

INSTITUTE AND FACULTY OF ACTUARIES

EXAMINERS' REPORT

September 2012 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.

D C Bowie
Chairman of the Board of Examiners

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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 September 2012 paper

As with previous papers, questions that focussed on knowledge of the Core Reading were generally well answered. Questions 6 (ii) and 6 (iii), were, however, often poorly answered. Whilst the report below gives quite a detailed solution, many candidates were unable to cover a wide enough range of valid points. Similarly, answers to questions that required candidates to think more widely, such as 3 (ii), did not show a sufficiently comprehensive understanding. Candidates should use Examiners' Reports to practice applying their knowledge to the situations set.

- 1** Solvency projections allow a life insurance company to assess its ability to withstand future changes, whether they be economic or company initiated for example assessing the impact of management decisions.

They allow the company to assess its future solvency position and its potential future needs for capital injections and to assess the probability of insolvency.

They also allow the company to determine the profile of its liabilities in terms of type, amount and duration.

The company may perform the solvency projections on either a regulatory or realistic basis.

Supervisory calculations often only look at the risks currently run but projections will show how risks change over time. This is especially important where risks increase over time as taking measures to control the risk at its current level would then not be sufficient in future.

Projections can also be used to assess how sensitive a company is to particular risks.

Solvency projections are also useful in assessing the amount of new business that the company can afford to write and the additional risks this runs. Also they may be used to assess the impact from changing product mix as a result of its new business strategy.

By projecting the solvency position on a stochastic economic basis a company can verify whether its current investment strategy is appropriate and assess the level of additional freedom it has. Solvency projection can help with the selection of an appropriate matching investment strategy.

Solvency projections can be used in determining the most appropriate bonus level and type to declare for with profits policies. Solvency projections will be vital if a company is considering the closure of a with profits fund. They will produce a run-off profile for the remaining liabilities and hence help establish the most appropriate course of action.

Once a risk profile has been determined, possible risk management measures can be tested through solvency projections to ensure they are effective and add value to the company, for example, a change to the company's reinsurance strategy.

In some countries, there may be a regulatory requirement to perform projections of future solvency.

Candidates did not answer this question as well as would have been expected. The most common problem was that students provided superficial answers or failed to distinguish between current solvency and projecting solvency. A number of candidates described how solvency projections would be performed which is not the "role" of solvency projections and hence not what was required.

- 2** (i) The embedded value is the present value of the future shareholder profit stream from the company's existing business together with the value of any net assets separately attributable to shareholders.

- (ii) (a) Increasing the best estimate assumption on term assurances means that the company will expect to experience more deaths and by implication higher claim payments than previously anticipated.

Higher claim payments will result in lower profits emerging into the future, when compared against the previous realistic mortality assumption.

Lower future profits will mean that the present value of future profits element of the embedded value is reduced.

There will be no impact on the net asset value element of the embedded value.

So overall, the embedded value of the company will reduce as a result of increasing the mortality realistic assumption.

- (b) Increasing the reserving assumption on the term assurances will result in an immediate increase in the level of reserves held, which in turn will reduce the net asset value of the company.

As the reserving assumptions have been increased, but the realistic assumptions have not been, the margin between the two sets of assumptions has increased.

This increase in the mortality margin will be released in each future time period, increasing the level of profit and increasing the present value of future profits element of the embedded value.

The overall impact is that the net asset value decrease is offset by an increase in the present value of future profits.

If the discount rate used in the embedded value calculation is higher than the assumed rate of investment return, as is likely, then the impact of discounting on the future releases of profit means that the embedded value would reduce as a result of increasing just the reserving mortality assumption.

If the discount rate is the same as the assumed rate of investment return, then there would be no change to the embedded value.

- (c) Overall, the impact on the embedded value is likely to be a reduction, and may be similar to that under (a) combined with (b).

If both realistic and reserving assumptions change by the same amount, then the net assets reduce immediately due to the increase in term assurance reserves and the PVFP remains unchanged.

The impact on the present value of future profits will depend upon how the margin between the reserving and realistic mortality assumptions changes.

If the margin increases then the present value of future profits will increase. For example, this could occur if the reserving mortality assumption was to be set using a 10% margin above the realistic assumption.

However, overall it is likely that the margin between the two sets of assumptions will remain broadly the same or that any difference will be relatively small. The present value of future profits is therefore likely to remain broadly unchanged.

