

Institute of Actuaries of India

Subject ST2 – Life Insurance

May 2009 Examination

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

Soln 1

(a)

- There may be a significant change in the mix of business by nature and size which may change the risk profile of the portfolio.
- The above may cause mismatch between expense allowance in the products and the actual expenses
- There may be a change in the mix of distribution channels. This could invalidate the pricing assumptions such as mortality, morbidity, persistency and expenses.
- The fact there are significant volumes may mean that the product has been mis-priced
- The office may not be able to cope in terms of additional administration resources required.
- Capital need may increase as a result of the above, both because of volumes and product mix

(b) Factors to consider:

- The underwriting process will become quicker on raising the limits. The product will become more marketable.
- The limits should not be too low when compared with the market.
- Very high limits on the other hand may lead to antiselection.
- Higher limit would reduce the number of reports required and hence would reduce cost.
- Also higher volumes of business could mean overheads are spread more improving profitability
- The pricing basis may need to be changed to be consistent with the revised limits
- More information may be requested on the application to enable more evidence to be collected without a medical
- The company would seek guidance from the reinsurer or take into consideration the underwriting terms set by the reinsurer.

Setting new limits:

- Take a sample of 1000 existing proposals with sum assured above the old limit but below the proposed limit. Compare the total extra premium charged on these cases with the amount that would have been saved because of the reduced underwriting with higher limits. If the saving is more, then the increase is worthwhile
- Allowance may need to be made for anti-selection if the company is out of line with competitors

- Arrive at the level of increase on the limits by arriving at equivalence between the two.
- If a case has been declined under the old limits and would not have been declined under the new, the likely additional claims based on the probability of death should be added to the extra premium.

[10]

Soln 2 a)

Insurance regulations often mean life insurance companies have to hold statutory reserves well in excess of the realistic reserves. This excess reserve over the realistic reserve plus the priced margin in a portfolio will be released over time (the VIF)

VIF is an economic asset, but it will not be recognized in a life insurance company's statutory balance sheet, though some accounting regimes do allow it to be recognized in the company's report and accounts.

Financial reinsurance allows the insurer to trade VIF, turning the economic asset into cash equivalent asset that can be used elsewhere in the business. This may help an insurer align its statutory balance sheet and report and accounts.

2 b) Two primary types of financial reinsurance – Asset enhancing and liability reduction

Asset Enhancing: The reinsurer gives a cedant, funds now that are repaid over the next few years only from the future emergence of the VIF as cash. This is very much like a contingent loan or debt, with repayment contingent on future earnings of the insurance portfolio.

In accounting terms, there are extra funds in the hands of the cedant, so recognizable asset in the statutory accounts are increased. However, there is no change in the accounting liabilities, although Deferred Acquisition Costs may need to be written down.

However, there should be little or no change in the realistic accounts (eg market consistent embedded value), except perhaps a change in the residual risk in the business.

Liability reducing: This is known under a lot of names, all with various tweaks and differences in the details. Names like virtual capital or time-deferred-stop-loss are often used.

The basic concept is that the reinsurer agrees to pay all the claims over and above $(100+x)\%$ of what would be expected. Providing future experience is predictable, such as mortality, the chance of losing money is low so there is only a relatively small fee.

The reinsurer has taken the last Rs.Ym of possible claims under very adverse scenarios so the cedant's liability reserves are reduced accordingly. Therefore liabilities decrease.

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.

[10]

Soln 3 a) The structure of a unit-linked is such that the company's liability is denominated partly in terms of units and partly in monetary (i.e. non-unit) terms.

