INSTITUTE AND FACULTY OF ACTUARIES

EXAMINERS' REPORT

April 2013 examinations

Subject ST2 – Life Insurance
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.

D C Bowie
Chairman of the Board of Examiners

July 2013

General comments on Subject ST2

The Examiners' Report covers more points than would be expected to get full marks. This is so that alternative approaches to questions by different candidates can be accommodated within the marking scheme. Candidates are expected to show knowledge of the relevant content of the Core Reading, but those who tailor their answer to the specifics mentioned in the question will score more highly than those who answer in a more generic way.

Comments on the April 2013 paper

As with previous papers, questions that focussed on knowledge of the Core Reading were well answered. In some questions, such as 3(ii) and 7(i), candidates tended only to list factors to consider rather than applying them specifically to the particular situation. Similarly, where questions required candidates to think more widely, such as 6 (ii) and 6 (iii), candidates often did not give comprehensive answers. Candidates should use Examiners' Reports to practise applying their knowledge to the situations set.

1 The formula for the dividend is:

$(V_0 + P)\ (i'' - i)\ +\ (q - q'')(S - V_1) + [E(1 + i) - E''(1 + i'')]$

Dividend = (1000 + 100) × (0.05 – 0.04)
+ (0.005 – 0.004) × (10,000 – 1,200)
+ 15 × 1.04 – 10 × 1.05
= 11 + 8.8 + 5.1
= 24.9

This was a generally well answered question though many lost marks through mixing up positives and negatives. A number of candidates failed to deduct the value of the contract at the end of the year from the sum assured.

2 The company needs to make sure that it understands exactly what costs are covered in the agreement and what costs remain with the company, e.g. termination costs are not mentioned as being part of the agreement.

In the expense analysis only costs which are covered in the agreement should be replaced with the fixed schedule of costs from the outsourcing agreement. The costs from the outsourcing company should be inflated in line with the terms of the agreement, which may stipulate a fixed rate or increases in line with an index. There may be a modelling issue if the outsourcer expenses inflate at a different rate to the overhead expenses.

Need to consider how overheads are impacted by the agreement and how overheads are allocated between products included in the agreement and those that aren't. The insurance company may be able to reduce some of its overhead functions if these are now covered by the outsourcing company, in which case some of its overhead costs would be replaced with the fixed schedule of costs.

Need to factor in how expense levels may change over time e.g. due to changes in the numbers of policies in-force (e.g. from persistency) or changes due to new business written. Also need to ensure that models are able to cope with different loadings for policies of different premium frequency

Need to consider what happens to costs at the end of the agreement. May need to consider what would happen to expenses if the outsourcing company defaulted or provided poor service. Need to consider loading in additional expenses for the costs of monitoring and managing the outsourcing relationship.

The company needs to consider whether it will load into the expense assumptions anything to recover the one-off costs of setting up the outsourcing arrangement, including any potential redundancy costs for existing staff if the company's own administrative functions are reduced. Need to consider whether there are any currency risks if outsourcing charges are denominated in a different currency.

This question was well answered by candidates who concentrated on setting of expense assumptions and who considered a variety of points. A number of candidates did not answer the specific question asked, and instead described the wider factors that the company would

need to consider if deciding to outsource rather than those relevant only to setting the expense assumptions; this did not gain marks.

3 (i) The method is:

(a) Calculate the premium the company would charge, on the current premium basis, to provide all the policy benefits after the alteration.
(b) Calculate a special surrender value, for the existing contract, that makes allowance for the initial expenses included in the above premium..
(c) Spread the special surrender value over the outstanding term, using the above premium basis, and deduct this re-spread surrender value amount from the premium in (a).

(ii) The method produces reasonable results when the term is reduced substantially because the value paid on conversion to immediate maturity will run into the normal surrender value.

It produces reasonable results when there is a substantial increase in term or in benefits because the method allows for the terms offered on new business.

Lapse and re-entry will not be a problem as the premium cannot be greater than that for a new contract.

The terms will be affordable by the company provided that the special surrender value does not exceed the earned asset share at the date of the alteration. Similarly, the expected profit should be the same before and after the alteration.

However the method can produce unreasonable answers for small changes in outstanding term or sum assured, depending on the surrender value basis and any changes in premium rates since the policy was effected.

It also may not be consistent with a conversion to paid-up status on a substantial reduction in premium, with outstanding term unchanged.

The costs associated with carrying out the alteration will only be recovered if allowed for explicitly in the surrender value respread.

