

Institute of Actuaries of India

Subject ST2 – Life Insurance

September 2016 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.

Solution 1:

i)

- Under a unit-linked policy, the liability is denominated partly in terms of units and partly in monetary terms
- The unit reserve represents its liability in terms of units under the contracts
- The non-unit reserve is the amount required to ensure that company is able to pay claims that exceed the unit reserve, and meet its continuing expenses without recourse to further finance

[2]

ii)

- Non-unit reserves can be determined using discounted cashflow method
- The company should project forwards its non-unit cashflows (eg charges, expenses, benefits in excess of the unit fund) on the reserving basis.
- This may need to be performed on a policy-by-policy basis.
- The calculation process starts with the last projection period in which the net cashflow becomes negative
- An amount is set up at the start of that period which is sufficient, allowing for earned 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 the absolute value of that negative amount.

[4]

iii)

- 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 i.e. there should be no future valuation strain.
- In aggregate, the sum of all non-unit reserves should not be negative.
- This last condition might be imposed at a policy class or type of business level for additional prudence.

[2]

iv)

- Combining the unit and non-unit reserve, if the non-unit reserves are negative would reduce the total reserves to be held.

- It would enable the company to use the future profits that are expected to emerge from the products to ease the capital strain immediately. Similar to actuarial funding.
- This would enable the company to use the additional capital to develop its business, either by writing more new business or in other ways.
- Or, make riskier investments with its free capital, therefore giving higher returns to the shareholders.
- However, this may not be permissible by regulations. Usually, unit and non-unit reserves must be reported separately.
- The restriction on no negative reserves applies to non-unit reserves separately
- Unless the surrender penalties are greater than the negative non-unit reserves, this might make the total reserves lower than the minimum surrender value payable, which might not be acceptable.
- Surrender penalties should be expressed in monetary terms, not as a percentage of the unit fund, otherwise ...
- this would also leave the unit fund liabilities mis-matched with the assets held
- Causing significant investment risk for the company.

[4]

[12 Marks]

Solution 2:

i)

- The mortality risk under a term assurance policy is much greater than under an endowment assurance
- This is because premiums are small and no material reserves are built up. Hence the sum at risk is high.
- The purpose of underwriting is to charge policyholders a premium appropriate to the risk they bring to the company. Underwriting is one of the main methods of mitigating mortality risk.
- Term assurance is a commodity product and is generally sold on the basis of premium rates alone.
- Averaging the premium for standard and sub-standard lives is possible and profitable rates can be derived, but if this is not the practice in the market there is a risk of attracting bad lives who will be able to get cover cheaply and turning away standard lives who will be able to get cheaper cover elsewhere.
- The premium under the term assurance product will reflect the underwriting standards. To offer competitive rates for standard lives (who form the majority of the market), the underwriting has to be more stringent than under the endowment products.
- Reinsurance is critical under term assurance product and the sum ceded to the reinsurer(s) is expected to be high especially given the company has no prior experience in selling term assurance. The reinsurer(s) might not support the product on the current underwriting standards as the risk for them will be too high.
- It may be a regulatory requirement.

[5]

ii)

- Anti-selection risk will materially increase e.g. from policyholders in ill-health who are able to get life cover at minimal underwriting than elsewhere in the market assuming that the rest of the market retains some medical underwriting.
- Actions of distributors: salespersons may encourage anti-selection.
- There may be a greater than expected proportion of policyholders who are a high mortality risk to the company e.g. from lower socio-economic groups who are unhealthier than average policyholders. Therefore the mortality for this product may end up being higher compared to the mortality on the existing endowment products and/or higher than assumed in the pricing.
- Pricing/data risk is increased because the company will not be able to identify substandard lives and quote separate terms for them. This is also relevant to valuation (reserving) assumptions.
- There is a risk that new business mix is not as assumed in the pricing based on the market statistics for a similar product sold by other players in the market.
- Competition risk: there is a risk of losing new business sales if competitors actively target the healthier lives by offering them lower premiums which in turn will increase the expected average mortality of the remaining lives.
- Some of these risks could be addressed by either declining more lives, or by introducing more blanket policy exclusions. Both of these would adversely affect reputation risk, e.g. more declined claims.