Part (i) is a standard bookwork definition, which most candidates managed to answer well. In part (ii), the first two parts were generally answered well, the most common problem being that candidates failed to provide enough detail for the marks on offer. Some candidates failed to consider the impact on the net assets and the present value of future profits despite being able to provide the definition in part (i). The final part of part (ii) was not so well answered as most candidates failed to appreciate that the relationship between the reserving and realistic assumptions was important and the two sets of assumptions may not be increased by the same amount.

- 3** (i) For setting terminal bonus, the company would be interested in policies due to mature in the coming period.

It would group them according to similar characteristics, for example, policies of the same term.

The combined asset share for the group at the maturity date would represent an equitable payout for that group. This could be determined using the current total asset share for the policies in that group rolled up (using projection assumptions) for the short period to the average maturity date.

By comparing the combined asset share to the combined guaranteed benefits (original sum assured plus accumulated reversionary bonuses) it is possible to determine an appropriate average terminal bonus rate, expressed as a percentage of either sum assured or sum assured plus bonuses to date.

This would need to be compared to what might reasonably be expected by customers.

In particular, the company would need to consider any adjustment required in order to smooth benefits. This could be done either directly to the terminal bonus rates, or through smoothing the asset share, or by adjusting the asset share by smoothing the investment returns used. The company may decide to

adjust the terminal bonus rates further to avoid any potential significant discontinuity in the rates (e.g. between rates applicable to similar terms).

The company would need to consider the terms and conditions that may impact the decision, for example, it is likely that terminal bonus cannot be negative.

- (ii) The impact will depend on the actual returns achieved by the fund. This will be different to the overall equity market change because the fund is unlikely to have been invested fully in equities, though consideration should be given to whether other assets held in the fund are correlated to equities. The company may also have had an effective hedging strategy in place. However, if the fund has experienced falls then the asset shares backing the endowment policies will have fallen.

Expert opinion should be sought on whether the fall is temporary or a correction previously accounted for. The company will thus need to consider the current level of payouts relative to the revised level of asset shares. It maybe that, at the recent declaration, payouts were below asset share for smoothing reasons and so now payouts may be back in line with the revised asset shares. So no action on terminal bonus rates need be taken in that situation.

However, if payouts are now above asset share, the company may consider reducing terminal bonus rates, unless they are already zero and so cannot be reduced.

If the company declares separate final bonus rates that apply on surrender, the company might act more quickly to reduce these rates in order to avoid selection against the fund.

Any reduction will be subject to:

- Disclosures to customers
- Ensuring that it does not breach their reasonable expectations or other regulatory restrictions
- The smoothing policy of the company, which will restrict the speed or magnitude of changes in payouts.
- The size of the free assets, if large, the company may be relaxed about the speed of any change.

In particular, the company needs to consider how quickly it can change its terminal bonus rates. Changing them immediately may contravene the contract and so the company would have to wait until the next scheduled terminal bonus announcement date and reconsider the position then, or it may have allowed itself complete flexibility regarding terminal bonus declarations.

There are also systems implications, which will mean there will be some delay before new rates can be implemented.

There will also be a need to announce the new terminal bonus rates to policyholders and distributors.

The impact on shareholder transfers should be considered as changing bonus rates will affect this.

The materiality of the product to the company should also be considered.

Many candidates appeared to struggle with this question. In part (i), despite the instruction in the paper for candidates not to provide details on how to calculate an asset share, some candidates still did. Often there was insufficient detail given in answers, taking into account the number of available marks. Candidates generally scored better on part (i) than part (ii). In part (ii), some candidates strayed away from thinking about the impact on terminal bonus rates as was asked for in the question.

- 4** (i) The model would need to allow for regular premiums rather than just single premiums at the start. It may also need to allow for premiums with different premium frequency, for example, monthly, quarterly, annually. The premium amounts may even be variable or flexible.

Modelling terms of more than 10 years, as endowments are likely to have terms of 20–30 years.

Allowing for conversion to paid-up status based on specified assumptions.

The payment of renewal commission.

Modelling an annual management charge, which may change in the future.

Modelling a minimum of the unit fund and the guaranteed sum assured at maturity and death. Therefore will need to consider moving to a stochastic model where the key stochastic variables will be investment returns.

There may be other dynamic elements introduced to the new model such as the reserving basis, or the charges could be modelled as varying according to economic conditions. Policyholder actions could be modelled dynamically, such as lower lapses near maturity if it looks likely that the maturity guarantee will bite.

Model point generation will need to be restructured to accommodate the above points and possible differences in target market.

May need to model duration dependent surrender rates given the change to the surrender penalty.

