Institute of Actuaries of India

Subject SP8 – General Insurance: Pricing

July 2022 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)
- Physical Loss (Partial and Total) to/of:
  a. drone
  b. payload (camera equipment, sensors, packages/ "slung items")
  c. ground station/control unit
  d. Spares
  e. Transit coverage
  f. Theft
  g. Loss of possession of Drone as a result of an Accident
- Cover against Third Party Liability due to usage of Drone to pay damages
  h. …including Defence Costs
  i. …for third party civil claims arising out of Bodily Injury or death or Property Damage, by an Accident

…or a handling error on part of the Authorized Operator, in accordance with the terms of this Policy

[1/2 Mark for each point]   [4]

ii) Personal Accident to Operator
Accidental Medical Expenses to Operator
Alternate Hire Charges
Drone War Liabilities
Cyber Liability Cover
Invasion of Privacy Cover
Night Flying Endorsement
BVLOS Endorsement
Drone in Transit Endorsement
Liability for damage to drone that insured does not own
Personal & Advertising Injury Liability

[1/2 Mark for each point]   [3]

iii) Size of Drone
weight of the Drone
Cost of Drone
Payload carrying capacity
Actual cost of payload
Type of payload
Usage of the Drone
Operator / Pilot Experience
Regulatory requirement for Minimum/Maximum Limit of Liability

[1/2 Mark for each point]   [2]

iv) Exclusions which can forms part of the policy structure is:

- Wear and tear, deterioration, depreciation
- War and Allied Perils Claims
- Atomic or nuclear fission and/or fusion or other like reaction or radioactive force or matter Strikes, riots, civil commotions or labour disturbances
- Electrical and Mechanical breakdown
- Claims arising whilst the Drone is being used for any illegal purpose or for any purpose other than those stated in the Policy Schedule
- used any racing or competition Flying
- outside the geographical limits stated in the Policy Schedule
- whilst the Drone is being operated by any person other than an authorised Licensed Operator
- being operated by any person under the age of 18 years

- Claims arising whilst the Drone is landing on or taking off or attempting to do so from a place which does not comply with the recommendations laid down by the manufacturer of the Drone
- Compliance with Air Navigation and Airworthiness Orders and Country Regulations
- Must comply with any usage regulations in force issued by any Country where the Drone is being operated
- When operated by the authorised operator /Pilot under the influence of liquor or such toxic substance
- used for Recreational Flying, unless specifically covered with additional premium and underwriting considerations.

[½ Mark per point]   [4]

v)
- Drone being a new product, the demand could be too low / high
- …difficult to cover fixed expenses if too low
- …capital strain if demand too high

- Lack of Internal / external data leading to
- …improper pricing
- …Reserving
- Inappropriate pricing structure leading anti-selection
- Inadequate understanding of risks leading to UW and claims handling challenges
- Loose Policy wording
- …gaps in coverage being offered
- …additional coverages not intended at time of pricing
- Availability of reinsurers
- Changing or evolving nature of risks
- Fraudulent claims
- IT failure / Cyber Attack
- Availability of Professional Aviation Surveyors could be a concern considering the fees would also be relatively small in comparison to survey of manned aircraft
- There is no guideline available in our country for arriving at the Third-Party Liability limit arising out of drone operations
- Reputational impacts
- Regulatory issues
- Accumulation of losses
- Poor expense control
- Poor claims management
- Governance issues / Operational failure
- Poor Investment returns
- Assets not sufficiently liquid

[½ Mark per point]   [6]
[19 Marks]

Solution 2:

i) A system by which the premium of each individual risk depends, at least in part, on the actual claims experience of that risk (usually in an earlier period, but sometimes in the period covered). The latter case is sometimes referred to as swing rated or loss sensitive, and there are often upper and lower limits defining a 'collar' or 'corridor'.

In a general meaning, Experience rating is a rating based purely on the experience of the historic risk presented, as opposed to 'exposure rating'.   [1]

ii) Number-Based Experience Rating:

Premium adjustments (whether prospective or retrospective) are based on the number of claims paid in respect of the policyholder, and the amounts of the claims are ignored.

