

Institute of Actuaries of India

November 2010 EXAMINATION

**Subject ST7 — General Insurance: Reserving & Capital
Modelling**

Indicative Solution

1. (i) A broker is an insurance intermediary between the seller and buyer of a particular insurance contract who is not tied to any party.

- Brokers act for their client – the insurer – to obtain reinsurance on its behalf.
- Reinsurance brokers may specialise in the reinsurance markets only, or else deal with insurance, reinsurance, retrocession and other financial products.
- Brokers use their specialist knowledge of the industry, their customer and reinsurance contacts to get the best reinsurance price.
- Brokers have other specialist areas of expertise such as:
 - ✓ actuarial and catastrophe modelling
 - ✓ claims handling
 - ✓ technical reinsurance accounting
 - ✓ market security
 - ✓ rating advisory
 - ✓ capital markets and advisory.

1. (ii)

- Industry loss warranties (ILWs) are a type of reinsurance contract where the basis of cover is not indemnity, *i.e.* repayment of actual losses suffered.
- Protection is based on the total loss arising from an event to the entire insurance industry rather than individual insured company's own losses.
- The original size of the industry loss is used as a trigger for eligibility to a recovery. The contract pays a specified fixed amount to the insured if there has been an insured loss of a particular type, *eg* a hurricane, to the insurance industry of a particular size. Often, the industry loss-trigger is fixed, with reference to published loss information or, say, a known CAT model.
- Breach of a second indemnity-based trigger is the basis for payment and is with reference to the value of the losses incurred by the insured.
- The second trigger ensures that the insured has an insurable interest in the cover.
- The payout to the insured may be fixed, so there is a potential mismatch that works in favour of or against the insured.
- Due to the nature of the contract, reinsurer payment should be quite quick once the insurer makes a claim.

[9]

2. (i)

- New class of business is written
- New risks not covered earlier under any product sold by company
- Writing business that is not new, but proposed to be written with major changes in its terms and conditions to such an extent that past data cannot be used
- Provision of cover for unusual risks
- Writing products which are completely new to the market
- Business is written in new territories
- Introduction of new rating factors for pricing in a product for which data was not built up
- Claims data not available for certain cells, *e.g.* at the tails of claim distribution
- Risks relating to climate are written
- When claims handling function is outsourced to a third party
- There may be errors in the data, *e.g.* faulty IT system, faulty data supplied
- Latent claims, large claims, may not be separated

(ii)

- Where data are not available for the tails of claim distribution,
 - Assumptions may be derived from necessary calculations on a few assumptions and using judgment to make a final choice on the best estimate number to be chosen.

- Since, this will give rise to uncertainty in the model output, care should be taken when interpreting the model's output and the error likely may be given as an estimate.
- While handling new risks, such as for new products, or claim events for which data are not available or the implied risk is changing too fast to use past data, such as in the case of climate risks, assumptions on claim frequency and claim severity may be based on experience in similar class of business, benchmark/ official statistics or a subjective judgment. Uncertainty will be linked to the actual circumstances in a particular case.
- Industry statistics or reinsurer's data may be considered for use where individual company has no data, but care is needed to adjust such experience for own likely experience taking into account differences in risks covered, policy conditions and the demographic/ commercial profile of risks likely to be written. Quantifying uncertainty in such cases may be less difficult.
- Where the problem is due to outsourcing, company's own experience may be adjusted to allow for differences in claims handling and the nature of risks, if any. Quantifying uncertainty in such cases may be less difficult.
- Where the problem relates to expense assumption in claims handling due to changes in operations, discussions with the chief operations officer and the finance team could provide a basis for the assumptions. Quantifying uncertainty in such cases may be less difficult.
- Checks should be made on the IT system and on information received

[9]

3 (i)

Assumptions:

- average claim amount from each year of notification remains stable
- outstanding claim estimates of outstanding claims for all the data years are best estimates.

