

44th India Fellowship Seminar

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The Emerging risk frontier: Climate and ESG risk assessment in Life insurance

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Agenda

- 1 Case Study: Background
- 2 Risk assessment
- 3 Risk Prioritisation
- 4 Developing Liability Scenarios
- 5 Strategies to Mitigate Risk
- 6 Setting assumptions without historical data - Factors
- 7 Next Steps

Q&A

Case Study: Background

As an Actuary in a Life Insurance Company, we are asked with presenting a comprehensive risk assessment related to climate change and ESG (Environmental, Social, and Governance) **considerations to the Board**. The potential risks that the company should consider, include:

Climate-Related Risks

1. Physical risks (e.g., increased mortality and morbidity)
2. Transition risks (e.g., regulatory changes, litigation)
3. Liability risks (e.g., increased claims from climate-related illnesses)

ESG-Related Risk

1. Environmental risks (e.g., investment portfolio impacts)
2. Social risks (e.g., reputational damage, changing consumer expectations)
3. Governance risks (e.g., board composition, executive compensation)

We have to **recommend on the risks** that the Company should prioritize, and how can the company develop potential liability scenarios, strategies to mitigate these risks? Also, given that there is no historical data, **detail the factors** we would consider in setting the assumptions.

Risk Assessment

Risk assessment : Climate Related risks

Why are climate related risks so important in India?

- High population density
- Geographical diversity
- Poor public infrastructure

Recent Incidents

- 2024 heatwave across North India led to over 200 confirmed deaths
- 2024 Assam floods affected 6.7 lakh people with almost 50 deaths

Regulator's view

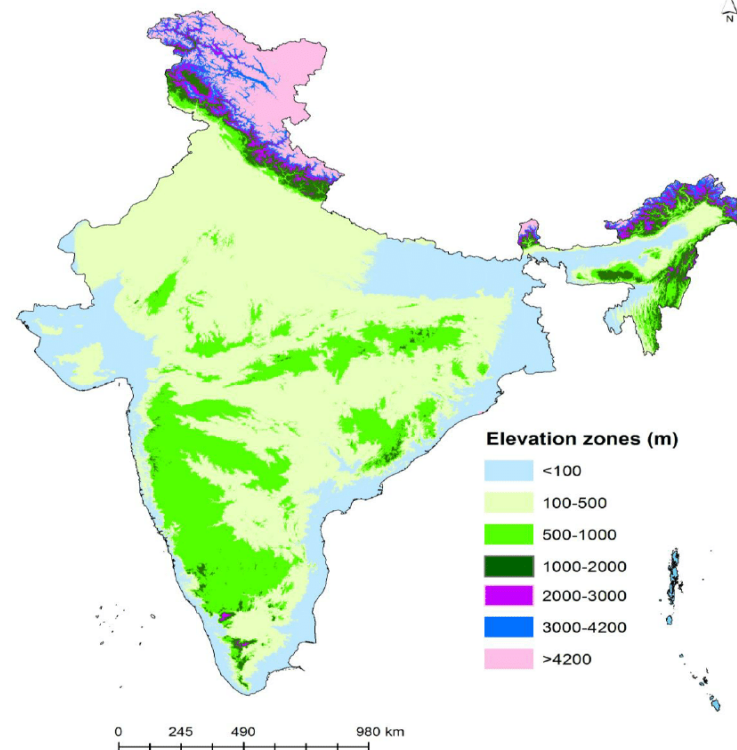
- IRDAI has also acknowledged climate risk and as per IRDAI 2024 (Corporate Governance for Insurers) regulations, life insurers are required to establish a comprehensive climate risk management framework to be able to manage these risks

Classification of climate risk

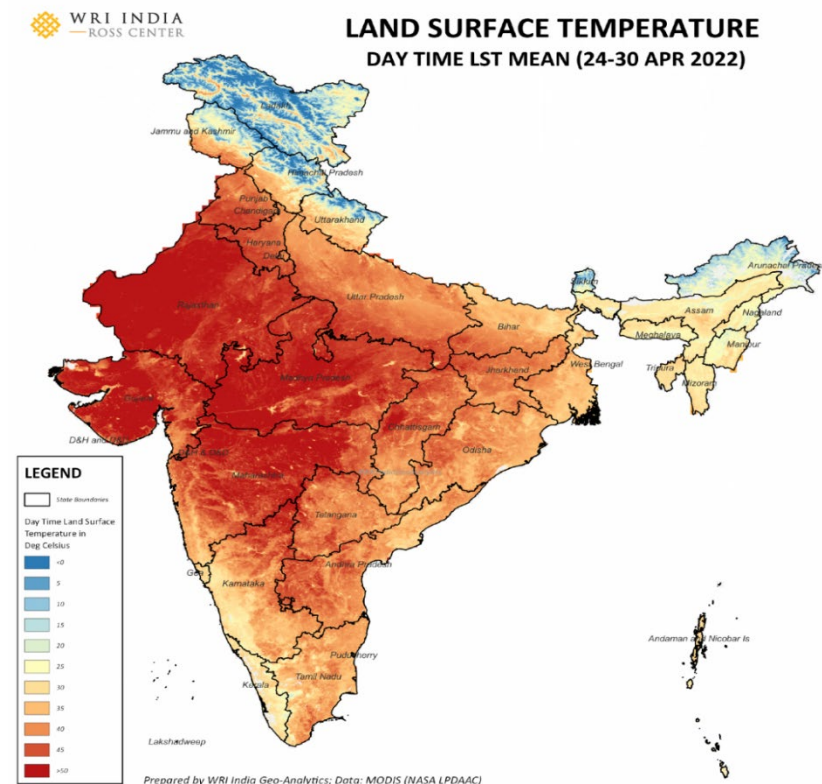
- Physical risk
- Transition risk
- Liability risk