- (ii) Initial price: how much does it cost to purchase and implement the new model versus amending the existing model.

Resources: how much effort would be involved in implementing the new model versus amending the existing model, and whether sufficient resources and correctly skilled resources, would be available.

Time: how long will each option take to implement and when will the model first be needed and whether the existing bond product could be added to the new model easily.

On-going costs: cost of maintaining two different systems, for example lease costs, cost of training up team on new system, ongoing support from the supplying company.

Knowledge: existing team will know the current model and will need to be trained on the new system, or a new team created.

Complexity: how simple the new model is to develop, maintain and run.

Flexibility: how well can the new model cope with changes to product features. The new model may be able to perform stochastic calculations.

Data: how easily can the new model link to the data inputs, for example administration system links.

Speed of running: may prefer the model with quickest run time.

Strategy: long-term plans for the company in terms of products and systems.

The reputation of the selling company should be considered and any impact on the company from this.

Risks: different risks are run with each approach; development risk if keeping the existing model whereas sourcing a new model introduces counterparty risk.

This question was reasonably well answered overall, with candidates finding part (i) easier than part (ii). In part (i), marks were missed by not expanding upon the information provided in the question. For example, making a point related to regular premiums but then not going further by including different premium frequencies, flexible premiums and paid-up options. In part (ii), most candidates mentioned the cost and resourcing impact of both options, but many were less able to think from a practical perspective in order to provide answers covering the wider points.

- 5** (i) A company would analyse withdrawal experience by:
- Type of contract
 - Duration in force
 - Sales method/business source/broker
 - Target market/territory
 - Premium size/benefit size
 - Premium frequency

- Premium payment method
- Original contract term
- Sex
- Age
- Type of withdrawal, e.g. income

- (ii) The calculations involved in the experience analysis should be checked to validate they are correct. Checks should be performed on the data used, for example, spot checks on anomaly values.

It should be ensured that deaths and maturities are being excluded and those policies that are being made paid-up but are not withdrawing are also being identified separately.

Experience should be analysed by the factors in part (i), i.e. perform a more in depth analysis.

Experience was higher than expected but it should be checked what the expectations were. Expectations could have been based on the current valuation and/or pricing assumptions or on the previous year's experience, and so the experience should be checked against each of these.

Any comparison should be done at an appropriate level in regard to the sub-groups, e.g. product and duration in force groupings. If the company is not comparing like with like, this could be causing the difference.

By splitting the analysis by the factors above, it could be determined whether it is only a certain product or a certain sub-group of customers which have caused the higher withdrawal experience.

If the analysis is verified as correct, then investigations should be done into the possible cause of the higher withdrawals, for example, a certain IFA may be moving customers.

Examples of other possible causes include:

- Changes in legislation
- Competitor premium rate / charges changes
- Changes to premium rates / charges for this company
- Economic changes
- Poor customer service
- Bad publicity for the company

There may have been a large number of contracts sold in one particular year that are now reaching a duration which normally experiences withdrawal spikes, for example, the end of a surrender penalty period, and this was not sufficiently allowed for in the expectations.

It should similarly be checked whether any guarantees or options are attached to a product that could cause a spike in withdrawals at a certain contract term.

Once the cause is determined it should be considered whether this experience should result in a change to valuation and/or pricing assumptions. This will be strongly influenced by the cause of the withdrawals and in particular, since assumptions should be a reflection of *future* experience the company needs to consider whether the higher level of withdrawals is expected to continue into the future.

If the cause is considered to be a one-off, then it is unlikely that the company will make changes to the future experience assumptions. If the cause cannot be determined then it is also unlikely that the company will want to make large changes to assumptions.

If the company discloses an analysis of embedded value, for example, it would be hard to explain to analysts the reason for assumption changes without data to back this up.

Similarly, if withdrawal assumptions are used for reserving purposes, then the company needs to avoid making arbitrary changes to the basis.

Further data may be required to make this decision, such as industry data or that of competitors.

Past practice for the company should also be examined as should any documentation around assumption setting. There may be preset limits which trigger assumption changes.

If the investigations flag up a problem area, for example product design, then action should be taken to rectify this.

Consideration should be given to performing more regular withdrawal analysis in future.

Part (i) was a standard Core Reading list question and most candidates were able to provide sufficient points to score well. In part (ii), some candidates still discussed ways in which the withdrawal experience could be managed despite being instructed not to do so. The majority of answers included reasons why experience could be different to that expected, which picked up marks. Most candidates were able to include checking the data and calculations in their solutions.

- 6** (i) The formula required is a mixture of a retrospective and prospective formula.

