

Institute of Actuaries of India

Subject ST4 – Pensions and Other Employee Benefits

October/November 2007 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.

1.) Indicative Solution:

a) List of possible regulations that a State may make:

*** Financial regulation**

- i. require advance funding,
- ii. require separation from the sponsor's other assets of any funds required to provide the benefits,
- iii. require trustee control of funds,
- iv. authorisation of those individuals or organisations that manage or invest any funds,
- v. regular checks on the adequacy of separated funds,
- vi. restrictions on the types of investments used for any funds.

*** External sources of protection**

- i require letters of credit to be provided for schemes from banks,
- ii require minimum credit ratings for organisations whose finances may affect the availability of funds,
- iii place a levy on relevant parties to provide compensation as an alternative
- iv to insurance against inadequacy. place outstanding benefit obligations as a high priority debt in the event of insolvency,
- v require financial guarantees from a parent company or shareholders, compel sponsors, managers, investment managers and any other relevant party to hold insurance against inadequacy of funds in the event of insolvency, negligence, fraud or any other appropriate event,
- vi supervise the finances of commercial benefit providers,
- vii supervise the marketing by commercial benefit providers.

*** Administrative and others**

- i. regular disclosure to potential recipients of the adequacy of funds and the ways in which those funds are managed and invested,
- ii. require individuals who are involved in, or who advise on, the administration of the benefit provision or the investment of related funds to report any bad practices to a State regulator,
- iii. require benefits to be provided for individuals who leave or surrender before retirement age.

b) Disclosure of information:

(i) How it improves security?

- If membership is voluntary, members have the option to leave the scheme if they feel that security is inadequate.
- If trustees exist, members can bring their views to their attention and also put pressure on the scheme sponsors.
- Might alert members of potential problems.
- Might encourage transparent running of scheme.
- Actions of scheme managers, accountants, investment managers, actuaries and other related parties will be open to inspection.
- Ensures that the beneficiaries are not misled and avoids false expectations.

(ii) On or before entry:

- i. Eligibility conditions.
- ii. Benefits provided under various circumstances.
- iii. Cost and contributions.
- iv. Details of scheme's constitution.
- v. Details of how the scheme is funded.
- vi. Investment of funds.
- vii. Security of benefits if the scheme were to close.
- viii. Any additional expense charges.

At regular intervals:

- i. Current entitlement to benefits and/or value of benefits.
- ii. Indication of prospective entitlement to benefits for future membership.
- iii. Financing of the scheme and choice of investment policy.
- iv. Any changes to scheme rules.

On commencement of receipt of benefits:

- i. Statement of amount of benefits payable.
- ii. Details of how benefit is payable.
- iii. Conditions to be satisfied for continuation of benefit payments.
- iv. Any contingent benefits.
- v. Any options available.

At all times members should have access to:

- i. Scheme's documentation, trust deed and rules.
- ii. Annual reports and accounts.
- iii. Actuarial valuation reports.

On leaving the scheme:

- i. Benefit entitlement.
- ii. Options available.

On death:

- i. Information to the member's beneficiaries on death.

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2.) Indicative Solutions:

a) Formulae for:

$$(i) \quad PUSCR = \frac{\frac{n}{A} S \left(\frac{1+e}{1+i} \right)^{R-x} a'_R}{Sa_{\overline{n}|}}$$

$$(ii) \quad AASCR = \frac{\frac{(R-x)}{A} S \left(\frac{1+e}{1+i} \right)^{R-x} a'_R}{Sa_{\overline{R-x}|}}$$

b) Different funding objectives:

- (i) PUSCR: Targets a fund, at the end of control period, equal to 100% of liabilities where liabilities for active members allow for projected salary growth.
- (ii) AASCR – Targets a contribution rate which is a stable percentage of pension able pay.

c) SCR calculations:

(i) PUM with control period of:

(a) 1 year: SCR = 238/1,720 = 13.8%.

