EXAMINATION

April 2005

Subject ST2 — Life Insurance
Specialist Technical

EXAMINERS' REPORT

Introduction

The attached subject report has been written by the Principal Examiner with the aim of helping candidates. The questions and comments are based around Core Reading as the interpretation of the syllabus to which the examiners are working. They have however given credit for any alternative approach or interpretation which they consider to be reasonable.

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Chairman of the Board of Examiners

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1 Premiums may be paid out of pre-tax personal income.

The government may grant additional amounts to effectively increase levels of premiums paid into contracts.

Investment funds may receive favourable tax treatment.

The fund may pay nil/reduced tax on investment income and on realised investment gains.

Any combination of the above would lead to higher investment returns overall.

Policy maturity proceeds may be received tax free

May have tax free incentive on surrender proceeds

Offering incentives to employers who contribute to savings products for employees

Some incentives may be subject to certain conditions (e.g. minimum term, only regular premiums, minimum period for investment for surrender incentives)

Taxation of life insurance companies may make them more attractive as a savings medium than contracts offered by other savings institutions which may be subject to a different fiscal regime

This question was standard bookwork and was answered well by most candidates. However, in many cases insufficient detail was given to gain full marks.

2 The company would have defined aims for calculating policy alterations, and may wish to ensure policy alterations can be simply administered and calculated.

Some insurers may want the alteration to be profit neutral such that the same profit is expected from the contract after the alteration to that expected before the alteration. The terms may therefore be likely to be set so the reserve and surrender value for the contract after the alteration should be the same as before the alteration. Alternatively it may want the expected profit after the alteration to equal the expected amount had the policy originally been written on its altered terms.

Any increase in benefit may be subject to additional evidence of health. The choice may depend in part on the scale of the alteration and when it occurs in the policies lifetime.

The company would also want to cover costs associated with performing the alteration

The company would want the altered terms to appear reasonable to policyholders and the company would also want to ensure consistency with

benefits given to other customers. It would therefore want small alterations in premiums to lead to small changes in benefits (and vice versa)

Large increases in premiums or benefits would therefore be expected to give changes consistent with terms available on new business. Terms would also ideally be consistent with those for paid up and surrendered policies

Ensuring terms are similar to current premium rates would also be desirable in order to avoid lapse and re-entry

It was surprising how poorly some candidates answered this question. Many candidates failed to discuss profitability, in particular the different approaches insurers might take with regard to the profitability of the altered contract.

3 The normal premium payable for the whole of life policy being issued now:

$P^{\text{basic}} = 20{,}000\, A_{[50]} / \ddot{a}_{[50]} = 20{,}000 \times 0.32868/17.454 = 376.62$

The premium payable for the policy taken out under the option, from the age of 60, would be

$P^{\text{option}} = 20{,}000\, A_{[60]} / \ddot{a}_{[60]} = 20{,}000 \times 0.45510/14.167 = 642.48$

The expected present value of the cost of providing the option is the expected present value of the benefits less the expected present value of the premiums

$$\text{EPV(benefits)} = 20{,}000\, A^{1}_{[50]:\overline{10}|} + \{ D_{60} / D_{[50]} \} \times \{0.7 * 20{,}000 * A_{60} + 0.3 * 40{,}000 * A'_{60}\}$$

This is because after ten years 30% have 40,000 benefit and are subject to a higher mortality, indicated by the primed functions.

The mortality assumed for those not taking up the option is AM92 ult.

Evaluating

$A^{1}_{[50]:\overline{10}|} = \{M_{[50]} - M_{60}\}/ D_{[50]} = \{448.91 - 402.93\}/1365.77 = 0.033666$

$D_{60} / D_{[50]} = 882.85/1365.77 = 0.64641$

$A_{60} = 0.45640$

$A'_{60} = A_{70} = 0.60097$

EPV(benefits) = 20,000 * 0.033666
+ 0.64641 * {0.7 * 20,000 * 0.45640
+ 0.3 * 40,000 * 0.60097}