Risk assessment : Climate Related risks

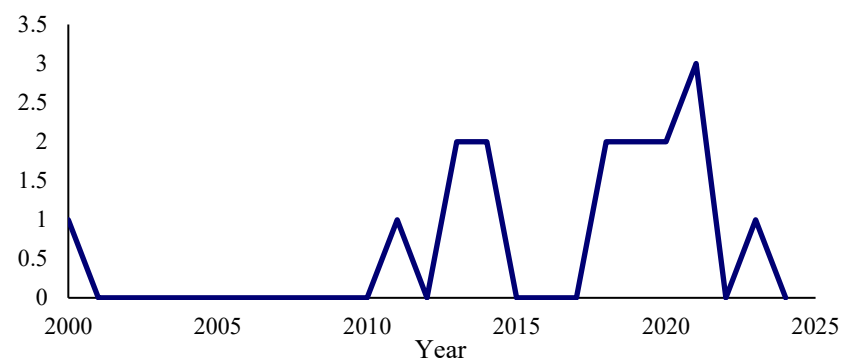
Height from mean sea level



Land surface temperature as of April 2022



Risk assessment : Physical risks

What are climate related Physical risks?	How does it impact life insurer?	Example: No. of SCS and ESCS landfalling in India *																																								
• Tangible and immediate impact • Flood, cyclones, heatwaves etc. • Increasing frequency and severity	• High mortality and morbidity due to increasing events • Concentration of policies leading to mass claims • Example: 2005 Mumbai floods • Anti selection risk • Business disruption • Increase risk of surrenders due to need for money during difficult times	 <table><caption>Approximate data from the graph</caption><tr><th>Year</th><th>No. of SCS and ESCS</th></tr><tr><td>2000</td><td>1.0</td></tr><tr><td>2001</td><td>0.0</td></tr><tr><td>2005</td><td>0.0</td></tr><tr><td>2010</td><td>0.0</td></tr><tr><td>2011</td><td>1.0</td></tr><tr><td>2012</td><td>0.0</td></tr><tr><td>2013</td><td>2.0</td></tr><tr><td>2014</td><td>2.0</td></tr><tr><td>2015</td><td>0.0</td></tr><tr><td>2016</td><td>0.0</td></tr><tr><td>2017</td><td>2.0</td></tr><tr><td>2018</td><td>2.0</td></tr><tr><td>2019</td><td>2.0</td></tr><tr><td>2020</td><td>3.0</td></tr><tr><td>2021</td><td>0.0</td></tr><tr><td>2022</td><td>1.0</td></tr><tr><td>2023</td><td>0.0</td></tr><tr><td>2024</td><td>0.0</td></tr><tr><td>2025</td><td>0.0</td></tr></table> <i>SCS and ESCS: Extremely Severe cyclonic storms</i>	Year	No. of SCS and ESCS	2000	1.0	2001	0.0	2005	0.0	2010	0.0	2011	1.0	2012	0.0	2013	2.0	2014	2.0	2015	0.0	2016	0.0	2017	2.0	2018	2.0	2019	2.0	2020	3.0	2021	0.0	2022	1.0	2023	0.0	2024	0.0	2025	0.0
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Historically, short term impacts of these events has not been huge due to

- Mortality risk not so significant for Endowment products, negative for annuities
- Impacted people less compared to total policies written
- Example: 2005 Mumbai floods leading to 1100 deaths

But as the frequency and severity of these events increase in the future, it will increase mortality and morbidity leading to higher claims

