

EXAMINATIONS

April 2003

Subject 302 — Life Insurance

EXAMINERS' REPORT

Introduction

The attached subject report has been written by the Principal Examiner with the aim of helping candidates. The examiners are mindful that a number of interpretations may be drawn from the syllabus and Core Reading. 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.

The report does not attempt to offer a specimen solution for each question — that is, a solution that a well prepared candidate might have produced in the time allowed. For most questions substantially more detail is given than would normally be necessary to obtain a clear pass. There can also be valid alternatives which would gain equal marks.

Mrs J Curtis
Chairman of the Board of Examiners

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- 1** *This was a straightforward piece of bookwork, with a command word of “State”. Given this, and only three marks, a large number of candidates wrote almost as much as they did for questions with three times the number of marks.*

Consideration of the general economic and commercial environment in order to set the context of the problem.

Specifying the problem

Developing the solution

Monitor experience and feedback experience into specification stage.

Act professionally throughout

- 2** *This question was generally answered well. The candidates who scored better were those who described how the additions to benefits method fitted the given investment mix, rather than those who described the investments that matched the distribution method.*

The Additions to Benefits method distributes surplus in the form of either reversionary bonus, special reversionary bonus or terminal bonus.

The way that surplus emerges depends upon the method chosen for valuing the assets and the supervisory reserves.

Under the Additions to Benefits method, once a bonus is declared, it is guaranteed and therefore forms part of the supervisory reserves.

The company has considerable freedom as to the rates of bonus declared and to the mix between reversionary and terminal bonuses; however, it must pay regard to policyholders' expectations which will have been set partly by reference to its past practice.

Fixed interest investments generally provide a stable investment return. Provided that they are held to maturity, the return is known at purchase, although the market value fluctuates between purchase and maturity, and there is some credit risk for non-gilt fixed interest investments.

Thus, reversionary bonus can be used to distribute the interest (and bonus loading) surplus arising from fixed interest investments. Conversely fixed interest assets best match the gradually increasing guaranteed liabilities as reversionary bonuses are declared.

Equity-type investments have both uncertain dividends and volatile capital values. It is desirable that the surplus distribution system permits this volatility to be smoothed. The ability to defer surplus – particularly through terminal bonus - does this.

The freedom to change reversionary bonus rates can help with distribution of income from equities, although fluctuations are often dealt with through terminal bonuses. The non-guaranteed nature of the terminal bonus is ideal to cope with the non-guaranteed capital return from equity assets

One-off capital returns can be distributed via special reversionary bonus, which does not generate future bonus expectations

- 3** *Generally poorly answered. Many dismissed the suggestion without considering the possible advantages. Others made irrational assumptions such as that without monitoring experience it must deteriorate, or that underwriting standards would need to be strengthened.*

The insurer will reduce its expenses if it no longer monitors experience itself, and so the suggestion might be reasonable if the insurer has access to some experience information – possibly from the reinsurer's own analyses.

Since the company is small, the expense of carrying out the investigation may be unjustified relative to the overall level of expenses given the limited exposure to experience.

The reinsurance treaty may require the company to provide experience data so that the reinsurer can monitor and report on experience. In this case the additional work involved in carrying out the analysis may be trivial and thus cost justified.

However, there is still a 10% exposure to experience so if this is a major line of business, or if sums at risk grow then the company may still want to analyse the experience itself.

This would give the company an independent check on the reinsurer's reports on experience and help it improve its understanding of the business

It will also provide a source of data to help set or validate pricing assumptions, valuation and embedded value bases, particularly if there is no requirement on the reinsurer to provide data.

Reinsuring a large percentage of the business will have an impact on the profitability (positive or negative depending on the terms offered). If the company subsequently wants to change the amount reinsured then it will want to have historic experience available on which to base its assumptions.

Also the company may want to investigate whether the reinsurance has provided value for money or whether other reinsurers can offer better terms at some future date, in which case historic experience will be important.

