

The Institute of Actuaries of India

Subject ST2 – Life Insurance

16th May 2007

INDICATIVE SOLUTION

Introduction

The indicative solution has been written by the Examiners with the aim of helping candidates. The solutions given are only indicative. It is realized that there could be other points as valid answers and examiner have given credit for any alternative approach or interpretation which they consider to be reasonable.

Arpan Thanawala
Chairperson, Examination Committee

Q.1)**(a)** Surrender values should:

- take into account PRE
- not exceed earned asset shares, in aggregate, over a reasonable time period
- at early durations, not appear too low compared with premiums paid, taking into account any projections given at new business stage
- take account of surrender values offered by competitors
- at later durations, be consistent with projected maturity values
- not be subject to frequent change, unless dictated by financial conditions
- not be excessively complicated to calculate
- be capable of being documented clearly

(b)

- Consistency with surrender values - reduction policy term of a policy to zero is equivalent to surrendering
- Consistency with paid-up values - reduction in sum assured of a policy so that no future premiums are required is equivalent to paid-up
- Consistency with new policies - increasing the sum assured is same as keeping the original policy and purchasing an increment policy at current premium rates.
- Reserve for the policy held before the alteration should equal the prospective reserve of the altered policy plus the costs of alteration,
- Profit expected from the contract after alteration should be the same as that before, or alternatively the same as the expected amount had the policy been written originally on its altered terms.
- Any increase in benefit may be subject to additional evidence of health.
- Costs associated with an alteration should be recovered.
- Large increases in premiums or benefits should reflect terms available for new business, in particular to minimize the risk of lapse and re-entry.

[8]**Q. 2)****(a)**

- Marketing manager probably believes that the guarantees only require a modest rate of return on invested assets and would not require much change from the current investment mix;
- There may be difficulties if the market value of bonds and / or equity shares fall but he may think that the company would be able to anticipate a looming problem and change its investment mix so that it is invested largely in fixed interest instruments and possibly shorten the term of the investment portfolio.

(b)

- Company has control over the investment policy so there is conflict between investing to meet the guarantees and investing for maximum performance.
- Policyholders have invested in an investment option described as 'balanced' and the company's track record is that the fund will include a meaningful proportion of equities and other long term investments. Policyholders will reasonably expect this to continue.
- There is therefore a cost of providing the guarantee which needs to be taken into account in pricing the product.

- Such an increase in price cannot simply be imposed on existing policyholders unless this has been clearly explained in the marketing literature and policy conditions.
- (c)
 - A maturity guarantee corresponds to a European put option on the investment funds at an exercise price corresponding to the maturity guarantee.
 - A surrender value option corresponds to a similar American put option or a series of options with different exercise prices which match the guaranteed surrender values.
- (d)
 - At the date of policy issue all guarantees will normally be expected to be “out of the money”, ie they will have no intrinsic value because current market rates are more than sufficient to meet the guarantees,
 - They will have a time value which is the result of the views of the market of the present value of the likely future costs of the option.
 - Thus the market price of a suitable option produces a way of costing an option incorporated in a life insurance policy.
 - It is difficult to ensure that the whole investment fund corresponds to a single option traded in the market.
 - However, an approximation is possible by using options written on market indices for equities and bonds.
- (e)
 - Exercising the option will generate little or no additional costs for lives in good health but will generate considerable additional costs for those in poor health.
 - A charge needs to be determined for all those entitled to effect the option.
 - The total expected additional costs of an option depend on the proportion of lives who choose to exercise the option and their health status. But the charge needs to be paid by all those eligible to effect the option not just those who exercise the option.
 - Valuing a mortality option requires two extra assumptions as part of the pricing basis:
 - the probability that the option will be exercised, and
 - the expected mortality of the lives who choose to exercise the option.
 - It is difficult to obtain data to derive these assumptions.
 - An indirect approach is to assume:
 - all lives eligible to take up the option will do so,
 - the mortality experience of those who take up the option will be the Ultimate experience which corresponds to the Select experience that would have been used as a basis if underwriting had been completed as normal when the option was exercised.
 - Suitable allowance needs to be made for inflation over the initial ten year period which will drive the amount of benefit that can be effected without evidence of insurability.
 - The charges for the insurability option are unlikely to increase with high rates of inflation.
 - Depending on the design of the product, charges may actually reduce with high rates of inflation if they are linked to ‘sum at risk’ in some manner and investment values increase in a high inflation environment.

