

# **Institute of Actuaries of India**

**May 2011 EXAMINATION**

**Subject ST4 — Pensions & Other Employee Benefits**

**Indicative Solution**

**A1 *Advantages of final salary schemes (employer's perspective)***

- Can target benefits, as a percentage of final salary, more accurately
- In particular, gives better rewards to those whom you may like to see better rewarded, e.g. high fliers
- The timing of contributions for funding of the promised benefits is flexible (within the limits of any regulation)
- Can produce a surplus if experience favourable (e.g. high investment returns)
- No risk of unexpected complaints at retirement since benefits are defined
- May be more comparable with competitors' benefits if many firms offer final salary benefits
- Can be popular with employees (particularly older employees) and their representatives
- Expenses may prove cheaper for a large employer.

***Disadvantages of final salary schemes (employer's perspective)***

- Exposed to risk of bad experience (e.g. low investment return, increasing longevity)
- Contributions can be volatile
- May be pressure to provide additional benefits if surplus funds arise
- May be perceived as unfair by members leaving service, if there is no/lower vested rights
- Cost of provision increases with age, which may influence employment policy more than job ability
- May be easily comparable with better value final salary schemes offered by competitors
- Expenses may be larger for a small employer (e.g. compliance costs) when compared to a simple form of money purchase scheme
- Benefit at retirement is not arrived at from accumulations and predictable only as a proportion of final earnings (less predictable in absolute terms).

[4]

**A2 (i)*****Roles the Government to play***

- Provide benefits to some or all of population
- Educate or require education about the importance of providing for the future
- Regulate to encourage or compel benefit provision by/on behalf of some of the population
- Regulate bodies providing benefits, and those with custody of funds, to attempt to ensure security for promises made, or expectations created

**(ii)*****For and against Means- tested benefits******FOR***

- May be a cost-effective way to guarantee that everyone achieves a certain standard of living in retirement.
- May be redistributive if taxes are raised from those with more wealth/income and means-tested benefits are then paid to those with little wealth/income.

*AGAINST*

- People may be discouraged from providing for themselves.
- May create a poverty trap whereby increases in a person's income (or assets) merely reduce the value of the state benefits.
- May encourage people to squander existing wealth so that they meet means test earlier than later.
- May be perceived as unfair to those who do provide for themselves.
- Means-tested benefits are not taken up by all who are entitled to them.
- More complicated to administer than a benefit provided to all.

(iii)

*Using taxation to encourage pension*

- Provide financial incentive via beneficial tax terms.
- Either full or partial relief.
- Provided to provider of benefit, recipient, or both.

*On contributions*

- Employer contributions deducted from profits before corporation tax.
- Employer contributions not classed as taxable income for employee.
- Employee contributions deducted from taxable income.
- Contributions subject to lower level of tax than profits / income.

*On investments*

- Investment income not subject to tax.
- Investment growth not subject to tax.
- Income or growth subject to lower levels of tax.

*On benefits*

- Regular income not subject to tax.
- Lump sum benefits not subject to tax.
- Benefits subject to lower level of tax than earned income.
- "Exempt, Exempt, Taxed" is common (for contributions, investments and benefits).
- May be upper limits on contributions and / or benefits.

**[10]**

**A3** The model can project, for a given investment policy, statistics (mean, standard deviation, percentiles) about the future financial progress of the scheme over the planning horizon.

This can cover matters such as:

- ❖ Ongoing funding levels;
- ❖ Discontinuance solvency;
- ❖ Contribution requirements; or
- ❖ Pension expense for company accounting.

The model can compare the impact of using different investment strategies. An optimisation process can be used to derive the “best” investment strategy i.e. the mix of assets which produces the “best” projected results for a given level of risk.

In this context, best might mean lowest future contributions, lowest risk of insolvency or some other measure, depending on the objectives of the trustees or company.

The model can produce information about future cash flow requirements for the scheme, to help identify times when the scheme is likely to have to realise assets.