If experience is bad then there may still be an impact on profitability through any profit commission. Even without this there may be an impact on the terms offered by the reinsurer for future new business.

Bad experience may be an indicator of poor underwriting or sales practice which would be highlighted by a mortality experience investigation. The reinsurer might highlight this from its own experience monitoring and may give assistance with underwriting as part of the treaty.

4 *Generally answered well, although in part (ii) some candidates mistakenly reproduced chunks of their answer to Q2. Better candidates got nearly full marks on Part (i).*

- (i) There may be restrictions on the type of assets a company can invest in; or the extent to which assets of a particular type can be included when demonstrating solvency; or the maximum counterparty exposure to an individual company or individual.

Solvency capital may have to be held in specific assets.

There may be limits on the extent to which mismatching is allowed.

There may be restrictions on the currency in which investments are denominated or on the territory in which the investments are located or marketed.

There may be disclosure requirements (e.g. on the amount of ethical investment) that favour certain asset types.

Regulations may mean that features of the investments (usually the yield) affect the rate of interest that can be used to value the liabilities. This can affect the choice of assets if it is required to demonstrate a significant excess of assets over liabilities.

There may be a requirement to establish “mismatching” (resilience) reserves. The more a company invests in risky assets with the hope of a higher overall return, the greater the mismatching reserve is likely to be.

The extent of surplus assets in excess of liabilities may affect the extent of investment in risky assets permitted.

- (ii) The company may expect a higher return from fixed interest investments.

Investing a high proportion in fixed interest investments may be compatible with the company's appetite for risk.

The company may maintain a high proportion of investments in fixed interest in order to smooth bonus payouts, or limit bonus volatility

The company only has a low level of free assets and therefore needs to conserve their value by investing a higher proportion in fixed interest stocks which are less volatile than other investments. This will be particularly

important as the level of free assets will directly impact the company's ability to write new business.

There may be regulatory benefits if holding higher levels of fixed interest investments reduces the value of statutory reserves by permitting a higher valuation interest rate.

Mismatching regulations may also have an effect if they require additional reserves to be held against the contingency of a fall in equity market values.

It would be normal to back the guaranteed benefits (the sum assured and existing declared bonuses less future premiums) with fixed interest assets. Because of the expectation of future premiums, policies recently taken out will have little or no guaranteed benefits on this basis. Consequently the feature may simply be because the with profits portfolio is more mature than the industry average.

A company with a history of higher than average reversionary bonus rates, or with higher basic sums assured for a given premium, would build up guarantees more quickly than the average.

Marketing literature, other published statements, and past practice may have built policyholder expectations of the investment backing strategy for the with profits business.

- 5** *The question did not state that the amc in design B is a percentage of the fund. Appropriate credit would have been given to anyone who made a contrary assumption and argued logically from it, but everyone made the obvious assumption. Very few candidates realised that if the profitability is the same, and yet B has greater requirements for capital and greater early termination values, the difference must emerge somewhere – in poorer maturity values than A. As usual, candidates who followed a logical structure managed to write down more of the relevant points.*

Sensitivity tests on the major assumptions should be carried out to check the company's exposure to changes in experience. The design with the lower sensitivity will be preferable. Design B will be highly sensitive to investment returns, as the only income depends on the size of the fund.

Competitiveness and marketability — The main feature affecting marketability is the benefits provided. The relevant benefits are the surrender and maturity values.

The simplicity of design and comprehensibility of literature will also be relevant features.

In order for the two designs to have the same profitability, Design B would probably have the greater annual management charge, unless Design A had higher unit allocations in later years.

Design A has a lower surrender value in the early years but higher later surrender values and a higher maturity value than Design B. This is because the effect of the lower annual management charge eventually outweighs the initial low allocation of units and the fixed expense charge.

