

# **Institute of Actuaries of India**

## **Subject SP4 – Pensions & Other Benefits**

### **June 2019 Examination**

## **INDICATIVE SOLUTION**

#### **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) Demographic factors that increase the cost of State retirement provision**

- Changes in birth rates – periods of boom in the past, for example following the Second World War, and falling birth rates in more recent times. [1]
  - This means there will be an increased number of pensioners relative to the number of people in the working population. [½]
  - Increased life expectancy – people are living for longer in retirement, so the retirement pension has to be paid for longer. [1]
  - Changes to employment patterns – people are starting to join the working population later (as an increased number of people choose to pursue higher education) ... [½]  
... and leave the working population earlier through early retirement. [½]
  - Both reduce the amount of contributions that are paid towards the pension. [½]
  - Earlier retirement can also lead to the benefit being paid sooner. [½]
- [4]**

**ii) Dealing with the increasing costs of State retirement provision**

- The State may decide simply to accept the fact that benefit costs are increasing, and just increase the level of contributions (taxes) collected from the working population to meet the cost. [1]
- However, there may come a level of contributions at which it is no longer acceptable to the working population to increase the rate further. [½]
- The State can look at reducing the cost of the benefits paid out by:
  - increasing the retirement age so that benefits are paid for a shorter time [½]
  - reducing the number of people who are eligible to receive the benefit, for example: [½]
  - only pay the benefit to those who have contributed for a certain number of years [½]
  - only pay the benefit to those still resident in the country in retirement [½]
  - reducing the starting level of the benefit ... [½]  
.... or a more politically acceptable solution may be to freeze the starting level of the pension (if normally it would increase year to year) [½]
  - changing the benefit to be means-tested or increase the stringency of any means testing carried out [½]
  - reducing the level of pension increases awarded ... [½]  
... for example, if salary-linked increases are currently provided then reduce to price-inflation linked increases. [½]
- Alongside any move to reduce the level of State provision, there will need to be steps to encourage or compel additional private provision ... [½]  
... this might be achieved via tax incentives and regulation. **[5]**

**iii) Means-testing of benefits**

- This change will reduce the cost of State benefit provision – since some people (higher income) will no longer be eligible for the benefits. [1]
- How large a proportion of the workforce is affected will depend upon the stringency of the means-testing. [½]
- Such a change may be viewed as fair, i.e. it helps redistribute wealth ... [½]  
... however some members of the population will be aggrieved if they have paid contributions but receive little or no benefit payment. [½]
- In addition, people who have been prudent and set aside private pension income will be penalised and it may therefore discourage people from making their own provision. [1]
- Means testing involves more complicated administration and increases costs. [½]

- It also puts some people off applying for the means-tested benefits. [½]
- Means testing can be seen as degrading (as it is an indicator of low income), which again discourages people from applying. [½]
- The change will lead to inconsistent treatment across generations, ie current wealthy pensioners will receive higher benefits than future retirees who are affected by means-testing. [1]

### Longer contribution period

- A longer contribution period means:  
individuals contribute for longer ... [½]  
... and individuals may be more likely to retire later, and hence receive benefits for a shorter period of time. [½]
- Such a change needs to be considered against the demographics of the country to ascertain whether it is reasonable to expect people to contribute for 30 years. [1]
- Certain groups in the population may not be able to contribute for this period of time, for example: [½]
  - people who pursue higher education [½]
  - people who take career breaks (eg maternity leave, carers) [½]
  - people in occupations that typically have a low retirement age (eg the armed forces). [½]
- The government may consider regulation to allow individuals to 'buy' missing years of contributions in order to qualify for a full State pension. [½]
- Such a change will need to be phased in over a period of time; in other words it is unreasonable to expect those currently close to retirement to meet such a requirement. [½]

### Consumer price inflation increases

- This should reduce the cost of pension provision. This is because we usually expect consumer price inflation to be lower than salary inflation. [1]
  - The reduction in costs will occur gradually over many years. How significant the effect is depends upon the gap between salary and price inflation.
  - There is a rationale to increasing pensions with consumer prices, since such increases should maintain the pensioner's purchasing power ... [½]  
... however, the standard of living provided by the pension will be eroded compared to that of the working population. [½]
- [10]**

