

Institute of Actuaries of India

Subject ST4 – Pensions & Other Employee Benefits

May 2009 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

A1	<ul style="list-style-type: none"> • Entry criteria to be dependent on age <ul style="list-style-type: none"> • A maximum age maybe introduced to prevent undue costs for those who will be short service employees • Can help consistency with HR policy of wanting a certain profile of employee age • A minimum age might ensure benefits provided to those who will value the benefits • Need to bear in mind any age discrimination law • Entry criteria to have a minimum amount of company service <ul style="list-style-type: none"> • Minimum service introduced to ensure that benefits are given to those who have provided a suitable level of service • and the pension scheme acts as a retention tool • Entry criteria to be dependent on grade of employment (e.g. managers only or workers only) <ul style="list-style-type: none"> • This criteria can be used to target benefits to those employees the company wants to direct its benefits expense to most • Often the level of benefits provided differs between different grades of employee • Entry criteria to be based on minimum hours worked (e.g. only full time workers or minimum level of hours) <ul style="list-style-type: none"> • Minimum hours can be introduced so to avoid administration costs of paying very small benefits • and provide benefits that are high in relation to the hours worked by the employee 	[5]
A2	<p>(i) Total fertility rates summarise the age specific fertility rates f_x (i.e. the ratio of births to population of women aged x generating them). The summation is over all ages for which $f_x > 0$, often taken as 15-49.</p> <p>Cohort: fertility rates are summed (over a period of time) for women born in a specified period e.g. all those born in the same calendar year</p> <p>Period: fertility rates are summed at a point of time (e.g. the rates experienced in one calendar year) for women of different ages</p>	
	<p>(ii) Cohort rates are generally preferred for their greater stability and their smooth rate of change over time</p> <p>Period rates are quicker and easier to obtain, and therefore suitable for immediate use</p>	
	<p>(iii)</p> <ul style="list-style-type: none"> • In practice the growth of population is more complex than can be demonstrated by the simple functions underlying these models. • The rate of growth is not constant over time. • The use of these models has tended to overstate the population by not modeling the rate of decrease accurately. • These models do not have limits to prevent population sizes 	

		<p>becoming negative.</p> <ul style="list-style-type: none"> The simple models simply project past data into the future, but this ignores the important factors that influence population change. Instead the model should lead to an understanding and incorporation into the model of underlying movements into and out of the population i.e. migration. 	
			[8]
A3	(i)	<p>Net Replacement Ratio = $\frac{\text{After-tax income in the year after retirement}}{\text{After-tax income in the year before retirement}}$</p>	
	(ii)	<ul style="list-style-type: none"> The level of income desired by the individual as oppose to lump sum benefits When the individual wants to retire What level of savings the individual has built up or inheritance What level of income is obtained by a working partner The personal circumstances of the individual e.g. marital status, dependents The level of loans still outstanding – it is usually expected that loans have been paid off by the time of retirement Level of costs after retirement: <ul style="list-style-type: none"> there will be lower costs for travel to work, contributions to employer pension schemes, there may be higher costs for leisure activities, holidays and healthcare The level of income before retirement <ul style="list-style-type: none"> lower paid employees may need a higher ratio than higher paid employees as a large portion of their income is for basic needs which remain post retirement. 	
	(iii)	<ul style="list-style-type: none"> Only considers the income one year before retirement. This can be distorted by variable pay, change in working patterns resulting in different remuneration just before retirement such as commission or overtime. No consideration is given to the future of the post retirement income such as indexation relative to inflation There is no allowance for survivor benefits attached to the post retirement income Does not actually consider the change in expenses in the crude formula 	