Design A will have a lower capital requirement at outset and will therefore have a lower cost of capital. As both achieve the same profitability, Design A will be able to afford a higher maturity value than Design B.

The preferable design will depend on the importance attached to surrender terms at short durations.

The charging structures used by other companies will need to be considered, it might be easier to sell a contract that is more clearly in line with other companies. Conversely, a different structure may lead to a marketing advantage.

If capital is limited, the higher capital requirement of Design B will be an important issue.

Design A has low allocation in the early years and so the unallocated premiums can be used to repay the initial capital quicker than in Design B. As a result design A is likely to have a shorter payback period.

Risk characteristics — Mortality is likely to be of negligible importance.

Withdrawals. As costs are recovered more slowly in Design B, it is more exposed to losses from early withdrawals, when initial costs have not been recouped. There may be legal or regulatory restrictions on early exit in the territory concerned which invalidate the better termination values of design B. Alternatively an active transfer market would make them more important.

The investment risk is borne by the policyholder in both cases, but there is a second-order expense risk, particularly for Design B. The expense risk depends on whether the annual management charge is guaranteed or not. If it is, then both designs are exposed to expense risk. Design A is less exposed to expense inflation risk as the charge is more closely matched to the expenses.

The extent of cross-subsidies — Unless the allocation rates of Design A or the annual management charge of Design B are dependent upon case size, both will be susceptible to cross subsidy. Design A will be less exposed as the policy fee is more closely matched with the renewal expense.

Administration systems — the design that most easily fits on the administration system would be preferred. Similarly the design that fits most closely with other products offered by the company will be preferred.

To make the final decision all the above factors would be considered. Each factor will be given a relative weighting and each design assessed. The design with the highest weighted score would be preferred.

- 6 *This question was generally answered poorly. Very few candidates who identified the principal risks subsequently developed their thoughts into a balanced critique of the proposal. In part (ii), most argued reasonably that the proposal was unlikely to address the issue and had some additional risks.*

- (i) Expense loadings may either be set by inflating the results of past analyses, or projecting future expected expense levels. The method chosen would depend upon the degree to which it more closely represented the best estimate of reality.

The primary risk is that an inappropriate method is chosen, or incorrect assumptions made, so that the margins in the rates for renewal expenses are less than the expenses incurred.

There is also a risk that the proposal doesn't address the problem, and that business volumes do not recover, discrediting the volume assumptions made.

Future total renewal expenses may be expected to differ from the past experience for many reasons. For example a recent corporate restructuring may bring efficiency savings, or an increased volume of business over which overheads can be spread.

However the predicted efficiency gains may not happen in reality. Predictions for many years into the future are particularly unreliable.

In projecting expenses, the company will have had to assume a split between initial and renewal expenses; it may get this wrong. Future levels of renewal expense inflation may differ from those assumed, either owing to general inflation or an incorrect assumption as to the proportion of expenses that will rise with wage rather than price inflation.

The rate revision may be too effective, increasing volumes markedly and putting strains on financial capacity and administrative systems

New business volumes in all future years will have to be predicted. This will be difficult to do accurately. A prediction of future lapse rates will also be required. If lapse rates are greater than assumed then the in-force volumes will be lower than assumed and renewal expenses per case higher.

Term assurances are price sensitive so there is a lapse and re-entry risk if rates are falling making persistency difficult to predict.

The rates need to allow for the product's share of the company's overheads. The split between products may differ from that assumed. If in-force volumes for other lines of business differ from those assumed then the overheads which have to be supported by the term assurance product will be different from those assumed.

The average policy size will be important as some expenses will relate to the size of the premium and some will be fixed per policy. Cross-subsidies between large and small policies are inevitable as a policy fee that exactly equates to the fixed expense cannot be charged if premiums are level.

The mix of business by age and term will also be important.

- (ii) It is difficult to see why this proposal would increase volumes sold, except to those likely to commit suicide.