Average cost per claim calculations:

Financial Year ended 31 March of notification	No. of claims	Total paid + estimates Rupees 000s	Average cost per claim Rupees
2005	8,300	44,650	5,380
2006	15,200	108,025	7,107
2007	64,570	463,880	7,184
2008	69,100	491,550	7,114
2009	92,300	655,210	7,099
Average cost per claim over 5 years			6,777

Analysis:

The first year data indicates a very low average cost compared to other years. Possible reasons for the feature could be

- it is the most fully developed year
- the first data year may have had a cautious underwriting/ claim settlement standard
- the first data year has a low exposure
- the estimates for other years are too cautious
- uneven pattern of claim inflation implied
- changes in mix of vehicles by type of vehicle and similar factors
- the first year of a book's business (which this might well be) is often found to be out of line with rest of experience for various reasons

The second and subsequent data years show a more stable average claim pattern and hence calculation may use only these years.

Exposure volumes are higher for these years and calculation may be weighted to take account of this.

Calculation:

Data for first year is excluded and only the second data year to fifth data year total claim numbers and incurred claim amounts are used.

Then, the average claim cost =
 $1000 \times ((108025+463880+491550+655210)/(15200 + 64570 + 69100 + 92300))$
 = Rs 7126
 Estimated outstanding= 81500 ×7126–470000 = 110798596 or Rs 110,799,000

Further assumptions used:

- mix of vehicles and policy covers and conditions are constant
- definition of the number of claims is constant over the period
- Claim settlement trends over the period are allowed for
- Estimates of outstanding claims are accurate and consistent from year to year, and are all at 31/03/2010 values

(ii) Inflation adjusted average cost per claim data and calculation steps:

Data required would be:

- amount of claims paid tabulated by year of origin and development year
- number of claims paid split in same way.
- consistent definition of a claim
- claim inflation over the period of data
- estimates of future claim inflation

Calculation Steps:

- 1) Claim data in cells are inflation adjusted to 31-03-2010 (incremental amounts inflated then cumulated)
- 2) Average claim amount in each cell from the inflation adjusted data is found by dividing by corresponding number of claims
- 3) Average claim amount arising from each development year is found (by averaging over the financial years)
- 4) Number of claims settled in undeveloped cells is projected, using the basic chain ladder method on the claim numbers.
- 5) Average claim amount by development year is applied to the estimated number of claims settled in each cell.

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4.

(i) Proposal A:

Insurance risk, market risk and liquidity risks are the main risks to be reviewed.

It is possible that the industry as a whole may take a stand that the burden of tax may not be passed on to policyholders but be absorbed as yet another part of their expenses, particularly in the case of retail business.

This would lead to need for review of underwriting risk and reserving risk

Even if the decision is to pass on the tax burden to policyholders prospectively, the burden in respect of period from start of financial year to effective date of implementation allowing for delays in setting up systems to capture new tax provision would give rise to the need for higher cash outflows during such temporary period.

Consequently, in either case, need to review investment holdings will arise giving rise to review of market risk.

If the relevant period of readjustment to the new environment also coincides with fall in equity values, due, for example to fall in insurance company equity values and a mild impact on equity market as a whole, the need for review of market risk is much more important.

Although company is large, there is a need to review liquidity risk due to, say-

- Unanticipated and sizeable expenses on system changes
- Loss of renewal premiums and new business due to anticipations of policyholders of increases in premium rates
- Gaps in performance of plans for implementation of a consequential change and poor realisation on cash outflow and inflow matching

There is also a possibility of the tax rate being increased at a future date

Proposal B:

Operational risk, insurance risk and strategic risk are the main risks to be reviewed.