### iv) The advantages of the proposal include:

- + It may result in an increased level of pension provision ...  
... and a reduction in the level of poverty in retirement.
- + Coverage is universal.
- + It reduces the reliance on State benefits ...
- + ... freeing up funds to target other, possibly more urgent, causes.
- + Private provision may be more efficient / competitive, resulting in lower costs.
- + Compelling people to provide may be cheaper than encouraging as, for example, it will not be necessary to offer incentives.
- + It may generate demand for investments, stimulating financial markets.
- + Compelling people to provide for their own pensions can work in practice.
- + It may result in a reduction in the taxes that were traditionally used to finance the State pension benefits.

### The disadvantages of the proposal include:

- Political unpopularity ...
- ... as the compulsion may be perceived as an extra tax.

- Some individuals may not be able to afford the contributions, e.g. the unemployed, carers or the low paid.
- Some employers may not be able to afford the contributions, e.g. small companies, forcing them to go out of business.
- The self-employed will also need special consideration.
- There will be difficulties in the transitional period and private provision will need to be phased in.
- There will be communication issues and a need to educate individuals and employers, which could be costly.
- The State will need to regulate the private provision.

[6]

[25 Marks]

**Solution 2:****i) Liabilities of the scheme**

The liabilities consist of benefit payments and expenses less contributions. [½]

*Nature*

- Active members' benefits will be real, linked to salary growth. [½]
- Deferred members' benefits are likely to be real, linked to price inflation in deferment. [½]
- The nature of current pensioners' benefits depends upon the level of price inflation:
  - if inflation is always greater than 5% then benefits are guaranteed in money terms [½]
  - if inflation is always less than 5% then benefits are real [½]
  - if inflation is sometimes above and sometimes below 5% then benefits are part fixed, part real in nature. [½]
- There may also be a practice of awarding discretionary pension increases. [½]
- Expenses will be real, linked to salary growth and price inflation. [½]
- Contributions are a negative liability, which are likely to be linked to salary growth (as they are typically expressed as a percentage of salary), ie guaranteed in terms of an index of salaries. [½]

*Term*

- Active members' benefits may be very long term, (for example, for a young member, term could be up to 70 years). [½]
- Deferred members' benefits may be medium to long term. [½]
- Current pensioners' benefits are short to medium term. [½]
- The term of the expenses will depend on the term of the benefit payments. [½]
- Contributions are likely to be paid regularly through the lifetime of the scheme (probably monthly). [½]

*Currency*

- Benefit payments, expenses and contributions are likely to be denominated in the domestic currency. [½]

*Uncertainty*

- Active members' benefits are uncertain in terms of the amount (defined in terms of future salary) ... [½]  
... and the term (dependent on the lifetime of the member). [½]
- Deferred members' benefits are uncertain in amount (linked to price inflation) ... [½]  
... and in timing as there is uncertainty over whether the member will remain in the scheme until retirement, eg may request a transfer value. [½]
- Current pensioners' benefits are uncertain in amount (linked to price inflation) ... [½]  
... but known in timing ... [½]  
... but there is uncertainty over the total term (dependent on the lifetime of the member). [½]
- Other benefits such as death benefits and retirement lump sums may be uncertain. [½]
- Expenses are unknown in amount and linked to the benefit payments in timing / term. [½]
- Contributions are unknown in advance (linked to salary) but are generally known in timing unless, for example, the sponsor defaults or makes one-off contributions. [½]

[10]

**ii) Suitable matching assets**

Investments in the domestic currency form a good match by currency. [1]

*Domestic equities:* [½]

- a broad match for active members' salary linked benefits in the long term [½]
- a good match for any discretionary pension increases as they are expected to yield high returns in the long term. [½]

*Domestic government index-linked bonds:* [½]

- a good match for the nature of the deferred members' benefits and some expenses [½]
- a good match for current pensioners' benefits if inflation is less than 5% pa. [½]

*Domestic government conventional bonds:* [½]

- a good match for current pensioners' benefits if inflation is greater than 5% pa. [½]

*Cash and money market instruments:* [½]