- This leads to a requirement for both a unit and non-linked reserve
- Unit reserve is part of the reserve that needs to be set up in respect of its unitised contracts. The unit reserve represents its liability in terms of units under the contracts.
- *Additional credit of 1 mark may be given if candidates mention calculating a bare unit price and multiplying by the number of units etc]*
- The non-unit reserve is the amount required to ensure that the company is able to pay claims and meet its continuing expenses without recourse to further finance
- To calculate the non-unit reserve it is necessary to consider year-by-year (an at outset of the contract possibly the month-by-month) incidence of the various components of the non-unit cashflows to determine if and when a non-unit reserve is required
- The company should project forward its non-unit cashflows (eg charges, expenses, commission, benefits in excess of the unit fund) on the (prudent) reserving basis. This may need to be done on a policy-by-policy basis
- The non-unit reserve can be calculated as follows:
 - The calculation process starts with the last projection period in which the net cashflows become negative,
 - An amount is set up at the start of that period which is sufficient, allowing for projected investment return over the period, to "zeroise" the negative cashflow
 - This amount is then deducted from the net cashflow at the end of the previous time period
 - The process continues to work backwards towards the valuation date, with each negative being "zeroised" in this way
 - When the process has been completed, if the adjusted cashflow at the valuation date is negative then a non-unit reserve is set up equal to that negative amount

- If the product offers any guarantees the cost of such guarantees may need to be determined using a stochastic model
 - A comparison of the resulting reserves on a continuing premium-paying basis and paid-up basis may need to be done and a greater of the two taken as the reserve
 - Resilience tests on the unit fund would be required to determine the level of charges
 - Subject to certain conditions, it may be permissible to hold a negative non-unit reserve under a contract
- 3 b) A negative non-unit reserve can be held for a policy under which future charges are expected to be more than sufficient to meet non-unit liabilities (including expenses)
- The reserve represents a loan from other contracts which have positive non-unit reserves. The loan will be repaid by the emerging future profits from the policy for which the negative non-unit reserve is held
 - Certain constraints may be imposed by regulators on the use of negative non-unit reserves, such as:
 - The sum of the unit and non-unit reserve for a policy should not be less than any guaranteed surrender value
 - The future profits arising on the policy with the negative non-unit reserve need to emerge in time to repay the loan
 - After taking account of the future non-unit reserves, there are no future negative cashflows for the policy ie there should be no future valuation strain
 - In aggregate, the sum of all non-unit reserves should not be negative

[13]

Sol 4) The model will be adequate if it effectively assesses the (future) profitability of a life insurance contract.

- To be effective the model will need to be sufficiently realistic
Factors influencing effectiveness:
- does it produced required output? We require a stream of profit flows to be the output from the model. Output should be capable of being checked for reasonability
- timings of cashflows – should cover whole term of contract and should be of desired frequency eg monthly, yearly.
- Model must allow for all factors influencing future profit stream to be incorporated as parameters
- Values for the parameters must be appropriate to the company and for the contract in question and to current and projected economic and commercial environment
- The model points chosen (e.g. age, sum assured, policy term) must be a realistic mix of business for the contract concerned

- The model must include all items of cashflows that the contract could generate such as all possible benefit payments, expenses, taxation and investment returns and any that may arise from options e.g. where guaranteed terms for conversion or renewal are available
- Model must allow for impact of statutory reserves and any required solvency capital on the resulting profit flows.
- The model must allow sufficiently for any interactions between components of the model e.g. the assumed sum assured and reserving assumptions at any projection point in the model should be related to the projected conditions at that time
- It should be capable of assessing the expected profitability and its likely variability. This would require the model to have the facility to be used stochastically, at least for key variables, particularly where the contract provided financial guarantees. At bare minimum the model must be capable of deterministic sensitivity testing
- Where the model needs to be used stochastically, the assumed distributions for the random variables should be realistic.
- The results from the model should be capable of independent verification for reasonableness
- The model must not be overly complex so that either the results become too difficult to interpret and communicate or the model becomes too long or expensive to run

[10]

Soln 5)

The life office/shareholders

Expressing the rate of terminal bonus as a flat percentage of the attaching bonuses leads to significant inflexibility. This makes it difficult to reflect accurately differences in investment return experienced by successive generations of policyholder. It therefore implies a high degree of pooling of experience (smoothing).

As the reversionary bonus is used to distribute a substantial proportion of the total surplus arising under the policy, this implies a rapid accumulation of guarantees.

