

Institute of Actuaries of India

Subject ST2 – Life Insurance

November 2013 Examination

INDICATIVE SOLUTIONS

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.

Question 1.

i)

- The reserves will get released when surrender happens.
- Assuming the reserves have been determined in line with the supervisory reserving principles, the release in the reserves would exceed the surrender value to be payable.
- Higher than expected surrenders would hence increase the regulatory surplus over the year.
- The company however also needs to consider whether the higher surrenders are just a one-off case or this trend is likely to continue into the future.
- If it is a continuing trend, then would need to revise the valuation lapse assumption.
- This would also impact the regulatory surplus over the year, depending on the extent of the change in the assumption.
- If the surrenders result in significant drop in the inforce policies, then would need to consider increasing the per policy expense, which would increase the reserves reducing the regulatory surplus.

ii)

- There should be no impact on unit-linked since the assets and liabilities are matched.
- Higher yields on the bonds are likely to increase the valuation interest rate to the extent that the yields are hypothecated to the current inforce book of policies.
- This would reduce the reserves and increase the surplus.
- If the bonds held are valued basis held-to-maturity, there will be no impact on the value of the assets.
- However, if the assets are marked to market, the higher yields would reduce the market value of the bonds held.
- The impact on the surplus would then depend on the degree of mismatching between the assets and the liabilities.

[6]**Question 2.**

i)

Projected cashflow approach is preferable as it has the following desirable features, as compared with formula approach

- It enables a company to measure the expected return that the providers of capital will receive.
- The sensitivity of the profit to variations in experience can be investigated so as to determine appropriate margins for the parameter values.
- The need to set up reserves and meet solvency requirements can be explicitly allowed for.

- The cashflows can be used to assess the financing requirements for a new contract, by using them to build up a model of the expected new business. Incorporating this into a model of the existing business, the impact of the financing requirement on the company can be investigated.
- The method can allow more easily for withdrawals and conversions to paid-up.
- It can more easily cope with complex benefit structures, in particular where the benefits depend on future assumptions.
- It is easier to incorporate assumptions that vary over time, including stochastic assumptions.
- The risk discount rate can take account of the term structure of interest rates.
- Tax can be allowed for more appropriately.

ii)

- Withdrawals are not financially neutral and affect profits.
 - At early durations, withdrawal benefits may well exceed the asset share, thus giving a loss.
 - At later durations, there may be a profit but this is unlikely to equate to the potential profits from a continuing policy.
 - Withdrawal rates are unpredictable and there is a need to test different withdrawal patterns to see the effect on profitability.
 - Profit results, if vary drastically, by varying the withdrawal assumption might imply a faulty product design.
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- The company also needs to ensure that the initial expenses get recovered while determining the surrender terms at different durations of the policy.

[8]

Question 3.

i) EV and its calculation

- 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.
- It can be calculated as the sum of:

(i) The shareholder-owned share of net assets, where net assets are defined as the excess of assets held over those required to meet liabilities.

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.

(ii) The present value of future shareholder profits arising on existing business.

The process of determining this amount is similar to performing a profit test, bearing in mind that some elements will not be applicable (eg new business expenses).

- The future cashflows on the existing business are projected and used to estimate the future shareholder profit. These future profits are then discounted back at an appropriate rate to determine their present value.
- It is important that the reserves used in the determination of net assets are consistent with those used in the determination of the present value of future profits.
- Tax is allowed for within the calculation as appropriate.
- It should be noted that, all else being equal, increasing the discount rate increases the degree of prudence.

ii) Analysis of change in EV

A company may analyze the change over a year in its embedded value (the sum of net assets and the present value of the expected future profit from existing business).

This will allow the company to:

Validation of calculations, assumptions and data

- The key here is the validation of assumptions. It is common to use the same assumptions for embedded value work as for pricing (other than the risk discount rate which is often set higher for pricing to take account of the extra risks involved in acquiring business).
- It is crucial that the assumptions used in product pricing be valid, and their continuing validity can be monitored by the analysis of embedded value movement

Reconciliation of successive years' values

- Due to the complexity of the models used to determine embedded values, and all of the other opportunities for error to creep in (for instance, insufficiently representative model points), it is essential to check the results thoroughly.
- One of the best ways of doing this is to reconcile the embedded value with the previous result, i.e. to identify in an analysis every contribution to the movement in embedded value.
- So this is a very detailed check here, which will in turn validate the calculations and data.