		<ul style="list-style-type: none"> • Any lump sum payments would distort the ratio and so should be excluded or spread to an annual equivalent • Need to allow for different types of employees and their different needs • One needs to consider all the income sources the individual may receive e.g. from the State as well as the employer • The theoretical ratios are assumed a full working career and this may not be the case for all. 	
			[10]
A4	(i)	<ul style="list-style-type: none"> • Rising cost of pension liabilities and unable to meet the same within the limited resources, could be due to change in demographics i.e. ratio of retired employees to the active employees is increasing • The impact on cost will be more noticeable particularly when the scheme is financed by PAYG method • Costs may increase if inflation linked benefits are offered • Constraints on budgetary transfers to support the cost • Exposure to post retirement risk, if annuities not bought out at retirement • Administration and communication can be more complex and so increased level of costs to maintain and also room for confusion amongst various stakeholders • Keep the entire workforce happy – there is a difficult balance to be met as the new entrants treated differently • Attracting new staff into the government sector as DB was seen as a differentiator and a valuable benefit • risk of future salary increases 	
	(ii)	<ul style="list-style-type: none"> • Control the states cost and by reducing the volatility of pension cost i.e. due to setting up of defined contribution scheme • Likely to be valued more by employees • Suits changing employment patterns • A funded arrangement may have a positive impact on investment markets, creates demand for investments • Not exposed to investment risk • No mortality risk if they buy out the annuity at retirement 	
	(iii)	There is uncertainty for the employee over the level of benefits, which may	

		<p>be less valuable than they expected for a number of reasons:</p> <ul style="list-style-type: none"> • not enough money was put in the first place • investment returns were lower than expected • annuity purchase terms were worse than expected due to lower interest rates and increased life expectancy • impact of inflation on purchasing power was not understood 	
		<p>Whilst most of the risks that are borne by the state in a DB scheme are transferred to the employee for a DC scheme, there may be a knock-on impact on the state if employees can't afford to retire or get much lower benefits than expected.</p>	
			[11]
A5	(i)	<ul style="list-style-type: none"> • To set an appropriate investment strategy, keeping in mind the long-term solvency of the pension scheme. • To understand the probability of insolvency for a given contribution rate and set of investment strategy • To project possible future variability in contribution requirements for a set investment strategy • To minimise the variability of the funding level • To best match pension increases • To determine an efficient frontier, eg suggest an appropriate strategy for a range of scenarios • To help determine the value of either / or benefits, eg underpin • Better understanding of the financial workings of the pension scheme • Explore sensitivity to assumptions about expected returns and risks. • To see the effect of increasing / decreasing the level of future discretionary benefits • Develop probability distribution of possible outcomes that helps the user to appreciate the risk of decisions taken • Models interdependencies between variables and is therefore more realistic 	
	(ii)	<ul style="list-style-type: none"> • Specify a measurable objective – to set an appropriate investment strategy, so as to remain solvent on an on-going basis with a probability, say 95% and maximise expected funding level. • Decide on the time horizon for the simulation. • Set strategies for asset mix and contribution rate, taking into 	

		<p>account any investment regulations for pension funds and any other relevant factors like tax, expenses, etc.</p> <ul style="list-style-type: none"> • Decide on the distributions to be used for the stochastic model and set appropriate parameters for the distributions. • Choose liability cash flow model (including demographic assumptions) • Test strategy by performing a number of simulations – each simulation will project the values of the assets and the liabilities along with the contributions for the whole time horizon. • Consider distribution of results of all the simulations by reference to a relevant feature. • Measure the achievement of the objective specified above. • Vary the item being optimised, in our case, the investment strategy, repeat the simulations and measure the achievement of the objective each time. 	
			[13]
A6	(i)	<ul style="list-style-type: none"> • At retirement an amount of pension is surrendered (or exchanged) for a cash lump sum. • The lump sum obtained for 1 unit of pension is referred to as the commutation factor • Either the amount of pension to be surrendered can be defined (e.g. 1/3rd of the pension at retirement) or the amount of the cash lump sum is defined (e.g. 3/80ths x pensionable service x final salary) • Formula: $\text{Pension surrendered} = \frac{\text{Cash lump sum}}{\text{Commutation Factor}}$ <p>Or</p> $\text{Cash lump Sum} = \text{Pension surrendered} \times \text{Commutation Factor}$ <p>And</p> $\text{Residual Post-commutation pension} = \text{Pre-commutation pension} - \text{pension surrendered}$	
	(ii)	<ul style="list-style-type: none"> • The lump sum should, in effect, represent the capitalized value of the pension that is being surrendered. • An equation of value is the starting point for setting the commutation factor: 	

