

INSTITUTE AND FACULTY OF ACTUARIES

EXAMINERS' REPORT

April 2011 examinations

Subject ST2 — Life Insurance Specialist Technical

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

July 2011

- 1** (i) The restrictions that could be placed on a life insurance company are:
- A restriction on the types of contract that a life insurance company can offer;
 - Restrictions on the premium rates, or charges that can be used for some types of contract;
 - Requirements relating to the terms and conditions of the contracts offered, for example, with regard to how paid-up policy and surrender values are to be calculated;
 - Restrictions on the channels through which life insurance may be sold or requirements as to the procedures to be followed or the information required to be given as part of the selling process;
 - Restrictions on the ability to underwrite. For example, a prohibition on the use of the results of genetic testing, or to differentiate between different classes of policyholder e.g. males and females; and
 - An indirect constraint on the amount of business that may be written. This may be through regulations regarding the minimum level of mathematical reserves that must be held, often combined with minimum requirements regarding the solvency margin of the company.

The regulatory framework within a country may limit what a company would like to do in terms of investment. There may be restrictions on:

- The types of assets that a life insurance company can invest in. For example, localising assets in a specific currency;
- The amount of any particular type of asset that can be taken into account for the purpose of demonstrating solvency. For example counterparty limits to a particular issuer or limits on the type of asset; and
- The extent to which mismatching is allowed at all.

The regulatory environment affects the liability valuation basis which can, for example, impact the choice of assets through their relationship with the investment assumptions used to value the liabilities. A particular asset distribution may allow a company to use a higher investment assumption and thereby reduce the value of liabilities.

There may be regulatory restrictions in terms of which institutions can transact life insurance type business.

- (ii) The aim of restrictions imposed by governments or regulators is usually stated to be the protection of the policyholder, and the company needs to bear this in mind when designing products.

The restrictions may also have the effect of either restricting innovation or reducing the benefits that could otherwise be given to policyholders.

Restrictions on the type of contract, the premium rates charged or on the terms and conditions offered will clearly have a direct impact on product design.

Restricting the sales channels through which the products are sold will influence the complexity of the product sold. For example, a product sold through an IFA will be more complex than a product sold through direct marketing.

Restrictions on the level of underwriting that can be used may influence the charging structure that can be used. A restriction on the level of underwriting may also result in products being offered with lower levels of death benefit.

Restrictions may change the cross-subsidies between groups of policyholders which could impact the design of the product.

If minimum levels of reserves are required, as a way of placing an indirect constraint on the amount of business that may be written, then this will influence companies into designing products that help reduce the level of reserves required. For example, companies may offer fewer guarantees if the reserving requirements are large or may offer unit-linked rather than non-profit or with-profit contracts. Companies may also consider features which improve capital efficiency.

If there are restrictions on the investments then this may influence the company to offer products with fewer investment guarantees such as guaranteed maturity values. In addition a restriction on investments may create issues with unit linked funds that can be offered.

The wider regulatory environment in terms of which institutions are allowed to transact life insurance type business is also important. In practice, life insurance companies are likely to have the monopoly of providing pure protection benefits, but not of providing savings benefits.

The other institutions offering savings contracts, for example banks, will usually be subject to different regulatory controls from life insurance companies, leading to a non-level playing field with regard to the terms on which such contracts can be offered.

Part (i) was generally well answered with better candidates giving the wide range of answers required. Part (ii) was poorly answered with many candidates not tailoring their answers to the question "how the restrictions might influence the design". Instead they answered a wider question about how restrictions may influence a company generally and hence gained little credit.

- 2** (i) The overall risk is that the charges, either within premiums or explicitly defined in the product, accruing to the company are insufficient to meet the actual expenses incurred by the company.

The risk is greater if the charges and expenses are not well matched in terms of timing and nature, and is reduced if the charges are variable.

There is parameter and model risk with the assumptions. For example, the inflation assumption is set incorrectly when pricing.