E.g. bonus-malus or NCD systems used in motor insurance

Cost-Based Experience Rating:

Premium adjustments (whether prospective or retrospective) are based on the total amount of claims incurred in respect of the policyholder over a defined period.

E.g. motor fleet (for larger fleets) and employers' liability.   [4]
                                                                                [5 Marks]

Solution 3:

i)
- Company might have underwritten a large Government Health Scheme leading to increased Health premiums for the year
- De-growth in other lines of business
- …driven by economic environment
- …withdrawal due to higher losses / UW cycle
- Company recently ventured into Health Group insurance
- Company has repriced its products to reduce loss ratios leading to increase in premium rate
- Company has tied with new aggregators
- Company has started selling through other channels such as Bancassurance channel
- Company has launched new Health products which are in significant demand
- Company has increased its presence in digital space
- Competitors has placed strict control on underwriting in some of loss making segment such as old age policyholder and more of these are migrating to this company
- Change in fiscal regime
- …e.g. tax relief on certain groups of policyholders buying insurance
- change in regulatory regime
- e.g. certain types of insurance becoming compulsory
- Pandemic resulting more people buying Insurance
- Company has weakened its underwriting process
- Company has moved its claim handling procedure to TPA who are lenient in claim settling
- increase in anti-selection by policyholders
- Company has started providing higher Sum Insured in existing policy/new policy which has higher premium
- Loss leader such as in Health Group to grab profitable property business
- Launched new product with good Wellness features
- Higher incentives to distribution partners
- strategic change in target market
- change in marketing method
- change in pricing structure
- introduction of new rating structures
- change in company reputation
- e.g. company providing service guarantee

                                        [1/2 Mark for each point]   [7]

ii) Expected pure risk premium = 15% * 50000 = 7500
Expected number of claims = 15% * 500 = 75
At 90% (P) probability of the actual pure risk premium to be within 10% (K) of the true mean, the number of claims for full credibility is
$=(y/k)^2*(1+CVx)^2$ where $y= \Phi^{-1}((1+P)/2)$
$=1*[(\Phi^{-1}((1+0.9)/2)) / 0.1]^2$
$=271$

So, credibility factor is = (200 / 271)^0.5 = 0.5265
The credibility weighted pure risk premium = 0.5265*9000 + (1-0.5265)*7500 = 8289.76   [5]

Assumptions:
- Estimated number for claims for IBNR has been included in the actual number of claims reported.
- Any open claim at time of submitting the data has been assumed to be finally settled at the same amount.
- It is assumed that mix of members will not chance in the next coverage year
- Inflation adjustment has not been done on the past year pure risk premium   [Max 3]

                                                                      [8]

                                                                [15 Marks]

Solution 4:

i) <u>Advantages of frequency / severity method over burning cost:</u>

- Identifies underlying separate trends in no of claims and claim amounts
- Mirrors the actual underlying claims process.
- More helpful in modelling complex reinsurance structures e.g. deductibles and limits.
- Can be blended with exposure-based methods
- Allows for changes in underlying exposure / business volumes

<u>Disadvantages of frequency / severity method over burning cost:</u>

- Need detail data requirements for both claims and exposure
- … to estimate development factors
- …estimate the distribution / parameters.
- Depending on the class of business and volatility in claims, the estimates could be un-reliable
- Time-consuming for a single risk and requires a high level of expertise.
- Difficult to develop individual claims to ultimate and may be a judgmental process.   [Max 6]

ii)
- Frequency and Severity need to be trended separately and there are different factors which impact the frequency and severity.
- Changes in risk profile
- Changes in policy terms and conditions
- Changes in social behaviour e.g. awareness or litigiousness
- Changes in regulatory environment
- Economic environment changes
- Legislation changes
- Changes due to underlying medical technology
- Wage Inflation or underlying claims inflation
- Court award inflation
- Litigation costs
- Future healthcare costs
- Impact of large losses or accumulation
- Changes in underlying claims deductibles thereby affecting the overall claims ultimate
- Trending is usually applied on the individual from ground up loss amounts, whereas the frequency trends are applied on the historical frequency at the policy level.