		<ul style="list-style-type: none"> • Pre-commuted pension x annuity = post-commuted pension x annuity + cash lump sum • The starting point will be to determine the cost-neutral set of factors so the scheme is in no worse a position whatever the member chooses • The assumptions for the factor need to be decided upon like discount rate, mortality and pension increases • It is the post retirement assumptions that are important • The assumption basis does not necessarily have to be the same as the funding basis as that would have been set with some prudence, thereby expecting some surplus to emerge in the future. By using that basis for commutation factors one is passing the value of that anticipated surplus to the members and thereby it could be generous. • One will need to allow for the benefits that are being commuted for example if the whole pension is being commuted including future death in retirement benefits or not • The discount rate used could be market related or fixed resulting in variable or fixed commutation factors. • Market related factors give fairer value and reduces exposure for the company due to economic conditions • Having fixed factors aids simplicity and members are able to plan better. • In theory, the factors should be different for men and women due to the different expected mortality however the law may not allow such a distinction and it is simpler to have one set of factors • Rates may be smoothed to make administration and communication easier • Where different elements of pension have different guaranteed increases in payment, one should have different factors applied to the elements of pension • An allowance for discretionary increases in payment to the pension could be allowed for • If the scheme defines the lump sum amount and has different portions of pension then one will have to decide in what order the pension is surrendered • If the law allows some or all of the lump sum to be tax free then there may be a constraint on the commutation factors to prevent the State being selected against • One may set the factors to encourage or discourage the take up rate • Although, it is widely known that take up rates are not sensitive to 	
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		<p>the factors as retirees desire the cash</p> <ul style="list-style-type: none"> Any changes to the rates need to be considered from a generational equality point of view. If there are to be significant changes then appropriate communication is required as well as time for members coming up to retirement to plan their finances on the new factors. Should consider what the market practice for setting these assumptions is 	
	(iii)	<ul style="list-style-type: none"> early retirement from active service early retirement from deferred service late retirement transfer value in exchange for deferred pension cash commutation on grounds of ill health additional dependant/spouse's pension additional guarantee period pension purchased with voluntary contributions/ transfers in 	
			[16]
A7	(i)	<ul style="list-style-type: none"> Trustees have a duty to ensure sufficient contributions are paid so that scheme benefits can be paid as they fall due For an ongoing pension scheme existence of deficit could be viewed as an unsecured debt on the sponsor This deficit will rank alongside other creditors of the sponsor If a pension scheme winds up there may be a deficit that will not be paid. The trustees will need to assess the security of accrued benefits and the differing priorities of various categories of members. To aid setting the general investment strategy and in particular how "safe" the backing assets need to be e.g. Government Securities. To aid setting a prudent valuation basis and in particular any adjustment needed to the discount rate to allow for the underlying risks To understand how much the employer can actually afford to pay and over what reasonable period the contribution schedule should extend. Relating the employer's ability to pay to their willingness to pay. Any trust deed & rules requirements. 	

		<ul style="list-style-type: none"> ● Assessing the impact of any statutory minimum contributions. ● Allows consideration of alternatives to cash payments e.g. charge on company assets. ● Assessing trustee demands for earlier payments of contributions to make good any deficits. ● Trustee decisions to trigger wind up or forcing cessation of future benefit accruals. 	
	(ii)	<ul style="list-style-type: none"> ● Assess business outlook in general and for business sector <ul style="list-style-type: none"> + Cheap - Subjective, difficult to quantify ● Review financial metrics (accounting ratios etc.) <ul style="list-style-type: none"> + Simple, cheap, can spot trends - Only annual figures available publicly, difficult to quantify risk ● Review implied market default risk (by looking at market prices and/or yields on equities and corporate bonds – more specifically use Merton model) <ul style="list-style-type: none"> + Up to date market information readily available - Bond yields can be influenced by external factors such as supply and demand - Few schemes have access to market info for their sponsors - No allowance for differences in debt priority ● Review credit rating from a specialist agency <ul style="list-style-type: none"> + Agencies have access to information that is not publicly available + Can be translated into quantifiable measures of risk which eliminates difficulties associated with market forces that affect prices - Only larger sponsors will have agency ratings ● Independent business review (by external credit advisory specialist such as insolvency practitioner) <ul style="list-style-type: none"> + Can help Trustees work out how much the employer can afford to pay - Expensive, requires cooperation of sponsor for access to confidential information 	
			[18]