Expenses can be a secondary source of risk as a result of other business risks.

For example expense assumptions may be invalidated by:

Lower than expected investment returns, which will mean that charges linked to fund performance exacerbate the expense recovery problem;

A change in the level of withdrawals or surrenders; or

A change in the volume or mix of new business e.g. a fall in volumes will reduce the contribution to overheads and recovery of development costs.

- (ii) The company expects to reduce its sales by around 40%, if it substantially reduces the sales of this product. Hence the company will first consider how it can cut its sales expenses.

The highest sales expenses are likely to be related to commission, which will clearly not be paid if the sales are not made. Reducing the commission level will help in the reducing volumes, but it would cut costs in respect of any distributors who will continue to sell the business at the lower commission levels.

However the company is also likely to have other employee related expenses related to sales. The size of this will depend on the sales channels being used.

For example, if the company employs a direct sales force, it is likely to consider reducing the size of this direct sales force through redundancy, especially if the direct sales force is paid a basic level of salary in addition to commission.

The company will also reduce the number of sales managers and sales function, since a lower number will be required to supervise the sales force as it reduces.

The number of sales branches, particularly in certain regions, and the number of support staff for the branches is likely to be reduced.

In some countries, it may be relatively easy to reduce the number of employees with little cost to the company (e.g. in a country that has a high

turnover of staff the company can reduce employee numbers just via stopping recruitment).

However, in other countries, making staff redundant is expensive and can in the short term increase costs rather than reduce them (this may especially be the case if employees generally have a long period of service with the life insurance company and this has to be reflected by law in their redundancy payment).

Given such a significant expected fall in its sales, the company may also look to reduce the size of its sales infrastructure e.g. by closing branches or merging branches together to form larger branches etc. – hence the company will reduce its rent and utility costs related to the branches.

The company will also consider the head office costs associated with new sales for this product. For example, it should be possible to reduce the size of the new business processing department, that are responsible for setting up the new policies, and it may be possible to reduce the size of the department dealing with the ongoing administration of this product (depending on the extent to which this process is automated) or potentially underwriting department costs.

The cuts in head office department staff expenses, may also lead to lower overall fixed expenses. For example, reductions in IT related costs and admin related costs such as office space.

The company could consider outsourcing options for administration departments if this helps reduce costs.

Marketing, advertising, and development costs are likely to be reduced. Lower volumes of in-force business will directly reduce investment related expenses.

The company could attempt to invest more in the sales and marketing of other products to replace the lost business from this product in order to stop per policy costs rising.

- (iii) If the expense assumptions are not reviewed regularly then there is risk that the assumptions used are inappropriate and the company may make a loss or risk insolvency

The expense analysis on which the current assumptions are based may have been carried out a number of years ago and hence the assumptions used will not have taken into account actual volumes written, mix of business or changes to the expense base.

Notably expenses related to new business will now have to be split over a much lower number of new policy sales than previously.

Whilst new business expenses may fall (e.g. due to the closure or restructuring of some distribution channels), it may be that they do not fall immediately or they may not fall proportionately in line with the fall in new business volumes.

Hence new business expenses for the remaining lines of business may increase as a result of the significant drop in sales of one product.

In addition, overheads will now have to be split over a lower number of policies than may have been forecast in the past causing annual per policy maintenance expenses to increase.

There may be other impacts that need to be built into the expense assumptions to be used in pricing e.g. a temporary increase in expenses due to high redundancy costs. In addition the extent of any cross subsidies need to be reviewed across all products.

The assumptions for existing business and potential new business for all products will need to be reviewed given the substantial shift in the relative volumes of business that is likely.