Risk assessment : Transition risks

What are climate related Transition risks?	How does it impact life insurer?	Indian context
• Caused by shift to low carbon economy • Evolving policies, regulations and disclosure mandates • Less tangible but equally significant	Regulatory risk • insurers failing to transition to new regulations and framework in time • Reputational risk • Insurers having global partners must follow global climate related disclosures • Smaller insurers struggle with data and systems Legal risk • Litigation risks from stakeholders if company unable to transition to more sustainable investments Investment risk • Reduced yields from a green investment strategy	• No standard disclosure requirements for Indian life insurers yet except for core BRSR norms • Few large Indian insurers have started aligning their climate-related disclosures with TCFD recommendations • Also started to integrated ESG factors into their research and investment decision-making process

Risk assessment : Liability risks

What are climate related Liability risks?	How does it impact life insurer	Example:
• Climate related illness & mortality • Caused by Gradual and persistent changes like rising sea level and temperatures	• Increase morbidity risk leading to increased long-term mortality, disability and critical illness claims • Lack of past data regarding illness and deaths due to climate change make it difficult to include these risks in pricing • Need for a higher margin for adverse deviation • Increase in reserves and capital requirements	As per WHO, • Heat stress is the leading cause of weather-related deaths and can exacerbate underlying illnesses including cardiovascular disease, diabetes, mental health, asthma • Heat-related mortality for people over 65 years of age increased by approximately 70% between 2000-2004 and 2017-2021 • climate change is expected to cause approximately 250 000 additional deaths per year worldwide, from undernutrition, malaria, diarrhea and heat stress alone

Risk assessment : ESG Related risks

What are ESG related risks

- Environmental, social and governance risk
- Non-financial factors
- Can materially impact company's performance, reputation and long-term sustainability

Why are ESG related risks important in India

- Vulnerable to climate change
- Socio economic diversity
- Rising stakeholder expectation

Regulator's view

- IRDAI has also acknowledged ESG risk and as per IRDAI (Corporate Governance for Insurers) Regulations, 2024, insurers are required to establish a ESG framework to be able to manage these risks

Recent updates

- Several large global life insurers, especially in EU have started phased divestments of fossil fuel and coal-based investments

Risk assessment : Environmental risks

What is Environmental risk	How does it impact life insurer?	Example:
- Environmental risks refer to the impact of environmental issues like climate change, carbon emissions and pollution - We will focus on the investment risk as we have covered climate related risks in detail in previous slides	Investment risk - Huge sums of money invested in debt, equities and real assets - Indian insurers traditionally have huge investments in infra and energy companies - face reducing profitability - Direct impact of natural hazards on real assets make it less attractive - Finding sustainable investment that do not compromise on returns in the short term - Green investments expensive and less profitable - Reputational and legal risk Mortality and morbidity - Increasing pollution leading to higher respiratory illness	- As India commits to net 0 emissions by 2070, fossil fuel based and companies with high carbon footprints face declining profitability and stricter regulation - Green energy companies are trading at higher earning multiples as compared to traditional companies - These companies offer much lower dividends as compared to traditional companies, compromising short term returns on these investments

Risk assessment : Social risks

What is social risk?	How does it impact life insurer	Example:
• Arise from the way organization interacts with customers, employees and broader community • Socio economic diversity and digital inclusion amplify these risks	• New age customers demanding digital services and quick grievance redressal • Mis-selling allegations, collection of personal unwarranted data for underwriting purpose • opaque claim process • Mis-handling or loss of data privacy • Greenwashing • Reputational risk leading to reduced future new business and increased lapsation	• Indian insurers have faced events of data loss exposing customer data • As per 2022-23 IRDAI annual report, 50% of complaints against insurers were due to unfair business practices • A big German investment bank had to pay hefty fine to settle greenwashing allegations

Risk assessment : Governance risks

What is governance risk?	How does it impact life insurer	Example:
• Governance risks refers to potential harm to an organization due to - ○ Poor structures ○ Poor Policies ○ Oversight in management	• Lack of diversity and independence in the board • Lack of expertise especially in ESG risk management • Executive compensation not linked to long term and sustainable growth • Not linked to policyholder welfare • Related party transaction coming under scrutiny	• Recently, governance and internal control of few companies in India (not insurance companies) have come under scrutiny because of ○ Lack of independence to question the board ○ Lack of internal controls ○ Board oversight • A large private Indian life insurer was awarded because of its strong corporate governance and internal control framework ○ Boost consumer confidence ○ Build reputation

Risk Prioritisation

Risk Prioritisation : Factors to consider

- These are non-financial and mostly emerging risks, it is difficult to prioritize these risks objectively
- Hence judgement has been used, and these risks have been rated on 3 factors based on the risk assessment we performed

01

Financial materiality - Expected financial impact of the risk based on likelihood and severity of the impact

