

INSTITUTE OF ACTUARIES OF INDIA

Subject SP7 - General Insurance: Reserving and Capital Modelling

May 2026 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 examiners have given credit for any alternative approach or interpretation which they consider to be reasonable.

Solution 1:**i) Advantages:**

- Fixed percentage charge method is easier to understand/communicate; quick cost saving
- A comprehensive assessment of operational risk requires substantial input from across the business, resulting in significant time and resource demands. Motor and health portfolios majorly involve high volumes of relatively small policies and claims, so gathering granular operational risk data can be resource-intensive. A fixed charge reduces this burden.
- Avoids subjectivity in modelling assumptions: Operational risk in areas like claims leakage, fraud detection, or third-party administrator performance in health insurance can be highly judgmental. A fixed percentage removes reliance on subjective inputs.

Disadvantages:

- This might not consider accurately reflect the firm's actual operational risk profile namely TPA errors in Health.
- There would be a need to do a modelling exercise to determine the appropriate percentage in any case.
- The charge could either overstate or understate the true risk exposure.
- Explicit modelling can identify key drivers of operational risk (e.g., claims processing delays, fraud hotspots) and areas requiring control improvement (TPA management, claim handling efficiency)). A simple charge provides no diagnostic value.
- The regulator may not approve such method.

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ii) Advantages:

- Improved Tail Risk Assessment: Captures extreme climate-related losses that may otherwise be missed.
- Enhanced Capital Adequacy: Ensures reserves and capital buffers reflect both historical and emerging risk exposures
- Regulatory Compliance: Aligns with evolving requirements for climate risk integration in capital frameworks

Disadvantages:

- Limitation of data introduces model uncertainty.
- Incorporating extreme climate events that have not yet occurred may cause capital models to overestimate tail risk
- Health-related climate risks (heatwaves, vector-borne diseases, pollution) are complex and influenced by socio-economic and demographic factors, making quantitative modeling highly uncertain.
- Climate change impacts evolve over decades. Determining the appropriate time horizon for capital models is challenging and may require scenario extrapolation, increasing uncertainty.
- Climate events can trigger losses across both health and motor simultaneously, creating complex correlations that are difficult to quantify accurately.

[3]

iii)

- Reserve risk: The reserve risk may increase due to:
 - Lack of experience in the Liability line
 - Significant delay in the reporting and settlement of claims
- Underwriting risk: The premium risk might increase due to uncertainty in the insurer's retained premium and profitability.
- Profit commission arrangements can partially offset the Insurance risk. However, there could be delay in determining the profit amount due to:
 - Latent claims
 - Increased exposure to large losses.

- Longer settlement of claims
- Diversification Benefit: Diversification benefit might increase as Liability line may not be perfectly correlated with health and motor business.
- Operational risk: Launching a new line might increase operational risk. This may be due to:
 - Greater complexity in underwriting
 - Long-tail nature of claims and complex claims handling processes.
- Liquidity Risk: Liquidity risk may increase due to Profit commission payments being contingent on profitability, which can delay cash inflows.

[3]

iv)

- Credit Risk: May reduce credit risk as a lower level of reinsurance recoveries would be assumed.
- Reserve risk: The risk might increase due to:
 - Higher claim severity and volatility on net basis
 - Reserves might fluctuate more in line with claim frequency and cost trends.
- Underwriting Risk: Risk might increase due to higher net profit volatility.
- Liquidity risk: Liquidity risk may increase as retaining lower layers leads to more frequent claim payments from own funds, particularly for motor accidents and major health claims.
- CAT Risk: No impact on CAT risk if the company has a separate CAT-XL cover.
- Strategic Risk: Changing reinsurance structure may alter risk profile. Retaining more risk may affect capital allocation decisions and product competitiveness.
- Operational risk: Greater reliance on internal claims processes across both health and motor portfolios might increase operational risk.
- Diversification benefit: Removing reinsurance in lower layers might reduce diversification benefit~

[3]

[12 Marks]

Solution 2:

- i) A stability clause is a treaty provision in a reinsurance agreement that adjusts the attachment point and/or limit of a layer based on an agreed index (e.g., inflation or loss cost trends). This ensures that the financial terms of the treaty remain aligned with expected changes in claim costs, providing both the cedant and reinsurer with a degree of predictability and protection against the impact of inflation or other trends on claims. An aggregate deductible is a provision in the treaty that requires the cedant to retain losses up to a specified amount (i.e. total sum of losses across all claims in a policy year) over a defined period before the reinsurer begins to pay

[1]

ii)

Reinsurer PQR:**Stability Clause:**

- + Ensures alignment of interest due to the indexation of the attachment point and limit.
- + It gives some protection against expected future inflation in the claims to the layer.
- Actual claims inflation may outstrip the indexation thereby eroding the benefit of the stability clause over time.
- Potential increase in expenses for setting up and managing more complex contracts.
- Indexed limits may increase exposure to larger nominal losses.