= 673.32 + 8,791.98

= 9,465.30

The present value of premiums (excluding the extra premium) is

EPV(premiums) = 376.62 $\ddot{a}_{[50]:\overline{10}|}$ +
$\{D_{60} / D_{[50]}\}$
$\times$ {0.7 * 376.62 * $\ddot{a}_{60}$
+ 0.3 * (376.62+642.48) * $\ddot{a}'_{60}$}

= 376.62 * 8.318 + 0.64641 * {0.7 * 376.62
* 14.134 + 0.3 * 1019.1 * 10.375}

= 3,132.73 + 4,459.03

= 7,591.76

$\ddot{a}_{[50]:\overline{10}|}$ = $\ddot{a}_{[50]} - \{D_{60} / D_{[50]}\}\ \ddot{a}_{60}$ = 17.454 – 0.64641 * 14.134 = 8.318

$\ddot{a}'_{60}$ = $\ddot{a}_{70}$ 10.375

The expected present value of the additional cost of the option is therefore:

9,465.30 – 7,591.76 = 1,873.54

This must equal the expected present value of the extra premium to cover the option cost, so:

$P^{\text{extra}} * \ddot{a}_{[50]:\overline{10}|}$ = 1,873.54

P^{extra} = 1,873.54 / $\ddot{a}_{[50]:\overline{10}|}$ = 1,873.54/8.318 = 225.24

This question was standard bookwork and was answered well by most candidates.

4 Data — checks will be made on the quality of data — this will help identify issues with data which could invalidate the valuations/projections of the company

Solvency — a valuation of the company is made at least once a year. This assesses the ability of the company to meets its liabilities when due.

Sensitivity tests will be used to test the ability for the valuation to withstand changes in experience

Investigations into the profitability of new business, including sensitivity analyses, will help assess impact of changes in new business mix and volumes.

Investigations will be made into the appropriate asset mix and investment policy, including stochastic modelling to test different investment conditions — consideration of the extreme values can help identify what circumstance will cause the company problems and enable management actions/strategy to be formulated

Experience — experience investigations will be carried out to confirm how the bases underlying the valuations compare to experience

Analysis of surplus — this will be further confirmed by any analysis of earning or surplus

These investigations will determine whether and how discretionary policy charges need to be amended and whether products need to be redesigned.

Analyses of expenses could validate assumptions used, and assess the extent of any mismatching of expenses and charges

Analysis of persistency will help management decide whether surrender / termination scales need review, and any customer retention activities need to be reviewed.

Changes in mortality experience could indicate changes in underwriting and claims management may be required. Separate investigations into the underwriting process and controls may be required

Distributions of surplus — a bonus investigation (including investigations into asset shares) will be undertaken to make sure that the company does not over-distribute bonuses, and treats customers fairly / meet PRE

Investigations into guarantees and options available, and stochastic modelling, will help assess the company's ability to withstand adverse economic conditions and assess the capital required.

Projections of solvency/ earnings, including the ability of the company to pay dividends, will help identify under what circumstances the company may need capital, and how much.

Projections of forecast new business and existing business will help assess capital requirements.

Investigations into the investment performance will monitor performance of asset managers

The reinsurance strategy will be reviewed, including retention limits and financing requirements, to check that the company's exposures are within the company's risk appetite.

Investigations into complaints will identify TCF issues and help with setting appropriate misselling reserves — these will help manage risks in the sales area, reducing the risk and impact of future litigation

This question was poorly answered by many candidates. Whilst candidates mentioned a number of investigations, in many cases there was no explanation regarding why such an investigation would be made and what risk it was designed to manage. Saying "so that management can take action" did not show sufficient understanding to gain marks.

5 (i) The amount of the reserves should be calculated by a suitably prudent actuarial valuation of all future liabilities, including options and guarantees, for all existing policies.