Part (i) was reasonably well answered but many candidates failed to mention the matching of charges to expenses by nature and timing. In part (ii) whilst many candidates did cover the wider points such as outsourcing and impacts on administration departments they failed to focus on the direct impacts on the distribution channels and sales related expenses. Some candidates explained how an expense analysis should be performed, which wasn't required by the question. Only the better candidates considered the 2nd order impacts on areas such as investment expenses. In part (iii) many candidates only referred to the impact on overheads. Better candidates included the impact on new business and the need to review cross-subsidies.

- 3** (i) The company has chosen to use pricing assumptions that broadly reflect expected future experience, with any risks to the company being allowed for mainly through the 2% loading and prudence in the credit risk assumptions. The company may prefer this approach to one that includes prudential margins in each assumption, since it may feel that it is easier to apply and more transparent. The company will not wish to include large margins in the pricing basis as needs to ensure the product is competitive.

It would then not be appropriate for the same assumptions to be used also for reserving since there is no allowance for prudence in the mortality and expense pricing assumptions.

This is not appropriate since a reserving basis needs to be prudent, as set out in the Groupe Consultatif valuation principles and local regulatory principles.

In addition, the local requirements stipulate that the risk free rate of return needs to be used as a discount rate. There may be separate regulations regarding permitted pricing bases in this country.

(ii) The main possibilities are one (or a combination) of:

- cash bonus
- premium reduction
- benefit increase

The premium reduction approach would not be possible since immediate annuities are single premium products.

A cash bonus would be similar to a benefit increase if payable but would be a one-off bonus on the annuity in the current year. The cash bonus will vary from one year to the next which may create issues with policyholder expectations.

A benefit increase will apply to all future annuity payments and hence the surplus recognition is spread over the lifetime of the contract. The amount can vary in future years

Considering now how the additions to benefits may apply:

Reversionary bonuses (RB)

A regular reversionary bonus is a bonus that is declared on a regular basis, usually each year, throughout the lifetime of a contract. Once declared it becomes attached to the basic benefits. Normally this cannot be taken away but this product is different, in that the amount can vary and the RB can be reduced.

By declaring an RB the company are setting expectations for policyholders and hence the any reduction would create issues.

Special reversionary bonuses

This method is possible, but, like the regular reversionary bonus, this would create expectations as it could imply that once declared it would be payable on top of every annuity payment.

Terminal bonuses

This method is not normally appropriate for annuities

However, could make one-off payment to their estate on death, for example during a guarantee period

“Revalorisation” method

This method is commonly used in continental Europe. The profit, or surplus, to be given to a particular contract is expressed as a percentage $r\%$, say, of that contract's supervisory reserve. The benefit under the contract and the premium payable by the policyholder are then

increased by the same amount.

Clearly there is no future premium on this contract, but this method could work by simply increasing all future annuity payments by $r\%$.

Normally would increase reserves by investment profit, but the approach would need to be amended to include expense profit for this product, i.e. the $r\%$ would need to include expense surplus.

"Contribution" method

The Contribution method pays a dividend to the policyholder for the surplus that has emerged, which is determined using a standard formula.

$$\text{dividend} = (V0 + P)(i'' - i) + (q - q'')(S - V1) + [E(1 + i) - E''(1 + i'')]$$

(Candidates were not expected to produce the formula to gain marks)

The formula for determination of surplus in this case is similar to the approach for determining a dividend under the contribution method

This method could be appropriate to use with adjustments.

For example, it is possible for the formula to be adapted to take account of the impact of mortality on the remaining benefits, and for the formula to be rearranged to fit the circumstances.

General points

Normally, from the point of view of the insurer, the probability of remaining solvent is increased by reducing and delaying the distribution of any available profits.

The company may wish to consider an approach which enables them to smooth the release of surpluses/losses over time.

The approach used may depend on the country/territory of the business, and on the methodology/approach used for other products sold by the company.

- (iii) The existing product provides an annuity which is fixed and cannot increase. The new annuity provides a lower starting point which can potentially increase to provide a larger annuity than the existing product. This means that policyholders with a shorter expected lifespan may benefit from the existing product.