Providing Management information

A company may analyze the change in embedded value over a year to understand the implications of various management actions on the value. The sort of information that it will give is:

- The value of new business written, normally by product
- The amount of any expense, withdrawal or mortality profit or loss
- The impact of free assets on embedded value growth (i.e. is spare capital being used efficiently, or is it just sitting around earning market yields and hence reducing the overall return achieved by the company)
- The impact of supervisory solvency capital requirements on the rate of return achieved.

Data for use in executive remuneration schemes

- Executive remuneration schemes should ideally be based on measures that reflect how well a company is really doing and so reward good management actions.
- The change in EV over a year is a good measure to use because it will be increased if, for example, the company has sold lots of new policies on terms that are expected to be profitable.

Provide detailed Information for publication of company's accounts

- Published accounts normally misrepresent the real financial situation of a company because they do not take any credit for the future profits expected to arise from business already written.
- This is a particular problem if a company is expanding quickly, because it will be making large revenue account losses (unless using heavy financial reinsurance) and will so seem to be in a bad way, even if in reality it is writing a lot of good business which will generate large profits in the future.
- Reporting embedded values will show a truer picture, although it is also much less prudent because it is entirely based on the idea of taking credit for future profits.
- Where this is so, companies may also want to highlight the changes in embedded value from one year to the next. This information will allow shareholders (and financial analysts) to see what the real drivers of company profitability are.

iii) Best Estimate valuation versus EV

- For a best estimate valuation the present liability is calculated for each policy using realistic assumptions.
- The sum over all policies is compared with the total asset value to give a measure of realistic solvency.
- This gives a measure of policyholders' benefit security, but the change each year in the retained profit (i.e. the change in the value of the assets less the value of the liabilities) can also be used to give a measure of profit as an extra piece of information.
- An embedded value calculation will consider the cashflows across the portfolio in each time period, rather than the present value of cashflows for each policy.
- The focus of an embedded value calculation is shareholder profit.
- An embedded value takes full account of the cost of capital in the value of the shareholder transfers, because each year's transfer has to be made from profits that arise in excess of the supervisory reserves held.

(So an increase in the supervisory reserves required will postpone the emergence of profit for the shareholders, at least for without-profits business, and thereby give a reduced present value when discounted at the risk discount rate.)

iv) Calculate EV

Shareholder Net Assets = Total assets less reserves less solvency capital = $1500 - 900 - 130 = 470$

Assuming 2012 as end of year 0, the projected cashflows excluding solvency capital projection is as follows

Time	Reserves at start (+)	Income reserves on (+)	Reserve required at end (-)	Expenses (-)	Outgoes (-)	Net Cashflow	Discounted value
	(1)	(2)	(3)	(4)	(5)	(6) = (1) + (2) - (3) - (4) - (5)	61.3
1	900	$900 * 9\% = 81$	820	30	100	$900 + 81 - 820 - 30 - 100 = 31$	27.4
2	820	$820 * 9\% = 73.8$	640	35	200	$820 + 73.8 - 640 - 35 - 200 = 18.8$	14.7
3	640	$640 * 9\% = 57.6$	0	40	630	$640 + 57.6 - 0 - 40 - 630 = 27.6$	19.1

The projection of solvency is also of the same pattern as release of reserves. So the solvency capital required is as follows

Time	Solvency capital at start (+)	Income solvency on (+)	Solvency capital required at end (-)	Net Cashflow	Discounted value
	(1)	(2)	(3)	(4) = (1) + (2) - (3)	116.4
1	130	$130 * 8\% = 10.4$	118.4	$130 + 10.4 - 118.4 = 22$	19.5
2	$(820/900) * 130 = 118.4$	$118.4 * 8\% = 9.5$	92.4	$118.4 + 9.5 - 92.4 = 35.5$	27.8
3	$(640/900) * 130 = 92.4$	$92.4 * 8\% = 7.4$	0	$92.4 + 7.4 - 0 = 99.8$	69.2

Thus the total embedded value of the company is $470 + 61.3 + 116.4 = 647.7$

[20]

Question 4.**i) Expense Analysis**

- The company would need to agree the period to which expense analysis will relate.
- It would want the period to be short enough to ensure homogeneous data but long enough to enable it to have sufficient data such that results are credible
- It would need to gather data subdivided into:

- Direct expenses: Expenses that depend on volume of new business or level of in force
- Overheads: Balance of expenses e.g. those that relate to general management and service departments not directly involved in new business or policy servicing
- Commission would be excluded from the investigation and allowed for as paid
- Need to ensure that “cells” are not too small otherwise analysis will become unreliable.
- The main costs are Salary and Salary related
- Such expenses would be split by department/function.
- The company would need to identify those departments that are directly involved in servicing policies, and those that are overheads
- Those departments that are obviously linked to a particular product can be allocated to that product line - Life Servicing.
- It would need to split time by process undertaken e.g. policy servicing, policy set up or claim settlement
- Where a function works on a variety of processes/products then the expenses can be split using a timesheet analysis
- Those departments that are identified as pure overheads (e.g. HR, Legal, Accounting, Actuarial Valuation) can be split pragmatically across other departments. e.g. HR could be split in proportion to number of staff in each direct area.