02

Time Horizon - Imminence of expected impacts

03

Controllability - Degree to which risks can be controlled by appropriate actions

Risk Prioritisation : Financial materiality

Risks	Rationale	Priority
Physical	• Direct impact on mortality and morbidity leading to higher claims • Higher claim outgo leading to lower profitability • Will depend on mix of products and geographical diversification	High
Transition	• High operational, expense and legal risk increasing the costs of the insurer • Loss from transitioning to greener investments • Higher costs and expenses leading to lower profitability	High
Liability	• Severe long-term impacts on mortality and morbidity • Result in higher claims leading to lower profitability • Difficulty in pricing these risks may lead to strain on profitability and solvency	Very High
Environmental	• Direct impact on investment yield and lower short term cashflows • Difficulty in finding new investment opportunities increase the risk • Severe impact on assets and returns on investments affecting profitability and capital position	Very High
Social	• Indirect and minimal impact on financials and cashflow • Reputational and legal risk may hamper ability to write new business	Medium
Governance	• Lower short-term impact, but long-term impact on financial performance • Executive compensation, internal policies and controls	Medium

Risk Prioritisation : Time horizon

Risks	Rationale	Priority
Physical	- Historical impact not significant - Emerging risk, expected to increase in future - But quick action needed to include them in pricing and underwriting	Medium - High
Transition	- Very sensitive to future policy and regulation shifts, hence an emerging risk - Urgent actions required on transition to sustainable investments	Medium - High
Liability	- Impacts have started to increase - Impacts to be significantly material in medium to long term - But quick action needed to include them in pricing and underwriting	Medium - High
Environmental	- Urgent actions required to divest from fossil fuel and environmentally harmful companies - To avoid risk of lower profitability - And to avoid legal and reputational risk	High
Social	Emerging risk, expected to increase in future consumer expectations are increasing regarding ethical and responsible business practices	Medium
Governance	Emerging risk, highly controllable nature makes it less urgent as compared to other risks	Medium

Risk Prioritisation : Controllability

Risks	Rationale	Priority
Physical	Highly dependent on external factors and insurers have limited control	High
Transition	- Mix of internal and external factors - Insurer cannot control government policies and disclosure requirements - Can take early actions by developing sustainable investment policies and aligning disclosures with global standards	Medium
Liability	Highly dependent on external factors and insurers have limited control	High
Environmental	- Have some control on the investment strategy - Cannot control the opportunities available in the market or hazards that impact its investments	Medium
Social	- Have some control on these factors - Can undertake ethical business practices to reduce these risks	Medium
Governance	Very high control on its internal board composition, remuneration policy, risk management and internal controls framework	Low

Risk Prioritisation

Risk Type	Financial materiality	Time Horizon	Controllability	Composite Priority
Environmental	Very High	High	Medium	High
Liability	Very High	Medium - High	High	High
Transition	High	Medium - High	Medium	Medium - High
Physical	High	Medium - High	High	Medium - High
Social	Medium	Medium	Medium	Medium
Governance	Medium	Medium	Low	Medium

Developing Liability Scenarios

Setting Context

To develop potential liability scenarios, we need to consider the following steps -

- Identify Key Risk Drivers & Prioritization
- Engagement with External Stakeholders
- Leveraging International Financial Frameworks
- Building Quantitative and Qualitative scenarios



Identifying Key Risk Drivers & Prioritization

Public health trends -
Impact on Mortality/
Morbidity from -

- Heatwaves
- Natural Disasters

Transition risks

- Regulatory changes
- Technology risks
- Market Risk
- Reputation Risk

Social Expectations and
Public sentiment
Examples -

- ESG investing backlash
- Visible gender bias

Legal and litigation risks -
Examples -

- Allegations of Greenwashing
- Mis-selling complaints

Prioritise risks as per likelihood and severity



Engagement with External Stakeholders

Who?

- Regulators
- Reinsurers
- Climate scientist
- ESG rating Agencies
- Medical researcher
- NGOs

How?

- Conduct surveys, workshop, stake holder meetings
- Guidance from reinsurers

Why?

- Validate assumptions
- Gather additional perspectives
- Enhance credibility of scenarios

Leveraging International Frameworks (1/2)

- Frameworks -
 - TCFD - Taskforce on Climate Related Financial Disclosures
 - IFRS S2 - International Financial Reporting Standard S2 - Climate Related Disclosures
 - NGFS - Network for Greening the Financial Systems
- Provide recommendations/guidelines for companies to disclose their climate related Financial Information
- Provides base scenarios for assessing the risks

Leveraging International Frameworks (2/2)

Orderly Transition	Disruptive Transition	Hot House World
• Successful climate action • Improved public health • Stable mortality trends	• Sudden regulation changes • Litigations over greenwashing • Reputational issues	• Climate action fails • Surging Mortality • Policy disputes • Regulatory penalties
• Scenarios created to provide a starting point for analysis • Not forecasts • Explores a range of plausible outcomes		