Part (i) was standard bookwork and answered fairly well though a common mistake was to omit the initial expense adjustment. Part (ii) required candidates to recall the principles but then apply them to this method. Weaker candidates only listed the principles, or could recall only the principles relating to setting surrender values or paid-up alterations (which are not relevant here). The stronger candidates correctly identified the relevant principles and discussed how they were or were not met by this method.

4 (i) The main risk to the company is that at the point of exercise the value of the backing assets will be insufficient to meet the guarantee. The main investment risk is interest rate risk. The precise nature of the underlying investment risk depends on how the company decides to invest to meet the guarantee.

The company might decide to hold fixed interest investments which match the maturity lump sum benefits by term. In this case, the risk is from interest rates at the guarantee date being *lower* than those used within pricing.

The company could then also decide to hold derivatives to match the guaranteed annuity options. These would need to be interest rate derivatives such as swaptions. This would reduce the inherent interest rate risk but introduce counterparty risk.

In order to minimise the risk of not meeting the cost of the guaranteed annuity benefits due to changes in interest rates, the company might instead decide to treat the policy more as a deferred annuity, i.e. hold fixed interest assets that are of sufficiently long term to back the expected guaranteed annuity payments. Interest rate risk will remain to the extent that precise cashflow matching is not possible. There is now also a risk that more policyholders opt for the lump sum benefit than expected at a time when yields are *high*.

The company may decide to invest in riskier assets in order to maximise the guaranteed return implicit within the contract, for example by holding corporate bonds rather than government bonds. This further increases the risk of not meeting the guaranteed annuity payments, e.g. due to defaults or credit spread widening.

There is a risk that the company incorrectly estimates the proportion of policyholders taking up the option and in particular the profile of proportions taking up the option at each age, or a different gender mix if a unisex rate has been adopted.

The company is also at risk from improving mortality experience. The company is exposed to anti-selection risk, with a risk that those in better health take the annuity option.

Also, the company is at risk from the expenses assumed in the pricing of the guaranteed annuity rate being lower than those experienced, e.g. due to generally higher than anticipated expenses or due to expense inflation being higher than anticipated in the original pricing.

If the guaranteed annuity options are "in the money" then there is a risk of lower withdrawals prior to the exercise date than allowed for in the pricing And similarly if the options are "out of the money" then there is a risk of higher than expected withdrawals prior to exercise.

There may be an additional reputational or mis-selling risk due to policyholders not understanding the option.

There is an operational risk that errors were made when pricing the option.

The inclusion of the option may make the contract too expensive, and hence unmarketable, leading to lower than expected new business volumes and problems recovering fixed or development expenses. Alternatively, if the product is very marketable, it may result in high new business volumes which will lead to high new business capital strain

(ii) One approach for determining the charge for the guaranteed annuity rate is to use an option pricing approach, i.e. by using the market value of a derivative that closely matches the guarantee or by using a closed form solution.

Under the option pricing approach the guaranteed annuity rate corresponds to a call option on the fixed interest bonds that would be necessary to ensure the guarantee was met.

Alternatively, a swaption could be used, i.e. an option to swap floating rate returns at the option date for fixed rate returns sufficient to meet the guaranteed annuity option. For either version, the exercise price chosen would be that required to produce the required fixed rate of return.

The company would need to determine an estimate for the proportion of policyholders taking the option at each age in order to derive the appropriate mix of terms of option on which to base the pricing.

Another alternative for the company would be to use stochastic simulation. A stochastic model is used to simulate the future price of assets.

The assumptions underlying the model must correspond to the proposed investment strategy. The most important economic assumption to vary stochastically for this type of option will be interest rates.

A large number of simulations are required in order to produce reliable results.

The cost of the option for each scenario is any excess of the present value of the guaranteed annuity payments over the lump sum benefit multiplied by the assumed probability of exercise at that age.

Assumptions for the mortality and withdrawal experience of the policyholders prior to exercise will also be relevant to the proportions exercising.

Withdrawal assumptions may be dynamically linked to economic scenarios. Also need to allow for mortality improvement both pre and post the exercise of the option.

The present value of the option can be determined by discounting the simulated cost of exercising the option at a suitable rate.

The company can then charge an additional premium having a present value which reflects the average simulated cost of providing the guarantee, with the potential addition of a margin for prudence.

Any additional expenses related to the option would also need to be loaded in.

The cost of the option would then need to be allocated in an appropriate way across the policies, allowing for the expected new business profile.