[6]

iii)

- The company may wish to consider if its existing reinsurance arrangement (if it has one) could be expanded to cover the new product for sake of consistency and ease of administration
- However, given that the pure risk faced under the term insurance is likely to be much higher, the company would want to ensure greater protection for the new product, and therefore might need different terms
- Additionally, the reinsurer would also wish to reinsure on different terms than previously
- The company would wish to consider the support it could negotiate for the new product, e.g. help with pricing....
- ... expertise in underwriting, which would be valuable to the company since it is a new entrant in the market for this product
- The company would wish to consider its own risk appetite while deciding the reinsurance arrangement.
- A high level of protection would help protect capital against adverse fluctuation in mortality experience...
- ...but would lead to a loss of profits from the product, due to reinsurer's profit margin
- Cost of reinsurance would need to be compared against the cost of holding a mortality fluctuation reserve and / or a pricing / underwriting risk reserve.

- If a reinsurance commission and / or profit commission is negotiated, this may offset the loss of profits, and may also help the company in cashflow management.
- The company would wish to consider the level of restrictions imposed by the reinsurer as part of the reinsurance arrangement. For example, the reinsurer may restrict the level of sum insured that can be written, or the level of underwriting required etc.
- It may be regulatory requirement to set a reinsurance arrangement in place for this product.

[5]

[16 Marks]

Solution 3:

i)

- To determine the potential areas of expense overruns, the company needs to first split the expenses by acquisition, maintenance, claim and investment to check where the expense overrun arises.
- Acquisition expenses may be further split into by agency and head-office, to further determine whether it is the distribution expense which is causing the overrun or the head-office costs.
- Firstly, select an appropriate period, so that the past experience is recent enough to be a good indicator of future, and at the same time voluminous enough to be reliable and obtain the expense for this period.
- Assuming that commissions paid are as priced, commissions may be excluded from the analysis. If this is not the case and the same premiums are charged for a number of different commission scales, then mix of business might be a source of overrun.
- Also any ad-hoc expenses incurred in the past but which are unlikely to be incurred in future should be excluded.
- Allocate the expenses into categories, which may be done based on the department or function. For example, the underwriting department's cost may be 100% allocated to acquisition.
- For some of the expenses which are not directly involved in any category eg: actuarial or office rent, their allocation into categories will require some drivers, for example, using timesheets, floorspace, headcount, etc.
- While performing the expense investigation any one-time expenses such as development costs for IT / infrastructure would need to be considered separately
- For such costs a period of amortization should be decided, and a method of spreading the costs across this period should be considered.
- Past expense inflation should be factored into the calculations.
- The acquisition expense needs to be further split between distribution and head-office. The costs of the entire hierarchy structure of agency along with any incentives paid out to them needs to be included fully under distribution. The remaining acquisition expense may be split based on the split of the functions supporting distribution, some of which may be direct and other indirect.

- Maintenance expense may be fully allocated to head-office since the distribution is primarily to acquire new business.
- These costs should then be compared against the expected costs – used in pricing, embedded value etc.
- This should also be compared against the expected costs factored in business plans and budget.
- This will help in identifying which is the primary area of causing an expense gap. That specific area would then need to be further drilled down based on the main expense heads under each.
- For example, if the analysis reveal that distribution expense is causing the overrun, then the distribution costs needs to be split into the various expense heads, such as salaries under the agency hierarchy, training costs, etc.
- Each of the expense heads identified would need to be benchmarked to ascertain the costs which are high.

[11]

ii)

- High costs are often incurred on inception of the policy due to high commission levels, and high acquisition costs.
- These are usually recouped over the term of the policy through renewal premium / explicit expense charge deductions.
- If the persistency is lower than expected, then these would not be recouped.
- Further certain expenses are fixed in nature and do not vary substantially based on the business volume.
- Lower persistency would decrease the policies inforce of the company.
- This would in turn increase the per policy expenses when the fixed costs are attributed to each policy. Thereby increasing the expense gap.
- Processing of lapses and surrenders would also have costs associated with them. Low persistency would imply greater costs incurred on lapses / surrenders

[4]

iii) Measures to improve overrun through better persistency:

- Perform detailed persistency analysis to identify the reasons for low persistency
- Change the charging structure in products to encourage better persistency
- .. and / or to recoup the expenses sooner subject to competition
- Similarly, may look to change the commission structure to encourage greater persistency
- Enhance customer services experience to ensure customer loyalty, and hence persistency
- Identify the product(s) that are particularly low in persistency and consider withdrawing / revising these
- Identify the agents/ manager of agents whose business has consistently shown low persistency, and consider remedial actions

- Incentivizing sales / business maintenance staff on achieving better persistency
- Changing the sales illustrations to shift emphasis towards long term benefits
- The insurer can encourage good persistency by adopting best practices such as needs analysis, etc. if not already doing so.