The proposal implies a high level of risk of losing top management staff to competitors and/ or to the insurance industry or to abroad, giving rise to a host of management risks, depending on the intensity and pace at which senior staff turnover actually takes place,

.. although it is possible that some staff leaving may not necessarily be the “key” personnel implying that the risk consequence is low for such positions

The loss of staff may lead to higher risks of mispricing and/ or deterioration in underwriting standards, claim settlement standards and reserving efficiencies. This necessitates a review of both underwriting risk and reserving risk

Despite loss of staff, a large company may still be in a position to attract talent and with regulatory controls on salary levels, the company may still be spending less overall and improve its profitability, at least over a medium term.

Failure to implement business plans or take appropriate decisions in time is a major risk in the event of loss of top management. This gives rise to need to review strategic risk.

[11]

5. (i)

The requirements are:

- Insurers should have procedures in place to monitor and manage their asset-liability positions
- The ALM should be based on economic value, and include scenario testing
- ALM measurement tools should be appropriate to the insurer and its risk characteristics
- The ALM should consider all risks that could have a significant impact on the insurer’s asset-liability position, including market risk, underwriting risk and liquidity risk
- The insurer should measure its exposure to market risk and credit risk
- The ALM should consider the effects of embedded options
- The insurer’s asset mix must enable it to have sufficient liquidity to meet its obligations as they fall due
- The board of directors should approve the insurer’s ALM policy, allowing for its risk tolerance
- The ALM should allow for different blocks of business
- The different functions involved with ALM should liaise appropriately
- The insurer should set controls in place relating to its ALM policies and review them regularly.

(ii)

(a) The ALM model may not have incorporated adequate or appropriate allowance for one or more of the following features:

- Money due from brokers is an item of net current assets and failure of a broker is a risk to an insurer. This points to need for addition to regulatory capital/ economic capital.
- Money held by brokers shown as broker balances in the assets is a non-investible asset and reduces investment return on the technical funds.
- Broker balances have also to be considered for credit exposures to the extent of any individual broker balances in excess of a normal limit (to be defined in the ALM model). The ALM model should also consider whether the Value-at-risk measure adequately allows for the concentration risk.
- Brokers render a wide variety of technical services with their specialist knowledge often specialising in reinsurance, rating help for new risks, processing routine claims, filter out any fraudulent claims, etc.
- However, the range of services varies from broker to broker and is often reflected in the commission rate paid and/ or other facilities allowed to the broker such as rules for retention of monies, extension of a direct link to insurer’s IT systems, etc. In some cases, broker might be acting in the capacity of a binding authority.

- This aspect gives rise to a number of factors to be considered for projections of cash inflows including delays and/ or netting of cash inflows and outflows, by individual brokers or alternatively by categories of arrangements/ levels of facilities to brokers and often allowing for deficiencies in the data provided by brokers.
- Larger commercial risks are placed generally through brokers, although dwellings are not so. Accumulations and CAT losses are also highly correlated with such risks
- Often, cross-subsidies within business brought by a single broker is a normal feature and it becomes difficult to sufficiently allow for the overall outcome for any particular broker or for the business from all brokers as a whole
- Profit sharing schemes exist in some cases to encourage brokers to pass on better quality business. However, in a period of soft market conditions, the insurer is under pressure irrespective of whether it changes the rates or does not change. This, combined with different commission rates to different brokers leads to a high degree of possible volatility in the business mix.
- While dealing with a number of brokers, there is higher risk of disputes with brokers, affecting cash flows and expenses.

(iii)

- All cash flows in both directions need reconsideration having regard to:
 - Linkages between the inflows and outflows and ensuring the full reflection of the financial significance of all broker arrangements without any gap or overlap
 - Allowing for any diversification effect within cash flows
- Assumptions on money defaults/ delays may be based on a matrix of such default/ delay incidences, made out, by broker arrangement types (say, 3 to 5 categories) and nature of risks underwritten or by levels of business concentration with individual brokers (again classified by say, 3 to 5 categories).
- Deterministic approach may be more suitable than a stochastic approach, as the company is medium size and in a growth phase making it difficult to get data for application of a stochastic approach
- Assumptions on claim frequencies, claim severities, IBNR and other elements which are part of technical liabilities may consider past experience, trends and a certain amount of judgment for future trends keeping in mind business plans of the company over the next 3 years.
- Stress testing should consider, among other things, impact of loss of relationships (with brokers), where business in terms of premiums is beyond a threshold limit, such as 10% of total broker business.
- Adequate number of scenarios may be tested with regard to aspects discussed in answer to part (a) above.