A8	(i)	<ul style="list-style-type: none"> ● pre-retirement mortality ● post-retirement mortality ● above for member and spouse ● proportion married ● age of spouse ● attrition rates / withdrawal rates ● retirement age ● ill-health retirement rates ● extent of retirees utilizing the facilities – sickness rates 	
	(ii)	<ul style="list-style-type: none"> ● What assumptions were used the previous year. It would be unusual to have significantly different assumptions each year. ● For mortality one could use standard tables for pre and post retirement ● The company may have considerable experience of its own to consider in terms <ul style="list-style-type: none"> i. utilization of the hospital and ii. related costs of running the hospital, including medicines. <p style="text-align: center;">This would be obtained from hospital records.</p> ● One would need to assess if the data is available and if it is credible for an experience analysis ● Adjustments to standard tables could be made to reflect the company's experience and specific industry ● The people will also have come from one area around where the medical facilities are located and so a geographical adjustment may also be suitable ● Age difference of spouse and proportion married can be taken from general population data (maybe with geographical adjustment if there is such data). Alternatively, past experience of the company's past retirees could also be analysed. ● Retirement rates and withdrawal rates can be taken from past experience, industry experience and also a guide can be taken from assumptions used for valuations of other benefits that are being valued such as a pension plan. 	
	(iii)	<ul style="list-style-type: none"> ● discount rate ● increase in medicine costs ● increase in medical equipment costs ● increase in the hospital staff wages ● price inflation ● estimate the amount of growth in the amount each retiree and dependent will use the facilities 	
	(iv)	<ul style="list-style-type: none"> ● the accounting standard may stipulate how the assumptions need to chosen ● - it may specify an index or source for the discount rate such as corporate or government bond yields ● - If no such guidance is given then one may consider using the company's internal rate of return or cost of capital ● - Past experience of medical costs for different cost centres of the medical facility could be analysed for medical costs, equipment costs and staff costs 	

		<ul style="list-style-type: none"> ● - The country may have a medical cost index as part of its general price index data.- For the hospital costs, salaries to consider ● should be nurse and doctor salaries as opposed to the miner's salary increases. One would look at the medical industry trends. ● - an assumption for price inflation will be used as a base for many of the other inflationary assumptions. ● - The price inflation assumption can be obtained from an index, or the market expectation from the difference in yields on fixed and index linked government bonds. The government's policy and targets can be used as a guide for a long term assumption as well. ● - the assumptions should be long term ● - accounting valuation assumptions are usually to be best estimate and there should not be chosen for prudence or with an optimistic view 	
	(v)	<ul style="list-style-type: none"> ● There should be consistency between price inflation and salary increases. ● Usually salary increases are expected to be higher than price inflation. ● The results will be impacted by the net difference between the overall medical cost inflation and the discount rate. ● This is for both pre retirement and post-retirement. 	
	(vi)	<ul style="list-style-type: none"> ● Purpose of the valuations are different, one for setting contribution rates and the other for stating expense in the financial statements ● Accounting valuations are usually more prescriptive in their approach regarding funding method and setting of assumptions ● Funding valuations may include allowance for future discretionary benefits ● Assumptions for accounting are usually set to be best estimate whereas funding may include elements for prudence 	
			[19]
			[Total 100 Marks]
