

Institute of Actuaries of India

Subject SP8 – General Insurance: Pricing

September 2021 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) a) Risks attaching basis b) losses occurring basis c) Claims made basis (1)
- ii)
- Two main types of run-off reinsurance are adverse development cover and loss portfolio transfers (1)
 - Adverse development cover is a retrospective stop loss on claims reserves. (1)
 - Loss portfolio transfer is a retrospective quota share on claims reserves. (1)
 - In adverse development cover, the structure can be customized to meet the needs of the insured e.g. a loss corridor, maximum limit of cover etc. (1)
 - In Loss portfolio transfers, the insurer has no further liability with respect to the block of policies, which have been transferred. (1)
 - In case of Loss Portfolio Transfer, reinsurers will often take control of handling claims because the profit they can make will largely be dictated by their ability to runoff claims for less than book value. (1)
 - In case of Loss Portfolio Transfer, investment risk is borne by the reinsurer i.e. risk that the reinsurer will generate less investment income when losses from claims are paid faster than expected. (1)

[4]

[5 Marks]

Solution 2:

- i)
- Area to be insured
 - Location of property (Seismic zone, flood prone areas etc.)
 - Use of Property
 - Owned or rented
 - What kind of security is available for property (CCTV, 24*7 Security guard etc.)?
 - Type of construction (RCC, Brickwork etc.)
 - What kind of fire safety features are available (Fire extinguishers, hydrants, sprinklers etc.)?
 - Age of building
 - Building floor
 - Whether the property is occupied during the day or not?
 - Whether it is a house or flat or some other construction?
 - How close is fire station?
 - Type of heating devices in property
 - Loss history
 - Any other relevant risk factor

[1/2 mark each, Max 5]

ii) Actuarial Investigations

- Reconciliation of premium and claim register with finance or any other credible source needs to be done.
- Consistency of premiums and claims i.e. Accident Year mapping / UW Year
- Changes in exposure or business mix
- Rate change over the years
- Claims frequency across different rating factors
- Claims severity across different rating factors
- Underwriting cycle effect and insurance premiums are getting softer?

- Is there any change in reinsurance arrangement
- The comparison of both gross and net loss ratio needs to be done
- Impact of Large loss on the overall loss ratio / profitability
- Accumulation / catastrophic exposure
- One off catastrophe event which may be increasing loss ratio
- Is experience and data credible enough as less data will increase volatility
- Is there any change in policy wording and consequently increase in coverage/exposure?
- Accumulation or bunching of claim from one related event or location
- Is there any change in claim handling cost and were they excluded or included earlier?
- Is there any change in regulation due to which loss ratio is increasing?
- Is there any change in claim reserving practice?
- Is loss ratio increasing due to lapse of few key accounts?
- Is there any change in the way company calculates unearned premium reserves?
- The historical data needs to be adjusted in order to arrive at revised base risk rates by appropriately account for all the changes and trends
- Whether company has enough credible data to re-price or adjust the premium charged
- Are there any industry standard or internal exposure curves available in order to price?

Pricing Approach

- The historical losses need to be broken down in attritional, large losses and catastrophe losses
- Standard price approach (burn cost method, frequency severity) could be use arrive the base risk cost, if credible data is available. However, this approach may not work for large commercial risks
- The severity could be estimated with the help of claim handlers, underwriters and reinsurers
- Premium also needs to be loaded for large losses in order to apportion the large loss load by assuming a return period to assumed severity
- Large loss could be different depending on the size of risk and there is a need to study claim distribution by sum insured bands to arrive a threshold for large loss
- Outlier should be removed while preparing the datasets for pricing
- There is a need to allow for incurred but not reported claims in pricing or to work on developed data in order to estimate the ultimate burning cost

[1/2 mark each, Max 12]

[17 Marks]

Solution 3:

i) Chi squared statistic:

- Scaled deviance shall be computed for fitted model using both the rating factors – “Experience” and “Age of the driver. Same shall be computed for the model without considering these rating factors. Let us refer to the former as Model 1 and second as Model 2. Model 2 will be a subset of Model 1. (1)
- Number of degrees of freedom is number of observation – number of parameters. In the case of fitted model considering both the rating factors (Model 1), number of parameters will be 2 more than the model which does not consider these rating factors (Model 2). (1)
- Scaled deviance of model 2 minus Scaled deviance of model 1 follows chi square distribution with parameter – Degrees of freedom of model 2 – Degrees of freedom of model 1, which in this case is 2. (0.5)
- Depending on the significance of the differences in Scaled deviance, it may be decided if Model 2 is an improvement over Model 1. (0.5)

