Institute of Actuaries of India

Subject SP7 – General Insurance Reserving and Capital Modeling

November 2019 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) The method relies on an assumption regarding the loss ratio ratio for an origin period without taking into account the claims experience to date for that origin period. Key aspects which should be considered for the loss ratio assumption [0.5]

- Benchmarks derived from other companies data or industry/market data
- Historical Loss Ratios. Derive these from specific company or class of business being analysed, possibly allowing for any trends or outliers in the observed historical loss ratios.
- Rate changes adjustment
- Claims inflation adjustment
- UW opinion
- Changes expected in UW and claims handling/settlement practices

[0.5 each, Max.1.5]

[2]

ii) The calculated UPR might in some circumstances (prove to be inadequate to cover future claims and expenses arising from the unearned portion of existing policies. In such circumstances an additional reserve, called the AURR, is created if full provision is to be made for future liabilities. [1]

iii) The issues are

- ULR used for IBNR includes ALAE (Allocated Loss Adjustment expenses) but does not include another claims related expense component which is the unallocated loss adjustment expenses (ULAE) [1]
- IBNR is held for expired book of business where the unallocated loss adjustment expenses are already accounted separately in accounts under salaries/ operating costs and hence there is no need for including the ULAE in the ULR for IBNR estimation. [0.5]
- AURR reserves are against liabilities arising from the unexpired book of business and therefore both the allocated as well as unallocated claims related expenses should be included. [0.5]
- For a business already underwritten, initial expenses like acquisisiton costs are already incurred by the company and separately accounted for in the expiring accounts. [0.5]
- For the unexpired book of the business, the future expenses will only be in relation to claims and claims related expenses including the unallocated loss adjustment expenses. [0.5]
- Hence the ULR which is used for the IBNR calculation should be loaded with the ULAE component and then only be used for AURR calculations. **[3]**

iv)

- UPR and AURR should be profiled similarly i.e. should be allocated in the same liability duration buckets. [1]
- UPR and AURR reserves pertain to the liabilities arising out of the unexpired book of business [0.5]
- UPR for short term or annual business should be profiled following the same pattern as that of IBNR reserves which are allocated in various liability duration buckets. But the profiling should be done with atleast a 6 month lag as IBNR is in respect of the expired book of business whereas the UPR is in respect of the unexpired book of the business. [1]
- UPR for longer term policies i.e. more than one year tenure policies should be profiled based on the tenure of the policy. This means first uniform allocation or equal distribution of the UPR into the different annual periods spread over the entire tenure of the policy. And then from each allocated annual period, the UPR reserves allocated/distributed can be further reallocated based on the IBNR development pattern with atleast a six month lag i.e. from the mid-point of each annual unexpired period. [1]
- Similarly AURR should be profiled/allocated into the same liability duration bucket as that of the UPR reserves [0.5]
- IBNR reserves may be profiled based on the development pattern of claims…..paid or incurred development. [0.5]

- IBNR development pattern will be long tailed for policies like liability business whereas it will be short tailed for policies like Fire. [0.5]

[5]

v)