In part (i) many candidates covered enough of the relevant sources of risk to score relatively well. However, few candidates discussed in much depth the nature of the investment (interest rate) risk, which depends on the approach taken to matching the guarantee, with only a few candidates mentioning derivatives.

Most candidates identified option pricing and stochastic simulation in part (ii), but a disappointing number appeared to have misunderstood this as being a mortality option (and so focused on the conventional and North American methods) rather than a financial/investment option.

5 (i) To produce a more accurate expense allocation at a product level, which has taken into account the actual time spent on each policy/type of expense rather than a uniform allocation.

To enable a split between expenses attributed to existing business and new business.

To more accurately determine the profitability by product type in order to identify unprofitable or uncompetitive contracts. This could be in order to reduce cross subsidies and reduce company exposure to selling products with low expense loadings and take action as necessary, e.g. repricing or cost-cutting.

To determine a more accurate forecast of future expenses in order that business planning and capital management can be improved and to enable it to reserve more appropriately for future expenses.

It may have been suggested by the auditors or by senior management.

(ii) As well as more detailed analysis of the expense data, the company will require more detailed breakdown of exposure data e.g. splits of existing business and new business policy counts and premium sizes.

For salaries the company will need to perform a detailed review of time spent by the relevant departments on each task, by new, renewal or claim, by product and probably also by premium frequency of the products.

It will need the salaries of staff in each department, including loadings for non-salary related costs e.g. pension contributions or any sales related

remuneration costs for sales staff. Timesheets may be required to split time between products and type of expense.

Overhead costs will need to be separately identified e.g. HR costs.

Rules will be required for allocation of indirect and overhead costs, which may require additional information. For example, property may be allocated in proportion to the floor space that each department uses.

Computer costs may be allocated according to computer usage by different departments. Computer costs will need to be amortised and so appropriate amortisation periods will need to be determined for these, e.g. based on expected useful lifetime.

Investment costs will need to be identified and apportioned.

Information will be required on the specific nature of any one-off costs, such as project costs, so that they can be amortised and allocated appropriately. The expected useful lifetime of any items purchased as one-off capital costs would be needed.

Information on any external expenses (e.g. advertising or underwriting costs such as medical tests) will also be required.

(iii) Compare the total expenses on old basis and new basis, and compare to budgeted expenses for the same year and check that there are no large differences.

If there are any unmodelled products then the modelled expenses will need to be adjusted for these.

Compare per policy unit costs under the new approach against the assumptions from the previous year and ensure that any major differences can be explained.

Compare the split of total expenses between direct and overheads with that in the previous year assumptions and ensure that any major differences are explainable. Similarly compare the split between initial and renewal expenses with the previous year assumptions.

Compare the unit costs per policy for similar products (e.g. two similar single premium products) to ensure that they are similar or that any differences can be explained.

Check for any oddities e.g. ratio of regular premium to single premium assumptions or any very large expense assumptions.

Ensure that there is no double counting of products or expenses.

Compare total expenses to the accounting data to check that all are included.

Ensure that all products have unit costs allocated.

Many candidates scored poorly in part (i) with many giving only one relevant reason identified. Part (ii) however was generally better answered, with many identifying and describing adequately the key additional information required. Part (iii) saw a range of marks with those giving thought to sources to compare against scoring well.

6 (i) Sources of data are:
Internal policy data for annuities (exposure measure and deaths)
Internal policy data for any similar products (e.g. deferred annuities)
Reinsurers' data
Industry data e.g. CMI data and models, actuarial tables
National statistics / government data
Academic studies
Medical journals
Consultants' data
Overseas data

(ii) Data risks include in-force or mortality data being inaccurate or incomplete.

Information required for grouping could be missing e.g. benefit level or age.

The data may be out of date if records have not been maintained, or the data may contain random errors due to manual inputting.

Late reported deaths may not be included in the period of investigation, or there may be a lack of notification of the first death on joint life policies.

The amount of data may be of insufficient volume, especially once the book is broken down into homogeneous groups and especially at extreme ages (and so individual policies could distort the assumptions for particular groups).

Small volumes of data also make it more difficult to analyse (and hence project) trends in longevity.

External data may be for a different population and this would result in determining mortality assumptions that are not appropriate for the book of business. This could be due to data being a different socio-economic cross-section of the population, a different geographical area, or due to different underwriting levels adopted (e.g. impaired lives).

External data is also likely to be less detailed and more out of date owing to the time taken to collect and publish the information. The data quality is also dependent on the quality of the processes undertaken by each contributor.

