INSTITUTE AND FACULTY OF ACTUARIES

EXAMINERS' REPORT

September 2015

Subject ST4 – Pensions and other Benefits Specialist Technical

Introduction

The Examiners' Report is written by the Principal Examiner with the aim of helping candidates, both those who are sitting the examination for the first time and using past papers as a revision aid and also those who have previously failed the subject.

The Examiners are charged by Council with examining the published syllabus. The Examiners have access to the Core Reading, which is designed to interpret the syllabus, and will generally base questions around it but are not required to examine the content of Core Reading specifically or exclusively.

For numerical questions the Examiners' preferred approach to the solution is reproduced in this report; other valid approaches are given appropriate credit. For essay-style questions, particularly the open-ended questions in the later subjects, the report may contain more points than the Examiners will expect from a solution that scores full marks.

The report is written based on the legislative and regulatory context pertaining to the date that the examination was set. Candidates should take into account the possibility that circumstances may have changed if using these reports for revision.

F Layton
Chairman of the Board of Examiners
December 2015

A. General comments on the *aims of this subject and how it is marked*

1. The aim of the Pensions and Other Benefits Specialist Technical subject is to instil in successful candidates the ability to apply, in simple situations, the mathematical and economic techniques and the principles of actuarial planning and control needed for the operation on sound financial lines of providers of pensions or other employee benefits.

2. This subject examines the ability of candidates to apply core actuarial techniques and concepts, together with specific knowledge of pensions and other benefit arrangements to simple, but practical situations.

3. The examiners therefore look for candidates to apply their knowledge of the core reading to the specific situation that the examiners asked, having read the question carefully. Too many candidates write around the subject matter of the question in more general fashion, or focus on one aspect of the issue at great length, in either case gaining few of the marks available.

4. Good candidates demonstrate that they have used the planning time well - an attempt to get a logical flow is a big advantage in making points clearly and without repetition. This also enables candidates to use the latter parts of questions to generate ideas for answers to the early parts (or use their solutions to earlier parts of questions to create a structure for latter parts). Time management is important so that candidates give answers to all questions that are roughly proportionate to the number of marks available.

B. General comments on *student performance in this diet of the examination*

1. The overall standard of scripts was broadly as expected, with a pass rate slightly higher than in the previous sitting. There was a wide spread of marks and the paper enabled the better candidates to demonstrate their knowledge and understanding of the syllabus.

2. It is very important that candidates consider all aspects of the question, and read the preamble fully. Candidates should consider the specific scenario given in the question and tailor their answers to the relevant points rather than listing all they know about a topic. There is never superfluous information in the question, and by using all of the information available, candidates can ensure they give a full answer. Giving just a little more to clearly show depth can turn a close fail into a pass.

3. The questions are set so that it should take approximately twice as long to answer a 10 mark question as a 5 mark one. Answers should therefore be similarly proportionate, as mentioned in the general comments above.

4. In addition, candidates should carefully consider the instruction – for example an instruction to list points should be answered with a list without attaching discussion. Similarly, a question asking for a discussion cannot be answered with a list of undeveloped points. The list of published command verbs should help students to understand the form of answers that the examiners expect.

5. More detailed feedback is provided on each question below.

C. Comparative pass rates for the past 3 years for this diet of examination

Year	*%*
September 2015	43
April 2015	39
September 2014	43
April 2014	40
September 2013	41
April 2013	41

Reasons for any significant change in pass rates in current diet to those in the past:

The pass rate for this examination diet is broadly in line with previous diets. Some variation in the pass rate between sessions is expected as different cohorts of students sit the examination.

Solutions

Q1 (i) Net Replacement Ratio = $\frac{\text{After-tax income in the year after retirement}}{\text{After-tax income in the year before retirement}}$

(ii) After-tax income before retirement = 1 * \$15,000 + 0.7 * \$45,000
= \$46,500

After-tax income after retirement = 1 * \$15,000 + 0.7 *\$15,000
= \$25,500

Net Replacement Ratio = \$25,500 / \$46,500 = 55%

(iii) (a)

- Pension contributions cease on retirement
- Mortgage repayments cease on retirement

There are other reasons why a lower replacement ratio may be sufficient:

- Lower travel-related costs (e.g. travel to work)
- Other work-related costs no longer apply (e.g. clothing/uniform)
- Children are grown up and no longer require financial support
- Other, non-pension, saving may have taken place whilst working and these savings no longer need to be built up

- There may be savings that can be spent in retirement to support retirement income
- Discounts on products and services may be available to retired people
- Income in final year of work may not be representative of career e.g. if bonus received

There are some reasons why a higher replacement ratio may be needed:

- More money may be required for leisure activities after retirement
- Healthcare costs may be higher after retirement

(b)

- The income he has available to spend, after pension contributions and mortgage payments, before retirement is therefore:

  $46,500 less ($12,000 + $6,000) = $28,500

- Because he does not incur these costs in retirement, a net replacement ratio of $28,500 / $46,500 = 61% would be sufficient to give him the same amount of income to spend.