Aggregate deductible:

- + Lower capital requirement due to reduced exposure.
- + Reduced claims: Cases where claim doesn't breach the aggregate deductible.
- Lower premium income with introduction of aggregate deductible; lower expected profitability
- More volatility in claims cost to the layer relative to the premium charged.

Insurer X

Stability Clause:

- + Cedant should be able to negotiate a lower premium due to the introduction of the stability clause.
- + Aligns reinsurance protection with inflation trend.
- Chosen index may not match actual liability inflation.
- Retains some inflation risk i.e. if the actual inflation is lower than the indexation, then more likely that a claim estimated to settle in the layer settles below the layer

Aggregate Deductible:

- + It reduces reinsurance spend (especially beneficial if reinsurance rates are hard).
- + It might be used to manage risk appetite.
- + It might lead to higher expected profit as ceding less of profit to the reinsurer.
- + Reduced credit risk due to lower exposure to reinsurer.
- + Retention of small losses might encourage improved underwriting discipline.
- Greater volatility in the retained losses.
- This might lead to increased insurance risk resulting in higher capital requirements.
- This might delay recoveries leading to liquidity risk.

[9]
[10 Marks]

Solution 3:

- If the estimated cost of claims arising from unexpired risks is greater than the Unearned premium risk, then an AURR is required to be made for future liabilities.
- It should be noted that the future liabilities should include unallocated loss adjustment expenses (ULAE) and any allowed or required discounting. Reasons to hold AURR:
 - Higher than expected level of claims frequency or severity.
 - Incorrect pricing at unprofitable premium rates.
 - Higher than expected claims inflation.
 - Court rulings causing an increase in expected claims costs.

- Higher than expected expenses
- Impact of discounting change (where required).

[4 Marks]**Solution 4 :****i) Key Assumptions:**

- Year 2021 is fully developed and is now in run off.
- Claims occur evenly throughout the year.

[0.5 mark for each assumption above, 0.5 mark for other relevant assumption, max 1 mark]

Computing development factors					
Accident Year/ Development Year	0	1	2	3	4
2021	4,200	7,100	8,000	8,800	9,000
2022	5,700	9,700	11,000	15,500	
2023	6,900	11,700	12,500		
2024	7,800	13,300			
2025	8,300				
IDF	1.6992	1.1053	1.1000	1.0227	1.0000
CDF	2.1128	1.2434	1.1250	1.0227	1.0000

[0.5 mark for each correct IDF (excluding column 4), 1 mark for CDF, 0.5 mark for excluding AY 2022 in DF 2,3 calculation, max 3.5 marks]

Computing ultimate value

Accident Year	Earned premium (i)	Ultimate as per CL (ii)	Paid (iii)	% undeveloped (iv)= 1-(iii)/(iv)	EP ELR (v)= (i)* 50%	BF Ultimate (vi)= (iii) +(iv)*(v)	Selected method	Ultimate selected (vii)= (vi) for BF, (ii) for CL	Reserves
2025	30,000	17,536	8,300	53%	15,000	16,200	BF	16,200	7,900
2024	26,000	16,538	13,300	20%	13,000	15,845	CL	16,538	3,238
2023	23,000	14,063	12,500	11%	11,500	13,778	CL	14,063	1,563
2022	21,000	15,852	15,500	2%	10,500	15,733	CL	15,852	352
2021	15,000	9,000	9,000	0%		9,000	CL	9,000	0

[0.5 mark for selecting BF for recent AY, 0.5 mark for calculating ultimates for AY2022-2025 correctly, max 2.5 marks]

Year	0	1	2	3	4
% reported	47%	80%	89%	98%	100%
Payment pattern for CL ultimate	47%	33%	8%	9%	2%
Payment pattern for AY 2025 reserves		63%	16%	17%	4%

[1 mark for each payment pattern, max 2 marks]

Computing Incremental cashflow:

Accident Year/ payment year	2026	2027	2028	2029
2025	4,964	1,270	1,333	333
2024	1,400	1,470	368	
2023	1,250	313		
2022	352			
2021				
Total	7,966	3,052	1,701	333