It could be necessary to generate stochastic scenarios taking into account both levels of inflation and asset performance in order to assess the amount of option charges likely to be received and the amount of benefit that can be effected at the end of the term.

- (f)
- The major risk in a reinsurance context is parameter risk – ie uncertainty in assessing the cost of the option at the time it is exercised combined with uncertainty as to the level of charges likely to be received over the initial ten year period.
 - This suggests some form of quota share arrangement where the reinsurer receives a proportion of all charges received and meets a proportion of all benefit payments.
 - Quota sharing would apply to both the initial and subsequent ten year period.
 - A reinsurer's assistance may also be required to develop the estimates of the parameters and a quota share arrangement may be an appropriate commercial response to the technical assistance provided.
 - Because the average initial sum insured is likely to be well below the normal retention limit, additional reinsurance to limit the company's exposure to claim rate fluctuations attributable to small numbers of large policies is not likely to be a major factor.
 - Similarly, because policyholders are drawn from across the country, they can be considered to be independent risks.

[16]

Q. 3)

- (a)
- Need to compete may lead the directors to take decisions which increase its risk profile beyond that which can be supported by the available resources.
 - Examples:
 - reduce premium rates or charges under new business contracts
 - offer additional guarantees and options under new business contracts
 - write new products or benefits which may not be ultimately profitable, or are inherently more risky
 - pressure to increase sales may lead to mis-selling
 - increase bonuses under existing contracts
 - increase salaries or commissions in the respective distribution channels
 - cutting costs could lead to loss of expertise or mal-administration
 - increase retention levels to retain more risk
 - on existing business with reviewable charges, either do not increase the charges, or reduce their rate of growth relative to what may have been intended originally.
 - The impact of the decisions can be compounded if greater volumes of new business result.
 - The financial strength of the new parent may allow the company to take on more risk
- (b)
- Professional guidance which give actuaries a framework of points that they need to consider in carrying out their responsibilities.
 - Guidance on the interpretation of government regulations.
 - May arise where the government does not want to be overly prescriptive in its requirements so as not unduly to restrict the actions of life insurance companies.
 - Guidance adds safeguards to the proper running of life insurers, it provides an opportunity for insurers to encourage consumers to invest in life insurance products.
 - Such products should then be lower cost and more flexible on account of enjoying an appropriate, but not undue and over-costly, regulatory regime

- Guidance may provide protection against pressure from proprietors to agree to courses of action that may not be in the best interests of policyholders.
- Protection of policyholders is a core part of an Appointed Actuary's responsibilities.
- (c) • Regular programme of advising the directors of the nature and size of the risks faced.
- Agreeing with the directors their risk appetite for the key risk categories
- Overall risk profile based on an aggregation of the underlying risks
- Allowing for correlating and diversifying effects.
- Particular attention to risks that are most material and/or the most sensitive to change.
- Nature of the risks should be explained, costed, and management strategies laid out to control the main risks.
- Model a range of long-term scenarios to show the impact on risk of variations to future experience,
- Consider a series of scenarios which might impact the company allowing for the inter-relations within the risks and management actions that may be taken, including for the fact that correlations may change in the stressed conditions
- Deterministic and stochastic modelling methods may be used as appropriate to model the nature of the risks concerned.
- Agreed risk management strategies should be well documented.
- Rules and procedures, these should then be monitored on an ongoing basis.
- In deciding whether a risk is acceptable need to take into account:
 - Capital and other resources available to the insurer
 - Cost of failing to meet the public interest need, as usually expressed in insurance supervisory legislation, for the company to avoid insolvency
 - Cost of failing to meet the requirements of any other applicable legislation
 - Consequences of a downgrading in credit rating eg adverse publicity and policyholders may be less likely to maintain or purchase policies with the insurer as well as the normal consequences of a credit rating downgrade of greater difficulty in raising additional capital in the market
- (d) • Expense control
 - Premiums and charges assume certain levels of expense and the actual levels of expenses being incurred should be monitored and compared with these amounts.
 - Comparisons should be made with expense ratios for competitors where possible because it is important to ensure that its level of costs remains competitive.
 - Expenses can be controlled by reducing the current cost base of the insurer to be within the policy loadings.
 - Commissions should be controlled by monitoring at the level of:
 - product line
 - distribution channel