Building Quantitative & Qualitative Scenarios (1/2)

Quantitative Elements

- Increase in mortality claims by 15% in summer months in urban areas
- 5-20% decline in investment value due to stranded assets
- 5-10% fall in persistency

Qualitative Elements

- Public outcry over Greenwashing
- Criticism over lack of transparency in ESG Disclosures
- Criticism over social issues such as Gender bias

Link scenarios to KRAs -

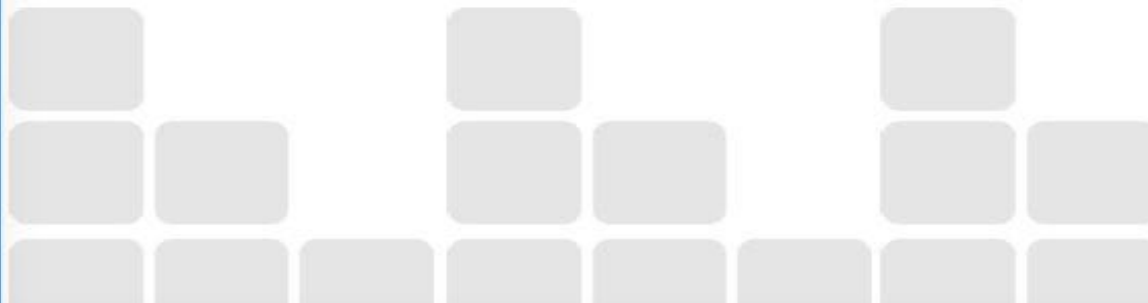
- Claim ratios, Persistency rates
- Complaint volumes, and resolution times
- Solvency, EV, ALM

Building Quantitative & Qualitative Scenarios (2/2)

Scenario	Impact	Assumption
Heatwave Scenario	• Increase in claims	• 10-20% increase in mortality
Pandemic due to climate change	• Increase in claims • Assumptions to be revised • Anti-selection	• 10-20% increase in mortality • Impact likely to worsen in future • 10% increase in persistency
Regulatory carbon pricing	• Investment losses • Assumptions to be revised	• 5-20% devaluation of carbon heavy assets • Reserves to be increased
Social Backlash - • Lack of transparency • Claim delay	• Trust factor reduces • Inability to meet targets	• Persistency falls by 10% • Lower future new business by 20% • Regulatory penalties



Strategies to Mitigate Risk





How to Mitigate the risks? (1/2)

Governance and Risk Framework Integration -

- Make best use of IRDAI's Corporate Governance Regulations, 2024 - Board approved ESG and Climate Risk Management framework
- Assign accountability to senior management for ESG/climate oversight.
- Integrate these risks into the ERM frameworks.

Investment Strategy-

- Integrate ESG factors in asset selection.
- Increase exposure to green bonds, infrastructure for renewables, and low-carbon sectors.
- Avoid stranded assets (e.g., coal-heavy portfolios).
- Align with IRDAI's Investment Guidelines and BRSR Core norms.



How to Mitigate the risks? (2/2)

Product Innovation -

- Design sustainable insurance products -
 - ESG-screened ULIPs
 - Premium waivers during climate related disasters
- Promote Micro-insurance for vulnerable populations like the existing PMJJBY & the upcoming Bima Vistaar
- Integrate Stress testing results into product repricing.

Underwriting & Reinsurance

- Use climate-adjusted assumptions
- Incorporate climate vulnerability metrics into underwriting
- Avoid coverage practices that may be perceived as discriminatory
- Review catastrophe reinsurance covers to protect against extreme climate events

Setting assumptions in absence of historical data - Factors to consider

Conventional approach for setting Assumptions

Key Assumption	Data Used	Economic Capital/Ind AS 117/ IEV	IGAAP Valuation
Mortality & Morbidity	Historical Experience by outgo split into duration and demographic cuts like product groups, distribution channel, Underwriting type, Gender, Sum Assured Bands etc.	Assumptions are kept closer to emerging experience with due weights given to historical experience and allowance for changes in future for improved underwriting practices, better medical treatments, nutrition, increased awareness, future pandemics etc. to approach a Best Estimate	Adjustment for a minimum of 10 % of margin of adverse deviation, worsening in case of assurance and improvement for Annuity over Best Estimate assumptions
Persistency	Historical Withdrawal, Lapse, Paid UP & Revival Experience by Premium/Count split by policy year and demographic cuts like product groups, distribution channel, Premium Bands, Premium Frequency, PT-PPT combinations etc.	Assumptions for withdrawal partial withdrawal, lapses & revival are kept closer to emerging experience with due weights given to historical experience and allowance for changes in future for improved underwriting & sales practices, retention techniques, policyholder behavior etc.	Adjustment for an increase or decrease (Whichever is adverse) for a minimum of 20 % of margin of adverse deviation.