***Limitations:***

- The economic model extrapolates from historical data to derive assumptions about future events.
- The outputs from the model may be sensitive to small changes to the assumptions, and this feature should be tested.
- The model will be particularly sensitive to small changes if the model attempts to model separately many different asset classes. For this reason, models are used to set benchmark asset allocations between broad classes.
- Implementation of asset selection is then the responsibility of the fund manager(s), whose ability to add value may be measured against the return that was achievable on the benchmark allocation.
- The process of fitting an economic model to data is not perfect, and the model will invariably involve some simplifications.
- The outputs from the model should be treated as providing insight rather than as a true optimization tool, and need to be tested to ensure that they accord with common sense.
- The model will indicate the trade-off between risk and reward.
- It does not produce an “optimal” level of risk, which will depend on the attitudes of the employer and/or trustees.
- Invariably the process of choosing a risk level involves some compromise between the parties involved.
- Optimal policies on an ongoing basis may need to be adjusted to reflect the possible impact on discontinuance.
- The model may not adequately model some practical aspects e.g. difficulties in selling large property holdings over a short time period.

[11]

**A4**

***Options for conditions of entry to the scheme***

***Minimum Age***

- As younger people are more likely to change jobs it may help to reduce the scheme turnover if entry to the scheme is restricted to employees above a certain age (e.g. 25 Years).
- Younger employees will not be as concerned about loss of early pension rights, so there is not likely to be a lot of opposition to this proposal from the work force, particularly as the proposed scheme is contributory.

### *Maximum Age*

- Some schemes set a maximum age on entry. This avoids giving very small benefits to late entrants.
- Such small benefits are relatively costly to provide and are administratively burdensome.
- It is likely to affect relatively few employees, though.

### *Immediate Entry*

- In some respects this may appear simplest – because there is never any doubt whether or not a member may join through age / service reasons.
- However, there is high turnover of staff (amongst full-time women) and this is likely to be heaviest amongst the younger and shorter service employees.
- There are high administration costs in setting up deferred benefits or paying refunds to early leavers, so there is a strong argument in favor of restricting entry to reduce the high turnover within the scheme.
- Equal access requirements prevent differentiation between men and women with respect to minimum age and service requirements.
- However, the availability of personal pensions and the necessary requirement to have voluntary membership may lead people to take out inadequate personal pensions (or even do nothing) if they can't join the pension plan immediately.
- To minimize this risk, the company may choose to bear the administrative costs of having immediate entry.

### *Minimum Service*

- Another way of reducing the high administration costs of high scheme turnover is to impose a qualifying period – clearly the longer the period the greater the reduction in administration.
- Of course, if the entry period is more than say two years, there may be some opposition from employees - particularly those who are not young when joining the company.
- The minimum service requirement may be waived for employees bringing a transfer value from another scheme.
- A combination of minimum age and service might be considered.
- For both of these, the company may provide death benefits to those in the qualifying period.
- A further point with the two approaches above is whether the eventual pension should include the qualifying period or not.
- The former is more attractive to employees, but is more expensive for the company. But the company is likely to favor the latter (exclude qualifying service) as the employee would not have paid contributions during the qualifying period. This could involve additional complications such as preservation problem as in the UK.

### *Part Timers*

- Inclusion of part-timers will increase the administration costs (messy calculations based on number of hours worked), as well as the actual pension costs.

- However, if a part-time employee stays with the firm for, say, 40 years working 20 hours a week, it may be difficult to defend the “no pension for part-timers” argument when the total time worked is equivalent to 20 years full-time.
- It may also reflect badly on the company if retiring part-times are seen to be left with no pension.

### *Sex Discrimination*

- The scheme has to be open to men and women on the same terms. As most of the part-timers are women the company may have no choice but to include part-timers.
- To exclude part-timers might be vulnerable to attack on indirect sex discrimination grounds, even though you haven’t discriminated directly against women.
- If you do include part-timers, you may want some mechanism for excluding those who work only a few hours.

### *Discretionary*

- Many small schemes are run so that membership is “by invitation only”. This is not really practicable for such a large group.