Underwriting costs

- There may be costs relating to the company’s underwriting process, for example, the cost of doctors reports or medical examinations
- These would be directly allocated to new business

Property Costs

- Property costs that relate to buildings occupied by the life company can be split using notional rents and then allocating by floor space occupied by departments, and then expenses allocated as per salaries above

Computer Costs

- Allocate to departments by computer usage
- Costs of purchasing new computers could be amortized over useful lifetime and then added to ongoing computer costs

Investment Costs

- Directly allocated to investment expenses
- Split directly by product line based on funds under management

One off capital costs

- Any relevant costs would be amortized over expected useful lifetime and treated as part of overheads and spread by department
- Items that are treated as an asset of long term fund will not be amortized. Instead there will be a charge (e.g. notional rent) made to departments and allocated as per salary expenses
- Exceptional Items that are unlikely to recur will be excluded from the analysis

ii) Expense assumption setting

Having determined the total expense for the period of investigation

- Expenses would need to be inflated from the period of investigation to the period for which they will be used
- They may also be adjusted for any known changes in expense levels, e.g. benefits from recent cost saving programs
- The company then would need to split expenses into initial, renewal, termination and investment expenses
- These could be further subdivided into regular and single premium business, paid up policies etc.
- The company would also want to split expenses into those that are per policy, per premium or per sum assured
- Having split all expenses of the company will be able to come up with total expenses by product line and within product line the expenses will be split into initial, renewal, termination and investment expenses.

- These would then need to be converted into allowances per policy using:
 - Number of new policies for new business expenses
 - Average number of policies in force over analysis period (for renewal expenses)
 - Average number of claims over analysis period (for termination expenses)
 - Investment expenses are likely to be expressed as a percentage of funds under management so that they can be treated as a deduction from earned investment return.
- The company would then want to compare its resulting assumptions to those derived from previous exercises and ensure that it understands any significant variations
- The company may then want to include prudent margins within the allowances

iii) Impact of proposed changes

Reserving

- Higher loading for maintenance expenses in the reserving basis would increase the reserves
- There will be a one-off strain due to increase in statutory reserves leading to a fall in free assets

Pricing

- Since the reserving allows for higher loading of expenses but the best estimate expense remains the same, extra prudence will be released in the future
- Higher reserving would lead to increased new business strain
- May need to re-price the product as the premium rates would increase due of cost of holding additional reserves if the discount rate exceeds the earned rate
- Would affect only the new business written and not the existing business
- Need to check whether the product is still competitive and acceptable to all distribution channels

Question 5.

The following factors need to be considered

Validation

- The company needs to check that there are no errors in the calculations and data.
- It needs to check that the data is complete.
- In doing these validations, it should look at both the data on death rates and the data on total exposure.
- It should check that all of the data is in respect of this product only.
- It could use a recent analysis of surplus to check if the mortality profits/losses are consistent with the mortality experience shown
- It should check that the data contains only the claims accepted by the company and not all intimated claims

Credibility

- The company should consider the amount of exposure for each of the in-force durations.
- It should then decide whether the experience investigation results are credible.
- For example there might have been very few policies which would have paid three annual premiums due to, say, higher lapses, which would make the 3+ result unreliable.
- Or alternatively, it might want to break the 3+ experience into say, 3 and 4+ years if there is enough data available

Relevance

- The mortality rate assumptions used in profit tests should reflect the future expected experience in respect of these contracts.
- The company therefore has to decide whether this historic investigation is a fair reflection of future expected experience.
- It therefore needs to consider whether any changes have been or will be made which might reduce the relevance of historic experience, such as:
 - Underwriting strategy
 - Distribution channel.
 - Target market.
 - Reinsurance
- The company should consider whether any external influences might have affected mortality rate experience during the past calendar year, such as any natural calamities (earthquakes, floods, terrorist attacks)
- The company should also consider whether any internal influences might have affected mortality rate experience during the first policy year such as relaxed underwriting including relaxed claims underwriting in any particular calendar year
- It also needs to consider the extent to which these external or internal influences are expected to continue.