(b) 2 years: SCR = (238+232)/(1,720+1,657) = 13.9%.

(c) 3 years: SCR = (238+232+228)/(1,720+1,657+1,614) = 14.0%.

(ii) AAM: SCR = PUSCR with 3 year control period = 14.0%. (Note all members leave scheme after 3 years)

d) MCR calculations:

$$\text{Surplus} = 3,125 - 2,941 = 184.$$

$$\text{Reduction in contribution rate} = 184/(1,720+1,657+1,614) = 3.7\%.$$

So all the contribution rates calculated above will be reduced by 3.7% to arrive at the MCR.

e) Relative pros and cons:

Projected Unit Method

Advantages

- i. 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.
- ii. Charge appropriate to company profit at the appropriate time.
- iii. 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

- i. Lack of stability/realistic measure of long term cost
- ii. 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.
- iii. The above is because it costs more to provide the pension for an older member than a younger member.
- iv. There's less time to benefit from the excess of investment return over salary progression

Attained Age Method

Advantages

- i. The benefits will be secure.
- ii. 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)
- iii. Stability/realistic measure of long term cost
- iv. The contribution rate will be stable if assumptions are realised.
- v. It gives a realistic measure of the required outflow over the period of members' service.

Disadvantages

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

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3.) Indicative Solutions:

a) Company Advantages

- (i) Restricts the exposure to a final salary promise, hence limits associated mortality, investment and salary risks. Practical impact depends on salary profile of employees.
- (ii) Promoting flexibility may be attractive for some senior employees.
- (iii) Helps make clear the value of the benefit promise to the individual.
- (iv) Company may be able to save money.

Company Disadvantages

- (i) By not providing benefits on pay up to the full pay, the company may not be making full use of the tax relief available.
- (ii) Possibly administratively cumbersome although this would depend on how the cash payment is calculated.
- (iii) Comparability issues for future and existing executives.
- (iv) Additional level of communication required and plenty of room for misunderstandings.
- (v) May restrict flexibility in offering early retirement deals for executive in future (without prohibitive cost).

- (vi) Cash flow may be an issue, depending on number of staff over the maximum limit and scheme surplus.

Employee's Advantages

- (i) Employee can pay extra sum as voluntary contribution to "buy back" lost pension.
- (ii) Employee can choose which elements of the benefit package are of most importance to them (e.g. retirement saving, life assurance etc.) and direct the additional sum accordingly.
- (iii) Employer's buying power should ensure that the cost of additional benefits to the employee is kept relatively low although complete flexibility may dilute buying power for little used benefits.

Employee's Disadvantages

- (i) Depending on how the calculations on the additional sum are undertaken and what benefits allowed for the employee may be better or worse off.
- (ii) Employee will have uncertainty over final benefit.
- (iii) Lower protection benefits for staff over the maximum limit.
- (iv) Requires more time/involvement (may be perceived as an advantage).
- (v) May be tax disadvantages.

b) Issues and principles:

- Needs to decide what benefit to target e.g. pension on normal retirement, early retirement leaving service etc. Targeting one benefit may lead to higher/lower provision of another benefit and an appropriate compromise should be established. Depending on what benefit is targeted, employees may feel the sum was over or under that which is necessary.
- If the calculation is made specific to each individual this would be administratively cumbersome but would ensure benefits are better targeted. It could also lead to comparisons between individuals which are difficult to explain.
- If a simple approach is used, it is likely that individuals cannot replicate the existing benefit formulae for all pay but that may be outweighed by the flexibility they have to choose how the money is spent. Could use market-related calculation each time or may be easiest to publish age related scale in advance subject to periodic review when assumptions change.

c) Elements of basis for calculations:

Assumptions:

- (i) The assumptions adopted for funding the final salary scheme will include margins and will be appropriate for membership as a whole.
- (ii) Need to decide the right balance between theoretical and practical.
- (iii) Depending on the assumptions used to determine the additional sum and depending on what benefits are targeted, the outcome will be different from the target.