[0.5 mark for each incremental Cashflow, max 5 marks]

Computing Discounted values:

Payment year	Undiscounted Incremental Cashflow	Disc %	Discounted Incremental Cashflow
2026	7,966	6.40%	7,723
2027	3,052	6.50%	2,777
2028	1,701	6.60%	1,450
2029	333	6.65%	266
Total reserves			12,216

[1 mark each for each correct “payment year”, max 4 marks]

[0.5 mark for total reserves]

[Marks awarded If AY 2022 is included in DF 2-3 computation and Total reserves is 17,630]

[18 Marks]

- ii) A stochastic reserving method is a reserving approach that models the uncertainty in claims development and produces a probability distribution of possible reserve outcomes, rather than a single point estimate.

Methods include:

- Mack's model
- Bayesian model

[1]

Key features:

- Produces a distribution of reserves rather than a single estimate.
- Allows estimation of reserve variability.
- Can produce measures such as:
 - Standard error of reserves
 - Confidence intervals
 - Probability of reserve adequacy
- Can distinguish between:
 - Process risk (randomness in claim outcomes)
 - Parameter risk (uncertainty in estimated parameters)
- Compare reasonableness of different sets of reserve estimates
- Monitor performance to see if claim movements are material

[0.5 mark for each point, marks available for other valid points, max 3 marks]

[4]

iii)

Particular	Mack's Model	Over-Dispersed Poisson Model
Distribution Assumption	Minimal; no specific claim distribution assumed	Assumes over-dispersed Poisson distribution
Variance Structure	Variance linked to development factors, estimated non-parametrically	Variance proportional to mean with over-dispersion parameter
Suitability for Property Line	Can be most suitable as data is stable and moderate-severity.	Need to check if it has high variability
Estimation Method	Method of moments	Maximum likelihood estimation
Parameter Uncertainty	Limited capture of uncertainty	Better capture of parameter and process uncertainty
Prediction Intervals	Analytical based intervals	Simulation based intervals, more accurate intervals
Handling Large/CAT Claims	Less sensitive to outliers	May need extensions to handle large property losses properly
Bootstrapping	Possible but less straightforward	Suited for bootstrapping method
Complexity	Simpler, easier to explain	More complex but offers deeper insights on reserve risk

[1 mark for each point max, marks available for other valid points, **max 6 marks**]

iv) Mack is more suitable as moderate, stable claims and some sparse development and more simpler to build.

[0.5 mark for naming the correct method, 0.5 mark for valid reasoning, **max 1 mark**]
[29 Marks]

Solution 5:

- The Shapley method allocates capital based on the average marginal contribution of each line to the portfolio across all possible sequences.
- Proportional: Allocates based on standalone SCRs: Property 300, Motor 900, Crop 100: large portion to Motor, small to Crop.
- Unlike proportional allocation, Shapley method accounts for correlations, diversification, and tail risk contributions.
- Property & Crop are moderately correlated (0.5): Crop therefore gets more capital than proportional, even though standalone is small.
- Motor is weakly correlated (0.25) with Property and Crop: Its marginal contribution to tail risk is less impacted by diversification; slightly lower Shapley allocation than proportional.
- Property: slightly reduced allocation due to diversification benefits with Motor
- Thus, Shapley captures how Crop or Property can contribute to tail losses, adjusting their allocation
- Proportional is simple method whereas Shapley is more accurate and risk-sensitive allocation.

[4 Marks]**Solution 6 :**

Key Ratios are:

Particulars	2026	2025	2024
GWP growth %	20.0%	25.0%	
RI Premium growth %	0.0%	68.8%	
NWP growth %	43.5%	-4.2%	
NEP growth %	18.5%	8.0%	
Ceded %	45.0%	54.0%	40.0%
Gross Claims ratio	46.4%	90.0%	50.0%
RI Claims ratio	41.7%	121.7%	53.3%
Net Claims ratio	50.0%	63.0%	48.0%
Expense Ratio	12.1%	23.9%	29.2%
Gross Commission ratio	20.0%	16.0%	15.0%
RI Commission ratio	7.4%	9.3%	9.4%
Commission ratio	30.3%	23.9%	18.8%
Combined ratio	92.4%	110.8%	95.9%
UW Profit	20	-10	15

[Marks available for any other valid ratio]

[0.5 mark for each cell, max 1 mark for each row and total max 6 marks]

- The company shows profitable underwriting in 2024 and 2026 (combined ratio < 100), but a loss in 2025 (combined ratio 110.8%, UW loss of Rs. 10 crores). This shows year 2025 was an adverse year due to higher claim ratio. It could be driven by:
 - A major catastrophe
 - Few large losses