Measures to improve overrun otherwise:

- Using the expense study to reduce costs in areas which have been identified as the ones primarily leading to expense overrun
- Identify the unproductive branches which sell little new business and close those. That would help save on the rentals, utilities cost, etc.
- Increase the productivity of the agency channel which would help bring down the per policy cost.
- Reassess the headcount needed, both in distribution and head-office, and scale down if needed
- Negotiating the current leases and vendor prices on better rates
- Consider selling through other channels also which have proven more cost efficient like internet.
- Consider outsourcing administration or other activities that might help reduce costs subject to any regulations
- Acquiring or merging with another insurer which would give scale and would help in bringing down the per policy expense
- Use the results of expense study to better reflect the expenses in product pricing

- Consider reducing the level of underwriting, claims investigation, etc.
- ... however, the implication on mortality costs, claim costs, reinsurance etc would need to be considered

[11]

[26 Marks]

Solution 4:

- i) Embedded value is the present value of future shareholder profits in respect of the existing business of a company, including the release of shareholder-owned net assets. The embedded value can be calculated as the sum of the shareholder-owned share of net assets, where net assets are defined as the excess of assets held over those required to meet liabilities and the present value of future shareholder profits arising on existing business.

These assets may be valued at market value or may be discounted to reflect “lock-in”, for example if they are required to be retained within the fund to cover solvency capital requirements.

In respect of term assurance business not written within the participating fund and the without profit endowment business, the following future cash-flows are projected and used to estimate the future shareholder profit

- Future premiums
- Investment income
- Future outgos (death, maturity, etc.)
- Future expenses including commissions and
- Release of supervisory reserves

These future profits are then discounted back at the risk discount rate to determine their present value.

For with-profits business, the most common way to calculate shareholder transfers are:

- as a proportion of the cost of bonus or
- as a charge deducted from the asset share

These can be obtained by projecting the cash-flows from the with-profits business similar to above without profits business.

Profits from the term assurance business which is written in the with-profits fund would need to be added to the profits of the with-profits business.

The projection of the cashflows should be using the best estimate assumptions

Under the cost of bonus approach, the shareholders will receive one-ninth (10/90) of the cost of bonus.

The bonuses used in the projections should be as per the bonus philosophy and consistent with the projected surplus.

Any surplus held back would get distributed at a later date, eg: on maturity by way of terminal bonus. The shareholder transfer in respect of such undistributed surplus would occur at such event.

Any excess of assets over the reserves within with-profits fund may also need to be split between with-profits policyholders and shareholders.

For example, the shareholder-owned share of the net assets may be taken as 10% of the net assets within the with-profits fund.

However, if charges are deducted from the asset shares of with-profits policies, then the embedded value calculation would simply involve projection of asset shares.

The reserves used in the determination of net assets should be consistent with those used in the determination of the present value of future profits.

Tax is allowed for within the calculation as appropriate.

[15]

ii)

- Two different bases are needed to calculate an embedded value: a supervisory reserving basis and a projection basis.
- We need the reserves:
 - to calculate the net assets (ie the assets less the reserves) and
 - in the projections to calculate the emergence of profits

As the embedded value is being prepared for internal management accounts, the calculation of embedded value for internal management accounts is likely to be on a best estimate basis.

Assumptions will be derived based on the best estimate of future experience, without the incorporation of any prudential margins.

The assumptions should be based on the recent experience of the company and any expected change in future.

The basis derived may be closer to that used for new business pricing.

The best estimate assumption will be required for expenses, persistency, investment return and mortality.

The reserving assumptions should be consistent with the best estimate assumptions and should be as per the local regulations, with prudential margins as required.

Embedded value calculations need to include an appropriate risk margin to allow for the unpredictability of profit emergence for life insurance business.

The rate of interest used to discount the future streams of surplus should reflect the risk inherent in these items.