Investment Return

- (iv) The investment return may be a best estimate.
- (v) If the cash sum is not invested in the same type of vehicle it will prove insufficient.
- (vi) The company needs to decide whether the basis should reflect the cost to the employer or the benefit to the employee Salaries.

- (vii) The salary progression of more senior employees may be different from the overall population. The assumption should reflect this fact but impossible to allow for individuals personal expectations

Discretionary Benefits (e.g. Pension Increases)

- (viii) It would seem reasonable to include allowance for discretionary benefits to the extent these form part of the “lost” competitive benefit level.

Demographic Assumptions

- (ix) Unlikely to make a significant impact relative to financial assumptions, so probably use same assumptions as used for other benefits (e.g. pension scheme).

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4 (a);

The form of discrimination may be in one or more of the following;

- In the level of benefits,
- Form of benefits
- Between providing OR not providing benefits.

Examples are;

- Level of benefits: establish a separate Defined Contribution scheme for senior managers with more generous benefits than the staff.
- Form of benefits: Establish a Defined Benefit scheme for senior managers as against Defined Contribution for others.
- Between providing or not: provide additional benefits to some group not available to others.

4 (b);

From Employer’s perspective, the differentiating features are;

Defined Contribution	Final salary Defined Benefit
1) Not exposed to investment and other experience risks or rewards	2) Employer bears investment and other experience risks or rewards
3) Costs directly controlled, hence relatively predictable and stable.	4) Costs vary according to scheme experience largely outside of the employer’s control.
5) No contribution flexibility	6) Contribution could be flexible within statutory limitations, if any
7) May have fewer regulatory requirements to comply with (for example actuarial valuations)	8) Cost of regulatory compliance
9) Higher costs directly related to member such as per member admin cost for tracking individual member records	10) Cost directly related to member will be cheaper
11) Employer vulnerable to pressure if resulting benefits turn out to be low	12) Can aid employee retention policy

4 (c);

Under a DC scheme, the accumulation of fund up to retirement is very easy to understand, however the conversion of this fund in to an annuity may cause some misunderstanding. Terms for conversion are not normally known in advance but will depend on those available in the market on retirement. Many different rates can be offered by different insurers and members may not understand why these rates vary resulting in to high level of discomfort about uncertainty of ultimate level of benefits.

One could argue that benefits on retirement under a final salary scheme are also fairly simple to understand. However benefits on withdrawal or early retirement are less simple involving re-valuation, adjustments etc. Understanding how cash equivalent transfer values are calculated is also more difficult in DB schemes.

The sponsor must ensure that any areas of difficulty are carefully communicated to, and discussed with the employees.

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5.)

In making some decisions, it may be reasonable to use a model that is deterministic in nature. A deterministic model is one in which each parameter is given a fixed value.

However there are many more decisions where a recognition of uncertainty or risk is paramount. The results of “real world” stochastic modelling can therefore help significantly in the decision making process., for example;

- when the incidence of income or the variance of income relative to benefits outgo or contribution income, is significant to the decision making process,
- when a guarantee is offered which is not or can not be matched by corresponding assets. For example if a DB scheme has a money purchase underpin, stochastic modelling can help determine the probability of underpin “biting”.

In a stochastic model a parameter may be given a probability distribution of values. A computer is used to randomly generate values within the probable bounds and a large number of projections are carried out (typically 10,000/- simulations). This will give a range of answers as against one result obtained from a deterministic valuation. The distribution of these answers can then be analysed enabling the mean value of a particular statistic and its variance about the mean to be calculated. The output might be the contribution level to achieve a particular funding level, or the funding level given a contribution rate.

In addition to helping illustrate the uncertainty, stochastic models can also be used to place a value on benefits, especially when these involve, “optionality” as in case of floors on pension increases.