[17]

6. (i)

- General insurance business is subject to a comparatively high level of volatility. Such volatility relates primarily to observed claim frequencies, claim severities and /or claim handling expenses.
- If the business is subdivided by class, currency, territory, major risk groups within a class and such other subdivisions, one may expect reasonable homogeneity in the subdivisions of the business. This is so because the chosen subdivisions would reflect the distinctive features of risk of the subdivisions.
- If appropriate subdivisions are not chosen, then the pricing of products, estimation of claim reserves and the overall results are subject to volatility, higher degree of uncertainty, inadequate capital or poor return on capital employed.

Total for (a)

(ii)

- Data available in certain subdivisions may be insufficient to apply statistical methods and use valid tests. In some cases, no data may be available.

- Level of granularity has to consider the purpose and use of the model. There may be business reasons why a fully theoretical level of subdivision may not be used. The size of the model and the time to run, review and test the model is an important practical consideration.
 - In a theoretical approach the chosen level of risk tolerance may imply, too fine a level of granularity leading to need for more than available data in some cells. Often, more data are needed to assess variability in claim experience than for a mean claim frequency or severity measure.
 - Often, pricing is made by reference to commonly accepted rating factors rather than by using all relevant risk factors and, in a capital modelling exercise, it may be considered as appropriate to use the same level of granularity.
 - Thus, in practice, the actual level chosen is a compromise solution, particularly for some of the less material risks, applying the principle of proportionality.
- Total for (b)

(iii)

- Subdivisions, which might represent rating factors and influencing claim experience, such as:
 - Age of driver, in say 4 or 5 bands, such as <18, 19-25, 26-35, 36+
 - Cubic capacity in bands, such as <75 cc, 76-150 cc, >150cc and special high end models
 - Manufacturer in 2 or 3 groups, depending on brand image
 - Vehicle age in bands such as new, 1-3, 4-6, 7+
 - Use of vehicle such as commuting, commercial such as couriers, other
 - Sex
 - Past claim record in groups by number of claims in the last 3 years
 - Region where policy is issued (as a proxy for location of use) in 3 groups, say, metros, other cities and the rest
 - Policy data may be subdivided using combinations of 2 or 3 factors from those listed above.
 - Claims data may be subdivided further by nature of claims in 4 groups, namely, vehicle own damage, third party (TP) property damage, TP bodily injury and TP death.
- Total for (ii) (a)

- (iv) 1. Identify all subdivisions of single factor, 2 factor and 3 factor combinations where policy or claim data is at least 5% or more and number of claims over last 3 years is at least of a statistically credible minimum size such as 1082.
2. Examine results of analyses of claim frequency and claim severity for mean and variance and rank the subdivisions in 1 above giving weight to total exposure and variability of experience. This could be a somewhat judgmental exercise.
3. Discuss with marketing or others in management team on the likely focus in business plan for the next 3 years having regard to volumes and profit targets to understand likely changes and movements in exposures for different subdivisions considered for use.
4. Finalise subdivisions to be incorporated in the model using the information up to step 3 above and using the “principle of proportionality”. Since the motor cycle is a minor segment within the motor portfolio of business, a comparison of subdivisions used for the main group will indicate the total number of subdivisions to be used as, for example 6 to 8 in motor cycle compared to 8 to 10 in the main group.
- Total for (ii) (b)

[16]

7.