The starting point in deciding on a suitable basis will be the basis used in the previous embedded value calculation. Any differences will immediately cause some movement in the embedded value.

The embedded value basis is likely to be more “best estimate” than the pricing basis. However the two should be looked at side by side.

Any differences will immediately lead to embedded value movements on writing new business different to those implied in the pricing basis.

[7]

[22 Marks]

Solution 5:

i)

- Market and Interest rate risk

Given the insurer writes annuity business only, it is likely that the duration of liabilities would be much higher than the duration of assets available, leading to mismatch.

Thus, a fall in interest rates would cause the liabilities to rise more than the value of the assets.

Even the duration of liabilities is not known with certainty because of the uncertainty in the mortality experience.

- Credit risk
The insurer is exposed to the risk of default on the corporate bonds held.
Changes to credit spread will also impact the value of any corporate bonds held.
- Mortality risk - Insurer is exposed to risk that policyholders live longer than expected, either business mix being different to expected, or due to unexpected improvements in longevity.
- Expense risk - Expense inflation may be higher than expected, or future business levels may be too low to cover the overheads.
- Operational risk
Insurer is exposed to risk of loss resulting from inadequate or failed internal processes, people and systems from external events.
Any outsourced functions may fail to perform their obligations.
- Liquidity risk - Some liquidity risk is possible if the insurer holds bonds with low marketability to make the annuity payments.
- Reinsurance risk - The insurer is small and makes use of reinsurance from a single reinsurer. Hence, it may have considerable exposure to its failure.

[10]

ii)

- “model” risk that the model, typically a probability distribution, chosen to represent future mortality, etc, may not be appropriate or may contain errors
- “parameter” risk that the parameters used with the model may not adequately reflect the future experience of the class of lives insured or to be insured, even though the underlying model may be appropriate
- “random fluctuations” risk that the actual future experience may not correspond with the model and parameters adopted, even though these adequately reflect the class of lives insured or to be insured

[3]

iii)

- The cost of capital method involves first projecting forward the future capital that the company is required to hold at the end of each projection period (eg year) during the run-off of the business
- The projected capital is the amount required to be held in excess of the projected liabilities at each period
- Calculation of the projected capital might require complex projections, stochastic modelling, correlation matrices and/or copulas...
- ... and should be determined according to the relevant regulatory basis
- However, regulations may permit a simplified approach which might involve selecting a driver which has an approximately linear relationship with the required capital...
- ... so that the projected capital can then be approximated as a percentage of the projected values of the driver
- These projected capital amounts are then multiplied by a cost of capital rate

- This cost of capital rate represents the cost of raising incremental capital in excess of the risk-free rate...
- ... or alternatively it represents the frictional cost to the company of locking in this capital to earn a risk-free rate rather than being able to invest it freely for higher reward.
- It can be calculated as the excess of the weighted average cost of capital over the risk free rate
- It may be dependent on the time period being considered...
- ... or it may be a specified fixed rate (eg 6% per annum in Solvency II).
- The product of the cost of capital rate and the projected capital amounts at each future projection point is then discounted using market-consistent discounted rates to give the overall risk margin.

[6]

iv)

- The market value of assets might be higher than the book value of assets, for example due to the drop in interest rates
- The value of liabilities under market-consistent needs to be valued at best estimate assumptions versus use of prudent assumptions under the earlier regulatory regime. All other things being the same, it will reduce value of liabilities and increase the free capital.
- Also, under market-consistent methodology, there is no flooring. Hence, with no flooring and using best estimate assumptions, all the future profits would get capitalized making the value of liabilities much smaller than the value of liabilities under earlier regulatory regime.
- The extent of the difference would though depend on the duration of the business.
- It is possible that the insurer took credit for the illiquidity premium available on the corporate bonds and thereby discounting the liabilities at a higher yield than risk-free rate, which would further increase the free capital position.
- The risk margin would potentially be higher than the required solvency margin (RSM) since it needs to account for all the risks which the earlier regulatory regime might not have to, for example, operational risk and liquidity risk are not expected to be part of the value of liabilities and RSM.
- Given the insurer writes immediate annuity, it is expected that the capital requirement and hence the risk margin would be highest in respect of the interest rate risk and mortality risk. How these two risks were getting accounted for in the earlier regulatory regime would give the extent of the difference in the free capital.

[5]

[24 Marks]