A stochastic model will require values relating to the variance, co-variance, skewness etc. as well as the mean, of the parameters. Although there is apparently a greater subjectivity involved because there are more parameters to specify explicitly, the risk of model error may often be less severe than that associated with the far stronger assumptions that are implicitly being made in the deterministic approach. Just because an explicit assumption has not been made about a parameter, does not mean an assumption has not been made implicitly.

The Actuary needs to decide whether the increased amount of information a stochastic valuation will provide justifies the additional computations needed. Other important considerations are the degree of spurious accuracy being introduced and the accuracy of the distribution functions that are replacing the deterministic values. For these reasons the stochastic approach is usually limited to economic assumptions rather than demographic ones.

An alternative approach to stochastic modelling that is often just as useful, is to run the deterministic model with different parameters. Subjectivity (and hence “model error risk”) exists in deterministic models in the choice of the range of values used in this sensitivity testing. For example one could produce results on a range of favourable and unfavourable assumptions – called scenario testing or sensitivity testing.

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6 (a);

Advantages:

- This may be attractive to members.
- It may be viewed that the Sponsor is less responsible if the member's fund is low due to investments failing to meet expectations, since the member chose the investment funds.

Disadvantages:

- Some members may feel they do not have the knowledge to make a choice.
- Individuals may make inappropriate decisions
- There may be cost associated with providing advice/communication/education to ensure the members understand what is being offered and the potential consequences of the choices they make.
- The projection of future benefits may be more complex.
- The scheme will need to offer a range of investment options – and there will be impact on cost

6 (b);

Members will want to accumulate the highest possible fund. Past experience has shown that over the long-term equities provide the highest return. However, equity values can be volatile and by investing solely in equities the member runs the risk that equity values will be low when the member retires.

In addition if the member's fund is invested in equities they will be mismatched against the investments that will underlie the annuity that they are to purchase at retirement. For this reason many defined contribution schemes adopt a Lifestyle investment strategy. Under such a strategy the assets of the fund are switched from equities in to bonds over the period of 5 to 10 years before retirement.

If it is expected that the retirement annuity will have level or fixed increases then the appropriate bond is a fixed-interest bond. If the retirement annuity is expected to have inflation-linked increases then the appropriate bond is an index-linked bond.

If the member wishes to take a cash lump sum at retirement then the appropriate Lifestyle strategy will switch their investments to the appropriate percentage of a bond of term reflecting the time to retirement with the rest as a bond of longer term.

6 (c);

Best estimate assumption is an assumption which has equal probability of overstating or understating the value of such assumption.

Each individual actuary can consider information and apply judgement to produce a set of assumptions that they feel to be their "best estimate" of future experience.

Different actuaries are quite likely to arrive at different sets of best estimate assumptions, based on their particular views about future experience. The key issue is that such assumptions are fully justified.

Further, there is not necessarily a single set of best estimate assumptions to suit every type of valuation. For example, a short-term discontinuance valuation of a scheme may be affected by short-term current market conditions. An ongoing valuation of a pension scheme is likely to use more stable long-term assumptions.

Different "best estimate" assumptions will also arise due to difference in the nature of the benefit provision, the assets held, the personal features of the beneficiaries (eg mortality risk) and other circumstances that differ from scheme to scheme.

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7 (a);

Unit rate

The Unit rate of premium is the total “single premium” divided by the total sum assured.

To determine the total single premium, age specific calculations are performed for each individual member and sum over all the members is then the total premium. However, rather than use this premium for the current year and perform the calculation again at the end of the year, the insurer converts it in to a unit rate applicable to the total sum assured. In most cases the insurer will guarantee this unit rate for the next two or three years (the guarantee period).

The unit rate effectively is an average mortality rate weighted by sum assured.

For the Unit rate to remain appropriate for the duration of the guarantee period, the age profile of the members must be expected to remain reasonably stable.

For large schemes the insurer will wish to try to produce a more accurate premium rate by taking account of the actual mortality experience of the scheme being insured. Failure to do so could lead the scheme selecting against the insurer.