There will probably be a higher number of claims in the first year of the contract as some claims that would previously have been declined will be paid. The extent to which this is the case depends on the territory and the target market and the extent to which these include potential suicides.

If the company doesn't reflect the extra cost in the pricing then profit will be less than assumed when the product was priced. If it does reflect the potential higher claims in the pricing then the premiums would increase.

If the increase in premiums is greater than the value potential policyholders place on the removal of the clause then the overall impact will be to make the product less competitive.

There will not be much data on which to base any assumption about the potential extra cost. Population statistics may be available.

Reinsurance terms offered may deteriorate.

People who are likely to value the removal of the clause are those who may be more likely to commit suicide. This may lead to anti-selection. The extent of this risk would depend on whether other companies still have a suicide exclusion clause.

It might be necessary to change the underwriting process to reflect the extra risk, although this may be difficult to detect through normal underwriting.

In practice it may be difficult to turn down claims due to suicide in the first year even with the clause due to bad publicity so impact on experience may be very small.

7 *This question was almost entirely bookwork, and relatively few candidates mentioned enough points to score highly.*

- (i) A net present value, NPV, is calculated when the profit signature or net cash flows under a contract or a group of contracts is discounted at a risk discount rate to produce a single figure.

In life assurance business profits emerge over a long period and are uncertain. The accounting approach to profit measurement of “sale proceeds minus cost of sales” breaks down.

According to economic theory, given a choice between two investments, an investor should choose the investment that gives the higher net present value.

Life insurance companies use net present values to assess the relative likely profitability of different contracts and hence assess which contracts are likely to make most efficient use of the company's capital. This information is likely to form part of the rationale for deciding which contracts a company should sell.

Net present values can be calculated for other investment projects as well as life insurance policies. For example, they may help the company to choose between launching a new product and investing in systems to support existing products.

- (ii) If the NPV is calculated for an anticipated volume of business, then it provides the life insurance company with a realistic assessment of the likely profits that will arise over and above those required by the provider of capital.

The NPV is easy to calculate as it doesn't require an iterative approach.

The IRR method determines the rate of return expected to be achieved on capital invested and this could be compared to the RDR to assess whether the return expected is satisfactory.

However, it doesn't provide information regarding the monetary size of the expected returns (over and above those required by the capital provider). The company may require a minimum monetary return for a product launch, for example, to be seen as worthwhile.

With the IRR method allowance for risk has to be made in the assumptions for the different elements of the cash flows.

The discounted payback period method calculates how long it takes the life insurance company to recover its initial investment with interest at the RDR. But it doesn't provide information regarding the likely size of return that will arise over and above that required by the capital provider. In particular, the discounted payback period ignores the cashflows that arise once the capital has been repaid.

Using the NPV method, the life insurance company can relate the NPV to indicators of the policy's worth to the company, such as market share or sales effort. For example, the NPV can be expressed as a percentage of the premiums expected to be paid under a contract or the commission associated with selling that contract. This type of analysis isn't possible using the other methods.

There is only one net present value that can arise for a given profit signature and a given risk discount rate. For a given profit signature, the internal rate of return may not be unique (i.e. there may be more than one IRR), if there is more than one change of sign in the profit signature.

If a policy makes profits from outset or has a very low capital requirement, the DPP and IRR methods may not result in a meaningful number, or may not even exist. This is not true of the NPV method — an NPV always exists.

- (iii) The drawbacks of using net present values are:

The NPV gives a deterministic and simplistic answer. It is valid provided that external factors have been considered appropriately. The other methods provide different information, which may be more relevant in particular circumstances.

The comparison of two net present values, and choosing the one with the higher value, is only valid if each of the NPVs has been calculated at a risk discount rate appropriate for that contract. For example, if one product is perceived as more risky, the NPV for that product should be calculated using a higher risk discount rate.

Alternatively the same risk discount rate could be used for all products, but margins taken in the bases used to calculate the profit signature.

