

INSTITUTE OF ACTUARIES OF INDIA

Subject SP7 - General Insurance Reserving and Capital Modelling

May 2024 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) Latent claims arise from perils that were unforeseen when policy was underwritten. These claims can emerge and be reported many years after the cause of loss. Example of latent claims from diseases caused by products or industrial processes, faulty construction of buildings, Asbestos / pollution / toxic mould.
(0.5 for each distinct relevant point, Max 2)

- ii) development of latent claims is uncertain- one court judgement can act retrospectively over many policies which can result in large losses for insurer

effect of judicial decisions is similar to inflation often referred to as court inflation

some characteristics of court inflation are:

- It has historically been higher than price inflation
- Court inflation tends to remain level for a period then increase in sharp jumps when new precedents are created
- Court inflation less predictable than price inflation

This further adds to the uncertainty

From time to time, judicial decisions will set new precedents for admission of certain claims and amounts at which they will be settled

Decisions relating to imprecise policy wordings can lead to admission of new types of claims that had not been allowed for in original costings. Liability claims are particularly exposed to this risk.

Courts also periodically set new levels of award/compensation for existing categories of claims

Effect of such awards will be to increase immediately the average amount at which all future claims of similar nature are likely to be settled including those that have already been reported

Such awards are very hard to predict so it is even harder to allow for this form of inflation than normal claims inflation.

Claim payments are intended to represent the future lost earnings of an individual following an accident, are likely to be based on the present value of that future income.

The courts may from time to time change the rate of interest at which insurers are allowed to discount future earnings

This change can have dramatic effect on overall claim payments

Court awards can be impacted by decisions made in other countries too.

(Max 8)

iii)

- frequency severity approach
 - Projecting the number of claims and average cost of claim separately
 - Adjust severity for impacts of inflation
 - Projection based on the origin period or aggregated by reporting period
 - Statistical approach and relies on sufficient data
- Bottom-up approach

- Individual reserving for each policy from bottom up.
 - Consider individual policy limits and deductibles
 - Estimate damage ratio, or assume full policy limit loss impact
 - Requires input from claims and legal experts given complexity of latent claims
 - Operationally intensive due to need to review each claim
 - Can be subject to individual bias and inconsistent treatment between claims
- Top-down approach
 - Estimating company's market share of the total loss to the industry
 - And the impact to each policy.
 - Can be subject to variability due to changes in the market view of the loss
 - Benchmark approach
 - Applying a benchmark factor to the portfolio of latent claims
 - Survival ratios are a common benchmark
 - Derived from the insured's history or from the market
 - Ratio is applied to the average annual paid
 - Other latent claims (at the potential stage)
- (Max 2 for any one approach described)

Solution 2:

i)

- Cancellation/ Postponement of the wedding due to
 - natural calamities, fire and other perils
 - theft and burglary
 - named persons unable to attend the event due to death, disability or hospitalisation

In such cases of cancellation or postponement, the following expenses will usually be recoverable:

- Advances given for bride, groom and other guests accommodation
 - Travel bookings
 - Advances for function hall booking décor companies
 - Expenses for booking pandits and beauticians
 - Wedding DJ, photographer, videographer etc.
- Physical loss or damage to the property covering, place of residence, wedding venue, any decorations put up, any sets erected at the wedding venue due to natural calamities, fire, theft, etc.
 - Loss of money or valuables like jewellery, ornaments, precious stones and appliances received from guests as wedding gifts.
 - Personal accident of the named persons - Coverage to bride and groom and other designated persons in case of permanent total disability, permanent partial disability, temporary or full disability & death arising due to accident.
 - Public Liability - Liability towards third parties for any accidents resulting in injury or damage occurring at the venue of the wedding, in connection with the wedding, during the policy period.

Typically, the coverage commences 24 hours before the commencement of wedding ceremonies and extends for a duration of 7 days, encompassing all wedding functions until the day following the marriage.

(Max 4)

ii)

- Losses due to civil unrest, terrorism, war, kidnapping etc.
- Financial damage if the bride and groom call off the wedding.
- Expected seasonal rains, storms, etc.
- Any family disputes among the bride, groom, relatives, or friends.
- Loss or theft from unattended venues or vehicles.
- Suicide, attempted suicide, or self-inflicted injury or illness.
- Loss of Money where it is stored other than in a safe/locker or Strong Room.
- Intentional damage to any property.

(Max 3)

iii) The product is likely to be written on a losses-occurring basis which provides cover for losses occurring in the defined period no matter when they are reported

(Max 1)

iv) The measure of exposure is the principal measure of risk for a policy. Premiums will be set according to the measure of exposure. The measure of exposure is sum insured.

(Max 1)

v) This product is expected to have short reporting delays as the event giving rise to claims usually occurs suddenly (eg- fire or burglary) and cause is easily determinable.