- Poor underwriting (high risk) in 2025 corrected in the 2026
- GWP increased steadily over the three years: 25.0% in 2025 and 20.0% in 2026. This could be driven by:
 - Entry into new market (geography/channel/etc)
 - Increase in incentive to the sales team
 - The GWP increase in 2026 could be driven by rate increases following the high losses in 2025.
- RWP increase at a higher growth rate (68.8%) than GWP (25.0%) resulting in decline in NWP (-4.2%) in 2025. This might be driven by:
 - Higher increase in reinsurance rate compared to gross
 - Changes to the reinsurance program
 - Changes in underlying risk
- Retention ratio trends suggest that the reinsurance arrangement might be a combination of quota/surplus and XOL and CAT arrangement.
- Expense Ratio: Drastic decrease from 29.2% in 2024 to 12.1% in 2026 reflecting improved cost efficiency. Likely due to increased use of process automation reducing operating costs, decrease in Fixed expenses (rent, salary).
- Gross Commission ratio has increased from 15% in 2024 to 20% in 2026. This might suggest that the company is providing more incentive to the intermediaries to grow the book.
- RI Commission ratio has slightly decreased in year 2026 (7.4%) compared to 2025(9.3%) and 2024 (9.4%). This could be due to adverse loss ratio in 2025.
- Year 2025, Net Claims ratio is significantly lower than Gross Claims ratio-which suggests reinsurance responding effectively.
- RI claims ratio is 121.7% in 2025.This might imply that the reinsurer might have been cautious in accepting risk after the high loss ratio in 2025.
- Distinguishing whether the 2025 loss spike was due to a few large claims or adverse one-off event or an increase in claim frequency helps in assessing reserve adequacy and reinsurance strategy effectiveness.

[0.5 mark for each point, marks available for other valid points, max 6 marks]

[12 Marks]

Solution 7:

i) Coverages are:

- Protection against non-payment of EMIs due to death or disability.
- Rental guarantee/ Lease guarantee: Covers unpaid rent/lease payment or property damage (deposit replacement)
- Trade credit insurance: Covers non-payment by buyers in commercial transactions
- Performance Guarantees: Ensures obligations under contracts or service agreements are met. Eg: construction bonds.
- Agricultural / SME Loan Guarantee: Covers defaults by farmers or small business borrowers, often government-supported.
- Customs / Tax Bonds :Guarantees payment of import duties, taxes, or other regulatory fees
- Student Fee / Education Guarantee :Covers tuition or hostel fee defaults by students or sponsors
- Utility Payment Guarantee: Replaces security deposits required by electricity, gas, or telecom providers
- Legal / Recovery Cost Coverage: Covers costs incurred in enforcing guarantees or recovering losses under the contracts

[3]

ii)

1. Protection against non-payment of EMIs

- Mortality risk: Higher-than-expected death claims can increase insurer payouts.
- Morbidity risk: Unexpected disability rates may cause more EMI defaults than anticipated.
- Concentration risk: Large exposure to a single borrower segment can magnify losses.
- Emerging health trends: Changes in disease prevalence may impact mortality/morbidity patterns.

- Behavioral uncertainty: Borrowers' repayment behavior may change unexpectedly.
- Policy changes: Government loan relief schemes can alter claim patterns.

2. Rental / Lease Guarantee

- Tenant failing to pay rent or lease obligations.
- Property damage exceeding deposit coverage.
- Concentration risk: Exposure to specific locations or tenant types.
- Economic downturns affecting tenants' ability to pay.
- Market-wide rental declines or sudden vacancy surges.

3. Trade Credit Insurance

- Buyer insolvency or delayed payments on commercial transactions.
- Concentration risk with large buyers or single industries.
- Foreign exchange or cross-border payment risks.
- Systemic economic shocks leading to correlated defaults.
- Political or regulatory instability in trading countries.
- Emergence of new industries with limited historical default data.

4. Performance Guarantees (Construction / Service Contracts)

- Contractor failing to meet contractual obligations.
- Cost overruns in project completion or remediation.
- Legal disputes over performance obligations.
- Regulatory or policy changes affecting contracts.
- Events like natural disasters or pandemics.
- Unexpected technical or design challenges in projects.

5. Agricultural / SME Loan Guarantee

- Borrower default due to crop failure or business losses.
- Sector/regional concentration risk.
- Delay in government support payments.
- Extreme weather events impacting repayment.
- Commodity price volatility affecting farm/SME income.
- Policy changes in government support programs.