Where no explicit allowance is made for future bonuses, the valuation rate of interest should be reduced

The rate of interest used in the calculation of the reserves should be chosen, taking into account the currency in which the policy is denominated, and having regard to the yields on corresponding existing assets and to the yield which it is expected will be obtained on sums invested in the future

The elements of the statistical basis (demographic, withdrawal) should be chosen taking into account the type of insurance, country where insured people live

The valuation should take account of the nature, term and method of valuation of the corresponding assets

The method of calculation of the reserves from year to year should be such as to recognise profit in an appropriate way over duration of each policy, and should not be subject to discontinuities arising from arbitrary changes to valuation basis

Each life insurance company should disclose the methods and bases used in the valuation

If valuation method defines expense to be used in the valuation, the amount should not be less than prudent estimate of relevant future administration and commission costs

(ii) **Suitably prudent method**

The Net Premium method is suitably prudent because:

- guaranteed benefits are valued directly by the net premium method
- bonuses which have already been guaranteed, whether described as vested, declared or allotted are valued directly
- options: the net premium method would not allow for the cost of options and so an additional reserve would be needed

Future premiums: the method takes credit for future premiums by valuing the net premium.

Future Bonuses

Allowance is made for future bonuses through a reduction to the valuation rate of interest.

The difference between the office and net premium may also includes a margin for future bonuses, although this margin would usually be used as an allowance for future expenses.

Terminal bonus is not reserved for explicitly. However, the method is used with a book value of assets, so that investment appreciation is taken to an investment reserve, and not brought into the comparison between assets and liabilities when surplus is determined.

Expenses and Commission

The margin between the office and net premium allows for future expenses.

A Zillmer adjustment may be used to allow for initial expenses. Though being implicit, this may not be adequate, in which case an additional reserve would be held, or the net premium restricted to a maximum % of the office premium.

Statistical Basis

The mortality used in the valuation is set prudently, by reference to current and expected future experience.

Interest rate

The valuation interest rate used in the Net premium method is related to the yield on the assets.

Recognition of Profit

The method produces a smooth emergence of profits, if used in conjunction with assets taken at book value.

Disclosure

The net premium method and basis are simple to describe for disclosure purposes.

(iii) The impact of a decrease in the value of assets on the valuation basis depends on the mix of assets and how much of the fall in assets is absorbed by the free estate. If the decrease in value of assets is primarily in the value of equity investments then this would be absorbed by a reduction in the investment reserve and would have little impact on the liabilities

If the decrease were accompanied by an increase in interest rates this would decrease the value of the liabilities because the valuation interest would also rise. However, this would not necessarily mean that the value of liabilities would decrease by the same amount as the assets because:

- the assets and liabilities are unlikely to be matched
- the valuation interest rate change also changes the amount of the net premiums meaning that the liabilities are less sensitive than assets of a similar term
- any changes to the implicit allowance for future bonus will have an impact
- the increase in the valuation rate may be limited by any restrictions in the maximum reinvestment rate allowed

The impact of the change in net premiums would be impacted by any restrictions on the net premium as a proportion of office premium

Parts (i) and (ii) were generally well answered. Part (iii) was poorly answered with a general lack of reasoning given in solutions.

6 The company will have to decide whether to offer just one of the charging structure options, or whether to offer both as alternatives.

Profit Testing
For each chosen version, it will have to perform profit testing to determine what level of charges will be sufficient to cover its expenses and provide a profit margin in line with target requirement.

If the result of these tests is that a charge which is acceptable to the insurance company exceeds *x*% and/or *y*%, then it may have to accept that one or both is not a viable option.

Assumptions

In order to perform profit testing, the company will have to make assumptions regarding future experience, particularly the level of future premiums and persistency.

The company will have to consider the fact that past persistency experience might not be relevant to the new charging structure. For example, the absence of explicit surrender penalties and the standardisation of charging structures means that employers might transfer their policies more readily.

Persistency and premium level experience might also differ between version (a) and version (b) of the charging structure.

Selection

As two charging structures will be available, employers could select against providers. For example, if they do not expect to be paying significant levels of future premium then they might be more likely to opt for a version (b) product. If they expect the term of investment of each premium to be relatively short, then they might be more likely to opt for version (a).

If the company offers both versions of the product, in order to reduce the impact of anti-selection it will have to decide whether it should introduce restrictions regarding the extent to which employers can switch between the two versions. However, such a restriction could reduce the attractiveness of the product to the market.

It might not be permissible under the new regulations.

It might also encourage employers simply to switch to other providers.

Market/Competition

The company should monitor what competitors are intending to offer, and set charge levels which are not out of line with these other products.

As the charging structure is so transparent, these products are likely to be purchased primarily on price. Hence the charges should be set as low as possible (whilst maintaining an adequate contribution to profit).