It can have long settlement delays as it would take time to assess the complete financial loss including the physical damage to property and loss of money/valuables

The claim frequency is expected to be low while the severity is expected to be high.

(Max 3)

vi)

- Outdoor or indoor wedding
- Location – eg-Destination wedding
- Cost of event management
- Cost of catering
- Expected number of people
- Number of functions
- Duration of the all-wedding functions
- Fireworks or not

(Max 3)

[15]**Solution 3:**

i) Assumptions

- The claim reserves are undiscounted
- Claims inflation, both past and future is 5% p.a.
- The claims are incurred at middle of the year hence inflation is applied accordingly.
- 2018 accident year is fully developed
- A constant proportion of the total number of claims from each origin year are incurred in each development year.

[3]

Adjust the claims incurred for inflation (till year end 2023) assuming that claims are incurred at middle of the year and compute the average incurred amount and its Development factors (DFMS)

Accident Year	Inflation adjusted Claims incurred (in INR '000s) in year of development>>					
2018	15,694	13,452	11,530	9,883	8,471	7,261
2019	15,569	13,345	11,438	9,805	8,404	
2020	15,427	13,223	11,334	9,715		
2021	15,816	13,557	11,620			
2022	17,097	14,654				
2023	18,240					

Accident Year	Average incurred amount					
2018	62,774	71,551	81,773	87,459	94,120	94,299
2019	56,615	64,781	73,797	84,525	80,803	
2020	53,380	91,829	1,12,216	1,19,940		
2021	52,199	89,189	96,033			
2022	53,763	92,165				
2023	54,609					
DFMS		1.469	1.146	1.090	1.017	1.002

Calculate DFMS for number of claims incurred.

Accident Year	Cumulative no. of Claims incurred					
2018	250	438	579	692	782	859
2019	275	481	636	752	856	
2020	289	433	534	615		
2021	303	455	576			
2022	318	477				
2023	334					
DFMS		1.592	1.287	1.177	1.134	1.098

Project the average incurred amount and the number of incurred claims

Accident Year	Projected Average incurred amount					
2018						
2019						80,956
2020					1,21,989	1,22,221
2021				1,04,690	1,06,479	1,06,681
2022			1,05,660	1,15,184	1,17,152	1,17,375
2023	80,233	91,982	1,00,273	1,01,986	1,02,180	

Accident Year	Projected no. of incurred claims					
2018						
2019						940
2020					698	766

2021				678	769	845
2022			614	723	820	900
2023		532	684	805	913	1,003

Use the projected incremental claims * projected average incurred amount to calculate projected total amount which is then adjusted for future inflation assuming that claims are incurred at middle of the year.

Accident Year	Projected amount (in INR '000s)					
2018						
2019						6,824
2020				10,079		8,396
2021				10,688	9,700	8,080
2022			14,448	12,530	11,372	9,472
2023		15,855	14,017	12,157	11,033	9,190

Accident Year	Inflated Projected amount (in INR '000s)					
2018						
2019						6,992
2020				10,328		9,033
2021				10,952	10,437	9,128
2022			14,805	13,481	12,847	11,236
2023		16,246	15,082	13,734	13,088	11,446

The IBNR reserves are INR 17,88,34,911.

(Max 18)

- ii) Reported claims
- consistent definition
 - if claim reserving protocols have changed then not suitable
 - nil claims
 - claim nos. can either include or exclude nil claims
 - its inclusion may lead to distortions because of change in claims recording approach
 - this will have an impact on claim frequencies and severity
 - settled claims
 - if projection of ultimate is based on settled claims then its definition is important
 - eg- when a date is flagged as closed on system or date of last payment
 - reopened claims
 - define how they are treated such that it cannot distort number of settled claims hence the average cost per claim
 - claims inflation
 - whether to apply inflation on the data
 - inflation index to be based on the line of business (eg- general economic inflation based on wages or prices)
 - changes in mix of business or policy terms as these changes will distort patterns and trends observed in data

- large claims to be separated from the attritional claims triangle based on a threshold

(Max 5)

iii) claim frequency

- Increase in crime rates
- change in effectiveness of car security systems
- change in stringency of driving tests
- change in attitude to claiming, leading to increase in the frequency of liability claims
- Regulation encouraging claiming for liability claims

Claim amounts

- Car parts and labor costs
- Regulation increasing the amount of cover that must be provided
- Regulation requiring the use of car safety equipment leading to a decrease in cost of bodily injury claims
- Regulation affecting claim costs (eg- minimum liability amount)
- Publicity regarding fault with a particular car make (eg- batch of cars sold with faulty brakes), leading to higher court awards for compensation
- Shortage of mechanics, leading to an increased cost of labour
- Change in procedures for building/repairing cars, leading to change in cost/ease of repairing cars
- Change in driving habits due to congestion
- Change in economic growth (eg- recession- few people may buy big, new and expensive cars, so the average claim size must fall)
- Change in rate of price inflation
- Change in rate of court award inflation
- Change in exchange rates, which may affect the cost of claims made overseas (i.e. people driving their cars abroad)
- Change in road conditions/ increased awareness