The absence of any terminal bonus on surrender may reduce the risk of financial loss from withdrawals when asset values are depressed, because of the cushion it could provide.

The new contract in contrast has a much higher bonus loading. Much of the reversionary bonus will come from premium margins.

In addition, assuming the other assumptions in the premium rates are largely unchanged, the higher bonus loading will result in a lower sum assured for a given premium.

Taken together, these two factors imply a much lower rate at which the guarantees under the contract will accrue.

The terminal bonus will become more important.

Expressing it as a variable percentage of the sum assured and attaching bonuses will provide the flexibility to reflect more accurately the actual investment returns experienced by different generations of policyholder, in line with the revised philosophy.

However, the ability to depart from the asset share by a limited amount does enable the office to retain a degree of smoothing.

By paying terminal bonus on surrender as well as on death and maturity, the excessive penalty that could otherwise have arisen on surrender is avoided.

In addition, over time, the office's free assets will be higher because of the greater proportion of terminal bonuses. This will imply greater financial strength and should be beneficial from a marketing point of view, and may eliminate the need for additional capital.

This may also result in freer investment policy (subject to limits of local regulation).

The shift to distributing surplus by terminal bonus rather than reversionary bonus will also be disadvantageous to shareholders as shareholder transfers are deferred, unless it is offset by the higher returns from the freer investment policy.

In addition, distributing bonus as TB means that shareholders get a lower percentage of surplus compared to RB because the cost of RB is determined on a prudent valuation basis.

Adding terminal bonus to surrender values leaves the office more exposed to financial losses from withdrawals immediately following a sharp fall in asset values.

The office may therefore consider introducing a more active approach to setting surrender values.

The office will have to consider whether it will be appropriate to write the new contracts in the same fund as the old contracts. The former have lower guarantees and should therefore benefit from a freer investment policy.

The policyholders

New policyholders will benefit from the higher maturity values that should result from the freer investment policy permitted by the new contract.

They will however receive a much lower sum assured, as a result of the higher bonus loading.

In addition, the total benefits under the contract will be less stable, given the different approach to terminal bonus and less smoothing resulting.

This may not appeal to those policyholders with a low appetite for risk.

The improvement in surrender values from adding terminal bonus will benefit discontinuing policyholders.

However, those policyholders reaching maturity may lose out, if previously surrender profits were redistributed to continuing policyholders.

[15]

Soln 6 a) The three main methods of distributing profits to with-profit policyholders are:

1. Addition to benefits method
2. Revalorisation method, and
3. Contribution method

6 b) The comparison is as follows:

	Addition to benefits	Revalorisation	Contribution
Equity and smoothing	Deliberate smoothing of asset share volatility over time. Sharing of mortality and expense experience is only very broadly equitable	Equitable distribution of investment profit. Mortality and expenses not usually included. Some smoothing over time achieved by valuation method.	Very equitable with regard to investment, mortality and expense surplus. Some smoothing.
Flexibility	Maximum flexibility to the life insurance company – how much bonus to give and when (now or at end)	No discretion to do anything other than apply the set formula	Considerable flexibility for total distributed; total is split by fairly fixed rules, although some judgement as to the groupings for application of the formula
Simplicity	Simple to tell	Simple both to	Complex to apply,

	policyholders what you are doing, more difficult to explain / justify ; they need to trust the industry	apply and to present to policyholders	and likewise to explain (but perhaps easier than addition to benefits as not reversionary)
Investment freedom	Can be lots, especially if conventional, use of high TB and super-compound RB	Very little, because surplus is distributed as it arises	Immediate, some surplus may be held back for terminal dividend but limited by transparency

[14]

Soln 7 a)

- An analysis should be made of the expenses incurred by the office in recent years, identifying any special costs, like installation of computer equipment.
- The expenses should be split up with those applicable for acquisition of new business, renewal, claims and investment costs.
- Expenses which cannot be straightaway apportioned, it should be done on the basis of sample study of activities, and then apportioned in relation to a suitable metric
- Investigations may be made to determine whether the expenses vary by class of policy.
- The expenses should be further sub-divided into those that can be based on sum assured, premium and per policy expenses.
- An estimate has to be made into expected future trend to the level of expenses and inflation in the future.