The NPV method says nothing about competition or the market in which the product is sold. A contract may have a very high net present value, but if it can't be sold, either because there are competitors with more attractive products or there is no demand for it, then the product will not sell.

Calculating the NPV for an expected volume of business, based on realistic assumptions about future policy sales, can mitigate this.

The same NPV can be calculated for unequal initial capital outlays. NPV needs to be related to capital outlay to create a profit margin. For example a company with limited capital resources may not be able to sell a capital intensive product, even if it generated a higher NPV than an alternative.

- 8** *This solution does not answer the literal question asked (how to build a model), but is the solution given by most candidates and expected by the examiners. Credit was given for answers dealing in greater detail with model building, but very few were seen. This is a common type of question where bookwork then needs to be related to a practical situation. Many candidates were unable to reproduce the parts of the core reading that are generic and then adapt their solutions to the specific situation being tested. Most candidates stated (correctly) that a stochastic asset model was required, without developing their answers as to why.*

- (i) A stochastic model should be used. This is because the cost of the guarantee is dependent upon future investment returns. If future returns exceed a certain

level then there will be no cost to the company. But if they are below that level then there will be a cost, which increases as returns reduce. Hence a range of future investment scenarios should be tested.

The stochastic asset model needs to be chosen and the assumptions, including the expected future unit growth rate and its volatility, need to be determined. A complex model may give better results but will take longer to run.

Assumptions are also required for future mortality, surrender and paid-up rates. These will probably be allowed for on a deterministic basis. All assumptions should be consistent with each other.

Some assumptions may be dynamically linked (e.g. lapses to the value of units) and should be capable of being overridden (e.g. nil lapses for supervisory valuations).

A time period should be chosen for the projections. Since the model is stochastic, a suitable period might be a year rather than a month, in order to avoid the model becoming too cumbersome.

Model points may be used rather than a policy-by-policy projection. The model points will be based on actual in-force data.

The model will project the unit values to maturity, allowing for future premiums and decrements.

This will be done under a large number of randomly generated investment scenarios, say between 1,000 and 5,000.

The model will then compare the projected maturity value with the guaranteed minimum amount, i.e. the sum of premiums paid (allowing for decrements). This is done for each scenario and for each model point.

If the projected value exceeds the guaranteed minimum amount then the cost for that particular scenario and model point is zero. If it is less than the guaranteed amount then the cost is the difference between the two.

These projected costs are then discounted back to the present scaled up, and summed across all model points. The average across all scenarios is the expected cost of the guarantee.

The variability of the cost should also be considered, e.g. by looking at the quartiles and 95/5 percentiles.

The model may be adapted to include future new business

- (ii) It is important to check that the model code is correct.

It is also important to validate all the assumptions used to determine parameters.

If model points are used, the company should check for model point error. For example, the calculations could be performed using a different choice of model points, checking that the results do not differ significantly.

The scaling up and aggregation of model points or data should be checked. For example, check that the total number of policies and total unit value at outset is consistent with in-force valuation data.

To check that the cash flow projections are being performed correctly, run the model using deterministic investment assumptions. One can then check that the cost is zero for high investment returns, and that the cost increases as the future investment return assumption reduces.

The model could be run using deterministic assumptions to ascertain the “breakeven” future investment return, which could then be checked for reasonableness.

To check the code, a simple projection spreadsheet could be used to perform a parallel check on the results for a single model point using a deterministic investment assumption.

The stochastic results should be checked for reasonableness. For example, is the expected cost a sensible proportion of total premiums?

An individual stochastic scenario could be checked for reasonableness, e.g. an extreme scenario in which future investment returns are very poor.

Sensitivity analysis should be performed, e.g. by varying the asset model parameters.

Any results from these analyses and reasonableness checks that are not intuitive should then be investigated further, as they may reveal coding or parameter input errors.

Results should be tested against the market price of a suitable derivative if one exists.