Both claim frequencies and claim amounts

- Change in speed limits
- Change in use of speed cameras
- Change in societal trends, eg- reduction in drink driving
- An unusually severe weather
- Introduction of speed-restricting technology in vehicles

(Max 8)

[31]

Solution 4:

i) Benefits of moving to RBC:

To adopt global best practice:

- Major jurisdictions have moved/are moving to RBC
- Understandable for foreign investors and foreign regulators
- Informative disclosures

To make risks visible:

- Quantifies significant risks
- Makes insurer's risk profiles visible to insurer's management, Board and regulator
- Indicates early warning and facilitates corrective action

To incentivize better risk management:

- Benefits of ALM, risk transfer, diversification- captured in capital calculations
- Efficient utilization of capital

(Max 4)

ii) The key risks that should be considered in the computation of RBC are:

- Insurance risk- Insurance risk is defined as the risk of loss arising from the inherent uncertainties about the occurrence, amount and timing of insurance liabilities, expenses and premiums. It is normally divided between
 - underwriting risk, relating to risks yet to be written / earned
 - reserving risk, relating to risks already written / earned.
- Market risk is defined as the risk that, as a result of market movements, a firm may be exposed to fluctuations in investment markets. Sources of market risk include movements in interest rates, exchange rates, equity prices and property prices.
- Liquidity risk is the potential that a firm is unable to meet its obligations as they fall due as a consequence of having a timing mismatch between assets and liabilities.
- Credit risk including counterparty default risk and spread risk refers to the risk of loss if another party fails to meet its financial obligations, or fails to meet them in a timely fashion
- Operational risk is defined as the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events. Operational risks include risks relating to administration, compliance, impact of events, fraud, governance, strategy, technology and pension scheme provision.
- Concentration risk is the risk arising out of aggregation of exposures in a particular location, line of business, peril, risk type, distribution type etc.

(Max 5)

iii) Bootstrapping the ODP model

Bootstrapping involves sampling (with replacement) multiple times from an observed data set to create a number of pseudo data sets. We can then refit the model to each new data set and obtain a distribution of the parameters.

The ODP model is widely bootstrapped.

When using bootstrapping in claims reserving, the idea is to fit a model to the past claims data, which we can then use to calculate expected figures for each past origin and development year. We then calculate the residuals, the differences between the actual figures in the past data and the expected figures that we've calculated. These residuals tell us about the likely size of the random component, and it is these values that we sample from to carry out the bootstrap process. The process used to bootstrap reserve estimates consists of the following stages (repeated many times):

1. Calculate the expected values and the residuals for each point in the claims triangle.
2. Re-sample (with replacement) from the residuals to obtain a new triangle.
3. Re-fit the chain ladder model to the new triangle to obtain a revised reserve estimate.

Mack Model

The Mack model reproduces chain ladder estimates and makes limited assumptions about the distribution of the underlying data, specifying the first two moments only.

The key assumptions are that:

- the run-off pattern is the same for each origin period (as for the chain ladder)
- the future development of a cohort is independent of historical factors (eg high factors in one period do not imply high or low factors in the following period)
- the variance of the cumulative claims to development time t is proportional to the cumulative claims amount to time $t - 1$. The model produces standard errors for both individual origin periods and for all periods combined.

The Mack model is distribution-free, in that no distributional assumptions are made, only assumptions about the first two moments. ‘Non-parametric estimation’ in this context simply means that the Mack model does not assume a distribution about the underlying data.

(Max 6)

[15]

Solution 5:

- i) An investor purchases a bond from the insurance company and therefore provides a sum of money to insurer.

The repayment of capital and interest if any is contingent on a specified event (catastrophe—ex: earthquake) not happening within a particular period of time. I

If the event happens, the insurer use the sum of money provided by investor to cover the cost of claims.

If the event doesn’t happen, the investor gets their interest and capital back in the normal way

[2]

Characteristics

Security

- Less secure than government securities.
- The level of security depends on the financial institute issuing these bonds III.

Marketability:

- Marketability is less compared to government bonds and corporate bonds.
- This is primarily because of smaller size of issue.

Liquidity: The value of these bonds tends to be more volatile and less predictable than government bonds or corporate bonds

The yields on such bonds are higher considering lesser marketability, liquidity and perceived additional default risk

The returns on catastrophe bonds are largely uncorrelated with macroeconomic factors i.e., a rare thing in the investment world.