Trends

- The company has only one years' worth of experience analyzed and so it is not possible to identify trends in mortality rates that might be expected to continue in future.
- The company should therefore perform further investigations of previous years' experience, and repeat the analysis in the future. This depends on historic data being available.
- This additional analysis will also help to give credibility to any proposal.

Assumption changes including other considerations

- Based on the limited analysis performed, the mortality experience suggests that the magnitude of the profit test assumptions is not significantly different, since the average is somewhat close from the 80% currently assumed.
- However, it might be the case that the profit test assumption of 80% might include a prudential margin (i.e. not the best estimate assumption), in which case there could be a need to make changes to assumptions
- However, there appears to be significant variation in experience by duration in-force (number of annual premiums paid), and so the profit test approach might be changed in order to reflect this, rather than continuing to use a level assumption throughout the whole projection period.

Comments on specific durations

- There is a significantly higher mortality experience in the first two years and hence the first and second year mortality rate could be increased to be consistent with experience.
- However, the experience for policy year 3 and above is significantly lower than the assumed rate and hence, the assumption could be made consistent to the experience

Other considerations

- The cost of changing the model will have to be weighed up against the benefit of the possible increased accuracy
- The company should consider whether other assumptions should also be reviewed in light of this investigation, such as those used in the valuation of in-force business or in reserving calculations.
- The company should look at the sensitivity of profit to changes in the mortality assumption.
- The company might wish to look at industry-wide experience for this type of contract, if available.
- It should also perform analysis of mortality experience based on sum assured (i.e. actual versus expected death outgoes)
- The company might wish to carry out further investigations, splitting the data by other factors (e.g. distribution channel or target market).
- It may also sought reinsurer's experience and expertise
- Given the higher mortality experience in the first two years, reinsurer may want to reduce any selection discount/commission payable to insurer or alternatively, may increase reinsurer's premium, atleast for any new business sold

Question 6.

i)

- The CEO has probably made the statement based on the total actual expenses incurred for each channel, which are Rs.1400 mn for Corporate Agent (CA) and Rs.725 mn for Own Sales force (OSF).
- However, the efficiency of a sales channel should be measured by the ratio of the actual expenses incurred to the volumes written, or...
- ...the ratio of actual expenses incurred to those assumed during pricing.
- The expense assumed during pricing:
For CA: $(35\% + 10\%) * 2500 = \text{Rs.}1125 \text{ mn}$
For OSF: $(25\% + 20\%) * 1000 = \text{Rs.}450 \text{ mn}$
- The actual expense to volume ratio:
For CA: $1400/2500 = 56\%$
For OSF: $725/1000 = 72.5\%$
- The overspend ratio:
For CA: $1400/1125 = 124\%$
For OSF: $725/450 = 161\%$
- On both the above ratios, CA is better than OSF.
- The statistics' summary provided is only for one year. The statistics should be analyzed for more than one year.
- The company should consider that having two different channels would also provide diversification of risk.
- Further, the demographic reach of both the channels might be totally different.
- The company sells 50% as term products through CA. Term products' market being a competitive market, it would be difficult to increase the sales through OSF without compromising the profit margin.
- Closing the CA channel could thus lead to overall reduction in the new business volumes and hence higher overheads per policy...
- ...unless the OSF is expanded enough in order to increase the volumes, but this would incur expenses which could be even higher than the current levels.
- Closing a channel would also cost money in terms of redundancies, and could lead to poor persistency.

ii)

- Type of insurance products sold by the bank, Eg: unit-linked, with-profits, etc.
 - This would help the insurance company analyze its existing product portfolio and prepare to design products to fill the gap.
 - This will also help identify certain segments where the bank may have missed whereas the insurance company can lend their expertise.
 - The product portfolio will give an indication of the margins the insurance company can expect.