- Other well argued, sensible approaches were credited even if they resulted in a different figure to 61%.

Generally candidates did well although some candidates incorrectly included pension contributions and/or mortgage repayments in the calculation of Net Replacement Ratio.

Q2 (i) n = number of employees
S = Salary of each employee
q = probability of death of each employee

Expected cost of benefit = $n * 4S * q$
Total payroll = $n * S$

Expected cost of benefit as proportion of payroll = $n * 4S * q / (n * S) = 4q$

(ii)

- For one employee, the probability distribution of the cost is:

  $4S$ with probability q
  0 with probability $(1 – q)$

- Therefore the expected cost = $4S * q + 0 * (1 – q) = 4Sq$.

- The variance of the cost is:

$$\{(4S)^2 * q + 0^2 * (1 - q)\} - (4Sq)^2 = 16S^2 * (q - q^2).$$

- For n independent random variables, the variance of the sum equals the sum of the variances

- Therefore, the variance of the cost for the n employees is $16nS^2 * (q - q^2)$.

- The standard deviation is the square root of this,

$$\text{i.e. } 4S * n^{1/2} * (q - q^2)^{1/2}$$

- Dividing by the total payroll ($n * S$) gives the result:

$$4 * (q - q^2)^{1/2} * n^{-1/2}.$$

(iii) Because the lives are independent, the probability of no deaths is $(1 - q)^n$
Therefore the probability of at least one death is $1 - (1 - q)^n$.

(iv)

- The standard deviation is a measure of the risk of providing the benefit
- The standard deviation of the cost of the benefit for n employees, expressed as a proportion of payroll, is inversely proportional to the square root of n
- And therefore reduces as n gets larger
- Hence, for a small firm of 50 employees the risk is fairly high
- E.g. just one death of an employee on average salary will increase the company's costs by a significant percentage of payroll in that year
- Particularly if it is one of the managers
- The resulting volatility of profits may be too great without insurance
- And may cause liquidity problems for the employer
- The risk is further increased by the fact that the lives are not independent…
- …but may be positively correlated
- For example, because all employees work at one site…
- …an accident at work could cause multiple deaths at the same time
- The managers of the business have much higher wages than average…
- …are older (higher probability of death)…
- …and positively correlated (husband and wife)…
- …and therefore represent a significant amount of mortality risk
- By insuring the benefit the company would pay a known insurance premium…
- …rather than an unknown cost of claims each year
- The insurance premium is likely to be higher than the expected cost of claims…
- …because of the insurance company's operating expenses…
- …capital requirements…

- …and profit margins…
- The company will need to consider whether it is worth paying the additional expected cost in order to remove the mortality risk
- Medical underwriting, especially of the managers, may help reduce the cost

Many candidates struggled with this question. Some appeared not to know the formula to calculate variance, and others failed to simplify the answer sufficiently. The answers for final part (iv) were stronger although few candidates were able to demonstrate the link to the earlier part of the question.

Q3 (i)

- Pre retirement mortality
- Leaving service / staff turnover rates
- Expected retirement age
- Ill-health early retirement rates
- Post retirement mortality…
- …including projections for future improvement
- Expected number of medical claims per annum in retirement…
- …broken down by age…
- …and sex…
- Expected cost of medical claims…
- …and recovery rates / duration of illness
- Expected rate of medical expense inflation…
- …and other inflation e.g. administrative expenses
- Discount rate / investment return

(ii)

- Pay as you go
- Claims are paid as and when they are made by beneficiaries when they arise
- No monies are put aside to fund for the claims…
- …although the company may wish to establish a book reserve
- This method has minimal cash outflow initially
- The cashflow will increase greatly later on when eligible employees have retired
- It is possible that the company may not have the resources to meet the cashflow at this time
- There is little security of the benefit for the member
- Security could be improved by combining with Just-in-Time funding triggered by certain events such as takeover of the sponsoring employer
- The cashflow is likely to be volatile…
- …a smoothed PAYG approach could be adopted to reduce the volatility
- No opportunity cost

