

ACTUARIAL SOCIETY OF INDIA

EXAMINATIONS

November 2006

ST2 - LIFE INSURANCE

Indicative Solution

Answer 1

1 a)

- ? A manufacturer is generally solvent if its balance sheet assets exceed liabilities.
- ? A life insurance company is solvent if its assets exceed its liabilities by minimum solvency margin prescribed by the Supervisory authorities. .
- ? Insurance Supervisory authorities will usually have requirements, in terms of the values a company can place on its liabilities for the purpose of demonstrating statutory solvency.
- ? Insurance Supervisory authorities will usually have requirements, in terms of the values a company can place on its assets for the purpose of demonstrating statutory solvency.

1 b)

- ? Supervisory requirements only require a determination of solvency to be made at a particular point in time.
- ? This will not assess ability of company to withstand future changes in external economic environment and experience of the company.
- ? Insurers need to assess amounts and types of capital required in future.
- ? Capital requirements are driven by nature of long term liabilities and future new business.
- ? If an insurer knew it was going to have solvency problems in one year's time, it may not have sufficient time to take appropriate action.
- ? The auditors will also want assurance that the company has, or has access to, enough capital to keep the company solvent until the next audit.

1 c)

- ? Deterministic approach using a range of assumptions with margins to test the impact of adverse future experience in various scenarios.
- ? Stochastic approach using simulations to assess the probability of adverse circumstances occurring.
- ? In either of the above, with and without new business.

1 d)

- ? Probability of ruin 1 – probability that at some time in the future the insurer would become insolvent, either on a supervisory value basis or on an expected values basis.
- ? Probability of ruin 2 – probability of running out of assets before the last contract went off the books.
- ? How determined – large number of stochastic projections undertaken and the percentage of failures noted.

[Total 8]

Answer 2**2 a)**

- ? An asset share is the retrospective accumulation of
 - o past premiums, less
 - o expenses, less
 - o tax , less
 - o cost of cover, at the
 - o actual rate of return on the assets.
- ? The accumulation could be carried out for a single contract or a group of contracts.

2 b)

- ? Commissions and expenses net of tax if relevant
 - o All expenses associated with the policy
 - o Initial and renewal commission
 - o Direct expenses plus share of overhead
 - o Tax will vary by country and also product type but asset share needs to reflect tax that company pays in respect of policy.
- ? Cost of providing all benefits
 - o Cost of insurance cover is mortality rate times amount payable on death (not mortality rate times amount at risk)
 - o Allowance for cost of options and guarantees
- ? Tax on investment income
 - o Deduct tax incurred on realizing capital appreciation plus an accrual for the deferred tax associated with unrealized capital
- ? Transfer of profit to shareholders
- ? Cost of capital to support contracts in early years
 - o New business generally results in some new business strain
 - o Cost of 'loan' provided by shareholders or other policyholders needs to be deducted
 - o Could be additions to asset shares for those policies that are providing capital.

2 c)

- ? Arise when expenses and claims incurred to date exceed premiums plus interest.
- ? Risk of policy lapsing before asset share becomes positive.
- ? Company then makes a loss.
- ? Exacerbated if company pays a positive surrender value in early years

[Total 10]

Answer 3**3 a)**

- ? Not a compulsory requirement for consumers to purchase life insurance.
- ? Propensity to purchase depends upon interaction between the natural inclination of the consumer to buy and the power of the insurer to sell.
- ? Consumers generally likely to need to be educated and informed as to the benefits of life insurance and the particular aspects of the insurance company's products.
- ? This is often best done by a sales person who receives remuneration from the sale of an insurance company's products.
- ? In the long run a life insurer will run a risk to profits if its sales effort is not aligned to selling products with useful benefits to customers.

3 b)

- ? Insurer runs risk if a policy is sold which does not meet the needs of a policyholder.
- ? Key risks are:
 - o Persistency risk – resulting in financial loss including the possibility of compensation
 - o Reputational risk
- ? Changes in intrinsic propensity of consumers to purchase particular products lead to new business risk as they can result in new business volumes or risk being different from that assumed. Presence of a sales person in the sales process mitigates this risk.