Conventional approach for setting Assumptions

Key Assumption	Data Used	Economic Capital/Ind AS 117/ IEV	IGAAP Valuation
Expenses	Expense study performed by company distributing expenses by Acquisition, Maintenance and by product groups (with consideration of Expense of Management regulation)	Assumptions are typically aligned with the expense study and attributed as % of premium, % of Sum Assured and fixed expense per policy besides the split by Acquisition and maintenance	Adjustment for a minimum of 10 % of margin of adverse deviation
Interest Rates	Existing portfolio yields, expected New Money yields with allowance for yields locked in through derivatives by line of business	Risk Free Rates used with adjustments for illiquidity premium (where applicable) & an alternative top down approach permissible under Ind AS	Weighted average of book yield and adjusted new money yield (Adjusted for derivatives) with an a immediate increase or decrease (which ever is adverse) of 10% of gross redemption yield from 10 year Gilt for the next 5 years and an additional 10% of BE rate for the subsequent years
Inflation	Long Term Inflation rates from credible sources like RBI reports, IMF data etc.	Generally used directly	Generally used directly, consistency with new money yields considered

Limitations of Conventional approach

Inadequacy for Emerging Risk:

Historical Data lacks relevance for new and evolving risk for example climate, environmental, social, antimicrobial resistance risk

Limited Availability and Quality of Data :

Data may be incomplete, incorrect or too old to be used for the purpose of future projection.

Appropriateness of Data :

While a clean and complete historical data may be available, it may not be fit for purpose, for ex- Industry data may not be relevant for a company which intends to write online only products.

Over Reliance on past trends :

Historical data may not be reflective of changes in human behavior, societal trends, policy shifts to be able to forecast future appropriately

Setting Assumptions without historical data : Climate & ESG Risk

In Absence of historical data, a triangulated approach can be used to allow for Climate and ESG risk in the existing Actuarial Assumptions, combining the following -

- 01 Use of proxy data from external source and industry benchmarks to assess the likelihood of Climate & ESG Related events
- 02 Use of Non-Traditional data sources for example Satellite Imagery, Geo-Spatial Data etc.
- 03 Assess own business attributes to evaluate exposures & Vulnerability in short term and long term
- 04 Incorporate Professional judgement & statistical techniques to overlay impact of Climate and ESG Risk on existing assumptions
- 05 Incorporate Bayesian Updating as data emerges

Factors to consider in triangulating Assumptions : Mortality & Morbidity

Potential External Data Source	Potential approaches to Quantify impacts	Factors to be considered	Professional Judgments and Checkpoints
• Institute of Health & Metric Evaluation (IHME), • National Disaster Management Authority • Ministry of Earth Sciences GOI • Inter Governmental Panel on Climate Change (IPCC) , • Open AQ, Etc.	• Credibility theory for blending Internal & External data • General Additive Modelling (GAM) with climate & ESG variables • Regime Switching Log Normal Models	• Climate Vulnerability Index of the Insured Geography - Heat Zones, Flood prone zones etc. • Urban and Rural Mix - Heat Island Effects, Pollution Levels, Hospital Proximity, Green house Gas Emission • Government Climate Preparedness • Age Group - Older Lives are more vulnerable to heat & Pollution • Occupation Mix - Outdoor workers face higher risk of climate exposure	• Ensure Assumptions are not overly conservative • Assumptions are defensible & not just statistically strong • Appropriate testing mechanisms to validate appropriateness of overlay • Document the rationale, sources and Range

Factors to consider in triangulating Assumptions : Persistency

Potential External Data Source	Potential approaches to Quantify impacts	Factors to be considered	Professional Judgments and Checkpoints
• Institute of Health & Metric Evaluation (IHME), • National Disaster Management Authority • Ministry of Earth Sciences GOI • Inter Governmental Panel on Climate Change (IPCC) , • Open AQ, Etc.	• Credibility theory for blending Internal & External data • General Additive Modelling (GAM) with climate & ESG variables • Regime Switching Log Normal Models	• Product Mix between Savings and protection • Demographic and Economic Characteristics of the policyholder - income bands, ticket size, employment type, age etc. • Geographic Variability - for Example Coastal areas are more prone to Floods & Cyclones • Urban and Rural Mix - Healthcare access and thus need for Insurance, awareness of ESG compliance	• Direct data to assess impact on persistency will not be directly available, judgement needs to be applied to correlate financial loss with lapsation to determine overlays and parameters • Apply professional judgement to localize International behavioral and economic data • Ensure Assumptions are not overly conservative • Parameter Risk must be acknowledged, and results must be interpreted with caution

