Institute of Actuaries of India

Subject SA3 – General Insurance

November 2023 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) Technical reserves might be higher for other insurers because of:
- Higher share of long-term policies leading to higher UPR
- Inadequate premiums being charged leading to a greater need for PDR.
- Higher share of long tail liabilities (e.g., Motor TP, WC, Liability etc.).
- Higher share of claims from business written on coinsurance basis where insurer is acting as follower insurer leading to slower claims development.
- Longer vintage (number of open years)
- Having explicit catastrophe reserve for future events.
- Insurer operating at higher loss ratio.
- Insurer expected to have higher litigation.
- Higher share of large or catastrophic losses at the end of year.

Or Net premium could be lower because of
- Degrowth in business or lower growth.
- Lower retention (e.g., to manage within available capital).
- Premium rates are lower (not profitable business) / Highly competitive market.
- Insurer aggressively capturing market share with lower premium rates and higher than expected loss ratio

Other reasons
- More business written in the second half of the year hence requiring higher claims reserves and higher UPR.
- Staff turnover in the claims department leading to delayed claims settlement.
- Differences in approach for arriving at and updating case reserves.

[5]

ii) Multiple factors impact emerging claims development. If the reserving basis is not altered then it may lead to inappropriate level of reserves.
Generally, reserves incorporate risk margins or margins of prudence and internal or external factors may lead to those margins being increased or decreased, as the case may be.

Internal factors

Changes in business mix
- New vs Renewal mix (e.g. New Individual Health business is expected to be more profitable)
- Change in geographical mix
- Change in age and gender mix / change in vehicle segment/sub segment mix, change in occupancy – e.g. extent of anti-selection due to cross-subsidy
- Change in product mix / Sum Insured Mix – e.g. Target Loss Ratio may be different
- Change in mix of business written as direct / co-share follower / inward reinsurance business
- Change in underwriting standards/controls

Change in policy conditions over time
- Extent of coverage provided – add-ons with wider coverages.
- Change in deductibles / co-pay share.
- Change in exclusions or waiting period e.g., Pre-existing Diseases exclusion
- Change in policy limits
- Change in coverage basis from loss occurring to claims made

Change in premium strength
- Adequate allowance for inflation or review of inbuilt inflation assumptions under New Health Products
- Effect / Extent of cross subsidy e.g., Group Health or Marine business sold as loss leader.
- Extent of focus on top-line growth/ market ranking e.g. ambitious targets set by management to gain market share.

- Exposure to tender business - expected to not be so profitable due to higher competition.

Change in claims practices
- Change in case reserving methodology
- Change in claims reporting/settlement/reopening practices
- Change in surveyors / TPAs.
- Change in Standard Operating Process (SOP) or agreed Turn Around Times (TATs)
- Strength of claims team – level of staffing and expertise
- Live streaming e.g. for faster Motor Own Damage claims settlement
- Use of AI to settle claims using photographs e.g. for faster Motor Own Damage claims settlement
- Extent of fraud undetected – by claimant, intermediary, insurance staff

Change in premium booking practices
- Extent of unallocated premium, retrospective premium adjustment
- Off balance-sheet items to the extent allowed for - e.g., policies where the insurer is on risk but not reflected through financials due to pending documentation (coinsurance follower business)

Change in mix of claims
- Extent of large/catastrophic losses and their treatment from a reserving perspective – amortised or excluded from the triangles
- Change in proportion of litigated claims
- Extent of claims settled through Court / Lok Adalat – may help save on penal interest.
- Extent of exoneration – e.g., in Motor TP.
- Extent of salvage and subrogation – e.g., in Motor Own Damage, Marine, Fire segment.
- Extent of recoveries achieved – e.g., in Trade Credit.
- Change in the mix of cashless vs reimbursement claims
- Change in mix of Death Vs Injury Claims – depends on sub-vehicle segment, geographical region (availability of ambulance and hospital).