- a good match for short-term cash flow requirements, e.g. immediate pension payments, expenses and transfer value payments [½]
- the need for cash is lessened if there is a steady stream of contributions, since contributions can be used to meet short-term outgo. [½]

*Property:*

- a real asset, so a broad match for real liabilities [½]
- rents, which can be used to pay for benefit outgo (as long as there are other liquid assets too) [½]

• offer diversification from equities. [½]

*Derivatives for hedging:* [½]

- Derivatives may be used to aid matching of the pensions in payment increases if inflation is sometimes above 5% and sometimes below. [½]

*Overseas assets:* [½]

- can provide a reasonable match to long-term, real, domestic liabilities ... [½]
- ... due to the purchasing power parity path theory, which says that, in the long term, the exchange rate moves to offset differences in inflation. [½]

**[8]**

**iii) Factors affecting mismatching**

- the funding level of the scheme – the higher the funding level, the greater the scope to mismatch
- the size of the scheme – all else being equal a larger scheme can take more mismatching risk
- the objectives of the sponsor and the trustees
- the risk appetite of the sponsor and the trustees
- legislation affecting which asset classes can be held
- scheme rules affecting which asset classes can be held
- tax treatment of different assets
- the availability of assets, for example whether index-linked bonds are available
- the relative cheapness and dearness of different asset classes
- the extent to which benefits are insured, for example if the scheme has insured death-in-service benefits then there is greater scope to mismatch
- the dealing costs involved
- the scheme's investment expertise
- whether the scheme is expanding or contracting
- the approach taken by competitor schemes
- the need for diversification.

**[7]**

**[25 Marks]**

**Solution 3:****i) Assumptions to be made**

- investment return
- general salary growth
- promotional salary growth
- price inflation
- pension increase rate
- estimated cost of annuity purchase at retirement
- family statistics, e.g. spouse age difference and percentage married
- expenses and expense inflation [2]

Pre-retirement decrements will be ignored as allowance for such decrements would result in a shortfall in meeting the target pension for those who reach retirement. [½]

The cost of any protection benefits over those based on the return of the fund value will be added to the contributions required. [½]  
**[3]**

**ii) Factors to take into account***General points*

For a DC scheme there is no guarantee that the target pension will be met. [½]

If the assumptions are not borne out in practice then the target pension will not be met. [½]

To illustrate the uncertainty over the benefit level it would be useful to give projections on a range of bases, e.g. optimistic, best estimate and cautious, to highlight the sensitivity of the figures. [½]

*Prudence*

To be “fair” to the members and the employer a best estimate basis should be adopted. [½]

The gaps between assumptions, in particular “i – e” are more important than each actual assumption, as this will dictate the overall level of prudence in the assumptions. [½]

It may be that a decision is made to move away from a best estimate basis. This may be to reflect the employer’s view. [½]

For example, a paternalistic employer may wish to err on the side of prudence so that the member has a better chance of receiving at least the target benefit. In this case prudent assumptions will be used. [½]

Alternatively, the employer may be concerned with the cost and therefore, as it may be difficult to reduce the contribution rates in future if there is over-provision, optimistic assumptions may be used. Contribution rates can then be increased in the future or the fund value topped up at retirement to attain the target benefits. [½]

*Specific points*

The pre-retirement investment return assumption should take account of the types of investment class that will be allowed, the investments actually held and any likely change in investment strategy as people get closer to retirement, e.g. life-styling. [½]

General salary growth assumption – needs to take account of industry statistics and macroeconomic policy. [½]

Promotional salary growth assumption – examine the company’s past policy and talk to management about future prospects. [½]

The cost of annuity purchase – this will depend upon the outlook for: [1]

- post-retirement investment returns, which are likely to be based on the outlook for bond yields
- Post-retirement mortality rates for member and dependant, which is likely to be based on general population or industry statistics allowing for future trends (particularly given the long timescale).
- Annuity prices from group pension products of insurance companies

Spouse age difference / percentage married – investigate the company records and/or use national statistics. [½]

[7]

[10 Marks]