3 c)

- ? Demographic assumptions
 - o Different channels are likely to appeal to different people according to their level of financial sophistication and income.
 - o These differences will be reflected in the demographic experience of the lives taking out contracts through each channel.
- ? Underwriting
 - o Stringency may vary with channel
 - o The simpler the sales process – eg telemarketing – it is likely that the underwriting will be less stringent (to maintain low costs) and the higher the mortality experience
- ? Expenses
 - o Commission rates and other distribution costs will vary
 - o The simpler the process the lower the costs of underwriting and processing generally
- ? Withdrawal rates
 - o Likely to be effected by level of financial sophistication and so channel related.
 - o Likely to be affected by whether the policyholder initiated the sale

? Competition

- Need for competitiveness varies with channel
- Insurance intermediaries (brokers) have an obligation to their clients to recommend products / companies with the most competitive terms other factors being equal
- Bank will want to ensure products sold by its staff to be reasonably competitive so as to avoid damage to its own brand
- A company's own sales force will often not be in a competitive situation

[Total 10]

Answer 4**4 a)**

- ? In the context of life insurance, this refers to a promise that the company will pay a specified sum of money – or sums of money – at specified times if a specified condition is fulfilled. The condition can be an event such as the surrender or maturity of a contract. It can also relate to guarantees for returns to eg match an index

4 b)

- ? The maturity value of a unit linked endowment is guaranteed not to fall below a specified minimum value.
- ? The surrender values under a unit linked contract are guaranteed not to fall below specified minimum values.
- ? The proceeds of a unit linked contract are guaranteed to be convertible to a minimum level of annuity.
- ? The unit growth is guaranteed to match a particular index

4 c)

- ? Identify an appropriate stochastic model of rates of return on investments
- ? Different models may be used for different types of investment
- ? Verify assumptions underlying the model are calibrated to historic returns and reflect expected market conditions
- ? Key assumptions will be the probability distribution used to model investment return and the mean and variance
- ? Verify assumption underlying the model correspond to the company's planned investment strategy
- ? The methodology should also reflect agreed management actions in response to varying future investment conditions
- ? Generate investment scenarios for the projection period required dependent on the nature of the guarantee by combining model, model parameters and a set of randomly generated numbers
- ? Project asset values and guaranteed values required for each scenario
- ? Identify the cost under each scenario – positive in a proportion of cases, zero in others
- ? Determine the average cost across all scenarios generated.

[Total 9]

Answer 5**5 a)**

- ? Financial outcomes:
 - revenue account,
 - balance sheet,
 - solvency,
 - embedded values
- ? Decision making assistance:
 - pricing,
 - product design,
 - determining bonus rates,
 - capital requirements,
 - shareholder dividends,
 - resource allocation to subsidiaries and distribution channels,
 - reinsurance needs,
 - investment strategy
 - company/portfolio sale/purchase.
- ? Expense budgeting.

5 b)

- ? Must be valid (accurately replicate the business)
- ? Must be robust
- ? Model points must represent the business accurately
- ? Model must include all the necessary parameters
- ? Parameters must be set appropriately
- ? Results should be verifiable and communicable to intended recipients
- ? Model should not be overly complex.

5 c)

- ? A model point is a single policy that represents a group of relatively homogenous different policies
- ? When results for the model point are scaled up, they provide a similar result to the

results obtained by determining results for each individual policy

- ? They are used to reduce the run times of complex models

5 d)

- ? Real and notional cash flow from the company's perspective
- ? Real cashflow – premiums, investment income, payments to policyholders, commissions to agents, expenses, tax
- ? The regulators require reserves and solvency margins also to be held
- ? If the real cash flow is inadequate to fund the reserves and solvency margins required, the shareholders will need to contribute cash to make sure the company is adequately capitalised.
- ? At a later stage when a claim arises the reserves will be released to help pay for the benefits and the solvency margins will no longer be needed. The Company may receive a return of cash.
- ? The last two points represent notional cash and are combined with real cash to provide an overall measure of cash, and hence capital required, for profit testing purposes.

5 e)

- ? Future unknown parameter values to be consistent with market values where a corresponding market exists eg parameter values for future investment return would be based on yield curves actually seen in the market
- ? A risk free rate of return would be used irrespective of type of asset held, as any yield above that is a reward for risk taken as hence should not be capitalised.
- ? Set the results of cash flow projections to be consistent with market values where a corresponding market exists. For example the cash flows associated with an immediate annuity would be valued as the maturity proceeds of a series of zero coupon bonds or matching term.