Change in reinsurance arrangements
- Change in treaty retention over time – e.g. in line with Risk Appetite or market conditions or availability of reinsurance.
- Change in Risk XL /Cat XL arrangements - attachment points, reinstatement rules, indexation criterion, loss participation within layers by Accident Year.
- Presence or absence of Loss Caps / clean cut conditions by Underwriting Year.
- Presence or absence of commutation in past / commutation time.

Learnings from Back Testing
- Utilization of prior reserves.
- Emerging claims development – allowance for slower or faster than expected claims development.

Other
- Reserving strength as required by Appointed Actuary / Regulator / Peer Reviewer.

Change in external factors
- Change in claim frequency – e.g. stricter enforcement of traffic rules, improvements in vehicle safety standards, lockdowns during Covid period leading to reduction in claims frequency.
- Change in claim severity – medical inflation, demand surge, wage inflation, general inflation levels.

- Landmark court judgements impacting Claims Severity.
- Change in legislation – e.g. caps on claim reporting time expected to result in faster claims reporting for Motor Third Party Liability Claims.
- Economic environment – e.g. increase in claim frequency associated with increased moral hazard during times of recession.
- Extent of market competition e.g. impacting Retail business like Motor Own Damage.

- Stage of underwriting cycle (which may be different for different segments).
- Change in minimum rate required by the treaty reinsurer e.g., for Commercial Fire Business.
- Change in Exchange rate – e.g., adding volatility in the development of Travel claims.

Other
- Change in accounting standards – Granularity or level at which reserves should be set.
- Change in regulations / guidelines
- Change in professional standards

[Max 10]

iii)

a) Different valuation methods used to value non-life insurers are:
- Dividend discount method
- Discounted cashflow method
    - Free cashflow to firm
    - Free cashflow to equity
- Performance metrics from published financials
    - Price to Earnings (PE ratio) – Trailing / Forward
    - Price to book-value
    - Price to GWP
- Option pricing method

[3]

b) Highly likely that the junior member in my team used traditional valuation methods and he/she assumed that current financial year performance could be used as baseline for projection purposes. His/her assumptions likely were the following:
- Current year financial performance is free from any anomalies and/or cat events
- Both non-life insurers have
    - similar business mix – product, customer segments, geographic segments
    - similar distribution channels, commission structure
    - similar expense ratio
    - similar investment portfolio
    - similar large loss / CAT impact
    - similar reinsurance arrangements
    - similar claim payment pattern
    - similar prior year reserve movement
    - similar gearing effect
    - similar net worth – loss absorbing capacity / capacity to support business
    - similar capital requirement under say Risk Based Capital or Factor Based Capital regime
    - similar solvency ratio
    - similar bad debt experience
    - Similar risk appetite
    - Similar investment time horizon

- Market is efficient.

The above assumptions are unlikely to be borne out in practice.

He /she further implicitly assumed:
- Similar future growth for both insurers by segment and hence exposure to same market conditions and underwriting cycles.
- Similar future profitability for both insurers.
- Similar dividend payment philosophy for both insurers.
- No capital constraints to achieve planned growth – same debt / equity share (Weighted Average Cost of Capital)
- Both insurers operate under the same tax and regulatory regime.

- Both insurers follow the same accounting standard.

[Max 5]

c) Future business plans:
- Expected future growth rate can be different – management aspirations, capital constraints, profitability focus.
- Expected net profits could be different – stemming from operating in different product segments or sub segments / geographic markets, different business mix and expected impact of underwriting cycle or competition in the market, change in mix of business by distribution channels.
- Capital requirements could be different – diversification benefit for multi-line insurer (Vs mono-line insurer), different segment mix, investment portfolio composition, reinsurance structure and strength of reinsurers or their domicile.
- Hence quantum of new business that an insurer can underwrite could be very different

Quality of unearned and bound business impacting ability to change profitability in the near future -
- This mix could be very different compared to mix of reference year's earned premium.
  e.g., Advance premium, long term products, other long-term contracts / arrangements not having premium review clause limiting the ability to change price, guarantees offered and to an extent not allowed for in reserves till valuation date.
  Such long term products can provide additional investment float and capacity to mismatch
- Hence quantum of new business required to offset the impact of bound business could be very different for two insurers.