### *Voluntary / Compulsory*

- All registered schemes are usually voluntary (except non-contributory life assurance only schemes where compulsory membership is allowed).
- However, many schemes are still administered on the assumption that people will join (i.e. you are put in the scheme unless you specifically opt out).
- It used to be the case that scheme membership could be made a condition of employment.
- Also, it is now quite common for schemes to provide a non-contributory lump sum benefit to all employees (including part-timers).

[12]

A5 (i)

### *Investment Types available for the New System*

#### *Equity*

- This is a real investment and can be used to back liabilities which grow in line with salaries in the long term.
- However, the Market value of equity can be volatile and therefore this is not a suitable investment close to retirement.

#### *Property*

- This can be accessed by an individual via a unitized property fund, again a real investment and can be used to back liabilities increasing with salary growth in the long term.

- Property investment can provide diversification from equity.
- Market values are more stable than for equity investments, but still an inappropriate investment close to retirement.

### ***Index-linked bonds***

- Index-linked bonds are a real investment and can back salary growth, particularly if this is likely to be close to price inflation.
- If government issued in a developed country, they are very secure.
- Market values are more stable than for many other investment classes.
- Returns are likely to be lower than on many other investments (*e.g.* equities) to reflect lower risk and at times demand outstripping supply.
- This is an appropriate investment close to retirement if an index-linked annuity is to be purchased.

### ***Fixed-interest bonds***

- Not a good match by nature for liabilities through much of the working lifetime.
- Government bonds issued in a developed country are a secure investment with relatively stable Market values.
- Returns are likely to be lower than on many other investments (*e.g.* equities) to reflect lower risk.
- Some corporate bonds may be held for diversification and to aim to achieve a higher return.
- This is an appropriate investment close to retirement if a fixed-interest annuity is to be purchased.

### ***Cash and money Market instruments***

- A real and secure investment but returns tend to be low.
- This is an appropriate investment close to retirement if some benefit is to be taken as cash.

### ***Overseas investments***

- Overseas investment is a mismatch by currency.
- Although some may be held for diversification and possibly with the aim of achieving higher returns.

(ii)

### ***Appropriate Investment Strategy***

- The individual will not have a choice over the individual assets held (these will be chosen by the fund managers) but will have the choice over asset sector, *e.g.* equity, property, and possibly asset sub-sector, *e.g.* utility equities, IT equities. The funds are likely to be unitized.
- The funds chosen need to reflect the personal circumstances of the individual (*e.g.* other

sources of income in retirement), their risk appetite and the level of any guarantees offered.

- As the individual is young, he can probably afford to take risk in the short term.
- The individual may receive advice to help determine the appropriate strategy. There may also be a default investment strategy.
- The individual will wish to achieve real returns over the period to retirement, in order to maintain pace at least with price inflation and ideally with salary growth.
- As the individual approaches retirement then, as the benefit is bought out at retirement, it becomes appropriate to hold more secure investments that are protected against significant swings in Market values.
- In the absence of guaranteed annuity rates being written into the contract, the appropriate matching assets close to retirement are bonds (since annuities are backed by bonds).
- This means holding fixed-interest bonds if a level or fixed increase annuity is to be purchased or index-linked bonds if an index-linked annuity is to be purchased.
- Some holding of cash or short-term bonds as the individual approaches retirement may also be required if a lump sum cash payment is to be taken at retirement.
- The process of switching into a mixture of bonds and cash is called lifestyling and this may form part of the policy or this may be an option for the individual or an automatic process that is followed.
- An appropriate strategy will be diversified across and within asset sectors in order to reduce risk.
- An appropriate strategy may include some overseas exposure to benefit from better returns and diversification.

[14]

**A6** (i)

- Surplus carried forward
- Investment experience
- Salary experience
- New entrant experience
- Withdrawal experience
- Mortality experience
- Early/normal retirement experience
- Ill-health retirement experience
- Contributions paid
- Benefit changes/augmentations
- Changes in valuation assumptions
- Change in valuation method

(ii)

Surplus for the year 2010 is Rs. 30 million (i.e. 900-850-(700-680))



(iii)

***Investment experience***

- To estimate the actual earnings on investment, we use following equation:  

$$700*(1+i) + (80-20)*(1+i)^{0.5} = 900$$
 Solving for “i” we get  $i = 19.2\%$
- This is significantly above what was assumed and must account for most of the surplus that has arisen. If the expected return had been achieved, we would have asset worth;  

$$700*(1+9\%) + (80-20)*(1+9\%)^{0.5} = 825$$
 It means the earnings from investment produced a surplus of around 75 million over the year (*i.e.* 900 - 825)
- Total surplus earned over the year is 30 million and it means that excluding this item, there is a deficit of some 45 million.