The company needs to evaluate the optimal pricing strategy by taking into account the interaction between margin and volumes.

The company should consider the size of the potential market and whether there is sufficient market demand for the product

If the target profit requirement is not met, the company will have to decide whether to offer either option for commercial reasons, despite the fact that it does not meet profit criteria

Expenses/Charges

The company should consider the financing requirement of each design. This should be in light of the level of its free assets and capital available (e.g. the use of financial reinsurance) . The better matched the charges and expenses, the lower the risk. This should therefore reduce the capital requirement (depending on the nature of the regulatory environment).

Charges expressed as a proportion of premiums might be expected to increase broadly in line with maintenance expenses, if the premiums paid are based on a percentage of salaries. Charges expressed as a proportion of funds under investment might be expected to increase at a rate in excess of expense inflation, but better match investment fees charged as a proportion of funds under management.

The insurance company will have to decide whether or not to make the charges fixed or variable up to the given maximum. Fixed charges might be more attractive to the market, but this would increase the risk to the insurance company and therefore is likely also to increase the capital requirement (depending on the regulatory environment).

The insurance company will have to consider what form and level of commission it should pay to the insurance intermediaries. For example, under version (a) it might prefer to offer fund based renewal commission, but premium based commission under (b), as this better matches the charging structure.

The company should consider whether other distribution channels may be more appropriate

Sensitivity

The company should test the sensitivity of profit to variations in future experience. For example, version (a) will be sensitive to future investment returns, and if $x < y$ then version (a) will also be more sensitive to early withdrawal experience.

Since both options will result in a cross-subsidy from large to small policies, the company should consider whether to impose a minimum case size.

Administration/Cross Subsidies

It should also take into account any limitations on product design as a result of its administration systems. If its existing products are similar to one or both of the proposed charging structures, then this will facilitate development.

Treating customers fairly

The company must consider TCF issues when deciding product design

This question was generally not answered very well. Most candidates failed to address a number of key issues and did not use the information given in the question. Some candidates did not seem to realise that the regulator had set a maximum charge and went on to discuss how the charge could be increased. Candidates often failed to compare and contrast the different designs of contracts, in particular the different risks the designs left them exposed to. There was also a general lack of understanding of group endowment contracts.

7 (i) The principles of investment are that an insurance company should select investments that are appropriate to the nature, term and currency of its liabilities.

The investments should also be selected so as to maximise the overall return on the assets, where the overall return includes both income and capital, and the extent to which the company may depart from investing in "appropriate investments" in order to match its liabilities, depends amongst other things on the extent of the company's free assets.

These investment principles can also be expressed as:

The life insurance company should invest so as to maximise the overall return on the assets, subject to the risks being taken on being within the financial resources available to it.

(ii) **Unitised with profits single premium contract with a term of 10 years, a guaranteed death benefit of the initial premium + 2% per annum compound, and return of fund (premium + bonuses) on maturity.**

On death during the 10 year term the policyholder receives a guaranteed amount of the initial premium plus 2% per annum compound. The company will ideally want to invest so that it has sufficient assets at any time during the term to meet this guaranteed amount. Therefore the company will want to invest in assets that produce a flow of asset proceeds that match the expected liability outgo.

The expected liability outgo each year will be the guaranteed death benefit multiplied by the probability of the death benefit being payable in that year.

The company may choose to invest in fixed interest securities to match the expected liability outgo. However the extent to which the insurer needs to do this will depend on the value of the death benefit versus the value of the unit fund under the contract during the term. This could be identified using stochastic modelling, and a portfolio of suitable, more secure assets, could be identified to reduce the likelihood of shortfalls in the future

On maturity the policyholder receives a return of fund (premium + bonuses) from the unitised with profits fund. Usually insurers want to maximise the returns that policyholders achieve by investing in their with profits funds and the policyholder will at least usually want to earn a real rate of investment

return throughout the term of the policy. Hence the insurer will invest in assets that are likely to produce the best real rate of return for the unitised with profits fund. This may lead the insurer to invest in equities rather than fixed interest securities, if equities are likely to offer the best real rate of return over the term of the contract.