Reinsurance arrangements can reduce future profitability -
- Reinsurance arrangements with high upfront commission requiring return of initial commission.
- Reinsurance arrangements with clean-cut features and to the extent not reserved for till valuation date to impact future profits.
- Reinsurance credit ratings - Credit risk associated with reinsurance held can give rise to additional capital requirement and higher return on capital.
- Additional cashflows (retrospective adjustments) associated with reinsurance arrangements having sliding scale / profit commission.
- Future reinsurance rates and support available - cost-benefit impact.
- Extent of reinsurance used to support existing and planned business growth.
- Hence quantum of new business required to generate similar profits could be very different for two insurers.

Change in Management
- Any expected change in top management and possible change in business strategy could impact future business volumes and profitability

Investment book
- Extent of long tail products giving freedom to invest in asset classes with long duration and earn higher returns.
- Hence the effect of change in interest rates could impact two insurers with different asset and liability durations differently.
- Extent of mismatch in assets- liabilities and possibility of liquidity risk can impact stand-alone health insurers / Crop insurer.
- Credit rating of investment assets can impact overall capital requirement.
- Equity exposure and associated capital charge or actual equity performance could be very different for two insurers.

Existing reserve strength
- Extent of risk adjustment or Margin for Adverse Deviation (MAD) in reserves held and any requirement to increase prior reserves can hurt future profitability.

- Different claim handling practices can result in different liability duration.

Capital
- Financial condition of parent and other group companies can impact overall capital availability for the insurer.
- Planned business growth will result in lower operating expenses (economies of scale) and lower capital requirements.
- Current solvency position will impact investment decisions and the ability to invest in riskier assets classes with higher expected returns
- Required rate of return on capital employed could be different (e.g. extent of gearing) or based on the nature of risks underwritten, reinsurance arrangements etc
- There might be capital constraints as existing shareholders may not be willing to infuse additional capital as required for future growth.
- May need to use reinsurance as an alternative for capital – this may impact valuation as future profits will be lower.
- Extent of ESOPs granted and its effect on existing shareholders.
- Regulatory minimum solvency capital level requirement.

[Max 10]
[33 Marks]

Solution 2:
i)

a) Risk Appetite / Governance
- Due diligence – contracting firm and past record, technology / machinery / expertise (e.g., if involves tunnel work)
- Following Board approved underwriting policy - Underwriting authority matrix based on project type and Sum Insured and following Risk Governance – e.g., use of Large Risk Committee for accepting risks beyond certain thresholds as per Board approved Policy
- Risk survey at the start and during the project
    - Availability of fire-fighting members and equipment
    - Loss prevention measures for endangered structures in close proximity to be carried out by the insured.
- Risk is covered under existing reinsurance arrangements

- Underwriting risk on coinsurance basis as per risk appetite

Policy Structure / limits / clauses

- Per claim excess /deductible
- Suitable testing period as part of the policy terms and conditions
- Time excess and finite period of indemnity for ALOP coverage
- Restricting policy liability to limited length of the uncompleted road at any one time / limited length of open trench in case of pipelines.
- Retrospective premium adjustment at the end of the project.
- Use of exclusions as per standard practice.
- Cover wise Sum Insured limits e.g., for debris removal, architect's fees to limit extent of liability.
- Limit Sum Insured per event

[Max 5]

b) Underwriting controls
- Age of livestock covered under the policy with limits on the minimum and maximum age
- Animal identification by ear tagging or use of microchips to avoid fraud at the time of claim payment.
- Photograph of animal with owner and photograph of animal with ear tag.

- Medical certificate from veterinary doctor to confirm good health of animal to avoid anti-selection.
- To make sure that the Sum Insured is in line with Market Value.