(iv)

***Salary experience***

- There is insufficient data to make a proper analysis
- Average salaries are a useful indication, but it is the salary history for those members with longer past service that is important
- Average salary has increased from 0.25 million to 0.27 million, an annual increase of 8%. *This does not greatly deviate from what was assumed.*
- If the 8% increase is uniform across all members the strain would be 1% (*i.e.* 8% less 7%) of 30% of 850 = 3
- However, the overall effect of salary increases may be a source of surplus or deficit
- For example, if members with larger past service liabilities (*e.g.* senior managers, older members) have received higher than average salary increases at the expense of the other members, salary experience would be a source of deficit and vice versa.

***Discretionary pension increase***

- Strain expected to be 5% of 50% of 850 = 21
- Assumes all new pensioners get a full years increase and increase paid immediately before 31/12/2010
- Would need to adjust figures for interest if increase paid at an earlier date and allow for lower increase on new pensioners (average half if a proportionate increase paid to them)

**[13]****A7 (i)*****Advantages***

- more competitive scheme, valued by employees, attract/retain staff
- paternal
- consistent with previous arrangements possibly
- may appear a better scheme, but at little extra cost if money purchase funds perform well.
- better death in service spouse's pensions possibly

*Disadvantages*

- may be subject to extra regulation i.e. DB in addition to DC
- more complex/costly to administer
- employees may not value underpin
- extra funding cost if underpin bites
- lack of cost control, additional volatility
- more difficult to incorporate into flex
- employee antiselection

(ii)

- Member choice of fund, therefore company cannot influence, unless it imposes an underlying investment strategy on the members (via the Trustees)
- Limit the number of choices to minimize number of investment outcomes
- Use “lifestyle” as a default as this could roughly match the underpin pension liability.
- But for leavers it is difficult to match transfer values or (ill-health) early retirements simultaneously as the retirement liability.
- If underpin not expected to bite then any special investment considerations can be ignored.
- Availability of suitable derivatives/financial instruments.
- Limit number of member switches.

(iii)

- 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 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” can be tolerated should be measured by amounts not incidence.
- Consider number of retirement / leavers / deaths expected.
- Decide on the underlying stochastic model e.g. Wilkie.
- 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.

(iv)

- Terminal funding — only pay for the guarantee as and when it bites on a “pay as you go” basis. Do nothing until guarantee bites.
- Pay “arbitrary” extra contributions to a reserve and top-up if necessary.

**[16]****A8 (i)*****Attained Age Method***

The AASCR, expressed as a percentage of earnings, is:

The present value of all benefits that will accrue to present members after the valuation date, by reference to service after that date and projected final earnings *divided by* the present value of total projected earnings for all members throughout their expected future membership.

The AAAL is:

The present value of all benefits accrued at the valuation date, based on projected final earnings for members in service.

***Projected Unit Method***

The PUSCR, expressed as a percentage of earnings, is then:

The present value of all benefits that will accrue in the year following the valuation date, by reference to service in that year and projected final earnings *divided by* the present value of all members' earnings in that year.

The PUAL is the same as the AAAL.

***Entry Age Method***

The EASCR, expressed as a percentage of earnings, is:

The present value of all future benefits for a typical member joining at the assumed entry age, by reference to projected final earnings *divided by* the present value of total projected earnings for the typical member throughout his/her expected membership.

The EAAL is:

The present value of total benefits, based on projected final earnings for members in service *minus* the SCR multiplied by the present value of total projected earnings for all members throughout their expected future membership.