Factors to consider in triangulating Assumptions : Expense

Potential External Data Source	Potential approaches to Quantify impacts	Factors to be considered	Professional Judgments and Checkpoints
• Institute of Health & Metric Evaluation (IHME), • National Disaster Management Authority • Ministry of Earth Sciences GOI • Inter Governmental Panel on Climate Change (IPCC) , • Open AQ, Etc.	• Credibility theory for blending Internal & External data • General Additive Modelling (GAM) with climate & ESG variables • Regime Switching Log Normal Models	• Elevated Claim handling expenses due to increased mortality & surrender claims varying by geographical variability. • Impact on expense due to own decarbonization strategies and investments in new technologies, systems and process to align with sustainable goals • Increased litigation expenses due to greenwashing or inadequate risk management • Impact on expenses due to cost related to collection of climate & ESG related data for assumption setting, reporting, system	• Direct data to assess impact on expense will not be directly available, judgement needs to be applied the correlate impact of increased expense due to increased claims • Estimate of own expenses due to decarbonization, cost of data collection and running model will need to be assessed independently • Ensure Assumptions are not overly conservative

Factors to consider in triangulating Assumptions : Interest Rates

Potential External Data Source	Potential approaches to Quantify impacts	Factors to be considered	Professional Judgments and Checkpoints
• Institute of Health & Metric Evaluation (IHME), • National Disaster Management Authority • UNEP FI Guide • Inter Governmental Panel on Climate Change (IPCC) , • Open AQ, Etc.	• Credibility theory for blending Internal & External data • General Additive Modelling (GAM) with climate & ESG variables • Regime Switching Log Normal Models	• RBI's response to economic slow down due to climate related events like flood, cyclones etc. in adjusting interest rates . • Volatility in equity returns due to climate related events • Impact on yields due to transitioning to green investments as a part of the overall portfolio and consequent impacts on Bonus Rates • Long term impacts of ageing population can disrupt economic stability prompting interest rate adjustments • Second order impacts on Corporate bond yields with their respective decarbonization plan	• Apply professional judgement to localize International behavioral and economic data • Ensure Assumptions are not overly conservative • Assumptions are defensible & not just statistically strong • Parameter Risk must be acknowledged, and results must be interpreted with caution

Other Considerations

Climate and ESG risk brings about both direct and indirect impact to Insurance company, below are few other factors that must be considered

- Credibility and relevance of external data to Insurer's portfolio and Indian Market
- Compliance with relevant privacy laws specially where customer related data is used
- Impact on Shareholder yields on transitioning to Green Investments
- Diversification impact on climate and ESG Risk overlay across assumptions
- Reputational impact of company's own ESG compliance and practices impacting future new business and persistency with second order impacts on expenses in case of a default
- Impact of increase in expense due to company's own rehabilitation drive for damages to company's assets and business interruption due to a climate event

Post presentation action Points -

- Perform gap analysis of company's current practices and ESG compliance approach
- Finalise the data sources & models to be used for Assumption overlay
- Assess the impact of assumption change on liabilities, current and future Solvency positions, Embedded Value and Margins
- Assess sustainability impact on existing premium rates for different product categories
- Set a detailed Climate and ESG risk related framework in line with IRDAI's Corporate Governance framework requirement, leveraging international & Local standards like
 - *Task Force on Climate Related Financial Disclosures (TCFD)*,
 - *IFRS S1 - General Sustainability related financial disclosures*
 - *IFRS S2 - Climate Related disclosure*
 - *Global Reporting Initiative (GRI) Standard*
 - *Business Responsibility and Sustainability Reporting (BRSR)*
- Integrate the framework with company's existing Enterprise risk management framework, such that same can be monitored, reported and presented at appropriate levels
- Continuous track of GOI's initiative towards Net Zero Target by 2070, the initiatives undertaken and the data emerging out of those changes

Thank You !!



Appendix

Potential External Data Sources



- **Institute of Health & Metric Evaluation (IHME)-**

IHME is an independent population research organization based out in University of Washington school of medicine. The organization shares impartial and open to all data across categories such as

- Details of Environmental, Behavioral related deaths & Disability by region, year, gender, age
- Health related spending projections, and other relevant data

- **Inter Governmental Panel on Climate Change (IPCC)-**

IPCC is a United Nations body that provides regular assessment of climate change, its impact and future risk; for ex- there are useful data related to increase in global temperature inducing climate events like floods, cyclone, windstorms, typhoons, draughts etc. and the related losses

- **UN Environment Program Financial Initiative Guide-**

UNEP Finance Initiative brings together a large network of banks, insurers and investors that catalyses action across the financial system to deliver more sustainable global economies, the publications provide integrated risk assessment on the impacts of increasing global temperature & pollution to Equity and Bond prices

Potential External Data Sources



- **Ministry of Earth Sciences GOI -**

The Ministry of Earth Sciences (MoES), under the Government of India, is mandated to provide services for weather, climate, ocean and coastal state, hydrology, seismology, and natural hazards. The publications provides useful details on-

- Increasing frequency and intensity of heatwaves across India,
- Rising sea surface temperature inducing severe cyclonic & flooding events
- Aerosol concentration across rural and Urban areas
- Climate variability, Rainfall Monitoring and prediction

- **Open AQ -**

Open AQ is an environmental tech non profit organization that aggregate and harmonise open air quality data from across the globe that can be used to analyse microgeographic variations in air quality that can be correlated with health outcomes

The platform provides Geo-spatial risk mapping that enables users to identify high and low risk zones.