Exposure to equity markets could be achieved through the use of financial instruments

The insurer may choose to invest in other assets producing real rates of return (e.g. property or overseas equities) to provide diversification

During the term of the contract, it is likely that the insurer will grant regular bonuses (either through an increase in the price of units in the with profits fund or by allocating additional units to a policyholder). These bonuses once granted form part of the guaranteed benefits that the policyholder will receive on maturity. Hence during the term of the contract the guaranteed benefits will increase and the insurer will want to invest in assets that match these guaranteed benefits by investing a greater proportion of the assets backing the contract in fixed interest securities. However if guaranteed benefits increase at a lower rate than that earned on the underlying assets then the proportion of assets held in fixed interest securities may not increase.

In some countries there will be regulations governing what assets the insurer can invest in (e.g. 50% of unitised with profits funds in government securities. There may also be a requirement to produce a guide for policyholders explaining the investment strategy for the unitised with profits fund.

There will be a need to follow any strategy disclosed in marketing literature

The insurer will have administration expenses throughout the term of the contract. These will be real in nature (e.g. since the salary costs of an insurance company are real in nature) and hence this expense liability should be matched by assets offering a real rate of return. In practice this is likely to be taken into account through the investing of some of the assets backing these contracts in real assets such as index linked securities.

We are told that the insurance company has a deteriorating solvency position. In practice this is likely to mean that it will take a more conservative view and will want to be more certain of having sufficient asset proceeds to meet the guaranteed death benefit than might otherwise be the case.

This is likely to mean that the insurer invests relatively more in fixed interest securities and corporate bonds than more volatile investments such as equities, to protect its solvency position.

The insurer may assess appropriateness or otherwise of investment strategies by using dynamic solvency testing and assessing the probability of ruin

The company will need to take into account its taxation position

(iii) **A fixed annuity contract paying a fixed amount each month to an annuitant until their death, plus 5*annual annuity payment minus payments made on death in first five years.**

Under this contract most of the future liability outgo is fixed in nature and therefore the majority of the assets backing this contract will be invested in fixed interest securities, where the asset proceeds from the portfolio of fixed interest securities match the expected fixed liability outgo. The assets held will be in the same currencies as the liabilities.

However, the liability outgo is likely to have a very long discounted mean term and it may not be possible for the insurance company to match the expected fixed liability outgo by investing in fixed interest securities, since there may not be sufficient fixed interest securities availably with a sufficiently long term. In this case the insurer will use immunisation techniques to select a portfolio of fixed interest securities (or financial instruments/credit derivatives) that provide the best match possible to the expected liability outgo.

Immediate annuities are very competitively priced in some markets and hence it may be that the margins for profitability are very tight within this contract. To improve the potential returns therefore, the insurer may choose to invest in assets that are expected to provide a slightly higher rate of return over the duration of the investment than can be achieved from investing purely in government backed fixed interest securities. This may mean investing in a variety of high quality corporate bonds (e.g. by investing in corporate bonds where the companies are of appropriate credit ratings) if they are available in the market place.

Corporate bonds usually offer a slightly higher rate of return than government bonds but are not as risky as investing in equities, but need to take into account the views of investment managers on corporate bonds

Care would be taken to keep to high grade bonds where some extra yield can be obtained from accepting liquidity risk but limiting the exposure to credit risk. This may lead the insurer to stick to investment in "safer" government securities (if this is the case), since the insurer cannot take on the risk of an issuer of corporate debt defaulting for the additional return provided. The extent to which the insurer will choose to do this will be influenced by the fact that the solvency position for the insurer has worsened in recent years.

The expenses of administering the contract will be real in nature, hence it may be appropriate to invest a small proportion of the assets backing the contract in index linked securities if they are available or equities.

For each tranche of annuity business written, a small number of annuitants will die within the first 5 years of the contract (this can be calculated through

reference to the appropriate annuitant mortality tables), resulting in an accelerated payment for these annuitants.

This can be allowed for in the calculation of the expected liability outgo (and will have the impact of decreasing the discounted mean term of the liabilities overall) and hence will impact the portfolio of fixed interest securities chosen to match the expected liability outgo.