- Portfolio immunization/duration matching, and cash flow matching are two types of dedicated strategies to safeguard the funding of liabilities when due.
- Immunization/duration matching aims to balance the opposing effects interest rates have on price return and reinvestment return of a coupon bond.
- A multiple liability immunization/duration strategy pays off better when the interest rate shifts are not too arbitrary.
- Cash flow matching relies on the availability of securities with specific principals, coupons, and maturities to work efficiently which is also a rare possibility if the capital markets, especially the bond markets, are not matured. [1 each, **Max. 2**]
- In general insurance, the cashflow timings and amounts are very difficult to predict because of operation of so many different perils with varying limits/sub-limits in the coverages provided. Also, most of the cashflows are short term in nature. Therefore, it is more of liquidity management than asset liability management. [0.5]
- In an ideal world in which one had access to all kinds of securities offering a full range of face values—coupons and maturities—a cash flow matching strategy would create a perfect match between the flow of cash and liabilities and completely eliminate any reinvestment risk or cash flow match risk. However, the ideal rarely exists in any real-world scenario especially in general insurance, and so a cash flow matching strategy is hard to achieve without a significant trade-off in terms of higher cash investment and excess cash balances being reinvested at very conservative rates [0.5]
- In cash flow matching, cash flows must be available before a liability is due, whereas, in multiple immunizations, liabilities are funded from cash flows derived from portfolio rebalancing on the basis of dollar durations. In this respect, a multiple liability immunization strategy is generally superior to cash flow matching. [0.5]
- However, in specific cases where the liability amounts and cash flows can be reasonably matched over the time horizon without much reinvestment risk, a cash flow matching strategy may be favoured for its simplicity. In some cases, it is even possible to combine the two strategies in what is called combination matching, where the portfolio assets and liabilities are not just duration-matched for the complete time horizon but also cash-flow matched for the initial few years. [0.5]

[Max.3]

[14 Marks]

Solution 2:

i)

a) The three components of error in any stochastic reserving exercise are

- Parameter Error: This represents the uncertainty in the parameter estimates assuming the model is correctly specified. [1]
- Process Error: This represents the randomness in future outcomes. Even if the model were correctly specified and the parameters correctly estimated, the volatility associated with the insurance process is likely to result in differences from the expected outcomes. In other words, its what is commonly called variance of a random variable. [1]
- Model Error: This measures the difference between the parametric form assumed for the model and the true but unknown parametric form, i.e. the error introduced by the choice of model. [1]

[3]

b)

- System unable to capture the date on which reserves are revised (Parameter error)
- Change in legal/claims environment (Model error)
- Unusual large claims (Process error)

- Emergence of latent claims (Model error)
- Change in claims case reserving (Process error)
- Nature of loss data missing in some claims (Parameter error)

[0.5 each, **Max. 3**]

ii)

a) Over-dispered Poisson and Mack Method [2]

b) There are two ways through which it is possible to align the two estimates i.e. ABE and SBE given that ABE is lower than the SBE.

1st : Additive scaling….i.e. shifting the best estimate of the reserve distribution but the standard deviation remains the same …..which means we are not reducing the variance of the original distribution i.e. the risk measure is kept the same and hence maintaining the same level of conservatism or prudent assumptions. [1]

2nd: Multiplicative scaling…i.e. shrink the original distribution by maintaing the same Coefficient of Variance in order to align with the ABE but in the process we are reducing the original variance i.e. reducing the original prudent/risk assumptions. [1]

Hence in this case, Additive Scaling is a better option.

[2]

iii) The issues in the approach are

- Net data provides an incomplete view of the underlying volatility in experience and systematically understates the potential downside risk, say if extrapolated to derive a capital requirement figure. [1]
- Reinsurance programmes may not respond (by design or through exhaustion) in the same way in the future as in the past. [1]
- For longer-tailed lines of business, the impact of existing reinsurance could be poorly reflected in the development to date (for example, under a "Risk XL" programme protecting a liability book) leading to greater estimation error in the final result. [1]

Hence reserving variability analysis should be carried out by using gross claims data. **[3]**

[13 Marks]

Solution 3:

i) The direct insurer incurs expenses in order to transact business (for example, commission to brokers). The reinsurer reimburses certain percentage of the premium ceded by the direct insurer to help cover the acquisition expesnes. This is called the return commission. [1]

Over and above acquisition expenses, the direct insurer also incurs expenses like advertisement and administration related expenses. In this regard the reinsurer pays further commission over and above the return commission to compensate for these additional costs. The commission over and above the return commission is called the override commission. The sum of return commission and the override commission is called the ceding commission. [1]