The new product guarantees a lower annuity and so the reserves are lower which will reduce the cost of the capital. This would increase the amount of surplus available on the new contract. The lower guarantee also increases the risk to the policyholder.

The new product is likely to have higher administration expenses, which may reduce the annuity value.

There is prudence in the pricing basis for the corporate bond default risk for the existing product. Assuming the defaults reflect the best estimate, then the new annuities will benefit from not having this prudence built into the premium basis.

On the other hand, if defaults are worse than expected this will mean the new annuity will be lower than that for the existing product in respect of this assumption.

The old basis allows for a liquidity premium in the earned rate which gives a higher initial annuity; the new basis does not. If this liquidity premium is not achieved (e.g. the company is forced to sell prior to maturity) then the new basis would give a lower level of annuity in respect of this.

The new annuity will be priced on prudent mortality and expense assumptions,

So we would expect surpluses to arise equivalent to these prudential margins if mortality and expenses are as expected.

Hence the new and old products would be on an equivalent basis. If mortality or expenses are better than expected, the new product would benefit whereas the old one does not.

If mortality or expenses are worse than expected, then the new product gives a lower annuity benefit in respect of these assumptions.

However, the new annuity cannot go below the initial annuity and so experience being worse than the reserving basis would only impact the annuity if these losses are offset by surpluses in other assumptions.

(iv) Profit criteria:

The company could use the following different methods for comparing profits:

- net present value, expressed in different ways
- internal rate of return
- discounted payback period

The net present value is the present value of the cashflows discounted at the risk discount rate.

The net present value of the new annuity is simply 2% of the premium since all future expected surpluses go to enhance payouts.

On the net present value approach, the old product is likely to produce a higher value for the same given premium, but this depends on the discount rate assumed.

This is because on a best estimate basis the prudence in the default assumptions used in pricing will fall into profits.

In addition, the reduction in the annuity for any cost of capital will also fall into surplus.

Given a choice between the future cashflows from two different investments, economic theory states that an investor should choose the one with the higher net present value.

However, this assumes that when two risky investments are compared each is discounted at a risk discount rate appropriate to its riskiness.

The riskiness of the new annuity cannot be measured by using a risk discount rate since future cash-flows on a best estimate basis are zero.

The internal rate of return is defined as the rate of return at which the discounted value of the cashflows is zero.

All other things being equal, a company should prefer a contract that has a higher internal rate of return.

However, the IRR for the new annuity is meaningless as under these projections there would be a positive cash-flow at outset and zero thereafter.

For the comparison to work it would need a negative cash-flow at outset and positives thereafter.

The discounted payback period is the policy duration at which the profits that have emerged so far have a present value of zero, i.e. it is the time it takes for the company to recover its initial investment with interest at the risk discount rate, or the period it takes to pay back the initial outlay allowing for interest.

In general the company will prefer a contract with a short discounted payback period

The discounted payback period will not usually agree with the net present value as it ignores completely all the cashflows after the discounted payback period, and in this case the new product will have a discounted payback period of zero (i.e. the initial investment is recovered at outset).

The company therefore has to consider the fact that the NPV may be higher for the existing product, but it has more risk attached as the guarantees are higher. The existing product also has a longer discounted payback period. The company will consider the capital position of the company and the appetite for risk before deciding which criterion is more suited.

This question was generally poorly answered, with many candidates failing to tailor their answers to the question asked. Part (ii) was very poorly answered with many candidates not considering forms of distribution other than benefit increase (e.g. cash bonus and premium

reduction). Many candidates did not tailor their answer to the question and instead just listed generic bookwork and gained little credit. The better candidates considered whether an approach was suitable for the product (e.g. terminal bonus not relevant). Part (iv) was largely bookwork and was well answered by those who made it this far through the question. However many candidates failed to show an application of the bookwork to compare the two products under discussion.