- For those distribution channels where the insurer incurs the costs of acquiring business – eg quotations systems – the number of quotations produced versus the actual business acquired should also be monitored and managed.
- Data ought to be collected at the distributor level if commission levels are performance related
- Termination rates
 - Premiums and charges assume certain levels of termination rates.
 - If these are too high, initial expenses may not be recouped and future profitability will suffer.
 - The insurer can monitor termination rates by product and channel.
 - Commissions or other remuneration can be designed to encourage better persistency and/or penalise early lapses and surrenders.
 - It may be possible to identify systematic reasons for the lapses and surrenders and to invoke suitable management strategies to avoid the trend continuing.
 - The insurer can encourage good persistency by ensuring that the product sold is suitable to meet the policyholder's needs.
 - The insurer should aim to maintain or improve the quality of ongoing administration and contact with the policyholder.
- New Business Levels and Mix
 - Although high levels of sales are good, life insurance sales require capital to be committed to finance acquisition expenses and prudential margins required by the Regulator.
 - Sales also require administrative resources including specialist underwriters.
 - Insurer needs to make sure that it has sufficient capital and administrative resources to allow the writing of new business.
 - This might involve the actuary recommending that the directors withdraw from sale those products that are the most capital intensive or for which inadequate administrative resources are available.
 - When products are designed and priced, assumptions will often be made about levels of sales and the profile, such as entry age and size of business that will be sold. The insurer needs to monitor the extent of mismatch between the actual new business sold and that assumed in the original pricing of the product.
 - It will be necessary to monitor the following items, by product line and distribution channel:
 - number of contracts
 - amount of premium
 - frequency of premium
 - policy charges/loadings
 - actual expenses incurred
 - capital to finance new business.

Q. 4)

- (a)
- Benefits under participating contracts are not guaranteed and depend on actual experience.
 - The insurer has discretion as to how the experience is translated into policyholder benefits.
 - However, discretion does not imply arbitrariness and in a number of countries there is a Regulatory requirement that this discretion be exercised in accordance with consistent principles over time.
 - There may also be general law regarding Unfair Contracts.
 - Even where principles are not formalized, expectations can be created by such factors as
 - Documentation issued by the life insurance company eg sales illustrations
 - Company's actual past practice including both actions and inactions in certain situations
 - General practice in the life insurance market.
 - Where such expectations are created, they might constrain the discretion that an insurer might otherwise exercise.
- (b)
- With profit premium rates contain margins designed to generate profit which will then be distributed to policyholders.
 - The bonus earning capacity of a block of contracts is the rate of bonus that those contracts can sustain over their future lifetime, on the basis of a set of assumptions with regard to future experience.
 - The pace at which risks are borne, the profit arises and the pace at which it is distributed may or may not be the same.
 - If part of the profit is deferred to some future date before being distributed then it will increase the company's free assets in the meantime, enabling a freer investment policy .
 - Under the additions to benefit bonuses will take two forms:
 - Reversionary which are typically declared each year and once declared cannot be taken away
 - Terminal bonuses which are typically paid on death or maturity only and at rates that are determined at the time the bonuses are paid.
 - The greater the proportion of total bonus declared as terminal bonuses the greater the degree of profit deferral.
 - Reversionary bonus can be calculated in one of three ways:
 - simple – the bonus is expressed as a percentage of the basic benefit under the contract
 - compound – the bonus is expressed as a percentage of the basic benefit plus any already attaching bonuses
 - super-compound – the bonus is expressed in terms of two percentages: one applied to the basic benefit and a second applied to any already attaching bonuses. Where this method is used the second percentage is typically higher than the first.
 - Super-compound approach defers the distribution of surplus more than the