#### **Solution 4:**

##### **i) Asset-based discount rate**

- an implied market discount rate is determined for each asset class [½]
- the discount rate is calculated as the weighted average of the individual discount rates based on the proportions invested in each asset class [½]
- the discount rate could be determined using the distribution of the actual investment portfolio or by using the distribution of a notional portfolio (e.g. by using the portfolio intended to match the liabilities) [½]
- where investment strategy varies over time: [½]
  - two discount rates (one pre- and one post retirement) could be used
  - the discount rate could change year by year

##### **Replicating portfolio – mark to market**

- implicitly assumes that a set of bonds can be found to replicate each type of benefit, from which a yield curve is derived [½]
- the yield curve is applied to the corresponding projected benefits to place a value on the benefits [½]
- the appropriate yield curves are those relating to government bonds (nominal or index-linked) [½]
- Sometimes, curves derived from the swap market are used [½]
- In practice, an “average” yield is often used as an approximation to the yield curve. [½]

##### **Discount rate equal to bond yields plus a risk premium**

- This method starts with the same discount rate as in the above method (i.e. bond yield) [½]
- but adjusts it, by the addition (usually) of a “risk premium” [½]
- The risk premium takes account of the returns expected on other asset classes held by the scheme [½]
- This adjustment may be constant or variable. [½]

[6]

**ii) Advantages of presenting results using a range of assumptions and for alternative economic scenarios**  
 In any valuation there will be uncertainty about the appropriateness of the assumptions used for the valuation process. [½]

A best estimate basis will not always be most appropriate for a valuation, for example the results on a more prudent basis may also be investigated to try to improve security. [½]

By running the results on different assumptions it is possible to better understand how the results would differ if the assumptions were not borne out but the experience of the scheme followed alternative assumptions. [½]

In this way the actuary can better understand the risks associated with recommending a given course of action (e.g. contribution recommendation, changes in investment policy) and explain this to the client. Furthermore the client is also better able to exercise judgement. [½]

Sensitivity testing (i.e. changing individual assumptions) can highlight which assumptions have the biggest financial impact on the scheme, and the likely range of results. It can also indicate which assumptions are the most important. Sensitivity testing will be particularly important if a deterministic approach is adopted where the assumptions have fixed values. [1]

Changing the economic scenarios (scenario testing) is useful to highlight the impact on the scheme of many assumptions changing at the same time, as is likely to happen in practice. It is possible to investigate “worst case scenarios”, for example the impact on the scheme of the domestic economy falling into recession can be understood. [½]

The scenario will be made as realistic as possible, so changes will also be factored into the demographic assumptions where appropriate. For example, in a recession it might be expected that voluntary withdrawals would fall but redundancies would increase. If probabilities are attached to each scenario the actuary and client can further understand how much risk is being taken with the current strategy. [1]

Scenario testing can be carried out whether a deterministic or stochastic approach is adopted. For example, under a stochastic approach the use of different distributions will be examined. The results of the analyses can be used to help the actuary better understand the financial significance of the assumptions and risks involved in a given strategy and impact on the position of the scheme. This in turn leads to the actuary better advising the client. [1]

The analyses will also be carried out for different valuations (e.g. solvency, funding, statutory tests) so as to show how they are affected in different ways. Such testing can help the client decide on future benefit design and affordability. Such calculations may be necessary to value any guarantees offered by the scheme. [½]

**[6]**

**iii) Main sections in a funding valuation report**

*Background information* [1]

- Who the report is addressed to and the scope of the report
- The date of this and the previous valuation
- The name and details of the actuary preparing the report

*Compliance* [1]

- That the report has been prepared in accordance with any applicable Guidance Notes / Actuarial Practice Standards and regulation and copies of statutory certificates if necessary

*Summary of benefits* [1]

- A statement of benefits, including allowance made for additional discretionary benefits



- Whether any benefits have been excluded, for example additional voluntary contributions and their attaching assets
- Insurance arrangements in place

*Summary data* [1]

- A summary of the membership data
- A summary of the assets held

*Inter-valuation period* [1]

- Contributions paid over the inter-valuation period
- Material developments during the inter-valuation period including deviations in experience from assumptions at the previous valuation

*Funding calculation* [1]

- A statement of funding objectives
- Summary of financial and demographic assumptions, with key assumptions highlighted
- Funding method
- Confirmation of consistency of approach used to value assets and liabilities

*Results of the valuation on given approach (ongoing, solvency etc.)* [1]

- Funding level
- Recommended future contribution rate
- Reconciliation of the results with the previous valuation

*Further action* [1]

- Agreed client actions, e.g. contributions to be paid, benefit changes
- Agreed actions by actuary including when the next review will occur

[8]

#### iv) Assumptions for pensioner valuation

*Post retirement investment return* [1]

- Should reflect investment strategy of the scheme

*Pension increases* [1]

- Guaranteed increases?
- Any discretionary practices

*Post-retirement mortality* [1]

- For retiring member
- Spouse
- Other beneficiaries, e.g. children
- Mortality improvements?