- Terminal Funding
- A fund is established at the retirement of a member…
- by means of a capital payment at that time
- The fund would be calculated to be sufficient to meet the cost of claims during the period after retirement
- This method has minimal cash outflow initially
- The cashflow will increase greatly later on when eligible employees reach the point of retirement
- The presence of a fund provides an element of security to retired members
- during the course of the scheme the adequacy of the fund will need to be monitored…
- …and adjustments made either by means of further payments or offsetting against future retirement payments (if there is a surplus)
- Opportunity cost if funds could be more profitably deployed elsewhere

- Funded in advance
- E.g. Lump Sum in Advance or Regular Contributions
- A fund is established by making contributions over the working lifetime of each member…
- …which are calculated to be sufficient to meet subsequent costs after retirement
- This method places an immediate cashflow requirement on the employer
- But cashflow should be more stable than the other two methods as there should not be significant increases at or during retirement
- The cost is paid during the time that each employee is providing services to the company…
- …and there should be no need to provide additional contributions in respect of an employee after he has left service of the company
- The fund will need to be monitored for its adequacy on a regular basis…
- …and adjustments made to the contribution rate on account of surplus or deficit
- This method provides greater benefit security for members
- Opportunity cost if funds could be more profitably deployed elsewhere

- Insurance
- The sponsoring employer pays premiums to an insurance company
- The insurance company will then be responsible for funding the medical benefits
- Premiums could be paid annually during the retirement of each member (variant of PAYG)
- Lump sum premiums could be paid at the point of retirement of each member (variant of Terminal Funding)
- Regular premiums could be paid during the working lifetime of employees (variant of Funded in Advance)
- The risk / variability of costs will be reduced by taking out insurance
- But the sponsoring employer remains exposed to the risk that the insurance rates vary over time
- Would be expected to be more expensive than meeting costs directly

- Because of contribution towards insurer's profits, capital requirements etc.
- Regular rebroking in a competitive insurance market will help to control costs
- Opportunity cost if funds could be more profitably deployed elsewhere

(iii)

- Introduce benefit accrual
- The scheme currently covers medical costs in full whether an employee works for one day or all the way up to retirement
- The cost would be significantly reduced if members accrued the benefit over their working lifetime up to retirement…
- …or at a fixed rate per annum (e.g. 2.5% per year up to 40 years)
- This might help to attract / retain staff…
- …as it will reward long-serving employees

- Require member contributions from employees towards the expected cost of the benefits
- This will directly reduce the cost to the employer
- The increased cost might be unpopular with existing employees
- Although employees might appreciate the value of a benefit that they previously overlooked
- Require contributions from pensioners to pay a proportion of medical fees when they arise
- …either a fixed excess…
- …or a fixed proportion of the claim
- Would reduce both the size of the cost of individual claims…
- …and the likelihood of claims…
- …because members would be discouraged from making small or unnecessary claims

- The employer could restrict the scope of the benefit
- By introducing eligibility criteria
- …for example a waiting period…
- …or restricting to certain classes of employee…
- Or by introducing restrictions on the treatment covered…
- …for example by only covering certain medical conditions
- …or exclusions for pre-existing conditions
- …or excluding treatments that are provided for free by the State
- Introduce a medical check-up on entry and refuse entry if failed
- This would make the benefit less attractive to employees if the restrictions are too great

- Place a cap on the total amount of benefit
- …either during each year of retirement…
- …or in total
- Still attractive to members if cap is set high enough
- As the benefit would not be available to those members who need it most

- So the employer should consider what medical benefits are provided by the State to cover the shortfall
- Encourages members to look after their own health

This question was answered well, and most candidates were able to obtain points in relation to three funding methods, and changing the benefit design of the scheme (although few suggested that the benefit could accrue with service and missed some marks as a result).

