1. Projected funding method
2. Current unit method

$$\text{AAM SCR} = \frac{\sum 1/A (R-x) * S * ((1+e)/(1+i))^{(R-x)} * a'R}{\sum *S* a[ R-x]}$$

$$\text{AA AL} = \frac{\sum P * S * ((1+e)/(1+i))^{(R-x)} * a'R}{A}$$

$$\text{EA SCR} = \frac{\sum 1/A (R-E) * S * ((1+e)/(1+i))^{(R-E)} * a'R}{\sum *S* a[ R-E]}$$

$$\text{EA AL} = \{ \sum (P+F)/A * S * ((1+e)/(1+i))^{(R-x)} * a'R \} - \text{EA SCR} * S * a[ R-x]$$

$$PUAL = \frac{\sum P * S * ((1+e) / (1+i))^{(R-x)} * a'R}{A}$$

$$PUSCR = \frac{\sum (1 * S * ((1+e) / (1+i))^{(R-x)} * a'R)}{\sum S * a[1]}$$

$$CUAL = \frac{\sum P * S * ((1/(1+i))^{(R-x)} * a'R)}{A}$$

$$CUSCR = \frac{\sum (1 * S * (1+e) (1/(1+i))^{(R-x)} * a'R + CUAL * e)}{\sum S * a[1]}$$

R = Assumed retirement age

X = age of the member at valuation date

S = salary at valuation date

A = accrual rate

e = assumed salary growth

i = discount rate

a'r = valuation of annuity payable from R

a [R-x] = annuity to determine present value of all future earnings

P = Past service at the date of valuation

F future service (i.e. (R-x))

E = Assumed entry age of the member

a''R = valuation of annuity payable from age R, based on the assumed proportion of males and females in the scheme

a [R-E] = annuity payable to determine present value of earnings over all service for a new entrant

a[1] = annuity to determine present value of next year' earnings

#### 4.(ii) Assumptions

1. Mature scheme is with a stable distribution by age, sex, salary and past service.
2. The entry age is lower than the weighted average age.

Actuarial Liability:

$$EAAL > AAAL = PUAL > CUAL$$

Standard Contribution Rate

$$CUSCR > PUSCR > EASCR \text{ ( High/ Low rule cannot be applied for the AASCR)}$$

The credit may be given knowing that if  $e < i$ ,  $AASCR > PUSCR$ .

#### 4(iii) **Reasons for difference between the figures**

The Attained Age Method of funding was used, hence to be consistent the death-in-service benefits would have been valued using a formula of the form:

\_\_\_ *Present value of benefits to expected death*

\_\_\_\_\_  
*Present value of 1% of salary to expected death*

In other words the average cost of benefits for the period is likely to be much higher than the current cost, since it effectively assumes an ageing workforce and the cost of death benefits usually increase with age.

The insurance premium is likely to be the expected claims cost over the next year only plus expenses, *ie* close to current cost.

The insurance cost might be less than you expect the cost of death benefits to be (*ie* the insurance may be cheap!) because of:

- competition
- heavier than average mortality in the scheme, which has not been reflected in the premium rates.

The insurance may not relate to the whole death benefit ...

... (*eg* may exclude spouses' pensions or may relate to just the excess over the past service reserve held).

The valuation basis may be prudent, giving a higher estimated cost.

For example:

- spouse's death-in-service annuities based on a long-term interest rate, not the current interest rates
- implicit or explicit allowance for discretionary pension increases.

The insurance company may have lower expenses.

The insurance company may not cover all employees.

#### 4 (iv) ***Two different methods***

##### *The current cost approach*

In other words the present value of the expected death claims over the next year plus expenses.

As this method only looks one year ahead it is consistent with the Projected Unit method.

This does not preclude the method being used alongside the Attained Age method being used to value the retirement benefits.

If the scheme membership ages due to a lack of new entrants then the current cost increases as the expected death claims increase with age.

This should not present problems for even a mature scheme, unless the scheme closes to new members.

##### *Actual group life-cover premiums*

These may be close to the realistic current cost. The premiums will include the insurance company's allowance for expenses and profit.

Any increase in the premium will not be under the control of the scheme and can be driven by commercial and market pressures. This may not present a problem provided the client understands that the premiums may rise.

As with the current cost approach premiums will increase if the scheme membership ages.