Part (i) was well answered. In part (ii) many candidates did not seem to appreciate the difference between a unitised with-profit contract and a unit linked contract, and hence failed to pick up many of the marks available. Part (iii), whilst being relatively standard bookwork, was poorly answered. In both parts (ii) and (iii) most candidates did not mention the deteriorating solvency position of the company and the impact that has on investment policy.

8 (i) There are no special charges that need to be taken to support the surrender or maturity or death benefits.

This means that the annual management charges from the two types of units and the bid offer spreads are required to meet the expenses, cost of capital and profit required by the company.

Depending on the size of the annual management charge on the capital units, the charges will start at quite a low level, and then grow each year as the fund increases.

In addition, a fixed percentage of the premium will be received via the bid offer spread.

The main expenses are:

- commission
- claims/termination costs
- sales and marketing related expenses
- initial policy set up costs
- renewal policy costs
- investment costs

Initial commission will be large, premium related and at the start of the policy.

If the company pays fund related commission then this could be matched by fund management charges

The claims and termination costs are likely to be small, but are not matched by any specific charges

The sales and marketing costs will be probably expressed as a premium related cost that will also be at the start of the policy.

The Initial set up costs will normally be expressed as a per policy cost at the start of the policy.

The charges collected at the start of the policy will be much too small to cover these costs.

On early surrender these costs will not be recouped

The renewal expenses will be expressed as a per policy cost and will be incurred each year.

The annual management charges do not perfectly match the renewal expense as the charge is a percentage of fund and premium not a fixed fee. However, the charges are likely to more than cover this expense.

The investment expense is likely to be expressed as a percentage of the fund each year.

The annual management charge matches the expense well as both are a percentage of the fund. It is unlikely that the investment costs will not be covered by these charges.

In total, the charges do not well match the expenses in timing.

The charges will more than cover the renewal and investment expenses, but the excess will be required to repay the other costs incurred at the start of the policy.

And to cover the cost of the capital used to cover that strain until it is repaid.

The annual management charges, being a percentage of fund, leaves the company exposed to stock market fluctuations. This is particularly so in later years when the majority of the charges will be in this form.

The charging structure may well meet the company's profit criteria, but it is not very capital efficient and so is only viable if the company has access to plenty of capital.

Fixed and overhead costs are not explicitly covered by any policy charge

(ii) It is common for companies to anticipate the extra future annual management charges associated with the capital units by actuarial funding.

It is usual to hold unit funds that exactly match the bid value of units purchased.

However, the full value is only needed at maturity or death.

It is therefore reasonable to hold the actuarial present value of the unit fund rather than the fully funded value.

If UF_t is the fully funded number of units purchased at time t, then the amount needed to be held is

$$UF_t \, A_{x+t:10-t}$$

If the discount rate is less than or equal to the extra management charge, then the fund will be able to meet its obligation to the policyholder.

Clearly the maximum amount of actuarial funding is achieved if the full amount of the extra annual management charge is used as the discount rate.

This releases capital at the point the capital units are purchased.

As the capital units are purchased in the first two years, this releases capital at the time when it is most needed.

It also converts the charge from a unit related one to cash, removing a large amount of the risk from stock market movements.

The only problem is that it means that the company can no longer pay out bid value of units on surrender, as it does not hold sufficient units.

It needs to introduce a surrender penalty that brings the terms offered to the policy holder in line with the actual units held.

This will be in the form of a unit penalty, decreasing as the duration to maturity decreases.

(iii) If all else is equal, the revised design incorporating actuarial funding will require a smaller additional annual management charge than before.

This is for two main reasons. Firstly, as the new business strain is paid back faster, the cost of tying up the capital is smaller. Secondly, there is less paid to surrendering policyholders

As the annual management charge is smaller the maturity benefits will be higher.

Those policyholders that surrender early in the term will receive less.

However, those that surrender late in the term may well receive more as the lower management charge may more than compensate for the surrender penalty.

The death benefit paid is the bid value of units and hence the change will be as for maturity benefits.

In general this question was relatively well answered. In part (i) the better candidates listed the different types of expenses and gained marks by discussing the basic properties of the charges and expenses of the product. Parts (ii) and (iii) were well answered.

END OF EXAMINERS' REPORT