7 b) The two methods of allowing for the expenses are sum assured differential method and policy fee method.

a) Sum Assured Differential Method:

- The per policy expenses and other expenses related to sum assured are combined to get the initial and renewal expenses related to sum assured.
- These expenses are calculated as premium rates related to average sum assured.
- For sum assured outside this range, flat additions to deductions are determined by calculating the per policy expenses related to the various sum assured within the various ranges, allowing for proportion of new business expected to written within the ranges.

b) Policy Fee Method:

- Basic premium rates are constructed ignoring all per policy expenses.
- The initial and renewal per policy expenses are expressed as a constant addition to the amount premium under the policy. The constant addition is called the policy fee.
- A modification of this method is to calculate the premium rate for the average sum assured.

7 c)

- The investigations over a number of years will give an indication in the trend of expenses.
- Care should be taken to identify any special feature. The rate at which the expenses have changed will indicate the degree of past inflationary trends.
- Where the expenses are actually a fixed percentage of premiums, eg commission, or of the sum assured no problems arise.
- However other renewal expenses such as the cost of collecting the premiums should make full allowance for inflation.
- Consideration should be given as to what expenses are related to price inflation and which to earnings inflation which may be different
- However, they are expressed, a convenient way of allowing for inflation is to introduce a margin in the premium basis interest rate.

[14]

Soln 8)

- The premium on any product is the price payable by the customer for the benefits offered on the product, the expenses and tax incurred by the insurer in selling and administering the policy, and the profit margin of the insurer.
- It is true that policyholders surrendering the single premium policy, particularly at early durations, might compare the premium paid with regular premium policies and question reasons behind there not being a surrender value.
- The profitability of the product would take into account the profits arising on surrender. Therefore should this change then the premiums would need to be recosted to take this into account
- Consideration would also need to be given to what competitors do on their SP products]
- Offering a surrender value will increase the single premium. Is the Sales Director okay with this increase? What will be the impact of this on anticipated new business volumes – will the sales be more because of the surrender value benefit or be lower because of the higher premium? Any change in expected volumes could impact the loading for per policy expenses.
- Comparing single premium with regular premium is not correct as the following assumptions in pricing bases could be different
 - . investment return
 - . expenses
 - . lapses and mortality
 - . commission

[6]

Soln 9)

- The liability created by an investment guarantee is the excess of the guaranteed amount (e.g. guaranteed maturity value of an endowment, or the fund needed to purchase the “guaranteed annuity” at current market rates), over the cost that would have been incurred at the time in the absence of the guarantee. The policyholder will only choose to exercise the option to take up this guarantee if it is “in the money”, i.e. is financially advantageous.
- The value of these liabilities can be determined using:
 - Option-pricing techniques
 - Stochastic simulation of investment performance
- The options incorporated into life insurance contracts are analogous to options traded in the market place
- A maturity guarantee corresponds to a (European style) put option on the investment funds at the exercise price corresponding to the maturity guarantee

- A guaranteed annuity rate corresponds to a call option on the bonds that would be necessary to ensure the guarantee was met, ie at an exercise price which generated the required fixed rate of return
- Alternatively, it can be mirrored by an option to swap floating rate returns at the option date for fixed rate returns sufficient to meet the guaranteed annuity option
- It is difficult to ensure that the whole investment fund corresponds to a single option traded in the market. However, an approximation is possible using options written on market indices for equities and bonds
- At the date of policy issue all guarantees will normally be expected to be “out of money”, i.e. they will have no intrinsic value because current market rates are more than sufficient to meet the guarantees, but will have a time value which is the result of the views of many investors (“the market”) of the present value of the likely future costs of the options

- Thus the market price of a suitable option produces a way of costing an option incorporated in a life insurance policy
- It is possible that a guarantee will not be “out of money”. For example, current yields might be historically so low that a life insurance company would be happy to provide a guarantee at a future date based on a higher yield.

[8]**[Total 100 Marks]**