F statistic:

- Here, instead of scaled deviance, total deviance of the model is computed for both Model 1 and Model 2. (0.5)
- $(\text{Deviance for model 2} - \text{Deviance for model 1}) / [(\text{Degrees of freedom for model 2} - \text{Degrees of freedom for model 1}) * (\text{Deviance for model 1} / \text{Degrees of freedom for model 1})]$ follows F distribution with parameters (Difference in degrees of freedom between model 2 and model 1, Degrees of freedom of model 1). If the same is significant, Model 2 will be chosen over Model 1. (1.5)

AIC statistic:

- Since model 1 and model 2 are nested, it is more appropriate to use chi squared test / F statistic than AIC. (1)

[6]

ii) Differentiation between Life curve and Gain curve:

- Both lift curve and gain curve can be used to validate the severity / frequency / burning cost for the fitted model. (1)
- Under Lift curve, all policies in the validation dataset in order of expected experience and then to group the policies into bands of equal exposure based on this ranking. (1)
- Predicted frequency / severity / burning cost has to be plotted and displayed as a curve. Whichever model has higher lift i.e., whichever is steeper is more predictive model. (1)
- Under gains curve, cumulative values (frequency / severity / burn cost) from both the fitted model and observed values are plotted against cumulative exposure (viz., policy years exposed, sum insured etc.,). (1)
- Statistical measure for the lift produced by the model is called Gini coefficient. The higher the Gini coefficient, the more predictive the model. (1)

[Max 4]

[10 Marks]

Solution 4: Pricing of standard fire products:

i)

- Since the insurer is a medium sized insurer with fire as a major LoB, insurer's own data will be the starting point to determine the pricing for the products. (0.5)
- Consideration can also be given to market rates / industry data (0.5)
- ...especially where companies' own experience is not credible or volatile (0.5)
- Need to consider only FLEXA and STFI related claims for pricing. (0.5)
- Need to consider different occupancies and rating factors e.g. individual dwellings, co operative housing societies etc. as applicable (0.5)
- Number of years of experience required in pricing may be decided depending on the availability of data. (0.5)
- Suitable adjustments have to be carried out for unusually high / light experience, large or exceptional claims, trends in claims experience, inflation, IBNR loading. (1)
- Other adjustments that have to be carried out are for change in underlying mix, cover / policy conditions, claims handling / underwriting changes, level of reinsurance coverage. (1)
- Insurer may choose frequency – severity approach or Burning cost approach. Since, it is expected that insurer has own data, insurer may price the same using frequency – severity approach. (0.5)
- From the risk premium, office premium shall be arrived at after loading for commission, expenses, reinsurance cost, profit margin etc., (0.5)

[Max 5]

ii)

- For pricing the product, the claim experience of the insurer along with the expected claims in the future plays a vital part. Given that XYZ has sizeable exposure to fire insurance business, the insurer is expected to have credible experience which leads to more correct pricing. Other insurers may not have as big a book as this insurer, hence those insurers may have relied on external data or not so credible data in pricing. This may have lead to difference in premiums. (1)
- In some cases, other insurers may follow reinsurer driven pricing and merely fronting the risks, which leads to a premium as quoted by the reinsurer. (0.5)
- Target market of the insurers may be different for example, XYZ may have exposure to more risky business, which leads to higher premium. (0.5)
- Strategy of the insurers may be different as some may want to charge lower premium, hence planning to capture more risks. (0.5)
- There may be difference in marketing expenses, policy administration expenses and other management expenses, which lead to a difference in premium. (0.5)
- Commission structure and expected distribution mix may be different, which lead to a differential pricing. (0.5)
- There may be difference in rating factors which may lead to a difference in pricing among policyholders and this may not be evident from observing premium differences only for few policies, which may be the conclusion of sales team. (0.5)

[Max 4]

iii)