                                                                 [Max 6]

iii)
- An incurred development factor to each individual loss (that is, open and closed claims), reflecting its maturity, to estimate its ultimate settlement value.
- A more realistic approach is to only develop open claims using "case estimate" development factors. These case estimate development factors will usually be higher than

incurred development factors at the same maturity to offset the effect of not developing closed claims.

- Stochastic development methods can be used to allow for the variation that may occur in individual ultimate loss amounts around each of their expected values. [Max 3]

[15 Marks]

Solution 5:

i) Model 1: Excluding Pet Colour
Model 2: Original model

Test Statistics:
$(D1-D2)/((df1-df2)*(D2/df2))=(215000-20000)/(((20-(20+5-1))*(200000/(50-20))) = 0.5624$

The upper 5% of $F_{df1-df2,df2}=F_{4,30}=2.69$

Since the test statistic is lower than the F value, we do not reject Model 1 over Model 2. That is, the model excluding the Pet colour is preferred. [3]

ii)

	Accident		Theft		Accident	Theft
	Frequency	Severity	Frequency	Severity	Risk Premium	Risk Premium
Base values	2%	50,000	5%	1,00,000		
Rating Factors and relativities						
Age of Pet						
>=4	1	1	1	1	1.0000	1.0000
<4	1.25	0.85	1.3	1.02	1.0625	1.3260
Pet Colour						
While	1	1	1	1	1.0000	1.0000
Black	0.9	1.5	0.95	1.2	1.3500	1.1400
Other	0.8	1.7	0.9	1.4	1.3600	1.2600
Sum Insured						
Low	1	1	1	1	1.0000	1.0000
High	1.1	0.9	2	1.9	0.9900	3.8000
Safety Device Installed*						
Yes		0.75			0.7500	
No		1			1.0000	

Earning will happen over 2023 and 2024. Average accident date can be assumed at end of 2023. Current data is middle of 2020. So, inflation and frequency trend are assumed for 2.5 years.
Claims Inflation factor = $(1+10\%)^{3.5} =1.40$

Frequency factor = $(1-5\%)^{3.5} = 0.84$

Accident Risk Premium = Base Accident Freq * Base Accident Severity * Claim inflation factor * Frequency factor = 2%*50,000*1.40*0.84=1166.56

Theft Risk Premium = Base Theft Freq * Base Theft Severity * Claim inflation factor * Frequency factor = 5%*100,000*1.40*0.84=5832.80 [Max 7]

iii) ● Easier to predict, validate and explain the separate trends exists for frequency and severity as compared to the compounded trend of frequency and severity combined.

- Interpreting trends of rating factors in total claims cost model is difficult as underlying reason not known.
- Opposite frequency and severity trends could increase difficulty in comprehending the model results.
- Quicker to model a total claims cost model and no need of combining the separate models.
- No correlation is assumed when Frequency and severity models are combined and both models are assumed to be independent, but in burning cost implicit correlation is assumed.   [5]

[15 Marks]

Solution 6:

i)
- All actual metrics with pricing assumptions.
- Both products need to be separately analysed as with variation in sum Insured same occupancy code has different risk characteristics
  ….and also at combined level to identify risk of different occupancy code.
- Comparison of Premium rates occupancy code wise with competitors
- Loss ratio of these products in Market
- Business mix, Exposure and Experience analysis by;
  ➤ Perilwise – Flexa, STFI, Earthquake and Terrorism for each Major occupancy code and at product level
  ➤ Geography
  ➤ distribution channel
  ➤ Occupancy code
  ➤ sum insured
  ➤ new vs renewal
- Premium rate changes for renewed business which was earlier in Standard Fire product to access profitability of renewed business
- Experience of risks where discount and Loading provided as per Underwriting Guidelines
- Expense analysis and allocation
  ➤ Fixed / variable and new / renewal, Direct / Indirect
  ➤ Actual expenses should be compared with planned

- Distribution cost
  ➤ Actual vs Expected - By channels separately for both products
  ➤ incentive paid to each channel

- Expense and Distribution cost need to be within Regulatory Expenses of Management Guidelines

- Portfolio movements: –
  ➤ lapses at renewal / renewal rates – Comparison with Earlier products
  ➤ new business volumes
  ➤ Strike rates
  ➤ mid-term cancellations and reasons
  ➤ volumes of quotations
  ➤ persistency and profitability by source/Occupancy code