This can be done in two ways;

Experience rating: The approach is based upon using the scheme’s past mortality experience and deciding whether it is appropriate to adjust the unit rate up or down from that derived using standard rates of mortality.

Profit sharing: Under this approach the insurer will take account of the scheme’s actual mortality experience during a year of cover. A scheme that has made little in the way of claims would receive a year-end premium refund , whilst a scheme that has made a higher than expected claims may be required to pay an additional premium.

7 (b);

Insured scheme: An employee benefit scheme where the sole long-term investment medium is an insurance policy (other than a managed fund policy).

Free cover limit: The maximum amount of death or disability benefit which an insurance company covering a group of lives is prepared to insure for each individual without production of evidence of health.

Burning cost: It is the amount of lump sum benefits multiplied by the probability of it happening over the next year and is added to the contribution rather than holding a reserve within the scheme, if such benefits were not insured.

If a scheme switches from insuring benefits to not insuring them, care will need to be taken as valuation methods may imply the need for a reserve to be held where one would not have been held before. This is particularly true of spouse’s benefits. Such benefits may depend on period of service the member has completed in the scheme. In this case if the benefits are not insured, a reserve will usually be held in the scheme to cover the benefits accrued to date. For lump sum benefits often no reserve is held and instead the amount of benefit payable and the probability of it becoming payable over the next year , with resulting cost being added to the contribution made to the scheme (burning cost approach). Alternatively a reserve could be held in respect of a lump sum benefit again possibly reflecting the service a member has rendered to date.

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8 (a);

Sponsor covenant may have impact on the advice actuaries provide as follows;

Valuation: Such a valuation advice shall mean total value of scheme member's benefits taking in to account all risks. This implies value of the benefits taking account of both the scheme's assets and monies due to be paid by the sponsor and how this amount might be affected if the financial conditions of the sponsor change.

Sponsor covenant can be allowed for by adjusting the discount rate (downwards) to allow for the risks relating to the scheme being under-funded or the sponsor falling in to distress or failing. Alternatively it could be factored in to the contribution schedule by requiring higher contributions to allow for the risk of default.

A key input required to allow the actuary to quantify this would be the rate of probability of sponsor default, which may be time dependent. In addition a corporate debt recovery rate could be allowed for.

Funding: This would mean the advice relating to i) the level of contribution the sponsor should pay, ii) how the scheme's assets should be invested and iii) what other arrangements should be used to finance the benefits.

Standard actuarial practices consider pension schemes funding either on:

- Ongoing basis implying no sponsor risk, or
- On a discontinuance basis assuming that the sponsor fails immediately.

The above are two extremes, however in most of the cases the situation falls in between.

Of more important to the Trustees is advice that takes explicit account of the risk of the specific scheme sponsor. The first task may be to determine whether the scheme is viable ongoing or in distress.

8 (b);

The risk of benefits being paid at less than x% in say n years time can be attributed between the following underlying causes;

- Existing deficit – current under-funding implies a significant risk.
- Sponsor covenant – the risk relating to reliance on the sponsor to meet any deficits at the end of n years. This could be further sub-divided in to the risk of defaulting on current contributions and the lack of sufficient debt recovery in the event of corporate failure.
- Investment mismatch – the risk relating to assets not being good match to the liabilities. This risk can be further sub-divided in to risks associated with economic factors and demographic factors.

In order to give quantitative advice, a measurement of risks need to be incorporated into the actuarial advice. A suitable measure would be default probability of the sponsor. There are a number of techniques designed to measure this quantity including the Value-at-Risk pproach. It is an attempt to provide a single number quantifying the risk. This is adapted to measuring risks associated with pension schemes as follows;

The value-at-risk measurement is;

“We are x% certain that the funding level will not be less than a given number say FL, for a given confidence level over the next n years.”

Alternatively we can take the absolute deficit, D, as the value at risk, the measurement being;

“We are x% certain that the deficit will not be greater than D for a given contribution level over the next n years.”

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