- It may be analysed if more flexibility may be given to underwriters depending on underwriting policy to quote a premium which may be lower. (0.5)
- Attractive add-ons may be added, which may be offered at lower rate which may help increase the take-off of the product. (0.5)
- Cross selling to existing policyholders (of other products) may be done including offering a cross sell discount. (0.5)
- If after a reasonable time the experience of the book is very favourable, premiums revision downwards may be refiled. (0.5)

[2]

iv)

- Given that both are benefit based add-ons, the consideration here is to determine only the frequency. (0.5)
- Since the perils which lead to a payment under the add-ons are almost the same as the base product, it is essential to benchmark the premiums under the add-ons to the base product. This not only make the premium calculation easier, but also more logical. (1)
- It is important to factor in take up rate of the add-on and also, anti selection risk while pricing these add-ons. (0.5)
- While arriving at office loadings, it is important to consider business projection for both base products and add-ons, as this may change the expense loadings while pricing. (1)

[3]**[14 Marks]****Solution 5:**

i)

- There could be an increased hospitalization and eventually claims related to Covid-19 pandemic
- Accidental claim should reduce on account of restricted movement of public

- There could be an increase in claim cost for all hospitalization due to increased protocol on account of pandemic, government actions and increase in equipment cost and doctor fees
- Deferral of planned hospitalization due to government lockdown
- Increase in claims for home treatment

[1/2 mark each , Max 2]

ii)

- Premium charged is a function of the expected claims in future and in order to price, it is very important to understand what is the impact of pandemic on future claim cost
- Pandemic could have both short and long term impact on claim cost. Important to understand whether the surge is one time or the same will have a long term increase in hospitalization cost
- Short term and long term impact need to be priced differently and its impact on pricing also depends on company's strategy, market share, underwriting cycle etc.
- The surge in claims need to be broken down in two components
 - Claims related to Covid-19 pandemic
 - Claims other than pandemic (Non Covid-19 claims)
- If pandemic is expected to be a one-time short term phenomenon, then ideally no explicit allowance should be made for its claim in Retail pricing, which is for long term
- Exposure based rates are hard to change and also influences the positioning of insurance company in industry. Very careful market assessment should be done before changing premiums
- There could be a stance to recover the pandemic related claim from retail customers and spread that recovery by charging a minimal over next few years
- However, this depends on how the company is placed and what is a stage of underwriting cycle in industry. Charging higher for recovery of pandemic related claims might make premiums excessive and result in loss of market share
- The view could be different in case of experience based group indemnity pricing. Experience based pricing provides flexibility in adjusting premium and premium can reflect the short term view of pandemic
- It is easier to have a view for next 1 year in group pricing rather than retail exposure basis pricing which is for long term
- Company may have different profitability on retail and group portfolio which allows them to take a different stance on loading for surge in claims
- If group portfolio is already with thin margins, then company may increase premiums by 25% in order to be prudent and to avoid large loss
- Competitor actions can be monitored more closely and effectively in experience based pricing rather than exposure based pricing
- The increase in claim cost should be studied by sum insured, family composition, age bands etc. in order to understand the impact of increase in claim cost
- Covid-19 pandemic might be leading to higher number of hospitalization for higher age or people with morbidity etc. It is important to understand the reason and rate of hospitalization
- The Covid-19 pandemic may be geography based and might be leading to higher number of hospitalization in few geographies
- It is important to understand the exposure of company towards potentially vulnerable population/geographies and then appropriately allowing for same in pricing
- The companies with higher number of vulnerable population will require higher rate hike in order to subsidize the losses
- The non covid claim trends should be compared with historical claims to understand the increase or decrease in claim cost for non covid claims
- Month on month comparison of non covid claims should be done as government restrictions might have caused a decrease in non covid claims due to deferral of planned hospitalization, reduced accidents etc.

- Deeper analysis basis frequency and severity of claims should be done in order to understand the impact on non covid claims on both rate and cost of hospitalization
- The disease mix should be compared with historical trends in order to understand the change in claims pattern
- The hospitalization cost for non covid claim might change due to extra protocol being followed during hospitalization and it is important to understand that for how long these protocols are expected to be in place in order to allow them in pricing
- If there is any dip in non covid claims due to government restrictions or fear of pandemic, then the claims need to be normalized or loaded as the pricing is for future which assumes situation to be normal as pre-pandemic
- Appropriate allowance need to be make for covid claim cost. This could be basis the past trend of claims received and future outlook of pandemic situation
- Experience based pricing may discount the surge in claim due to covid-19 if the situation is expected to be normal and then charging excessive premium may not be successful in free market