***Current Unit Method***

The CUSCR, expressed as a percentage of earnings, is:

The present value of all benefits that will accrue in the year following the valuation date, by reference to service in that year and projected earnings at the end of that year *plus* the

present value of all benefits accrued at the valuation date in respect of members in service, multiplied by the projected percentage increase in earnings over the next year *all divided by* the present value of all members' earnings in that year.

The CUAL is similar to the PUAL and AAAL except that future salary increases are ignored. The CUAL is:

The present value of all benefits accrued at the valuation date, based on current earnings for members in service.

(ii)

### ***Security***

Largest Actuarial Liability (AL) means highest security

AL for Entry Age exceeds Attained Age

- if entry age < weighted average Age

AL for attained age = AL for Projected Unit

AL for Projected Unit > Current Unit

- if salary growth > revaluation for leavers

### ***Stability***

- Model result only stable if no fluctuations in experience
- Instability results from difference in actual experience vs. assumptions implicit in method and parameter values.

The model result will be stable if, for Entry Age, assumed entry age and sex proportions joining is unchanged, and members join in line with assumptions

- for Attained Age there are no new members
- for Projected Unit Method, the age/sex/salary distribution is unaltered by new members
- under Current Unit Method, the age/sex/salary/past service distribution is unaltered by new members

### ***Realism***

- A method must have underlying assumptions that are likely to be met in practice
- The current unit method may, for example, be viewed as unrealistic if members are not expected to leave service at year end (or other example)

### ***Flexibility***

- An employer may require flexibility to match company finances.
- The most flexible are the Projected Unit and Attained Age methods
- Entry Age may lead to restrictions as target fund high – possible surplus.
- Current Unit has low target, hence low security and less flexibility
- Durability, opportunity cost and liquidity are also issues.

**(iii) Effect of benefit improvements**

- Assuming 1% change in pension increases, increases liabilities by 10% at age 60
- Assume annuity change for pensioners is more like 8% for 1%

*Actuarial liability*

To allow for change in pension increases:

Actives:  $480 \times (1.1 \wedge 0.5) = 503$

Deferred:  $48 \times (1.1 \wedge 0.5) = 50$

Pensioners:  $96 \times (1.08 \wedge 0.5) = 100$

*Standard Contribution Rate*

Assume that current SCR of 20% relates to retirement benefits only, *i.e.* it does not include an element for, say, expenses or lump sum death benefits.

Adjusting SCR for change of accrual rate and pension increases, revised SCR:

$$= 20 \% \times 80 / 60 \times (1.1 \wedge 0.5)$$

$$= 28.0 \%$$

*Modified Contribution Rate*

Total liabilities =  $503 + 50 + 100 = 653$ .

Past service position:

A deficit of  $653 - 634 = 19$ .

Know that surplus of Rs. 10 million financed a 1% reduction in contribution rate.

Deficit of Rs.19 million leads to  $19 / 10 \times 1 \% = 1.9 \%$  increase.

MCR = SCR (28.0%) + 1.9 % = 29.9 %

**(iv) Effect of change of salary growth assumption***Actuarial liability*

To adjust the liability for the actives, we need to use the average age weighted by salary and past service, *i.e.* 46.

Assume that members remain in the scheme until age 60, *i.e.* no withdrawal.

Adjustment to Actuarial Liability is

$$(1.04 / 1.05) \wedge (60 - 46) = 0.8746$$

Actives' Actuarial Liability becomes  $503 \times 0.8746 = 440$

Total liabilities become  $653 - 503 + 440 = 590$

Surplus become  $634 - 590 = 44$

Short adjustment period so can estimate that 44 is equivalent to 4.4% of salaries for 5 years

*Standard Contribution Rate*

To adjust the PU rate, we need to use the average age weighted by salary, *i.e.* 43.

Adjustment is  $(1.04 / 1.05)^{(60 - 43)} = 0.85$

Adjusting SCR in (iii) for change in salary escalation:

$$= 28 \% \times 0.85$$

$$= 23.8\%$$

*Modified Contribution Rate*

$$\text{MCR} = \text{SCR} (23.8\%) - 4.4 \% = 19.4 \%$$

[20]

**Total Marks [100]**

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