Other underwriting factors
- Vaccination status
- Applicable Law and enforcement - Food safety standard / protocol, animal disease protocol, govt monitoring and enforcement
- Govt scheme / dairy / individual owner
- Farm set up – location.
- Feed and feed storage.
- Exposure to wildlife, migratory birds, rodents etc.
- Isolation - epidemic management.
- Hygiene of workers, visitors etc.
- Manure and waste management

Policy conditions
- Suitable Policy excess/deductible

General exclusions
- pre-existing diseases.
- waiting period - diseases contracted within the first 15 days / 30 days.
- consequential loss (e.g. Revenue lost in case of pandemic / animal death).
- malicious or wilful injury, overloading.
- intentional slaughter.
- theft or clandestine sale of the insured animal.
- transport by air or sea.
- loss due to war and nuclear weapon related perils.

Claims
- Use of loss assessor/ surveyor / investigator at the time of claim to check the validity of claim and cross check with photograph.
- Reporting of claims within a pre-defined time period say 15 days.

[Max 5]

ii)

a)
- Social discount rate generally tends to be lower than normal discount rate that gets used for judging other projects not having social wellbeing as a criteria.
- Use of Lower discount rate gives more weightage to future expected cashflows
- Use of Social Discount Rate thus helps the project pass the minimum threshold criteria used at Project Appraisal Stage.

[2]

b)
- Intergenerational equity – to protect the interests of coming generations from irreversible environmental damage based on continued use of existing technology.
  With newer technology expected environmental damage would be lower (but projects with new technology can only be sanctioned if Social Discount Rate gets used and includes interests of future generations by having a time span of say 100 years rather than just using 10 /15 year time horizon that might be considered in other cases)

- Intragenerational equity – This will emphasise the wellbeing of different segments of the population belonging to the same generation by comparing the post-project adoption benefits with the current status quo and widening the scope of stakeholders.

- Second order effects / social externalities – Adoption of the new project may impact social well-being by reducing pollution levels or may reduce accidental deaths and thus reduce strain on the economy. So, non-inclusion of such benefits at project evaluation may lead to incorrect decisions.

- Affordability/Inequality – Wider adoption can help reduce costs and make the project more affordable.
  Further, adoption of the new project might help to reduce such gap or help prevent any increase in such gap by directly helping the most vulnerable sections of the society.

- Subsidies – e.g., below cost fuel (in use currently due to heavy subsidies passed by Govt.) can lead to more usage and may do more harm to society.

- financing / polluter pays – if not financed now, current situation can lead to more severe consequences in future to all. Hence, with use of carbon tax, country can incentivise more appropriate behaviour. Penalising existing practices will also help in selection of new projects as the cost-benefit advantage of the existing system will reduce with imposition of additional taxes

- other factors like bio-diversity, impact on heritage assets, ground level water levels, quality of natural resources, insecurity of affected segments (living in flood prone regions), can also be considered by using Social Discount Rate if not able to quantify the effects through cashflows.

PESTLE Analysis - to see the bigger picture alongside potential constraints.
Multidisciplinary analysis – to see the bigger picture and implications of each strategy.

(RBI recently issued Green Bonds with 5 and 10-year terms and slightly lower interest rates than other Government securities of similar duration.)

[Max 5]
[17 Marks]

Solution 3:

i) Reasons for variation of Best Estimate liabilities from reserves projected using chain ladder methods / BF Method:

- As per IRDAI (ALSM Regulations) and IBNR circulars, under the current regime, discounting of reserves is not permitted. Further, under the current regime, there is no need to incorporate inflation for claims reserving, and hence reserves need not be discounted as both will counter each other. But under IND AS 117 and Risk based capital, discounting of claims is permitted both for claim liabilities and premium liabilities. Hence there is a component of discounting in best estimate liabilities.
- Stochastic reserving when used for setting reserves, can give a result different from that of Chain ladder method, as it depends on whether bootstrapping based on paid chain ladder method / incurred chain ladder method / BF method was used.
- Use of chain ladder method – involves assumptions namely development factors over different development periods being independent, no statistical distribution assumptions, whereas the method used for best estimate liabilities will have different assumptions
- Prudence needs to be removed from reserve estimates and the same will be explicitly loaded through risk adjustment / risk margin under IND AS 117 / RBC. Under the current regime, prudence is inbuilt in the reserves.
- Best estimate – could be mean / median / recent selection of factors / excluding 1H 1L factors etc., however, from the perspective of triangles, more consistent development factors may currently be utilized for arriving at the reserve estimates.