[2]

ii)

a) Loading the entire device costs to the Motor Own Damage Premium may be a financial burden to the policyholders in terms of affordability. This is especially true when the target segment consists of policyholders who would be expecting an overall lower premium based on their vehicle usage pattern. So in such a scenario, the insurer can bear the entire device costs with a charge to the shareholders accounts or it may recoup the expenses through some reinsurance arrangement provided the reinsurer is willing to bear such costs. [1]

The possible reinsurance arrangements are

- Quota Share

  Under quota share arrangement, the entire device costs or a part of the deivce costs can be recouped from the reinsurer through the ceding commissions. The exact ceding commissions can be estimated based on the proportion of the device costs to the overall ceding premium to the reinsurer. A normal quota share arrangement will also have risk transfer in addition to covering a portion of the device costs. [1]

- Financial Reinsurance arrangement

  The same as quota share arrangement but with insignificant risk transfer. This can be achieved through a loss cap and loss corridor arrangement where the overall outgo of the reinsurer is capped irrespective of the actual losses. [1]

[3]

b) The possible challenges are

- The arrangement may not be economically viable for both the parties [0.5]
- This is because of the device costs being considerably high compared to the overall targeted OD premium [0.5]
- Intitially to start with because of lack of usage based data pertaining to past experience, the product may be anti-selected and therefore the loss ratios may be high compared to expected. Any high loss ratio will put further pressure on the economic viability of the scheme. [0.5]

Way forward

- The reinsurance treaty may be looked at on a three year horizon period. [0.5]
- The one time device costs may be spread across the three year period which will help towards achieving economic viability. [0.5]
- On a three year horizon period, a part of the amortized device costs can also be borne by the policyholder reducing financial pressure on both the parties. This will also ensure that the policyholder does not pay exhorbitantly high premium. [0.5]

[3]

iii) It would be necessary to point out that the capital requirements will depend on a number of things including:

- purpose of exercise
- available data
- sensitivity of the results to the different assumptions including the correlation assumptions.
- In particular, it is important to communicate that there is considerable uncertainty and that a range of results should be produced, based on different assumptions.
- The purpose of the exercise will affect the basis used.
- It may be useful to recommend a range of appropriate basis.
- However, it is important to point out that such bases will not necessarily be appropriate for other uses
- Since it is a new company, there will be limited data available
- Any data used may lack relevance. It is important to highlight this, emphasizing any specific concerns over its quality and/or relevance
- And to point out that such issues may affect the validity of the results.
- The client should be made aware of any limitations of the advice given.
- Any actual judgment that maybe needed should also be highlighted.
- It is important to emphasize that the final result is highly dependent on the assumptions made.

- The most significant assumptions will vary for different classes of business, however claim frequency and claim severity are likely to be amongst the most important ones.
- Assumptions will be chosen based on the current economic, regulatory, and tax environments, however it is important to point out that if these change , then the assumptions will need to be amended accordingly.
- It will be necessary to point out that the correlation assumptions are also important, particularly in future if the new insurer is planning to expand (either in terms of market share for existing classes of business or into new business classes)
- Examples of possible correlations include :
- correlations within the risk types, example within any one class of business or between asset classes when assessing market risk
- Correlations between insurance risk and market risk
- The advice should highlight the importance of continually monitoring and updating the results And the need to comply with and monitor any regulation and/or guidance on setting capital requirements. [0.5 each, **Max.10**]

iv)

a) Would want to model CATS & large claims separately in underwriting risk as they can be major drivers of experience at the tails of distributions