- compound approach which defers more than the simple approach.
- (c)
- Policyholder
 - Probability of insolvency reduced if profits deferred and free assets accumulated but policyholder may take solvency of a life insurer for granted
 - If deferred profits result in a less constrained investment policy, long term benefits may be enhanced
 - Deferred profits may reduce amounts payable on death in the short to medium term and this may be considered to be contrary to the prime purpose of life insurance.
 - Beyond a certain point, deferral of profit could be held to be inequitable to policyholders who, for legitimate reasons, terminate their policies prematurely.
 - Intermediary
 - Deferred profits may result in improved long term benefit illustrations but reduced short term death benefits and cash values.
 - The balance of advantage and disadvantage is dependent upon how prospective policyholders value short versus long term benefits.
 - Insurer
 - Probability of insolvency reduced if profits deferred and free assets accumulated
 - Free assets may be a source of capital to finance new business
 - Free assets may increase ability to adopt a less constrained investment policy
 - If a policy of profit deferral is introduced and held to be inconsistent with policyholder reasonable expectations, a Regulator might intervene.
 - If shareholder benefits are linked in some manner to distributions to policyholders, deferral could be to shareholders' financial disadvantage.
- (d)
- Under an accumulating with-profits policy, bonuses are added annually in relation to the premiums paid to date plus previously declared bonuses.
 - Similar to conventional with-profits contract with recurring single premiums.
 - There is an explicit relationship between each single premium paid and the addition to the benefit to which it gives rise.
 - A terminal bonus may be added when the policy becomes a claim on maturity, death or surrender.
 - The contract may specify a guaranteed minimum rate of accumulation but guarantees provided by accumulating with-profits products are likely to be less than the guarantees under conventional with-profits.
 - Can be unitized and described as a "unitised with-profits" contract.
 - Where unitised, it is similar to unit-linked.
 - The most important difference relates to the way that the company determines the price of the units.
 - There are two basic ways in which the unit part of the contract could operate.
 - The price of a unit remains constant. The company allocates additional units to each contract, usually annually at the bonus declaration.

- The company changes the price of a unit, usually on a daily basis..
- Amount payable on surrender will be the bid price of the allocated units less any surrender penalty specified in the contract.
- Company may also retain the right to apply on surrender a market value adjustment determined at the discretion of the company.
- Premiums may be payable as a single lump sum, recurring lump sums, or as regular monthly or annual amounts.
- Charging structures may be any combination of:
 - policy charge or fee (taken from either the premium or the fund)
 - percentage allocation during an initial period
 - a different percentage allocation after the initial period
 - bid-offer spread
 - charge for risk benefits
 - annual management charge.
 - Alternatively, the charges could be taken implicitly through the bonus rate, with no explicit charging structure.

[21]

Q. 5)

- (a) • The profit signature of a contract is the sequence of profits over time from inception to termination, normally presented graphically.
- The profit signature demonstrates the capital requirements and how quickly profits emerge, but it is unwieldy to use especially when comparing different products.
- (b) • Normally a single figure that summarises the relative efficiency of contracts with different profit signatures.
- It gives the level for a particular characteristic that the company is willing to accept.
- By applying a profit criterion to different contracts with different profit signatures it may be possible to say which contract makes most efficient use of a company's capital.
- (c) • Net present value
 - Discounted profit signature at the risk discount rate
 - Given a choice between the future cashflows from two different investments, an investor should choose the one with the higher net present value.
 - However it is subject to the law of diminishing returns; if it were not, then a company that could sell one policy with positive net present value could sell an unlimited number of policies and increase the value of the company without limit.
 - No point in designing a contract with a high net present value if it cannot be sold.
- Internal rate of return
 - Rate of return at which the discounted value of the cashflows is zero.
 - A company should prefer a contract that has a higher internal rate of return.
 - However, the internal rate of return does not always agree with net present value.
 - If there is more than one change of sign in the stream of profits in the profit signature, the internal rate of return will not usually be unique.
 - The net present value can be related to useful indicators of the policy's worth to the company, in terms of sales effort or market share. There is no way to do this with the internal rate of return.