- Claims analyses will cover
  ➤ Changing frequency and severity of claims
  ➤ Sufficiency of reserves/Outstanding amount
  ➤ Small claims Vs Large claims
  ➤ Impact and incidence of large claims
  ➤ Catastrophic events and their impact
  ➤ Assessing concentration of claims and risk
  ➤ Estimation of claim trends
  ➤ Impact of any one off Large Loss impacting any Occupancy code performance

- Reinsurance investigations are to analyse the:
  - recoveries on gross claims
  - extent of accumulations
  - need for catastrophe reinsurance
  - value for money
  - appropriateness of cover
  - profitability of layers
  - effects on capital

[Max 12]

ii) Take Corrective measures to improve performance
Gaining Market Intelligence and make changes in premium rates
Managing Risk
Carry out a profit testing exercise
Estimate price elasticity curves
Create lifetime pricing models
Redesign rating tariffs
Feed into other processes, such as capital modelling
Reserving Exercise   [4]

iii) The aggregate claims are $S_3 = X_1 + \cdots + X_3$, where $X_1, \ldots, X_3$ are independent but not identically distributed. Policy claims amounts are uniformly distributed on (0,5)

Mean of the claim Amount in Sukshma policy= μ_i = 2.5 Crore

Variance of Sukshma policy Amount = σ_i^2 = 5^2/12

Mean of the Aggregrate Claims = $E(S_3)$ = $\sum q_i \mu_i$ = (0.02+0.03+0.04)*2.5 = 0.225 Crore

Variance of Aggregrate Claim= Var $(S_3) = \sum q_i \sigma_i^2 + q_i(1-q_i)\mu_i^2)$

Since Xi are independent
={0.02(5^2/12)+0.02(1−0.02) 2.5^2}∔ {0.03(5^2/12)+0.03(1−0.03) 2.5^2}+∔
{0.04(5^2/12)+0.04(1−0.04) 2.5^2}
=5^2/12(0.02+0.03+0.04)+2.5^2(0.02*0.98+0.03*0.97+0.04*0.96)
=0.1875++0.544375
=0.731875   [4]

iv) In case if only total losses happens:

Mean of the Aggregrate Claims if only total loss happens = $E(S_3)$ = $\sum q_i \mu_i$ = (0.02+0.03+0.04)*5 = 0.45 Crore

Variance of Aggregrate Claim if only total loss happens= Var $(S_3) = \sum q_i \sigma_i^2 + q_i(1-q_i)\mu_i^2)$ Since X_i are independent

={0.02(5^2/12)+0.02(1−0.02) 5^2}∔ {0.03(5^2/12)+0.03(1−0.03) 5^2}+∔
{0.04(5^2/12)+0.04(1−0.02) 5^2}
=5^2/12(0.02+0.03+0.04)+5^2(0.02*0.98+0.03*0.97+0.04*0.96)
=0.1875++2.1775
=2.365   [4]

[24 Marks]

Solution 7:
Steps are as follows:

- Take the 5 to 7 years ground up claims data and corresponding exposure over the same period
- Also assess the claim handling expenses and their inflation.
- Estimate the change in the risk premium changes as a result of introducing the excess.
- Calculate the total expected claims cost assuming no excess (ie from the ground up), by multiplying the expected frequency by the expected severity.
- Estimate the frequency and average severity of claims that are beneath the proposed excess, and the frequency and average severity of claims that are above it.
- The new total claims cost will reduce by: excess amount X number of claims expected above the excess plus avg. severity of claims beneath the excess X expected no. of claims beneath the excess
- The percentage reduction in risk premium can therefore be calculated by comparison with the risk premium prior to the introduction of the excess.
- The change in % of the office premium rate will depend upon other factors e.g. change in other expenses, judgement on change in claim propensity and attitude towards recovering the excess amount by inflating the bills, change in reinsurance cost and any change in profit loading.
- Co-pay mathematically impacts the average severity by the co-pay percentage and does not impact the frequency of claims.
- But other factors mentioned in point 8 needs to be think through and factored before estimating % reduction in office premium.

[7 Marks]

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