[Max 10]

iii)

- Stage of underwriting cycle may influence heavily on premium charged
- Market share and positioning of company in industry
- Competitor actions
- New insurer may enter and undercut existing insurers
- Shareholders expectation will influence the level of profitability the company want to operate at
- The change in distribution cost will influence the premium charged
- The claim handling expenses might increase due to surge in claims and that may influence the level of premium need to be charged
- Reinsurance arrangement might have helped company in absorbing losses on net. This might have caused less burden on company profitability and hence eventually may not require high increase in premiums
- Change in regulations, if any
- Change in policy terms and conditions
- Changes in economic environment will influence the premium paying capacity and eventually will influence the premium charged
- Any change in expenses?
- Any change un investment income?
- Profit loadings?
- Difficulties in establishing a technical price due to volatility in claim experience
- Price elasticity of demand

[Max 5]

[17 Marks]

Solution 6:

i)

- Terms and conditions of the aggregate excess of loss treaty need to be ascertained. Whether there is an upper cap on the amount that will be paid by the reinsurer need to be determined. It is essential to determine whether the aggregation is by year or by an event, as the approach changes depending on the level of aggregation. (1)
- Reinsurer may use exposure based pricing / experience based pricing for pricing the cover. (0.5)
- In exposure rating, it is common to use first loss scales for the purpose of pricing for property insurance. (0.5)
- If credible data of cedant is available, it is common to use experience based pricing. Experience based pricing involve burning cost method / stochastic frequency / severity model. (0.5)

- Under burning cost approach, reinsurer applies the terms and conditions after adjusting for claims inflation and future expected trend. (0.5)
- Unusually light / heavy experience, change in underwriting of cedant, economic conditions, change in business mix of cedant need to be considered while adjusting the claim amounts. (0.5)
- Claims data should contain both case outstanding reserve and IBNR. All ground up losses of cedant shall be estimated. This is especially essential if the aggregation is by year, as total loss may exceed the annual limit. (0.5)
- Large losses are of particular concern in reinsurance pricing. Hence, suitable loading for large losses need to be included in pricing. (0.5)
- If loss triangles by underwriting year / year of loss are made available, then same may be developed and burncost based on upper limit shall be determined. (0.5)
- Since, it is normal that the data with reinsurer is quite sparse, reinsurer will use stochastic development factors / claim amounts to arrive at the burning cost estimate for the claims. (0.5)
- Severity / frequency trends may be modelled separately if the reinsurer uses frequency severity method. (0.5)
- Catastrophe loading is essentially important in case of aggregation of loss by event. OEP and AEP may be taken from catastrophe modelling softwares. Exposure of cedant plays an essential role in determining the severity for this. (1)
- Consideration for any inuring reinsurance covers, aggregate deductibles, indexation. (0.5)
- Other loadings of reinsurer viz., expenses, ceding commission, profit margin, contingency margin need to be factored in while pricing. (0.5)

[Max 8]

ii)

- It is essential to consider fully indexed limits, server indexation clause and franchise indexation clauses differently.
- By making a suitable assumption about future inflation rate, the average effect of indexation can be calculated.
- This inflation rate can be applied to both the reinsurance attaching point and upper limit and accordingly the burn cost can be recalculated.
- However, depending on whether the aggregation takes place by event / year / peril, the inflation rate varies from case to case.

[0.5 mark for each point , 2 marks]

[10 Marks]

Solution 7:

i)

- Policy dates (start, end, Installment date, cancellation, endorsement etc.)
- Renewal date, if policy is renewed
- Date of issue of renewal notice
- Type of payment option chosen (EMI/One time)
- Premium amount before and after renewal
- Distribution channel (Direct, Agent, Banks etc.)
- Policy by policy data
- Product name or code
- Installment premium
- Average premium is policy premium for whole term divide by number of policy
 - Company has issued two policies