- CAT events can impact across multiple lines of business and without separating them analysis would be distorted
- Would also want to remove CAT events if model receives any inputs from CAT models such as RMS as otherwise there is a risk of double counting with the non CAT UW risk
- Would want to be able to model these events individually where possible as the severity distribution affects reinsurance recoveries
- Reinsurance recoveries have a major impact on capital at the tails of distributions
- Would not want to model attritional claims individually however as this would lead to such a high volume of claims that it would be computationally challenging to model
- In any case it would be hugely difficult to fit a severity curve that was a good fit to attritional claims while still being heavy enough in the tail to adequately represent large claim potential
- Catastrophe events would even need to be modelled separately from large claims as they would have a different severity distribution
- and would produce different reinsurance recoveries for the same severity
- and may even be covered by different reinsurance programmes
- Large claims and catastrophes will also distort reserve runoff patterns so may need to be removed for reserving risk models to be appropriate
- In particular, if using stochastic methods such as bootstrapping, the presence of these large claim events may cause the methods to produce extremely volatile results
- For historic losses or major events in the claims history it may be appropriate to include a specific model or to model as a separate class of business
- This could recognise specific features of the claim or event, such as the current uncertainty over market losses (particularly for recent CAT events) or the particular legal position of a large claim
- These events are also likely to be more strongly correlated with credit risk as they may also impact reinsurers and affect their capital position
- There may also be links with market risks, particularly for large catastrophe events which often impact the equity market in particular

- There may be some links with operational risks as well as management may be distracted by large events of this nature [0.5 each,**Max.8**]

b)

- Catastrophe type claims should be modelled separately from attritional and large claims especially for events that may impact more than one class.
- Cat events cannot be modelled from the firm's own experience because of their rarity.
- Due to their different nature, natural and man-made catastrophes maybe modelled in different ways
- For natural catastrophes such as earthquake or windstorm, proprietary models can apply to the firm's exposure to simulate a distribution of possible cost similar to the event being modelled.
- It is the firm's responsibility to ensure that the model is suitable, for example by allowing for demand surge, climate cycle and so on and to test the results against the known impact of recent catastrophes and to resolve or adjust for any discrepancy.
- Demand surges reflect the basic economic reality of reduced supply and increased amount following a natural catastrophe. In insurance context they can be defined as a temporary increase in repair or mitigation cost as a result of a natural catastrophe, example an increase in rebuilding cost resulting from a shortage of building materials after an earthquake.
- For man-made catastrophes other than terrorism, the firm is likely to have to develop a bespoke model e.g. for the effect of a severe recession on its creditor business, one might assess the impact of recessions of various depths and then model the drivers or indicators of recession to fit a distribution to these costs.
- Alternatively a subjective allowance could be made, without using a sophisticated model.
- For example, the insurer could estimate the likelihood of a catastrophic event of a particular size for example 1 in 20 year event of a $5m loss. The insurer could then build up on the catastrophe reserve over time by setting aside $250,000 each year.

[0.5 each,**Max.5**]

[31 Marks]

Solution 4:

i) **Combined Operating Ratio:** This is also known as the operating ratio. It is the sum of the claims ratio and expense ratio and is usually used to analyse the performance of an insurer purely from an underwriting point of view i.e. writing only insurance business. [0.5]

Strictly it is not a ratio as the denominator would not be same for the claims ratio and the expense ratio. [0.5]

Also combined ratio does not include any investment income, including the investment income earned from policyholders funds. [0.5]

Profit Margin: This is usually calculated as insurance profit divided by net earned premium. This ratio is sensible because the numerator does correspond with the denominator. [0.5]

The profit margin calculation is usually based on total profits including the invetsment income on free reserves. [0.5]

Therefore this ratio is usually less useful for comparison purposes because the investment income on free reserves is not generated by writing insurance business and obviously depends on the size of the free reserves. [0.5]

[3]

ii)