Q4 (i)

- They provide a fixed rate of interest (coupon)
- And fixed redemption proceeds at a given point in time
- Often a higher running yield than equities
- They are normally tradable at any point up to the redemption date
- Liquidity will vary greatly between different bonds
- Depending on things such as the issue size
- Security of return depends on the creditworthiness of the issuer
- The yield is typically higher than equivalent government bonds
- Accounting for higher credit risk
- And lower liquidity
- Higher yielding (junk) and lower yielding (investment grade) varieties reflect the creditworthiness of the issuer
- Available in a number of different currencies
- A small amount of inflation-linked corporate bonds are available

(ii) **Advantages**

- Inflation-linked government bonds more closely match the inflation-linked nature of the scheme liabilities
- Hence funding level will be more stable
- Default risk is lower compared with corporate bonds
- Better marketability of portfolio
- Longer dated inflation-linked government bonds may be available, making it easier to match longer dated scheme liabilities

Disadvantages

- There will be transaction charges associated with the switch
- Inflation-linked government bonds are lower yielding than corporate bonds
- Hence a lower discount rate may be needed to value the scheme's liabilities
- Resulting in higher liabilities
- And higher employer contribution rate
- The availability of bonds of suitable duration might be limited
- Difficult to time the switch optimally – markets could move against the scheme

(iii)

- Equities
- Volatile investment returns
- Therefore not a close match for inflation in the short-term
- But over the long-term company profits may be correlated with inflation

- Property
- As rents may be correlated with inflation over the medium term
- Or have specific inflation-linked increased built into the rental agreement
- Not a good short-term inflation match

- Overseas assets
- As high domestic inflation should cause a depreciation of the domestic currency over time
- Leading to overseas assets rising in value when measured in the domestic currency
- The inflation protection is only approximate
- And this introduces currency risk

- Invest in globally traded commodities
- Such as oil, precious and industrial metals, gold
- As high domestic inflation should lead to an appreciation of the price when measured in domestic currency
- The inflation protection is only approximate

- Purchase inflation-linked annuities
- Very good match for liabilities
- But might be expensive due to insurance company loadings

- Use inflation swaps or other derivatives
- Good match for inflation
- Introduces counterparty risk
- Introduces complexity

A relatively straightforward question that was answered well. For part (iii), in some cases, candidates lost marks for not making sufficient points regarding how the alternative asset class would reduce domestic inflation risk.

Q5 (i)

- gradual removal of liabilities by the continuation of the scheme without any further accrual of benefits
- transfer of the liabilities to another pension scheme with the same sponsor
- transfer of the funds to the beneficiary to extinguish the liability…
- …either as cash or transfers to individual DC pension schemes
- transfer of the funds to an insurance company to invest and provide a benefit

- transfer of the liabilities to an insurance company to guarantee the benefits
- transfer of the liabilities to a central discontinuance fund, operated on a national or perhaps industry wide basis

(ii)

- The funding target scheme should ensure that the Scheme has a very good chance of meeting its liabilities without further help from the employer.
- Prudent assumptions should be used for funding
- Together with a prudent funding/valuation method
- These may be similar to the assumptions used for a buyout valuation
- Including future expenses
- Without the margins for insurance company profit
- Scheme will be moving from fully funded to a deficit position
- Consideration needs to be given to the amount and timing of contributions to eliminate the deficit

- A more cautious investment strategy should be followed
- With the liabilities closely matched
- Typically government and corporate bonds will be used
- And longevity swaps/bonds and annuities may be used
- Consideration needs to be given to the timing of the transition in investment strategy
- Market or funding level triggers may be used
- The amount of risk taken will depend on whether the Scheme sponsor is willing and able to make up any shortfall

- The managers should consider the past practice of awarding discretionary benefits…

- …member expectations…
- And the extent to which they are provided for in the funding target
- Are there any restrictions in the scheme rules or legislation?
- Fairness between different generations of member
- And different categories of member will be difficult
- If generous discretionary benefits are provided early on then there may not be sufficient funds to provide discretionary benefits later on…
- …if mortality or investment experience is adverse
- Whereas if the managers adopt a more cautious approach to discretionary benefits, then only members still alive when the discretionary benefits are granted will benefit

- Overall, discretionary benefits may be less likely if the Scheme is moving to a deficit position on the new funding basis

Some candidates answered this question well, but others missed obvious points (e.g. that the change to a self-sufficiency basis would likely put the scheme in to deficit). A number of candidates struggled with the implications for discretionary benefits, in some cases making the assumption that the provision of such benefits was being considered for the first time.