- 3 years' policy with premium amount of 300 for 3 years
 - 1-year policy with premium amount of 1200 with equal monthly installment option
 - Number of policies: 2
 - Total premium is $300 + 1200 = 1500$
 - Average premium is $1500/2 = 750$
- Renewal rate is defined as number of policies renewed as a proportion of number of renewals due
 - Company has issued multiple policies with policy ending date in month of valuation
 - Policy 1: 3-year policy which got cancelled before issue of renewal notice
 - Policy 2: 1-year policy issued with monthly EMI option
 - Policy 3: 1-year policy with one-time premium
 - Number of policies: 3
 - Number of policy for which renewal is due: 2
 - Assuming both policies renewed
 - Renewal rate (net of cancellation): Number of policies renewed / Number of eligible policies due for renewal i.e. $2/2$, leading to 100% renewal rate

[Max 4]

ii)

- System should be designed in a way that it captures the complete policy information
- Should allow for calculation and manipulation of data
- Process for reporting the results
- Should capture all relevant policy and transaction information
 - Dates
 - Amounts
 - Coding for products
 - Deductible
 - Sum insured
 - Coverages
 - Policy number etc.
- Should aid in decision making
- Easier to use and processes data fast
- Should be flexible
- Cost effective
- Should flag the outliers or inconsistencies as per designed rules
- Data should be complete
- Lapse rate should have clear definition as how the lapsed policies are treated. What is the treatment of policies with EMI option?
- System should be documented and easy to operate
- Should be technologically advanced and future ready
- Should be extendable
- Output should be reported at the user defined level of granularity
- Ownership of data entry, coding etc. should be well defined
- Should allow for user based restrictions for data security purpose
- Compatible with other system within companies
- Should cater to requirement of different teams (finance, underwriting, investment, risk management etc.)
- The data system should be flexible enough to allow for premium adjustments to be made
- The system should record commission paid to broker and other intermediaries
- Should apply logical checks and avoid entering inconsistent information by user
- Should be able to capture and fit complex reinsurance structures
- Should allow for export of data in multiple formats

- Easy linkages should be provided to systems which can read directly from core system
- System should be able to give warnings and confirmation before changes can be made to the rating factors or other key data
- Training manual should be provided
- Should be able to handle large and complex databases

[Max 10]

[14 Marks]

Solution 8:

- Large commercial risks are not homogenous. They vary from each other. (0.5)
- There may not be much data viz., policy details, claims experience may be available as they are very less in number. More over where the same is available, the same may not be credible. (1)
- They are low frequency high severity risks. Burning cost approach is well suited for high frequency low severity risks. Mostly they are for class rated products. (0.5)
- Period over which losses under large commercial risks were observed for these risks are shorter than the return period of losses under consideration. (0.5)
- Some of the events may not have occurred in the past and may not be captured by the burning cost approach. (0.5)
- For example, in case of large commercial risks, perils like earthquakes, hurricanes, nuclear disaster, terrorism are of significance. They may not have occurred previously. Hence burning cost approach may not be applicable in this case. (0.5)
- Experience rating may not be possible in view of data unavailability for these risks. Moreover, the risks are quite complex to be modelled using burn cost approach. (0.5)
- Catastrophe modelling starts with a past event but applies over a much longer scale. Hence the same captures the return period for a peril. (0.5)
- It uses stochastic event set thereby including the possible future events. This includes events which have not happened in the past. (0.5)
- The model calculates the effect of the events defined on the insured portfolio utilising a detailed understanding of the insured location. (0.5)
- It also allows for change in frequency, severity, change in portfolio, changes in vulnerability of buildings etc., Same is not possible with burn cost approach. (1)
- As catastrophe models take input based on seismology, meteorology, hydrodynamics, structural and geotechnical engineering, the same is able to predict better compared to traditional burn cost approach. (1)
- It also has vulnerability module, which helps to determine the magnitude of loss. (0.5)

[8 Marks]

Solution 9:

i)

- Marketing expenses
- Product development cost
- Policy issuance cost
- Policy servicing cost

[0.5 mark for each head, 2 marks]

ii)

- Current expense level of insurer needs to be estimated, out of which that can be attributed to the product shall be considered.

- Sometimes, current expenses of the insurer may be quite high in view of age of the company or one off expenses, for which rationalisation of expenses has to be done.
- Expense may be analysed differently as direct expenses and indirect expenses need to be considered separately.
- Due consideration has to be given to expense capping due to regulations.
- It is better to consider per policy expense for pricing. However, sometimes, one off expenses may have to be rationalised across the book.
- Claims related expense (if any) may also be considered while arriving at the assumptions.

[0.5 mark for each point , 3 marks]

[5 Marks]