- 50th percentile of reserves could be used for best estimate purposes which may not be the same as that under the chain ladder method.
- Best Estimate could be based on judgment too from the range of reserves.
- Chain ladder method excludes ENID – latent claims etc. if the same have not occurred before.
- Cumulative Development factor less than 1 can also be selected from the perspective of best estimate liabilities, which may lead to negative IBNR. Under the current regulations, negative IBNR is not permitted.

    Diagnostics which can be employed to assess if the best estimate reserves only get booked:
    1. Reserve utilization ratio
    2. Actual vs expected analysis
    3. Bootstrapping
    4. Back testing
    5. Ultimate tracking

- Reserve utilization ratio: Reserve utilization ratio tracks the Paid + O/S + IBNR utilization of the opening reserves during the year. Reserve utilization ratio can be tracked both at the individual accident year / underwriting year cohort and also at the aggregate level. While this method is helpful to see how opening reserves have been utilized as well as whether the opening reserves are sufficient, a key drawback is that if there is under reserving for a particular accident year / underwriting year, the same may result in a lower utilization ratio, which will be incorrectly viewed as a positive sign by other stakeholders.

- Actual vs expected analysis: Actual vs Expected analysis (AvE) tracks the difference between actual claims experience and the expected experience, based on the assumptions from the most recent reserving exercise. Paid or Incurred ultimate claims can be used to track the actual paid / incurred during the financial year against that expected.

- The change in ultimate cost resulting from reserving assumption changes can be compared to the output of AvE analysis. Ordinarily, ultimate movements should be in the same direction as the AvE. The magnitude of the ultimate movement should also be proportionate to the AvE change. Reserving assumptions should be challenged if (for example) actual experience is worse than expected, but changes to reserving assumptions have reduced the ultimate or failed to increase the ultimate in line with emerging experience.

- Bootstrapping claim triangles or historical development factors is a common method to measure reserve variability in a structured and quantitative way. Plausible alternative datasets are derived by sampling residuals between the best fit chain-ladder and the dataset from which it is derived. A range of ultimates is produced from the outcome of the alternative projections. This provides a quick quantitative assessment of the uncertainty in the reserves.

- If the output of the fitted chain ladder is towards one end of the range of simulated outcomes, this could mean that:
    - Too many "outlier" link ratios have been excluded from the analysis
    - The model is fitted to an inappropriate number of historical origin periods

- Back-testing in the context of reserve validation means assessing the goodness of fit when applying current reserving assumptions to older historical cohorts.

- The ultimate liability estimated at a preceding valuation date may be revised at the current valuation date. This revision can arise due to any of the following reasons:
    - Updating data for the current period (for e.g. adding a diagonal to the Chain ladder method)
    - Change in method
    - Change in assumptions

    By splitting the reserve change under the above headers, the movement in ultimate claims may be studied and better understood

ii)

- Inflation to build in reserving estimates. This is especially true for TP lines of business.
- Policy data e.g. lack of historical data split according to the granularity required; sparse data availability.
- Latent claims
- Underwriting cycle
- Changes in reinsurance
- Large claims (extreme events or just catastrophes)
- Volatility in case reserves
- Quality of Data
- Return period of cat losses / large losses
- Changes in underwriting
- Changes in claim notification/settlement practices
- Aggregate policies – combined data
- Legal changes e.g. court inflation
- Changes in pricing
- Anchoring
- Known events not in data
- Social and economic factors
- Changes in Distribution methods
- Change in business mix across geographies

[Max 5]

iii)

- There are different methods to arrive at the Risk margin:
  - Cost of Capital approach
  - Margin over current estimates
  - Provision for adverse deviation
  - Value at risk based approach

- The cost of capital approach requires the risk margin to be calculated by determining the cost of providing an amount of capital equal to the Solvency Capital Requirement (SCR) necessary to support the insurer's obligations over the lifetime of the liabilities. The underlying approach is to calculate the insurer's technical provisions and SCR for each year in the future until the liabilities are fully run off.