5 f)

- ? Approach becomes highly subjective where there is not an active market in the corresponding item – eg mortality and persistency.
- ? Volatility in results as a result of market movements
- ? Efficient market theory has limitations as investor sentiment can sway market levels
- ? There is not an obvious way of dealing with tax where the tax position of a company is different to the average market position.

[Total 13]

Answer 6**6 a)**

- ? Usually stated to be the protection of policyholders.

6 b)

- ? Restricting innovation
- ? Reducing benefits that would otherwise be given to policyholders
- ? Increasing the amount of capital required
- ? Increasing the cost of products

6 c)

- ? Types of contract
- ? Premium rates and charges
- ? Terms and conditions of contract eg
 - o benefits
 - o paid-up values
 - o surrender values
- ? Distribution channels
 - o Type
 - o Commission rules
- ? Procedures to be followed or information required in the selling process eg
 - o training requirements,
 - o cancellation rights,
 - o benefit illustrations
- ? Underwriting restrictions eg
 - o Genetic testing
 - o Males v Females
- ? Indirect constraint on the amount of business that can be written eg
 - o Minimum reserves
 - o Solvency margins
- ? Investment restrictions
 - o Type of assets
 - o Amount of any particular type of asset that can be taken into account for the purpose of demonstrating solvency
 - o Extent to which mismatching is allowed at all
 - o Extent of currency matching / localisation
 - o Indirect restrictions through the relationship with investment assumptions used to value liabilities

6 d)

- ? All liabilities arising out of the contract can be met including options
- ? The valuation should be generally prudent with assumptions viewed in aggregate
- ? It should include appropriate margins for adverse deviations of relevant factors
- ? Amount of reserve for each policy should be at least as great as any surrender value guaranteed and should therefore not be negative
- ? Bonuses should be allowed for both existing and future and as no explicit allowance is made in the net premium reserve for the latter, the rate of interest used should be lower than the rate derived from the expected return on assets by an appropriate amount
- ? Future bonuses should take into account policyholder reasonable expectations
- ? Future expenses should be allowed for
- ? Valuation should take into account the nature, term and method of valuation of the corresponding assets, depending on the type of policy
- ? Method of calculating the reserves should be such as to recognize profit in an appropriate way over the duration of each policy
- ? Allowance for lapses or going paid up should be made if it increase the reserves
- ? Allowance for the possibility that the company may cease writing new business.
- ? Population mortality will be adjusted having regard to historical experience and industry tables where applicable

[Total 13]**Answer 7****7 a)**

- ? Pricing – essential to establish a policy’s fair share of the company’s costs so that the correct premium or charge can be levied.
- ? Reserving – depending on the reserving method, an assumption about future costs may need to be made– or to check that the implicit margins in the net premium method are adequate.
- ? Embedded values – assumption about future costs will need to be made.
- ? Asset shares – these are often used to determine terminal bonuses or dividends and also for assessing appropriate surrender values – historical expenses have to be apportioned between different policy types.
- ? Dividends for participating policies where the contribution method is used – expenses will need to be analyzed into policy groups so that the dividend can be properly calculated for each group.
- ? Budgeting – the actuarial and accounting areas will need to allocate costs to assist with budgeting for the coming year

- ? Investment costs may need to be directly allocated to unit funds

7b)

- ? Cost could be amortized over its useful life.
- ? Amortization amount added to ongoing computer costs.
- ? Computer usage would be split by department and then departments' costs allocated to the products.