**Ans 5.**

(i) The benefits to be offered might include:

- Coverage for use of hospital facilities ( i.e. bed , room)
- Cost of medical treatment (e.g. surgery, x rays, pharmaceutical drugs)
- Cost of physician and nursing care
- Health screening - a part of preventing programme , which should help reduce claim costs in the long run
- Reimbursement for loss of income for the member
- Coverage may be extended to the dependants
- lump sum or stream of income cover long term costs in the case of serious injury
- long term medical care, if career is terminated through injury
- rehabilitation treatment
- physiotherapy treatment courses
- continuation option if temporarily out of work
- continuation option if employed abroad

(ii) **Characteristics of the membership and impact on design:**

- The player will be mainly young and healthy but possibly prone to injury. How prone to injury is likely to vary with the sport, for example it is reasonable to assume more injuries with boxing than cricket.
- A short expected working lifetime. Job mobility may be high between clubs and chance of working abroad.
- a huge variation of earnings between successful and average players
- a high level of injury during a playing career
- a high incidence of transfers between playing clubs
- a possibility of continued employment within the sport as a coach or manager
- a low level of job security particularly as a coach or manager
- a value to their employer which is often very different to their current level of earnings
- The glamorous lifestyle, which can have an adverse health impact

**This could impact on the scheme design as follows:**

- Choose type of cover i.e. injuries sustained during playing/training included, inclusion of major diseases or not
- Industry wide good to ensure minimum level of cover if employed by member club but unlikely to meet full requirements of high earning individuals needing specialist treatment.
- Loss to the club in terms of value of services foregone may be variable at clubs option with player simply getting continued earnings.
- Potentially very high level of protection cover required to meet loss of earnings through career terminating events.
- Self financed continuation options desirable whilst not in employment of member club.
- There is Risk of selection, e.g. player about to be dropped may feign injury, therefore the association may need to ensure appropriate claims underwriting is in place. Underwriting is also needed to ensure any self inflicted injuries are excluded.

Ans 6

**(i) Risks and ways of mitigating the risks for the sponsoring employer funded scheme**

- The employer bears all the risks
- Costs of providing the benefits are higher than expected
- So if experience (investment, mortality, administration costs) is unfavourable, the sponsor has to pay more contributions than expected
- Mitigation
  - Increase the contributions to be paid by the employees in case of a contributory scheme
  - Change the structure of the scheme, e.g. close the scheme to new entrants or reduce some benefits
  - Discontinue the scheme
- In extreme circumstances the scheme may put the employer out of business, legislation changes might increase costs.

**Risks and ways of mitigating the risks for the country's unfunded scheme**

- The risks are borne by the country at large
- Risk is the experience is worse than expected
- Mitigation - If experience is worse than assumed the sponsor can
  - increase general levels of taxation
  - borrow money against the country's future growth / prosperity
  - reduce the benefits for e.g. such as an increased retirement age

**(ii)**

**Data considerations – Funded occupational scheme**

- Most relevant employee data available from payroll system/individual data from administration systems (if any) or by asking employees e.g. regarding marital status
- Need to keep in contact with retirees / former employees to ensure correct benefit payments
- Funded scheme data regards to the investments of the scheme.

**Data considerations – Unfunded state scheme**

- If available, use data from current and past contributing members
- If full individual data not available, use population statistics or sample data
- Take steps to ensure that only individuals who have contributed are eligible for benefits
- and that the benefits granted correlate with historical contributions.

**Actuarial assumptions – Funded Occupational Scheme**

- Salary increase assumptions should relate to the particular industry taking account of any local factors
- Demographic assumptions based on suitable industry data, published mortality tables
- Investment returns should take account of the investment opportunities the local market, the opportunity for overseas investment
- the required investment mix which depend on the matching of assets and liabilities



- the risks that the employer wishes to take
- Allow for any legislative restrictions.

#### **Actuarial assumptions – Unfunded State scheme**

- Assumptions relate to the economy as a whole e.g. wage inflation, inflation index if benefits are inflation linked
- The current and likely future rate of employment
- Demographic trends, such as changes in life expectancy, rate of ill-health retirement, number of marriages, number of children, migration, economic activity rates
- An investment assumption only needed to the extent that a contingency reserve is built up to maintain cash flows, to smooth the costs to members and their employers to allow for changing demographics
- Investment assumption to take account of the expected return on monies invested on the local economy and expected growth in the economy.

#### **Funding objectives – Funded Occupational Scheme**

- Advance funding with aim of providing security of accrued rights on ongoing basis and discontinuance basis
- with stable contribution rate, subject to periodical review

#### **Funding objectives – Unfunded State scheme**

- Enough funds to pay benefits as they fall due
- Stable contribution subject to periodical review as a result, there is likely to be a contingency reserve built up which can be used to support unexpected additional cost
- and smooth the way towards a long term increase in contribution rates, should this be required.

### **(iii) Methods of financing social security schemes**

#### **Pay as you go**

- The contribution income in each year equals the benefit expenditure so no fund is established
- The contribution is likely to vary each year and will generally rise as the system matures or the population ages
- A control period could be adopted — using an equalised annual contribution rate covering the expected income over a fixed number of years

#### **General average premium**

- The level contribution rate is payable throughout the lifetime of the scheme
- A relatively high initial rate is set compared to the pay as you go method
- The contribution is calculated as the present value of all future benefit expenditure / present value of total salaries of the contributing population in all future years
- The contribution rate is stable and substantial reserves are set up under this method

#### **Terminal Funding**

- The contribution income in any period is the amount required to finance the capital of the benefits awarded in the period i.e. benefits are prefunded at the time they are awarded
- Widely used for pension benefits paid from occupational injuries funds