- 4** (i) The product is valuable if the option is “in the money” when the policy matures i.e. when interest rates are low, and provides a guaranteed income for the child once they reach 18 and if they go to university.

The income matches a potential future liability outgo and enables parents to plan potential future cash-flows.

There is less risk of the child spending the proceeds all at once on items the parents might deem as wasteful.

It may encourage the child to go to university, in line with possible government initiatives to encourage further education

- (ii) The policyholder retains the investment risk during the first 18 years of the policy and the risk that returns are lower than expected.

Risk of insolvency of the insurer.

Risk of changes in tax legislation that reduce the value of the policy.

If charges are variable during the unit-linked investment phase, risk of higher than expected charges.

Risk of low surrender payments before the option is taken, particularly early in the period compared with premiums paid. The parents' circumstances may change and result in problems paying premiums, resulting in them wanting to make the contract paid-up.

Risk that the option is “out of the money” when the policy matures and hence the option fee might not be felt to have been good value.

Risk that the student may not go to university, or may go later rather than at age 18 which would invalidate the option..

If the option is taken:

- Risk that return offered by the annuity is less than returns available if invested the money direct.
- Risk of university fees being higher than expected, eg due to high inflation, which would erode the value of the level annuity.

- Risk that the student dies whilst the annuity is in payment, so the parents would not feel that this was good value.
 - Risk that the student's situation changes and they would have needed the whole fund for a large lump sum purchase e.g. deposit for a house
- (iii) Short term investment yields at maturity are less than assumed in pricing the annuity conversion rates so the option "bites" and the company hasn't received enough income from the charges to meet the cost of the option

This risk would be exacerbated if investment returns have been high over the first 18 years so that the unit-linked fund on which the conversion rates are to be applied is higher than expected.

However the charges to meet the cost of the option are linked to fund values, so these would be higher than expected which offsets the above risk to some extent.

The company is not able to purchase assets (e.g. 5 year bonds) which match the potential future liability appropriately.

Take up of the option is greater than expected when in the money

This is exacerbated if option terms are not strict enough, e.g. don't require evidence of offer from university

Definition of "university" isn't strict enough and more institutions than expected are classed as "universities" in the future.

Reputational risk e.g. if do not pay out when policyholders expect or policies mis-sold at point of sale.

Marketing risk from policyholders who are not entitled to the annuity and so may be aggrieved by having to pay for others, or want the option themselves.

Expenses risk over the whole period from birth, since the conversion rates would have allowed for an expected level of expenses which might prove to be much higher than expected, particularly if inflation has been high

Counterparty risk if used short term corporate bonds to back the annuity once in payment or if derivatives such as swaptions are used to back the liabilities.

Volumes sold are different to those expected. Low volumes may lead to expenses not being recouped and high volumes may lead to issues with customer services.

The mortality risk is minimal and hence the company does not have a significant exposure to this risk.

- (iv) Include sufficient margins for prudence within the pricing of the option

Hedge the option with appropriate assets. For example, purchase a swaption which will enable the company to swap floating rate returns for fixed returns at the rate guaranteed if yields move into the money

Monitor experience and re-price the option for new business regularly

Reputational risk could be managed through clear initial marketing and sales literature, which may be via an appropriate sales channel.

In particular need to ensure the terms and conditions for take-up are clearly defined and limited. For example, only allowing option take up on certain universities, only allow option take-up if met certain conditions.

Charge a fixed fee rather than an increase to the annual management charge to reduce the risk of the income from the fee not being sufficient

Make the option charge variable to allow the company to react to unfavourable experience

When the annuity is in payment, invest in government bonds to reduce credit and counterparty risk

Monitor actual expenses regularly and put processes in place to control the level of expenses incurred.

Perform adequate research on the potential market before launch in order to determine a realistic estimate of expected sales volumes.

The company could consider reinsuring the option, provided there were reinsurers available to accept the risk at a cost that is reasonable.