The retrospective element is:

$$D_x / D_{x+t} (P \times 0.95 \times \ddot{a}_{x:t} - S \times A_{x:t}^1 - I - e \times \ddot{a}_{x:t} - f \times A_{x:t}^1)$$

The prospective element of the formula is:

$$- 0.05 \times P \times \ddot{a}'_{x+t}$$

And also need:

$$- C$$

Where:

P = annual premium

S = sum assured

I = actual initial expenses

e = actual renewal expenses

f = death claim expenses

C = cost of surrender

$D_x / D_{x+t}, \dots, \ddot{a}_{x:t}$ and $A_{x:t}^1$ are based on actual mortality and investment return experience.

\ddot{a}'_{x+t} is based on best estimate future mortality and investment return assumptions.

- (ii) The policy has been in-force for three years and paid three premiums
 $= 800 \times 3 = 2,400$.

5% of this (120) is taken as profit and therefore needs to be deducted from this amount.

95 is taken as an initial expense

75 is taken for renewal expenses

10 is taken as surrender expenses

Investment earnings over the three year period will offset these deductions to some extent. The actual investment return earned has been 4% per annum over the three year period, which is roughly equal to a total return of 8% (the average in force period for premiums paid = 2 years, since they are paid annually in advance), which is approximately 100.

The two main reasons for the surrender value being only around 50% of premiums paid are the deduction of future profits and the provision of death benefit cover:

The value of future profits (5% of future premiums) is also deducted from the surrender value. This is a material amount due to there being a long outstanding remaining term of the policy (from age 53 to expected death). Allowing for expectation of life and discounting, the multiplier is 16.524 years. The value of future profits (where $x + t = 53$ and $P = 800$) deducted from the surrender value payable is

$$0.05 \times P \times \ddot{a}'_{x+t} = 16.524 \times 800 \times .05 = 661.$$

The policy has also provided the policyholder with death cover over the three elapsed years, and the cost of this is also deducted from the surrender value.

This is a material amount due to the high sum assured benefit payable on death. The mortality rate at 50 is 0.0035, so the approximate cost of death cover over the three years would be $0.0035 \times 3 \times 50,000 = 525$.

Therefore, taking into account all of the above elements, the surrender value should be approximately:

$$800 \times 3 - 120 - 95 - 75 - 10 + 100 - 660 - 525 = 1,015.$$

Although not equal to the quoted figure of 1,200 this is sufficiently close to demonstrate the reasonableness of the figure.

- (iii) If the experience had been as expected in the pricing basis, then it would be expected that the asset share would run into the sum assured as the policyholder got older. The deduction of the future 5% of premiums would reduce this figure, but this is unlikely to cause the surrender value to become negative as the policyholder is now 85 and the value of future premiums would not be significant.

The main reason for the negative surrender value is the actual experience having been worse than expected.

Mortality has been as expected, so this is not a contributory factor.

Initial expenses are lower than expected and so this is **not** a contributory factor.

Renewal expenses have been 5 per annum more than expected, and over 35 years this will have accumulated to around $35 \times 5 \times 1.04^{17.5} = 350$.

Interest has been 4% per annum as opposed to 6% per annum assumed in pricing. This will have had a significant impact on the surrender value. At a high level assuming 50% of the premium is left after expenses and life cover, the impact could be $400 \times .95 \times 35 \times (1.06^{17.5} - 1.04^{17.5}) = 10,000$.

Death claim and surrender expenses were not priced for and so this would have contributed towards the negative surrender value.

It is likely that interest rates have had the biggest impact.

- (iv) The calculation cannot exceed earned asset shares, in aggregate, over a reasonable time period, and so in this respect it meets this principle.

On early surrender, the policyholder is getting back only a fairly low proportion of the premiums paid (e.g. 50% at three years). This may not meet policyholder expectations and so the principle.

As identified above, a significant part of the reduction in value would be due to the deduction of future profits. This also may not be consistent with policyholder expectations and so the principle.

There is no data to check how the surrender values compare to those offered by competitors.

At 35 years (and probably several years before that), the surrender value would need to be set to zero as the calculation results in a negative value. This does not tend to the sum assured as the policyholder gets older and therefore does not meet PRE.

The surrender value is not subject to frequent change, unless dictated by financial conditions and so meets this principle.

The approach appears to be complicated, particularly since volatile historic experience either needs to be built into the calculation, or it needs to be smoothed – therefore does not meet this principle.

It is possible to document this approach and so meets this principle.