- The product portfolio will also indicate the additional areas of risks the insurance company will get exposed to.
- Marketing plans and growth (past and projected) for the bank by customer segment and geographical presence
 - This will help the insurance company project the potential new business the bank is capable of doing.
 - It will also help identifying any opportunity the bank may have missed so far.
 - The information on customer segment and geographical presence will help set the demographic assumptions.
- Commission received by the bank on acquisition of business as well as renewal premium.
 - This would help to determine the commission which the bank would expect to receive under different lines of business and would provide a comparison with the commission loadings under the company's products
 - It would also indicate whether some of the products need to be re-priced to allow for the compensation structure of the bank.
- Persistency experience of the policies sold by the bank
 - This will give an indication of whether the persistency experience of the bank is line with the industry. If not then what will be the additional cost incurred to improve persistency.
 - The persistency experience will also be important to model the cash flows to determine the compensation structure.
 - If the experience is bad then it will be worthwhile putting some commission claw backs in place. An additional compensation could be paid if the persistency is good.
 - The insurance company could also restructure commission to put more focus on renewal commission to improve persistency.
- Number of complaints received by the Bank in a year for the past few years and the compensation paid to the customers
 - This will give an idea on the sales practice of the bank and compare it with the industry
 - Compensation paid to customers due to mis-selling will have to be allowed for in the offer made to the bank. The insurance company can either allow for it explicitly in the contract that any such payout to the policyholders will be borne by the bank or allow for it implicitly in the cash flow projections.

[16]

Question 7.**i) Possible uses of asset share:**

- Determining the surrender value to be offered
- Determining the level of payouts to the policyholders (bonus rates calculation)
- Ensuring equity between different generations of policyholders
- Offering any alterations terms
- Determining the smoothing level
- Determining the level of MVR to be applied (for UWP business)
- Estimating the cost of investment guarantee offered under its products
- For documents required at point of sale illustrating projected maturity & surrender values based on asset shares
- Determining profit/loss at maturity
- For calculating the estate to assess the level of investment freedom and the new business strain which can be supported by the estate

ii)

- Benefit payouts are usually smoothed. They exceed the asset share when economic conditions are poor and vice-versa.
- Benefits may be increased above the asset share to distribute a one-off surplus.
- Benefits might be reduced below the asset share to build surplus in the WP Fund, for example to support the solvency.
- Death benefit (minimum sum assured) might exceed the asset share, especially when the market conditions are depressed.
- Similarly, policies with guaranteed surrender value could exceed the asset share.
- Some companies may aim to pay out less than asset share on surrender, as a form of surrender penalty.

- A no-MVA guarantee on UWP products could result in the benefit payouts being different to the asset share.
- During the initial duration of the policy, asset shares can be negative. Hence, any early payouts would exceed the asset share.
- The terminal bonus (TB) rates are usually determined on a portfolio rather than on an individual policy level. Hence, rarely will the benefit payout match the asset share exactly.
- The same TB rate is normally applied to policies irrespective of premium size, policy status (paid-up, inforce), etc. Similarly, there are often approximations in the TB setting approach. In such circumstances, exact asset share is unlikely to be paid.
- Benefit payouts may be temporarily increased above asset share for competitive reasons.

iii)

- Since the unit-linked liabilities are roughly same as that of with-profits but account for 75% of the new business, this means that the with-profits business is close to maturity.
- The Finance Director's suggestion would hence help in achieving the objective of rebuilding the surplus quickly without much impacting the future new business.
- However, PRE would have been formed with respect to the TB and the suggestion would go against the PRE.
- The Director's suggestion would be even more difficult to justify if the investment markets have been performing fairly well.
- Need to explore other ways also of building the surplus. Eg: levying an additional charge on the asset shares. Though this will build up the surplus slowly.
- Or, if surrender profits can be used to build the surplus.
- New business volumes may be restricted so that minimal capital gets used up. Though this may not be a popular choice.

iv)

- The company would calculate asset shares for a range of policies maturing in the next year or the next few years.
- This would include policies of different cohorts (eg: different policy terms, different lines of business – pension and life, etc.)
- These asset shares would then be compared with the guaranteed basic benefit plus declared reversionary bonus under the policies.
- If the company's bonus policy is to pay out the asset share, it would set terminal bonus so as to equate these two amounts.
- However, the above would be subject to smoothing.
- Smoothing effectively tends to smooth out peaks and troughs in investment markets from year to year.
- The company will therefore calculate the changes in payouts and asset shares in recent years and the projected change in asset share for a policy of a given term over the next few years.
- For example, if the asset share is projected to decrease over the next few years then the company is likely to set terminal bonus rates which are lower than they would otherwise have been.
- This is so that it is possible to keep payouts broadly in line with asset shares in the future without requiring large changes in future payouts.
- The extent to which payouts are smoothed from year to year should be consistent with past practice and PRE.
- In practice, for admin simplicity, the company is likely to have one terminal bonus scale for policies of different premium sizes.

[19]