- A new player would have a lot of capital or free reserves to start with. [0.5]
- A new player will be spending a lot in setting up of admin systems, branding and advertisements in initial years. [0.5]
- A new player will also be paying relatively higher acquisition expenses to start with to procure business. [0.5]
- A new player will be spending on building team. [0.5]
- Being an insuretech player additional amount will be spent on creating the digital technology platforms facilitating innovation. [0.5]
- Overall the management expense and acqusition expense would be very high in the initial years for the reasons stated above. [0.5]
- Being new, it will be difficult to procure the good business from the market immediately and hence new business strain will increase the losses emerging from the business. [0.5]
- Initially the volume of business wirtten will be disproportionately lower than the expenses stated above. [0.5]
- The combined ratio, which is made up of expense ratio and loss ratio, would therefore be much higher. [0.5]
- The profit margin may look good in the initial years due to investment income earned on the free capital reserves, which will be high. [0.5]
- Therefore the investment banker may suitably consider all these aspects before using these ratios and especially using them for comparing with other insurers. [0.5]
- The other insurers being compared with may be at different stages of their business life cycle. [0.5]

[Max 5]

iii)

(a) Combined ratio will completely change under IFRS.

- All the insurance expenses will now include the claims and acquisition expenses.
- Investment or financing expenses will be a separate component.
- All the insurance expenses will now be compared with the insurance revenue (e.g. Premiums) to estimate CSM (Contractual Service Margin) [0.5]
- Insurance revenue, Insurance expenses and CSM will be estimated separately for direct insurance business and reinsurane business. [0.5]

Similarly Profit Margin will also change.

Under IFRS, effectively any profitability of the business will be measured in terms of CSM arising out of a business line. The CSM will largely depend on the allocation of expenses and hence how profits emerge during the tenure of the policy. [1]

[2]

(b) IFRS is just an accounting method based on sound accounting principles. The economic valuation of a compnay never changes because of the change in accounting methods. [1]

[11 Marks]

Solution 5:

i) The normal structure of the reinsurance arrangements in any organisation is as follows

- The first reinsurance arrangements which apply are primarily the proportional treaties e.g. quota share/ surplus treaties. The gross to net retention of these treaties are normally kept at a level which depends on the risk profile of the business covered and also on networth/risk appetite of the organisation. So for example, if the businesses covered are profitable then higher retention

levels are normally preferred by the direct insurers. Such treaties are normally taken for homogenous classes of business like Health and Motor. [0.5]

- The net retention of the proportional treaties stated above are then protected by excess of loss treaties. The usual gross to net retention of these treaties is normally kept at a level in order to be within 5%-10% of the networth of the company depending on the risk appetite of the organisation. Such treaties are normally taken for heterogeneous classes of business like property. [0.5]
- The final net retention of all the treaties stated above are then further protected on an aggregate level through aggregate excess of loss covers for example CAT excess of loss cover. The usual net to net retention of these treaties is kept at a level in order to be within 2%-3% of the networth of the company depending on the risk appetite of the company. [0.5]
- Since the company is new and writing Motor and Health business, therefore quota and surplus treaties should usually be taken for such lines of business. Proportional treaties ensure that the reinsurers are aligned with the insurer's pricing and hence lot of support is expected from the reinsurers [0.5]
- The net retention of the proportional treaties stated above may be further protected by excess of loss treaties as explained above. [0.5]
- If the company is writing Motor Third party business, then because of exposure to high value losses, excess of loss cover may be purchased for the same with limits and attachments aligned to industry benchmarks. [0.5]
- Property businesses are usually protected through surplus or excess of loss treaties. Since the company is new, chances are high that the property business would be protected through surplus treaties as the size of the risks would be limited in this case which is preferred by the reinsurers. The net retention of the surplus treaties can then further be protected by the excess of loss treaties. [0.5]
- Motor and Property business would be exposed to CAT perils like floods, EQ, cyclone etc….hence an aggregate CAT excess of loss treaty should be arranged for this business. [0.5]
- There are special arrangements like quota cum surplus and whole account risk cum cat excess of loss cover which are usually arranged to optimize costs through better terms and conditions from reinsurers. Reinsurers normally prefer such arrangements especially for new players as they guarantee premium cession to the treaties to a large extent.