(iii) The company should reconcile exposure data with that used for previous analysis.

To do this data should first be grouped in some sensible way.

Simple checks can be performed by reconciling data at both investigations using business on and business off over the period. This could be done for number of contracts or for the amount of annuity benefits in payment.

Data can also be checked against accounts data e.g. annuity benefits paid.

Checks could be made for unusual values e.g. zero or very large values or impossible dates of birth or ages.

Distribution of data items can be checked to identify outliers or clusters of unusual values.

Spot checks can be performed on specific policies.

The data extraction process should be checked. The company should also implement automatic checks on input data as well as keep IT systems up to date with well maintained data.

Ensure that administration staff are well trained and understand the importance of accurate data.

There should be a clear proposal form for the initial data gathering to ensure it is an accurate reflection of the customer's details.

Ensure a sufficient volume of data in each population.

Check that the populations of any external data being used is consistent with the internal population and, if not, an appropriate adjustment should be applied.

Ensure that the most up to date external data is obtained and used and, if necessary, roll forward any lagged data.

Check against any national database of deaths to potentially identify any un-notified deaths or first life deaths.

The basic bookwork in part (i) was answered well by well-prepared candidates, with many gaining close to full marks. A few candidates concentrated on the individual data fields in the company's own data rather than data sources, as required by the question.

The basic points in part (ii) were covered by most, with the stronger candidates expanding on the points, e.g. data at extremes.

Part (iii) was generally not so well answered, with some candidates focusing on the wider issues resulting from poor data rather than mitigation actions.

7 (i) **Profitability**

This is a protection policy and so is likely to be non-linked.
The company will need to ensure that the premiums charged will be sufficient to cover the benefits to be provided and the expenses in most foreseeable circumstances and provide an adequate profit margin.
The company will need to consider whether it wishes to include sufficient loading in the premiums to recover the product development costs and whether it will require this product to make any contribution to overheads.
The company therefore needs to assess the likely volumes of business which could be sold.

It will need to consider whether premiums will be reviewable.

The company will also need to consider whether it will increase premiums based on answers to the health questionnaire or whether it will exclude individual children. This is unlikely to be popular with the government, but the decision on this would have a material affect on profitability.

In determining the price and profitability of the contract, the company will need to ensure that its assumptions reflect appropriately the relatively high mortality rates expected. However policy lapse rates might also be relatively high, as premiums may become unaffordable.

Marketability

The product design needs to be attractive and marketable. The benefits offered appear to be determined already and it is likely that these are intended to meet a real need at as low a cost as possible. There is therefore little scope in considering innovative design features.

The company may consider whether to offer a surrender value, but this is unlikely.

The key target market is the poorer section of the population, therefore the company needs to aim to keep the price very low in order for it to be sufficiently attractive to purchase.

This may also depend on the distribution method which will be used and how the sales force are remunerated.

The product probably needs to be regular premium to ensure affordability and hence need to consider also how premiums will be collected.

Competitiveness

New products need to be competitive against any similar products available.
If the company wins the contract through the negotiations with the government then this will not be an issue as there will be no competitors.
If there are other companies in negotiations then the company will need to show value for money. However, financial strength is likely to be the most important factor as the government will not wish to be endorsing a company which could go insolvent.

Financing requirement
The company will need to consider any financing requirements and will want to minimise them. This is made more difficult as there is no scope to adjust the benefits; however financing requirements would be lower if the premiums were reviewable.

The company will need to check that it has sufficient capital to cover the financing requirements.

Risk characteristics
The company needs to consider the level of risk associated with the product and its ability to withstand this, which may depend on its level of free assets.

The main risks involved are around the child mortality rates, the average number of children that would be insured, the birth rates and the fact that it is an indemnity product covering unknown funeral costs. These costs will also depend on underlying inflation which may be relatively unstable, if this is a developing economy.

The company would need to carefully define what is covered (i.e. what is meant by "basic funeral costs") to avoid unexpected payments.

It also needs to consider possible aggregation or catastrophe risk (e.g. epidemic, natural disaster), including the concentration of risks in one location.

The company will need to consider any correlation between risk factors, such as child mortality rates and number of children in a family.

The company would need to include a sufficient margin to allow for the fairly high level of uncertainty, particularly given that it has not written a product like this before and has no existing experience. The government may have data that would be useful.

There may also be a high risk of anti-selection, with individuals who are planning to have a large family being more likely to take out the policy. And similarly there may be a high risk of selective lapses, with individuals with more healthy children being more likely to lapse their policies.