7c)

- ? Percentage of first year premium to cover marketing / distribution type expenses – marketing sales effort increases with policy size and company emphasizes new annualized premiums in its management activities generally.
- ? Percentage of first year commission to cover marketing / distribution type expenses – commission is a proxy for the direct effort incurred in making sales.
- ? Percentage of first year premium to cover costs of processing new business – a means of spreading costs over the new business activity and implies a degree of cross subsidy from large to small policies which may be desirable in the public interest or to ensure small policies provide perceived value for money.
- ? Per policy amount to cover costs of processing new business – recognizes that with the exception of underwriting expenses, new business processing costs are likely to be the same for small and large policies.
- ? Per sum insured amount to cover underwriting costs – the underwriting effort and expenses incurred increase with policy size.
- ? Percentage of annual premium to cover ongoing maintenance type expenses - a means of spreading costs over the maintenance activity and implies a degree of cross subsidy from large to small policies which may be desirable in the public interest or to ensure small policies provide perceived value for money.
- ? Per policy amount to cover ongoing maintenance type expenses - recognizes that maintenance costs are likely to be the same for small and large policies.
- ? Per claim amount to cover costs of processing claims - recognizes that claim costs are likely to be the same for small and large policies.
- ? Where possible expenses would be based on experience for current products, adjusted for different systems etc
- ? Need to decide on contribution to overheads eg marginal cost or full allocation

7d)

- ? Company expenses might be fundamentally high.
- ? The pricing actuary might not have a meaningful allowance for per policy expenses, such as a policy fee or a size discount, in the rating structure
- ? You might have suggested percentage of premium type assumptions for expenses that do not vary with policy size. This could give rise to excessive premium rates for large policies.
- ? A substantial proportion of the company expenses might be fixed and because the company is new these are a large proportion of the total. You have, nevertheless allocated all such expenses in your expense analysis so that the expense assumptions are high.

- ? Revisit the expense assumptions and ensure that expenses that do not vary with policy size are not being expressed as a percentage of a volume measure.
- ? Revisit the expense analysis and try and identify the fixed and variable components within the expense categories.
- ? Revise the expense assumptions so that they include the marginal incidence of expenses with some contribution to the company's fixed expenses.
- ? Reconsider the allocation of fixed costs between maintenance and initial
- ? Consider the impact of potential policy increases if this is an option on the policy
- ? Make sure appropriate allowance been made for commission clawback and tax relief

7 e)

- ? Introducing a policy fee or size discount if this issue has been overlooked.
- ? Increase the allowance for risk in the profit testing if a marginal expense approach is being suggested.
- ? Change commission and clawback terms
- ? Aim for a higher minimum premium to increase average policy size
- ? Streamline or outsource processing to reduce costs

[Total 22]

Answer 8**8 a)**

- ? Select investments that are appropriate to the nature, term and currency of the liabilities
- ? Select investments so as to maximize overall return where overall return includes both income and capital gain
- ? The extent to which the appropriate investments referred to above may be departed from in order to maximize overall return will depend amongst other factors on the extent of the company's free assets.

8 b)

- ? Immediate annuities have benefits that are guaranteed in money terms
- ? Company will want to invest so as to ensure it can meet the guarantees, even if investment conditions change.
- ? This means investing in assets which produce a flow of asset proceeds to match the liability outgo.
- ? The liability outgo will be a series of cash payments decreasing over time but extending to when the final annuitant dies.
- ? Government securities will be acquired so that the proceeds will match the payments as far as possible, with little or no risk of default

- ? Recognising the fact that the cash flows will vary as future mortality varies
- ? Some annuitants may live for more than 25 years; this is a risk but Government Securities with terms greater than this are usually not readily available.

8 c)

- ? Construct a model
- ? Liability model projecting annuity payments and expenses would already have been determined as part of the initial investigations.
- ? Asset model may have been determined as part of the initial investigations, if not a stochastic model will have to be developed incorporating shares.
- ? Project liability and asset cash flows using the original investment strategy for a number of scenarios eg 1000.
- ? Value liabilities and assets each year on the supervisory basis.
- ? Consider the relationship between year by year assets and liabilities to establish a 'base case' acceptable number of 'failures'.
- ? Replace a proportion of the Government Securities with an assumed proportion of shares – no right answer as to which – experimentation will be needed.
- ? Rerun the model using the same liability cash flows and consider the new relationships between assets and liabilities.
- ? Experimentation needed to see if there is scope to increase annuity rates without increasing the number of failures.
- ? Alternatively increasing initial assets might reduce the number of failures
- ? But to the extent additional assets are needed, a charge for the additional capital needs to be incorporated into the profit testing and this might negate the increased annuity rates.
- ? There is no straightforward answer to a question of this type; it is a question of examining alternative scenarios and verifying outcomes that are with the company's comfort or risk tolerance zone.

[Total 15]**[Total 100]**