- This requires assumptions regarding
  - Run off pattern of liabilities
  - Cost of capital rate
  - Capital charge for each of the premium risk, reserve risk, counter party default risk, unavoidable market risk, operational risk
  - Correlation between various risks due to diversification
  - Risk free rate for discounting of capital required.

- Since Crop LoB has sparse data, run off pattern of liabilities may not be straightforward. They are expected to have skewed values nearing crop cutting. Hence, the payment pattern will have humps apart from having lean development in few development periods. Curve fitting of development factors has to be done so that the development pattern can be made smoother.

- Capital charge for each risk can be arrived at by either using a stress based approach / 99.5% Value at risk based approach.

- Internal model can be used to study the volatility of each of the risks. For crop LoB, since the volatility is more, stochastic modelling – ODP on chain ladder method, ODP on incurred chain ladder method needs to be carried out which will capture the volatility of ultimate claims and provides an idea about coefficient of variation for both process error and parameter error. This coefficient of variation can be used to arrive at the capital charge for reserving and premium risk.

- If sufficient internal data is not available for bootstrapping, market data available, RI data and proxy data viz., weather data can be used to arrive at the capital charge for the premium / reserve risk.

- It is expected that premium risk capital charge will be more compared to reserve risk capital charge as the volatility of premium risk is expected to be more, in view of the unexpired risk coverage.

- Since crop has a short tail, market risk is expected to be insignificant. Since most claims get settled with in a year, interest rate risk, spread risk etc., are not expected to be material.

- Counterparty default risk is expected to be a major contributor to the SCR, as the ceding % is high in Crop LoB. Hence, depending on the reinsurer credit rating and other economic conditions, the expected probability of default can be used to arrive at SCR for counterparty default risk.

- Similarly, the SCR required for each of the future years for existing business, UPR and premium received in advance is calculated. This could be either done by calculating the expected risk capital in each of the future years or by using a driver (namely IBNR + OS run off, UPR, RI receivable etc., depending on nature of risk) and calculating the capital required in future year till all the liabilities are run off completely.

$$CoC \cdot \sum_{t \geq 0} \frac{SCR(t)}{(1+r(t+1))^{t+1}}$$

- Risk Margin is calculated using the above formula , where CoC is cost of capital and r is the risk-free rate.

[Max 10]

iv) There are many ways to generate cashflows from the reserves (viz., IBNR, Outstanding claims, UPR). The most commonly used method is to use the paid claims pattern to arrive at the claims expected to be paid for each of the future years.

- For arriving at premium liabilities, the claim payment pattern has to be applied with a suitable lag, as premiums need to be earned over a suitable time period

- In case the payment pattern has to be applied to underwriting year cohorts (as expected for INDAS 117), the pattern has to be taken from underwriting year origin triangles directly.

- Or if accident year origin cohorts are being used for arriving at the pattern, the premium earning pattern needs to be applied first and then the accident year pattern has to be applied on the same.

- If underwriting triangles are used for projecting the ultimate claims, segregation has to be made between the cashflows pertaining to earned and unearned business.

- The above method is dependent on the following assumptions:
  - Future payment patterns will be the same as observed in the past
  - There are no expected changes either due to regulations / internal practices which cause a change in payment pattern. For example, with the introduction of amended Motor vehicles act, it is expected that reporting delay and subsequently settlement delay will reduce, hence payment pattern is expected to change.

- There are no changes in customer behaviour – with respect to lapse / discontinuance (more from premium liability cashflows perspective)

- Using payment pattern to convert reserves to cashflows may lead to model error, particularly if the underlying model used for estimating reserves is different from paid chain ladder method.