[4]

ii)

a)

- Short tail (dominated by annual crops)
- Correlated risk- one drought event usually impacts large geographic area
- Highly participated with government subsidy
- High volatility in claims experience
- Catastrophic nature
- Reliance on Climate /monsoon
- No 'claim occurrence' date
- Politically influenced
- Potential for organised fraud
- Area based approach (PMFBY) and index based approach (WBICS) which are subject to significant basis risk

[0.25 for each, **Max 2**]

b)

Challenges

- Data Availability [2]
  - Government remains the primary source of yield data
  - Yield data at granular level not available
  - Data Gaps – errors in declaration e.g. crop sown/area sown may differ,
  - Completeness and Accuracy of data available
- Lack of credible and comprehensive Crop Insurance pricing models for Indian market
- Lack of persistency / renewal of business as it is yearly tender driven
- Frequent policy changes by the Government
- Catastrophic risks in Crop Insurance
- Less innovation in product features for changing climate as compared to improvements in other countries
- Crop Cutting Experiments (CCE) limitations
- Financial illiteracy among the farmers about product design
- Inadequate training to conduct CCEs
- Complex product design
- Reliability and validation of yields from CCE and Weather stations
- Basis Risk for weather based insurance which results in farmers receiving payouts which are not aligned with actual losses
- Moral hazard and adverse selection

[0.50 for each, **Max 5**]

c)

Choose appropriate method based on [1]

- Nature of business
- Guidance from regulator
- Data availability and
- Consistency in results

Case reserves - It can be determined based on claim calculation using CCE data/weather data [1]

UPR - It can be kept as 50% of annual premium to be conservative or using 1/365 method [1]

PDR - Evaluate premium against expected claims and expense. If expected claims and related claims handling expense (say x%) is greater than 100%, then PDR is kept as (x%-100%)*UPR. [1]

IBNR-

Ultimate loss ratio method: [3]

- commonly used method,
- Used globally as well
- Ultimate losses expected less claims reported so far.
- ULR estimates for different product and cropping season available from claims/UW department;
- Easy to implement;
- Not dependent on speed of claims settlement;
- It embeds the catastrophe claims information through ULR.

Other method: BF method/Chain ladder- unsuitable because: [3]

- Claims settlement pattern not reliable

- Link ratio initially can be volatile
- Ignores the latest weather info available in the market.
- Basic assumption of chain ladder method is that the claim settlement pattern in the past will continue in the future. However most of the crop insurance claims are paid subject to the subsidy receipt from the government. Claims are settled quickly when subsidy has been received and claims settlement is delayed in case the subsidy is awaited.
- This primarily makes claims settlement inconsistent from quarter to quarter, violating the basic premises of chain ladder method.

[10]

[21 Marks]

Solution 6: Investigate following possible benefit of economies of scale: [2]

- the benefit of economies of scale with the combined distribution network
- the savings that will be possible with combined model office
- the savings in underwriting, management of data and claims handling expenses
- The benefits/issues which may arise as an effect of combining the employee benefit schemes.
- Benefits of possible diversification of business in terms of target market, location etc.

Investigate the trend in premium rates to identify any major change in the strategy. Check this in conjunction with the following: [2]

  - market share and trend in the market share
  - new business levels and trends

Investigate the following in relation to claims: [2]

- frequency and average cost
- trends in above
- analyse the above by accident year, development year and payment year
- check for any large losses
- Investigate the adequacy of reserves by approximately calculating the reserves, if sufficient information is available. Also investigate reserving trends in UPR and IBNR by comparing the reserves of various years to identify trends, if any.

Others: [2]

- statutory solvency levels
- credit rating of the company
- free surplus
- the asset mix of assets supporting liabilities
- the asset mix of assets supporting statutory capital and free surplus

Investigate various accounting ratios/financial statements [2]

- investment returns in conjunction with the asset mix
- profit margin
- ROCE
- P.E. ratio
- loss ratios by line of business
- operating expense ratio
- combined ratios
- any qualifications in the financial statements by the auditor
- any mention of contingent liabilities
- tax liabilities [0.5 for each, **Max 10**]

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