- The note would indicate how the model allows for the capital requirement of a particular portfolio: whether it is on a gross basis with explicit allowance for reinsurance, or it is on a net basis where the liabilities are considered on net of reinsurance basis making an implicit allowance for reinsurance.
- It would also include a brief explanation with illustrative numbers of why the choice is made and how the alternative would not be appropriate.
 - The note would also cover issues associated with modelling the reinsurance recoveries:
 - The provisions in the reinsurance treaty relating to limits on the number of reinstatements, number of reinstatements which are free (that is, prepaid) or paid.

How the risks in the tail of the relevant distribution are considered, allowance made for the possibility of exhausting available reinsurance protection

..and the contingent cost of any reinstatement premiums will also be described quoting the relevant numbers from the model and the model outcome.

- The statement on the calculation of such reinstatement cost will be supplemented by a statement on an assessment of the built in cost of “free” reinstatements in the original premiums.
- In case an implicit allowance for reinsurance recoveries is made in the model, a brief description of how the allowance operates, the likely outcome with 1 or 2 illustrations and a statement of the associated uncertainty will be included in the note.

- If the reinsurance treaty protecting a particular portfolio is not on a risks attaching basis, the note will indicate how the risk of an increase in the cost of renewal and inability to renew the treaty have been incorporated in to the model.
- Additional capital thrown up on this risk would be identified with a statement on the uncertainty associated with the approach.
- The note will include a brief description of how the credit risk associated with potential reinsurance recoveries is dealt with.
- The manner in which allowance for reinsurer default in the event of a large portfolio
- ..and allowance for correlation between such default and market risk of fall in asset values is made will be described
- ...along with a statement on the additional capital to meet this risk and the degree of uncertainty associated with the assessment.
- The note will include a description of any reinsurance covering multiple classes and the manner in which recoveries are allotted back to the individual contributing classes. Similarly, for whole account reinsurance protections.

- The description of treatment of recoveries will be accompanied by a statement on how the allocation of reinsurance premiums has been made.
- ...If a stochastic model is the basis used for the purpose, brief statement on how the model works and the outcome will be included.
- The note will also cover aspects relating to diversification effect, changes to insurance risk, credit risk, liquidity risk implied in the model and any issues relating to data deficiencies and how they have been dealt with in the model.

[12]

8.

(i) Loss ratio = Claims Incurred/Earned Premium

2008-09: 245/305 = 80.3%

2009-10: 465/495 = 93.9%

Expense ratio = Expenses Paid (including commission) /Written Premium

2008-09: (82+33)/322 = 25.5% + 10.2% = 35.7%

2009-10: (96+52)/535 = 17.9% +9.7% = 27.7%

Solvency ratio = (Assets – Liabilities) / written premium

2008-09: 138/322 = 42.9%

2009-10: 150/535 = 28.0%

(ii) Loss ratio

The loss ratio has worsened.

Possible reasons:

- ✓ More large claims and/ or a catastrophe in 2009-10.
- ✓ Poorer quality business (indicated by higher loss despite more premium).

- ✓ Generally poor claims experience due to higher TP claims in motor and higher proportion of major damages in household.
- ✓ Poor underwriting due to change in staff.
- ✓ Inadequate premiums.
- ✓ Deterioration in claims controls due to changes in procedure and/ or staff.
- ✓ Strengthening of reserves for outstanding claims by revision of standard reserving procedures or IBNR.
- ✓ Change to the level of reinsurance cover
- ✓ Reduction in claim recovery from reinsurers or salvage.

Expense ratio

The expense ratio has improved.

Possible reasons:

- ✓ Lower per policy expenses increased volume of business.
- ✓ Cost reduction measures.
- ✓ Lower commission rates due to-
 - Increased use of a different sales channel.
 - An expansion in the class with lower commission rate.
 - Reduction in profit-related commissions due to deteriorating results.

Solvency ratio

Solvency has worsened.

Possible reasons:

- ✓ Net assets have reduced although premiums have increased
- ✓ Poor claims experience
- ✓ Lower returns on assets

[8]

[Total Mark 100]