6. Customs / Tax Bonds

- Non-payment of duties, taxes, or regulatory fees.
- Enforcement and recovery cost risk.
- Concentration of exposure in specific importers or sectors.
- Changes in customs/tax laws affecting obligations.
- Judicial or administrative delays in enforcement.
- Sudden government policy interventions
- Political or trade disruptions affecting payments.

7. Student Fee / Education Guarantee

- Non-payment of tuition/hostel fees by students or sponsors.
- Delays in verifying and processing claims.
- Economic shocks affecting sponsors' ability to pay.
- Policy or regulatory changes in education funding.
- Social or demographic changes affecting student enrollment.

8. Utility Payment Guarantee

- Non-payment of electricity, gas, or telecom bills.
- Concentration risk from industrial or high-volume consumers.
- Regulatory tariff changes or subsidy alterations.
- Industrial shutdowns or mass consumer defaults.
- Technological shifts affecting payment behavior

9. Legal / Recovery Cost Coverage

- Cost of enforcing guarantees or recovering losses.
- Delays or inefficiencies in legal proceedings.
- Changes in legal or regulatory environment.
- Judicial delays or unpredictable litigation outcomes.

[8]

iii)

Aspect	Group Financial Guarantee Product	Individual Financial Guarantee Product
Distribution Channel	Sold through institutional partners (banks, NBFCs, employers); partner acts as intermediary	Sold directly by insurer via agents, brokers, or digital channels
Commission / Incentives	Institution receives commission or incentive from insurer; generally lower per person due to volume.	Agents or brokers earn commission per policy; digital/direct sales may have minimal commission.
Operational Structure	One master policy covers many members; bulk administration	One policy per individual; separate processing and servicing
Onboarding Process	Fast onboarding using group data; minimal documentation per member	Detailed onboarding with KYC, financial checks, and documentation
Underwriting Approach	Simplified underwriting; risk assessed at group level	Detailed underwriting; individual risk assessment (income, creditworthiness)
Risk Assessment	Homogeneous/pooled risk; limited differentiation	Heterogeneous risk; pricing and approval based on individual profile
Pricing	Standardized pricing across group members	Risk-based pricing customized per individual
Claims Initiation	Usually initiated by partner (e.g., lender/employer)	Initiated by insured or nominee directly
Operational Cost	Lower per borrower due to scale; less administrative effort.	Higher per policy due to individual servicing, marketing, and underwriting.
Renewals / Persistency	High persistency due to automatic linkage (e.g., loans/payroll)	Lower persistency; depends on customer renewal behavior
Product Customization	Limited; same coverage for all group members.	High flexibility; insured can choose sum assured, riders, and term.

[8]

Solution 8:

- **Administration risk:** Risk of error or failure associated with the administrative aspects of firm's operations.
 - Increased due to recent acquisition (integrating different systems)
 - Increased risk as a result of new business lines being written so risk of adequate information not being captured.
- **Compliance risk:** Risk of non-adherence to legislative and internal firm requirements.
 - Risk increased as a result of new business strategies which may not be fully embedded and processes / requirements may not be known
 - AML/KYC and data protection risks increase due to new customer segments
- **Event risk:** significant event that occurs and has significant impact on firm's operations.
 - Example a natural disaster closing offices where the claims staff are based meaning claims cannot be processed and resulting in reputational damage.
 - Pandemics or cyber attacks affecting IT systems and customer service
- **Fraud risk:** Risk associated with the deliberate misappropriation of funds.
 - Changes in management and onboarding new staff for new business lines.
 - Inexperienced staff in new products may be exploited by external fraudsters.
- **Governance risk:** risk associated with senior management not effectively performing roles.
 - Entirely new management team still establishing governance processes.
 - Lack of experience with integrating acquisitions or new business lines.
- **Strategic risk:** Risk arising from the inability to implement appropriate business plans and strategies, make decisions, allocate resources or adapt to changes in the business environment
 - Entering new markets without established experience increases the risk of mispricing, misjudging claims experience, or loss of market share
 - Increased risk who have an entirely new management team who have embarked upon strategic change which has not yet been evaluated.
- **Technological risk:** Risk of error or failure associated with the technological aspects of its operations
 - Increased risk given new acquisition.
 - Be reliant on technology (i.e. website sales, quote systems, rating as well as claims recording etc.) as a result, damage associated with technological risk high
 - Cybersecurity vulnerabilities and data breaches.

[10 Marks]