- If there is significant model error, the predicted cashflows may be front loaded / back loaded compared to actual cashflows. This will result in over reserving / under reserving as the number of years to discount decreases / increases if cashflows are front loaded / back loaded respectively

- Wrong payment pattern also leads to errors in Actual vs Expected analysis.

- Any unusual payment pattern (eg. early settlement of claims occurring due to cat events) needs to be excluded to arrive at a stable payment pattern.

- There will be elements for which it is difficult to derive a cashflow pattern (for example, claims projections for a class of business with sparse development data – especially for liability lines and new LoBs). Reasonable assumptions would have to be made to arrive at a suitable pattern and these assumptions may be based on another cashflow projection that would be expected to have similar features (may be TP payment pattern for liability / use of market data).

- The ALAE expenses may follow a different payment pattern compared to the claims pattern. Assumptions need to be considered for the same.

- Expected cashflows in respect of policies bound but not incepted may have totally different payment patterns compared to earned exposure, as more volatility is expected in the same. Suitable adjustments need to be made for the same.

[Max 10]

v)

Sources of Non modelled risks could be due to four main categories:
- Lines of Business not covered by Cat Models
- Coverages which are offered in direct insurance which are not covered by Cat models.
- Geographies and perils not covered by Cat models
- Secondary effects and perils not covered by Cat models

- Lines of Business not covered by Cat models:
    - It is usual that the Cat models usually cover lines of business like property, fire, engineering etc.
    - Some lines of business like motor (both OD & TP), freights in transit, personal accident, workmen compensation may also be impacted by Catastrophe risks which may not be covered under regular cat risk model.

- Coverages which are offered in direct insurance which are not covered by Cat models.
    - Most catastrophe models cover physical damage and business interruption.

    - However, not all coverages in the base policy are considered in CAT models.

    - For dwellings, this may include additional living expenses due to flood / hurricane event. For IAR policies, this could be cost of debris removal and machinery breakdown.

    - During forest fire, earthquake / floods there is a chance of contingent business interruption losses, as suppliers affected by the disasters are unable to meet contracts to their customers around the world. All these aspects would not have been considered in CAT models.

- Geographies and perils not covered by Cat models
  - There have been instances in the past where existing CAT models have not considered material catastrophe events viz., Covid 19 pandemic, World trade centre loss 9/11 etc.,

  - Also flood risks are hitting areas which in the past had minimal flood risk viz., Uttarakhand, Sikkim floods. Hence insurance exposure to these geographies would not have been captured under the Cat model.

- Secondary effects and perils not covered by Cat models
  - Cat models usually model risks which correspond to direct risks but which do not capture the losses from resultant or secondary perils.

  - Examples of secondary perils may include:
    - Storm surge
    - Fire following earthquake/terrorism/flood
    - Tsunami caused after earthquake
    - Liquefaction
    - Landslide/mudslide after earthquake
    - Theft after a cat loss
    - Regulatory intervention
    - Other consequential losses

[Max 10]

vi)

- There are different methods for quantifying non-modelled risk:
  - Expert judgement – rule-of-thumb methods, often used where little or no data is available, or only a subset of data is used.
  - actuarial/statistical – data-driven statistical methods, particularly useful when some loss data is available.
  - Geospatial – methods of varying complexity based on mapping risks within defined geographic areas.
  - Catastrophe model modification and building – using another model as the basis for quantifying non modelled risk.

- The methodology adopted will depend on materiality of risk – in terms of exposure to risk, company's risk appetite, availability of data, proportionality.

- Actuarial methods require data. These could be:
  - Insurer's losses due to the non-modelled risks.
  - Industry losses due to the non modelled risks.
  - The losses need to be adjusted for inflation, exposure growth, insurance coverage etc.,
  - Using what if scenarios to estimate the losses due to non-modelled risks – for each peril.
  - Despite all these, the actuarial methods could be of limited use due to non-availability of data, uncertain return period, poor sampling etc.,

- Once they are modelled, correlations between risks, lines of business, aggregation across geographies needs to be done to arrive at the capital risk charge for cat risk.

[Max 5]
[50 Marks]

****