- (v) (a) Option Pricing techniques

A guaranteed annuity rate is analogous to either a call option on bonds with an exercise price that generates the required rate of return or a swaption which gives the holder the option to swap floating rate returns at the option date for fixed rate returns sufficient to meet the guaranteed annuity option.

The option can be valued based on the market price of the similar derivative, if such a price is readily available.

- (b) Stochastic simulation

Another approach is that the company would price the option by building a stochastic model.

The model would project future investment returns, particularly short-term bond yields, stochastically together with assumptions about the take-up rate of the option which would take account of expected policyholder behaviour and whether the guarantee is “in the money” at maturity

The price of the option would be determined by considering the average present value of a number of simulations.

The charge used to recover the price of the option would also need to be included in the stochastic projection, particularly since it is to be expressed as a percentage of the fund.

A margin is likely to be added to the “cost” of the option.

- (c) Alternatively the company may use a closed-form solution (e.g. Black Scholes) to value the option.
- (vi) This option is likely to be popular with policyholders who like the certainty of knowing that paying a regular premium would guarantee university fees being met.

It may therefore increase sales of the product and hence increase profits to the company.

However, the company should consider whether the option would in fact give enough additional sales to offset the development costs and risks arising

The additional premium required for the guarantee may result in the product being too expensive and demand very low. However, accumulating premiums may encourage continued payment which can improve persistency experience.

There is a large risk that the fees would increase by more than the life insurance company expects.
and the shareholders would have to meet any shortfall if the pricing of the option was insufficient.

This exposes the company to even more investment risk over the first 18 years of the policy since the value of the policy at maturity will be key.

The company could mitigate this risk by restricting the fund choice available to policyholders.

However, investment in lower risk (fixed interest) funds can cause problems with the annuity rate conversion option, since their value will be higher when the option bites and so the additional cost to the company is even higher since the conversion rate is applied to a higher fund.

The company could pre-negotiate fee deals with certain universities.

The proposed feature also introduces additional administration burden, e.g. are the payments made to the university or to the student; if the former then this increases the number of transactions needed; if the latter then would need to check the amounts carefully to avoid fraud.

Further cost from needing to include in the systems a calculation that accumulates the amounts paid in order to check whether the total has been triggered.

The total may be seen as being arbitrary; potential reputational problems if fees are denied to someone who fell a little short e.g. due to missed premiums during economic recession.

The terms and conditions should be clearly defined. For example stating clearly what university fees cover, how long paid for etc

There is a risk of anti-selection from people whose children are attending universities with high fees. For example, payment of late top ups in order to get the guarantee.

The company would need to consider whether competitors offer similar products and if so what their terms are.

This question was relatively well answered. Where candidates failed to understand the design of the product and hence did not make sensible comments e.g. by indicating that the investment risk during the first 18 years of the original product, was with the company not the policyholder. In part (v) many candidates focused on the European and North American style approach to put options rather than considering the approach for pricing the product. Part (vi) was answered reasonably well with better candidates gaining points for thinking about the wider aspects.

- 5** (i) Investment should maximise the overall return on the assets. In order to minimise risk, the company should select investments that are appropriate to the nature, term and currency of the liabilities. The company may depart from the above depending on the level of free assets.

Or

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

Candidates were given credit for either solution.

(ii) Taking each of the liabilities in turn

Level annuities:

The liability is guaranteed in money terms and can be very long term. There is a requirement for a regular income from assets to pay the annuity outgo

Fixed interest securities are likely to be the best match with a mix of government bonds and corporate bonds.

Corporate bonds give higher yields (but with higher default risk), which may be important if annuity pricing is competitive or if government bonds are in short supply.

The company should aim to match cashflows by term however this may be difficult as there may not be bonds available of sufficiently long term.

Index-linked annuities:

The liability is guaranteed in terms of prices index, will be long term, and will require a real return from assets to pay annuity outgo.

Ideally the assets would be linked to the same index as the liability.