There is also the potential for fraudulent claims such as claims for uninsured children or from fraudulent distributors not passing on premiums.

The company may wish to consider reinsuring some of the risk. This may also enable them to gain technical expertise from the reinsurer with product design, pricing and underwriting.

The company would need to consider any investment risk, and the availability of any suitable assets to match liabilities

Onerousness of any guarantees
It is unlikely that any further guarantees will be offered in addition to the guaranteed death benefits, since this needs to be a simple low-cost product given the target market.

Sensitivity of profit
The company needs to consider the sensitivity of profit to variations in future experience. It may be possible to reduce the sensitivity by having reviewable premiums.

Extent of cross-subsidies
The company needs to consider the extent of any cross-subsidies. There are significant cross-subsidies within the pricing of this product due to there being one premium irrespective of the number of children.

It appears that the company has no way of avoiding these cross-subsidies, so it therefore needs to estimate carefully the likely mix of business when pricing the product.

It may decide to introduce cross-subsidies with other products, i.e. offering this (at least initially) as a loss leader.

Administration systems
The company needs to consider the systems requirements of the proposed new product. It is a relatively simple product so this may not be onerous, unless there is a need to allow for reviewable premiums.

However, the system may need to allow for a lot of lives insured which may require additional fields.The system will also need to allow for multiple deaths on one policy.

Consistency with other products of the company
This is unlikely to be an issue given there are unlikely to be any similar products being sold.

Regulatory requirements
The company should consider any specific regulatory requirements. This should be covered under the negotiations. It could be time-consuming to get a finalised agreed structure. In particular the government will want to ensure that the company cannot increase premiums to an unreasonable level and it will want to ensure that profit margins are not extreme. Particularly given that the target market might be perceived as relatively vulnerable.

The company should also consider any tax implications.

The company should consider the impacts of either a change in legislation, or change in government.

(ii) The cashflow approach will allow for the complexity of the product i.e. multiple lives insured and multiple projected decrements on the same policy. In particular it will also allow the company to investigate the sensitivity to profit both to the variations in experience (particularly mortality) and the variations in numbers of average children insured.

The cashflow approach allows the measurement of the expected return that the providers of capital will receive. A cashflow approach will allow for the projection of both statutory reserves and capital requirements. It will also facilitate allowance for reviewable premiums.

The company will wish to project future layers of new business and a cashflow approach will be able to take account of projected layers of new business and can be easily incorporated into a model of the business as a whole.

The method can allow more easily for lapses, which are likely given the low level of income of the target market.

The company may wish to allow for stochastic decrements or decrements that may vary over time. It is unlikely that stochastic investment returns will be required since this is a protection policy. However, mortality could be projected stochastically and similarly lapses which will impact per policy expenses.

The method allows the modelling of interdependencies between variables and the link between the variables and economic conditions.

The company will need to model projected birth rates since newborns are automatically insured. This may also need to be varied stochastically as it is a key assumption and may also vary with factors such as the economy.

The risk discount rate can take account of the term structure of interest rates.

Tax and reinsurance will be easier to allow for.

(iii) The company has no previous experience on which to base the model point data and needs to use risk factors to determine model points. The company is therefore likely to discuss this with the government and in particular the likely spread of number of children to be covered.

Could use grouping by age of child, sex of child, by region or by parental ages. Need to allow for any rating applied via underwriting, likely volumes of sale and even expected birth rates.

The company may need to investigate how the mortality rates vary by age profile. For example it may find that infant mortality rates are higher than for older children. Funeral costs might also vary by age.

It may wish to take this into account in the pricing and so model points will need to allow for all risk factors.

Some of the risk factors (e.g. age) may be banded.

Note that since there is just one premium for all policies, irrespective of the number of children covered, the premium rate will need to be set across all model points and averaged out.

There were many marks on offer for part (i); however many candidates did not include enough detail in their descriptions to be appropriate to the high number of available marks. Listing the factors to be considered(e.g. cross-subsidies) was not enough to score significant marks. Better candidates related each factor to the product e.g. cross-subsidies between smaller and larger families. Few candidates seemed to use the information provided about the negotiations with and endorsement by the government.

Part (ii) was generally well answered, with well-prepared candidates gaining good marks by considering a variety of points.

In contrast part (iii) was not so well answered with candidates generally not including enough specific detail in their answers that related to the given situation (e.g. not recognising that the company has no data itself on which to base the model points).

END OF EXAMINERS' REPORT