- If a policy makes profits from the outset then the internal rate of return may not even exist.
- Discounted payback period
 - Discounted payback period is the policy duration at which the profits which have emerged so far have present value zero. at the company's required rate of return on capital
 - The rate of return on capital will be risk-adjusted – the more inherently riskier a products and the more volatile the profits the higher the risk margin required
 - A company with limited capital might prefer to sell contracts with as short payback periods as possible.
 - The discounted payback period will not usually agree with the net present value as it ignores all the cashflows after the discounted payback period.
- (d) ● Insurance regulations normally require life insurance companies to hold supervisory reserves in excess of realistic reserves.
- This excess reserve over the realistic reserve plus the priced margin in a portfolio will be released over time (this is the “value in force” or “VIF”).
- VIF is an economic asset, but it will not be recognised in a life insurance company's statutory balance sheet.
- Financial reinsurance allows the insurer to turn VIF into a cash equivalent asset that can be used elsewhere in the business.
- (e) ● Fin Re type 1 - Asset enhancing
 - The reinsurer gives a cedant funds now that are repaid over the next few years from the emergence of the VIF as cash.
 - This is like a contingent loan or debt, with repayment contingent on future earnings of the insurance portfolio.
 - There are extra funds in the hands of the cedant, so recognisable assets in the statutory accounts are increased.
 - However, there is no change in the accounting liabilities (if the VIF is not recognised as an asset in the statutory balance sheet of the cedant because of its contingent nature, then anything contingent on it does not have to be recognised as a debt).
- Fin Re type 2 – liability reducing
 - Reinsurer agrees to pay all the claims over and above $(100+x)\%$ of what would be expected.
 - Providing future experience is predictable the chance of losing money is low so there is only a relatively small fee.
 - Reinsurer has taken the last slice of possible claims under adverse scenarios so the cedant's liability reserves are reduced accordingly.
 - There is only a small change in the assets, so the net assets of the business increase and the statutory balance sheet appears stronger.
 - As the VIF actually emerges as cashflow, then the cedant recaptures the risks over time
- (f) ● Risk that reinsurer becomes insolvent and cannot meet claim payments as they become due.
- However cedant retains liability to the policyholder.
- Supervisory authority may require the reinsurer to “deposit back” its share of the total reserve under a reinsured contract with the cedant.
- The Supervisory authority may also regulate the reinsurer, or liaise with its overseas counterparts, to reduce the risk of reinsurer insolvency.
- It may also require prior notification of financial reinsurance contracts so it is aware of them
- (g) ● Different capital requirements
- Diversification benefits
- Different taxation

- Different assessment of risks

[18]

Q. 6)

- (a)
- The Appointed Actuary will want to ensure that his or her work is founded on valid data.
 - A general sense of professionalism may be reinforced by professional conduct requirements or even statutory obligations.
 - Consequences of a material error in the valuation could extend to
 - Compromised security to policyholders
 - Inappropriate discretionary benefits to policyholders – particularly participating policyholders
 - An unnecessary requirement for shareholders to subscribe additional capital or an underdistribution of policyholder dividends
 - Misleading disclosures in accounts or regulatory returns
 - Ripple affects to the commercial prospects of the company of a general loss of confidence by stakeholders.
 - In extremis, disciplinary action could result if the Actuary were deemed to have acted negligently
- (b)
- Data reconciliation
 - Using data similarly grouped data at successive investigations, the following check is made for each group:
 - data at previous investigation, plus
 - business come onto the books, less
 - business gone off the books, equals
 - data at current investigation
 - The above can be used to check the following items of data according to the product type concerned:
 - number of contracts
 - sum assured
 - office premium
 - number of units actually allocated sub-divided by unitised fund
 - changes in the number of units allocated arising from switches between unitised funds
 - changes in the premium payable and benefits under existing contracts.
 - The movements data should be checked against any appropriate accounting data, especially with regard to benefit payments.
 - Consistency checks
 - Average sum assured or premium should be sensible, and consistent with the figure for the previous investigation.
 - Ratio of basic sum assured to premium should be consistent with the previous investigation.
 - Unusual values or spot checks
 - Very large or zero unit values
 - Impossible dates of birth or retirement ages or start dates.
 - Examinations of distributions of data for example unusual clustering, investigation.
 - Randomly selecting a number of policies and comparing an extract of the computer held data with the information in the paper administration files.
 - Analysis of surplus
 - Analysis of surplus seeks to explain the reasons for the change in the valuation result between one valuation date to another.
 - A major discrepancy in the analysis compared to previous analyses may indicate a problem with the data.

[14]