*Family statistics* [1]

- Age difference between member and spouse
- % married at date of death

[4]

#### v) Mortality analysis

Collect all relevant data at specific date, e.g. previous valuation date [½]

Split the data into homogeneous groups, e.g. by age, sex, member / beneficiaries, [½]

The extent to which this can be carried out will be limited by the volume of data available... [½]

Given this is a large scheme, there should be sufficient data [½]

Calculate Exposed to Risk and derive rates of mortality experienced using the actual number of deaths	[½]
Compare the rates with a standard mortality table	[½]
Smoothen the results, as appropriate, keeping in mind the overall shape of the standard table...	[½]
It is important to allow for improvements in mortality rates and trends in mortality for future...	[½]
	<b>[4]</b>
	<b>[28 Marks]</b>

**Solution 5:**

i) Disadvantages of providing annuities within the plan

**Disadvantages to the employer***Risks*

The following post-retirement risks would fall on the employer: [1]

- investment risk, i.e. the risk that investment returns are lower than expected
- longevity risk, i.e. the risk that members live longer than expected
- expense risk, i.e. the risk that expenses are higher than expected
- uncertainty regarding contingent dependants' pension payments, e.g. whether they are paid and how long dependants will live.

*Annuity rate*

There may be high administration costs, in setting up and reviewing annuity rates. [½]

There is a risk that members will feel they are being treated unfairly if annuities are poor value compared with those available from the market. This could result in ill-feeling and bad press... [½]

There is a risk that some members will feel they are being treated unfairly if plan annuities are more generous for some ages than others, or guaranteed at some ages and not others or different for the different genders. Also when rates change, members currently retiring may feel that they are being treated unfairly compared with members who retired in the past. [½]

*Investment*

Investment options may be constrained, e.g. investments may need to be held to match the annuity paid. [½]

*Practicalities*

The risk of the uncertainty of changes in taxation and legislation falls on the employer. [½]

**Disadvantages to the member**

*Size of pension* [1]

There is a risk that members may not receive as favourable annuity rates from the employer as from the market, e.g. the employer may not review the annuity rates frequently, or may smooth between ages and/or genders.

*Security* [1]

There is a risk that there is adverse experience in the plan or that the employer offers generous terms and a deficit arises, resulting in pensions not being paid in full which may be due to a possible wind-up of the pension plan.

*Flexibility* [1]

If annuities are provided from the plan then they may be of a set form, whereas purchase from an insurance company may give the member greater choice (e.g. different dependants' attachments, pension increases). [6]

**ii) Advantages and disadvantages**

The main advantage of insuring the death benefits is that cash flow problems that arise from having to pay large sums at unpredictable times will be avoided. [1]

Cash flow problems would be more likely to occur when paying out lump sums – spouses' pensions are usually less of a problem in this respect. [½]

For small schemes insurance will provide valuable protection against possible insolvency too... [½]

Also, for new schemes, a few extra deaths than anticipated could jeopardise the security of the remaining members' accrued benefits if the death benefits were not insured. [½]

Another advantage of insuring the death-in-service benefits is that the insurers take on the mortality risk. [½]

The main disadvantage of insurance is that insurers write this business to make a profit. Purchasers of the insurance therefore lose out by contributing towards this profit. [1]

However, group life is usually a very competitive class and the profit margin is not large. If profit sharing is involved the margin may be further reduced. [1]

For large schemes experience is more predictable and cash flow problems are unlikely to arise in the normal course of events. However, a catastrophe could cause significant problems and therefore a large scheme may take out catastrophe insurance. [1]

[6]

[12 Marks]

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