The risk of losing some or all of the capital in the event of catastrophe does occur, their risk exposure can be reduced by diversifying among many different catastrophe bonds

(any three characteristics explained, 3)

[5]

ii) Diversification:

Diversifying across various geographies, lines of business, industries to diversify the risk

Securitisation- This is the transfer of insurance risk to the banking and capital markets. Among other things it is used for managing risks associated with catastrophes as the financial markets are large

It also involves converting an illiquid asset into tradeable assets.

Examples of illiquid assets are future profits, mortgages

(2)
[7]

Solution 6:

Assumptions:

365 day year length is assumed while calculating the earning pattern.

- i) Risk is written linearly increasing basis in each year. In first year=1x, second year 2x and 3rd year =3x
 $6x = 1095$
 $X = 182.5$
 1st year = $182.5/1095 = .17$
 2nd year = $365/1095 = .33$
 3rd year = $547.5/1095 = .5$

Earnings are calculated for each accident year

Accident Year	GEP
2018	3,000
2019	9,333
2020	21,667
2021	28,600
2022	38,460
2023	45,210

(7)

Gross loss ratios:

Accident Year	Gross Incurred Claims (in INR '000s)	GEP	LR (GIC/GEP)
2018	150	3,000	5%
2019	1,919	9,333	21%
2020	22,962	21,667	106%
2021	11,083	28,600	39%
2022	19,615	38,460	51%
2023	24,866	45,210	55%

(1)

The reasons for the trends in loss ratios are as follows:

volatility in engineering line- frequency and severity

bad business written in 2018, 2019 or 2020 increasing the LR in 2020

large loss in 2020 due to natural calamity, faulty materials used in construction

high frequency in 2020 due to concentration of risks written at one location

business rapidly growing which can attract poor risks

started business in 2018- not enough data to better price risks

(with explanation of each point, 2)

- ii)** Since reserving is being done on an Accident quarter basis, then it will be across more than one underwriting year with potentially very different rates. When reserving at March, the current underwriting year would have earned very little and might not show any impact yet, but is likely to manifest later on There could be a potential change in the claim development pattern as it may change the underlying mix of business Due to de-tariffication, it is likely there is a significant reduction in prices, and a change in the exposure
 People who could not previously buy insurance might now be able to afford it
 It is therefore possible that in the early days the company might end up taking on bad risk
 The rating factors are still prescriptive, so the company will not be able to price completely as it might want to -the reserving exercise will have to take this into account and allow for additional reserves
 This might result in a sudden reduction in the premium received, with the same amount of exposure – the reserves must take this into account ...This may mean that an AURR is needed
 It might be prudent not to release reserves from the prior years because the current year premium might not be sufficient to pay for this year's claims T
 The latest price monitoring report should be obtained to see which direction the prices are going in.
 Since the reserving exercise is being done at the end of Q1, it might be too early to predict the market trends with certainty
 The reserving actuary must allow for sufficient reserves at this stage due to the uncertainty, which can be released later on if it turns out not to be required
 The propensity to claim might change due to de-tariffication and introduction of new products in the market.
 Since medium company hence lesser data available to price risk
 De-tariffication could lead to anti-selection from both old and new customers
 The new customers entering the market and potential for a change in the mix of existing customers means that the frequency of claims may change
 as different customers will have a different likelihood of being involved in an incident that leads to a claim
 There will also be a change in claims severity
 as they type and severity of incidents that customers will be involve in may change if the underlying customer mix has changed
- (6)
- iii)** When setting up reserves for the current accident period,
 Chain Ladder method might not be a very suitable approach since it is too early, and the exposure is changing so Chain Ladder can predict too high or too low Ultimate Methods such as the BF use weightings based on Chain Ladder patterns and so will still be somewhat impacted
 The company has been writing business only for 6 years so there is not a lot of experience anyway
 The claim frequency and severity is likely to change as well, but too early in March to predict with too much surety
 This may mean that the average cost per claim method may no longer be appropriate.

It might be best to apply an expected loss ratio method approach although if the underlying profile is changing then it may be harder to pick the expected loss ratio, particularly if new customers are joining the market

The projected premium must be adjusted for the 10% rate reduction indicated by the Pricing Actuary

and the loss ratio adjusted accordingly if using Expected Loss Ratio approach

although this additional adjustments may be needed if the underlying risk has changed Keeping in mind the current accident period will be comprised of claims from prior underwriting periods as well

The actuary must consider both accident period and underwriting period approach to validate any emerging trends

Should also consider any historic trends or under or over estimating initial expected loss ratios

Discussions with underwriting and claims team may help the actuary understand the changes in the underlying risk profile that are taking place

As the experience in the current accident year will likely be mostly business written in the previous year

so it could be argued that previous methods used would still be suitable as the earned profile may not be materially changed - May want to consider using exposure based methods

(4)

[20]