### Scaled Premium

- The contribution rate is between the extremes of pay as you go and general average premium
- It is similar to using an equalised pay as you go rate but the fund cannot fall to zero
- A fund will be built up but the scheme will not be fully funded
- It may be complicated to operate

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### Ans 7

- (i) Assumptions would be needed on the following items:
- The investment return that will be earned on the fund before age 75
  - This would reflect the nature and type of investments which can be used by the fund
  - The annuity terms that are likely to be available at age 75
  - This requires a prediction of underlying interest rates in 15 years' time
  - The insurance company future expense loadings and future mortality rates
  - The administration expenses during the period
  - The actuary would need to consider building in allowance for improvements in mortality

Could also assume that the scheme will be selected against; i.e. those in poor health will select draw down and 100% spouse's pensions

If individual details are not available the actuary may need to assume an average age difference between spouses.

For pensions that increase in line with inflation an assumption about long term inflation or net return above inflation is required.

For the pension to be sustainable you would not allow for mortality before age 75.

In order to maximise flexibility could use more optimistic assumptions for the maximum and less optimistic for minimum.

- (ii) Further information required would cover items such as:

What is the individual's current personal position? What sex are they, are they married, do they have children.

May be a tax efficient way of transferring capital to dependants if they don't buy an annuity.

What investment choices does an individual have with their fund? If choices are restricted little chance of making an investment profit.

Is the individual in good or bad health? If the member is in good health then the annuity may be good value as they expect to live longer than average converse is true if individual in poor health.

How large is the pot (small funds limit flexibility)?

How important is the pension in the individuals overall wealth this will indicate level of risk they are prepared to take with their fund.

How financially aware are they and what are their cash flow needs

Cost of pensions will increase relatively because member has survived. Mortality drag?

What happens to the fund on death before age 75?

What is the cost of providing an equivalent level of life cover?

What are current interest rate levels?

What changes are expected in the next 15 years?

Can an annuity be bought at any time or is it a one off decision to pay the pension from the fund until age 75.

Does the individual want future flexibility regarding the structure of the annuity e.g. pension increases and spouse's pensions?

What are the expenses of certifying the minimum and maximum pensions and how are they paid for.

What are the other expenses associated with running a fund.

(iii) Maximum pension would be based on a single life non increasing pension.

$$\text{Max pension} \times (a_{15|} + v^{15}a_{75}) = 200,000$$

Minimum pension would be based on a joint life index linked pension

$$\text{Min pension} \times (a_{15|} + v^{15}a_{75:72}) = 200,000$$

Assumptions:

Discount rate assumption for the next 15 years and thereafter

Inflation assumption for index linked annuity

Age difference between the member and his spouse

Mortality assumption

(iv) Lifestyle Switching

Lifestyle switching involves the movement of the member's defined contribution fund from the existing asset mix into investments which will be a match for the benefits that will be taken at retirement.

Lifestyle switching helps reduce the member's exposure to volatile market values close to retirement.

This will usually involve a movement from equity investment into bonds of an appropriate term.

The bonds chosen may reflect the nature of the annuity that will be purchased e.g. index – linked bonds will be held in case member wants to select inflation – linked annuity, fixed – interest bonds for a level annuity.

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**Ans 8**

- (i) Money purchase schemes will offer member choice of fund therefore company cannot influence the investment strategy, unless it imposes an underlying investment strategy on the members (via the trustees).

Limit the number of choices to minimise number of investment outcomes

Company will have to use "Lifestyle" as a default as this could roughly match the underpin pension liability

For leavers it is difficult to match transfer values or ill health, early retirements simultaneously as the retirement liability

If underpin is not expected to bite then any special investment considerations can be ignored

Availability of suitable derivatives/financial instruments

Limit number of member switches

- (ii) **Ways to fund the underpin**

The company could use Terminal Funding – only pay for the guarantee as and when it bites on a "pay as you go" basis. Do nothing until guarantee bites.

Set aside reserve, which could be calculated using stochastic modelling techniques.

Pay "arbitrary" extra contribution to a reserve and top – up if necessary.

- (iii) **Stochastic techniques to fund the cost of the underpin**

Use stochastic modelling to meet expected cost of all retirements in 95% of the likely investment scenarios, and meet transfer value guarantees, ill – health, early retirements as and when they arise.

In using stochastic techniques it would be necessary to identify the risks and set appropriate objectives.

For example, is the risk to be measured by inadequate reserves for retirements or other pre-retirement contingencies.

Unlikely to be able to meet guarantees in all circumstances due to different investment time horizons and hence expected returns.

What percentage of failures will can be tolerated, should be measured by amounts not incident

Consider number of retirement, leavers, death expected.

Decide on underlying stochastic model e.g. Wilkie Model

Model attaches probabilities to future investment returns and economic scenarios

Run the model to produce estimated fund values and hence money purchase pension

Run 1000's of simulations as required

Repeat the exercise for alternative member investment choices

Consider the mean and standard deviation of results

Where the money purchase pension is less than the guarantee, place a present value on the excess to establish the reserve required.