Q6 (i) Membership data

- Name or unique identifier
- Category of member (staff/works)
- Status (active, deferred, pensioner, dependant pensioner)
- Sex
- Date of birth
- Date joined scheme
- Contributions paid to Scheme
- For actives – current basic salary
- For actives – part time working details / periods of absence
- For deferreds – Date of leaving pensionable service
- For deferreds – Basic salary at date of leaving
- For deferreds – Deferred pension at date of leaving
- For Pensioners – Date of leaving
- For pensioners – Date of commencement of pension
- For pensioners – Current pension in payment
- Anything indicating non-standard benefits
- E.g. transfer-in, augmentation
- Marital status
- Date of birth of spouse
- Typically an assumption will be made rather than data collected for the last two items

(ii)

- Reconciliation of membership in each category compared with the data used for the last valuation…
- …and the pension scheme accounts…
- …taking account of new entrants, leavers, retirements and deaths…
- …and checking date of leaving/retirement within last 3 years where there is a status change
- Check than new entrants have not been omitted

- Checks on individual data – investigate outliers
- Age of active and deferred members between 20 and 65 (say)
- Age at date of joining 20 or greater
- Age of pensioners 65 or over for normal retirements

- Age of dependant pensioners 50 or over
- Active salaries within a particular range
- Deferred pensions within a particular range
- Pensions in payment within a particular range
- Increase in basic salary since last valuation within a particular range
- Increase in pension in payment since last valuation consistent with price inflation
- Member contributions consistent with length of service and salary
- Date of leaving service after date of joining
- Deferred pension consistent with salary and length of service
- Check for missing data

- Global checks – compare with last time
- Compare total…
- …and average
- Pension, deferred pension, accrued pension
- Compare average age in each category
- Investigate any unusual results

- Check contributions paid
- And pensions and lump sum benefits paid
- Against figures in pension scheme accounts

- Spot checks for random members against administration data
- And last time's data
- Checking all groups with different benefits are covered
- Similar spot checks for high value members

(iii)

- x is the member's age
- AP is the member's accrued pension
- EP is the member's early retirement pension
- r is the assumed rate of price inflation (and revaluation in deferment)
- i is the discount rate
- l65 and l_x are from the mortality table used in the valuation
- a_{65} and a_x are annuity rates at a net interest rate of i – pension increase rate
- C is the member's contributions to the Scheme
- The simplifying assumption has been made that death in deferment would occur half way to retirement age

The equation of value is then:

- $EP * a_x = AP * a_{65} * (l_{65} / l_x) * ((1 + r) / (1 + i))^{65-x} + 5C * (1 - l_{65} / l_x) * (1 / (1 + i))^{(65-x)/2}$

(iv)

- Liquidity risk – pensions will be brought into payment sooner and the Scheme my not have sufficient assets to pay the benefits
- There may be a surge of early retirements in the first year
- Mortality risk – if pensioners and spouses live for a shorter period than expected then they will normally receive a more valuable benefit under the early retirement option
- Although early retirees with no spouse who die very quickly may receive less pension than the death in deferment return of contributions lump sum
- Investment risk – duration of liabilities will change and existing liability matching may be inappropriate…
- …and matching will be less precise as duration will be harder to calculate when members have the option
- Selection risk – members in poor health may be more inclined to take early retirement than members in good health…
- …so that the mortality assumptions in the equation of value are not appropriate and the option is more expensive than expected
- Changing market conditions…
- …may mean that the discount rate is not appropriate and paying the pension at age 65 would be less expensive
- Administrative expenses of implementing the option are greater than expected
- Operational risk – calculation errors
- Reputational risk if conversion terms turn out to be poor value for members

(v)

- Give the employer the power to set the terms of the option
- Make it a requirement for members to obtain the consent of the employer before early retirement is permitted
- Both of these will give the employer greater control
- For example allowing it to suspend early retirements if liquidity is an issue for the Scheme
- Mortality and selection risk will be difficult to mitigate
- Because individual underwriting is unlikely to be practical
- An approximate solution might be to make the option less generous
- By assuming slightly heavier mortality in the equation of value
- Restrictions on the availability of the option could be introduced
- For example relating to health status or minimum retirement age
- The early retirement factors could be dependent on market interest rates
- To account for changing market conditions
- Although this will make the administration more complicated and expensive
- Compared with fixed factors
- Review investment strategy to ensure correct duration of assets…
- …and sufficient liquidity

- Reduce reputation risk by careful member communication or provision of independent financial advice

Most candidates provided good answers to the first three parts of this question, but struggled with the final two parts often as a result of failing to consider a sufficiently wide range of risk types. In particular, in part (iv) most candidates focused on the risks of defined benefit pension schemes in general rather than on the introduction of the option.

END OF EXAMINERS' REPORT