The principle of no duration discontinuities will not be met if historic movements are not smooth.

This was the least well answered question on the paper. Most candidates were able to gain marks on part (i), with most marks being lost by lack of accuracy in providing the formula.

In part (ii), many candidates simply calculated the surrender value from the formula, which was not what was requested. The question asked for a reasonableness check, so a more high level calculation with explanation was required – and some candidates did make a good attempt at this. Some credit was given for calculating the surrender value where calculated correctly. However, the skills being tested were the ability to identify the key elements of the calculation and use them to “demonstrate the reasonableness” of the figure. Just inputting the numbers into the formula does not demonstrate such skills, and also may have been unnecessarily time-consuming.

Part (iii) was also generally not well answered with most candidates failing to score very highly. Those candidates who were able to pick up some marks noticed the worse experience for both renewal expenses and interest.

Part (iv) was reasonably well answered, the most common reason for missing out on marks being not directly answering the question asked and just providing a list of the principles for determining surrender values.

- 7** (i) The company will want to obtain evidence about the health of the applicant to assess whether they attain the company's required standard of health.

If they do not attain the required standard then an assessment of their state of health relative to that standard will be made.

The company will need to obtain medical evidence from the following sources:

- Questions on the proposal form completed by the applicant
- Reports from the medical doctors that the applicant has consulted
- A medical examination carried out on the applicant by a doctor, nurse, paramedic or pharmacist
- Specialist medical tests on the applicant.

The level of medical evidence required will normally increase for higher levels of benefit and higher ages.

Other factors that can affect mortality risk will be investigated:

- Family medical history
- Smoker status
- Occupation of applicant
- Country of residence
- Possibly also socio-economic factors.

Underwriters will interpret the evidence by making use of:

- Doctors specifically employed by the life insurance company
- Underwriting manuals prepared by major reinsurance companies.

Basic underwriting may be done using specialist underwriting software. For more complex underwriting then experienced professional underwriters will be used.

Applicants who reach the required state of health will be offered standard terms. Other applicants may be:

- Declined, where the company will not accept them on any terms
- Deferred for a temporary period of time.
- Offered special terms
- Sent for further medical tests.

Special terms that could be offered can be specified as:

- An additional premium commensurate with the extra risk
- An exclusion clause which would exclude payment of claims that arise due to a specified cause or causes.
- A reduced benefit level.

- (ii) Reducing underwriting will reduce underwriting costs and also speed up the application process, which may improve attractiveness of product to distribution channels and may increase volumes sold.

Underwriting may not be a barrier to sales for some customers and so volumes would not be affected for these cases.

Profit may therefore increase but only if the reduced underwriting costs and impact of higher potential volumes outweigh the potential higher claim costs.

If the company has reinsurance then it would need to consult with its reinsurers as the terms offered by the reinsurer are likely to require a certain level of underwriting. If underwriting is reduced then reinsurance terms would be changed and premiums are likely to increase. Alternatively, the reinsurer may refuse to continue to cover the business.

The company needs to consider the level of underwriting used by peer companies. If it moved out of line with their practices, then this may expose the company to increased anti-selection, especially if the company ends up with the most relaxed underwriting in the market.

Relaxed underwriting and increased anti-selection would mean that the company is likely to end up with worse claims experience. Its “standard” premiums would therefore have to be increased, which would reduce the attractiveness of the product, and also is likely to make the anti-selection effect worse.

The company might find that it has to decline more cases based on the limited underwriting that it does under the proposal, and this could cause poor publicity.

A less detailed level of underwriting would reduce the homogenisation of the risks that the company is exposed to. This could lead to higher fluctuation of claims experience and thus the need to hold higher reserves.

It would also make product pricing more difficult, for example, parameter estimation is hard as there is no previous experience.

There may be options available on the product (for example increasing cover with no evidence of health), reducing initial medical underwriting will also increase the anti-selection risk on these options.

The company could consider reduced underwriting in line with a review of the product features, for example it could consider simplified underwriting for policies that are within certain limits (i.e. within specified age ranges, sums assured).

Need to consider any regulatory restrictions, although as this is a proposal to reduce underwriting then this is not likely to be an issue.

There may be one-off costs associated with the change, for example changing forms.

A tighter claims management process in future may be needed as a result of the changes.

Candidates generally answered this question well. Part (i) was standard bookwork and most candidates were able to score well. Despite similar questions being asked in the past, part (ii) was not as well answered with the poorer candidates generally failing to provide a wide enough variety of points to score well.

END OF EXAMINERS' REPORT