Likely to match by index-linked securities if available, otherwise a basket of fixed interest assets and/or equities/property.

Term assurance liability is guaranteed in money terms, and is likely to be matched by cash and fixed interest of appropriate term

Expenses - for all the above products expenses may be matched by index-linked bonds.

Unit-linked:

The unit liabilities should be matched by unit-linked funds directly.

Non-unit liabilities are held in respect of expenses & mortality risk. In practice it will be difficult to match exactly, but could be matched by fixed interest/cash/index linked or real assets.

Solvency Requirement is likely to match with low risk investments e.g. cash and/or fixed interest securities.

Free Assets can be invested in real assets, e.g. equities, but extent will depend on level of mismatching elsewhere and will want to maximise overall return

General points:

- should also aim to hold assets in the same currency as the underlying liabilities,
- need cash for liquidity purposes.

(iii) Asset mix

- there is a high level of mismatch (of 5,000, 10% of liabilities) on unit-linked liabilities
- the higher the mismatch, the higher the risk of losses to the company so it may need to be reduced – particularly if free assets fall
- total fixed interest is more than enough to cover “guaranteed” liabilities so also would appear that this could be matching some of the linked funds
- index-linked bonds of 7,000 held to match indexed annuities and non-unit reserves and likely some of term/level annuity liabilities relating to expenses.
- Level of index-linked bonds perhaps looks low compared to liabilities, but there may not be sufficient index-linked bonds in market.
- Mix of corporate and government bonds may be satisfactory, although credit risk on corporate bonds may mean the default risk is too high, depending on the credit ratings of these bonds.

Equities with total holdings of 15,000, appear to be matching the free surplus and some of the unit-linked liabilities.

There is a relatively high level of overseas equities. Difficult to say if this is appropriate, but need to assess currency of mismatched linked liabilities

General comments

- There is a reasonable free surplus which gives the company an opportunity to mis-match to some extent to seek higher potential returns.
- This may, for example, be the reason why the company has invested in overseas equities.
- There is a high proportion of cash which can be good for liquidity. However too much cash can limit potential for high investment returns.

Credit was given for any sensible numerical examples and comments which indicated that a candidate had analysed both the assets and liabilities of the company.

- (iv) Use model of in-force business, using model points and a model investment portfolio based on company's proposed (or current) investment strategy

Liabilities and assets are projected forward using expected future experience for assumptions, and test variations on these best estimate assumptions.

For liabilities use current basis and project forward to end of each year on supervisory basis

Need to make assumptions dynamic and linked to assumptions used to project assets

Project all assets forward using assumptions for future investment return

For assets a stochastic investment model can be incorporated to project future investment income and capital gains/losses, and could also use stochastic inflation rate models to project future expenses

Look at statutory solvency position at end of each year including a projection of solvency requirement.

Will need to identify what "comfortable" level of solvency is, which will depend on regulatory requirements, nature of business and the level of cover over solvency margin provided by competitors.

May also take into account future new business growth plans and hence future new business strain

Results will give a statistical distribution of amounts available to meet solvency requirement, and hence calculate probability of future insolvency (probability of ruin). This should be compared to the expected level chosen at outset.

Repeat the process for different investment strategies.

May want to extend process such that it includes the effect of investment strategy on future shareholder earnings – would want to develop investment strategy that maximises future shareholder income whilst minimising probability of insolvency.

This was a relatively straightforward question, and the content has been examined many times before. In general the question was well answered. The poorer answers did not provide enough detail in part (ii), and a number of candidates surprisingly suggested that the solvency requirement would be matched by equities. Some candidates referred to with-profits, which was not required by the question. In part (iii) a number of candidates showed a lack of understanding of how unit linked contracts work, suggesting that the difference was due to actuarial funding. Candidates who made sensible comments or provided a different analysis to that shown in the solution to part (iii) were given credit. Part (iv) was generally well answered.

END OF EXAMINERS' REPORT