Potential External Data Sources

- **National Disaster Management Authority (NDMA) -**
Provides detailed mapping of hazard prone areas across India, the data includes numbers of lives lost due to those hazard by geography and hazard.
The portal also provides detailed data on government's expenditure in response to disaster relief and rehabilitation indicating economic burden of climate and ESG even that can be a useful indicator of impact on lapsation.

Potential Models

Regime Switching Log Normal Models (RSLN)

RSLN assumes that a system can switch between 1 state to another between a finite number of regimes, for example moving from a steady state to a climate event and coming back. Similarly moving from the current state to a state of increase in pollution in long term.

These switches are typically governed by a Markov process, that is a probability of moving to a new regime depends on the current state. In each regime the parameter is expected to follow a log normal distribution.

For Ex- $\log(St) \sim N(\mu_i, \sigma_i^2)$ when in regime i

Where :-

St can be current Mortality/Lapse/Expense/Return at time t

μ_i - Mean value for regime i

σ_i - Volatility in regime i

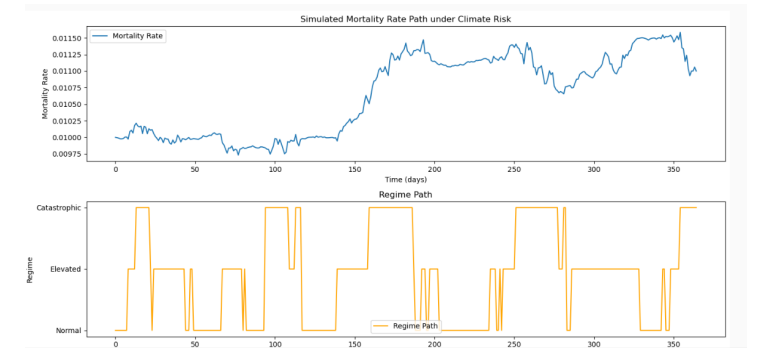


Illustration of a Mortality forecast under different regimes

The mean, variance, probability of moving regimes can be determined from external data

Potential Models

General Additive Modelling (GAM) with Climate & ESG variables

GAM is a statistical model where the linear predictor is replaced with a sum of smooth functions of the predicted variables. This allows the model to capture non-linear relationships between the predictors and the response variable.

The General form of a GAM is :

$$g(E[Y]) = \beta_0 + f_1(X_1) + f_2(X_2) + \dots + f_p(X_p)$$

Where-

Y : Response variable

$g(\cdot)$: Link function

β_0 : Intercept or baseline

$f_j(X_j)$: Smooth function of predictor X_j

$$g(E[\text{Mortality}]) = \beta_0 + f_1(\text{Age}) + f_2(\text{Time}) + f_3(\text{Temperatura Extreme}) + f_4(\text{Aerosol Impact}) + \dots + f_p(X_p)$$

$$E[\text{Mortality}] = \text{Exp}(\text{sum of functions})$$

Illustration of a Mortality forecast using a GAM

Smooth Functions are typically splines (For Ex- Cubic Splines, B Splines) & Link functions can be a log function to estimate the number of deaths or lapsation

Potential Models

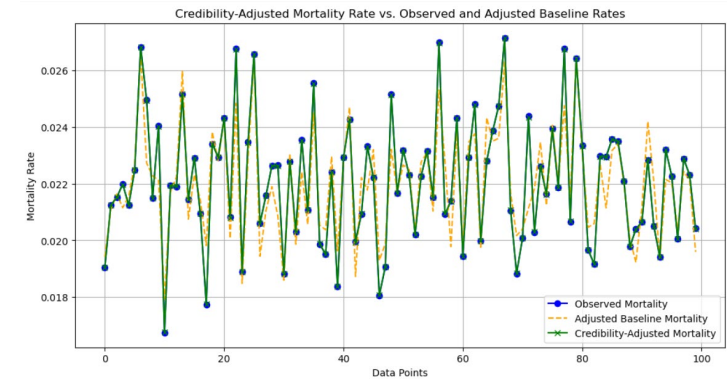
Credibility Theory using Bühlmann credibility

Credibility Theory is a traditional approach used by actuaries to combine own data with population data. The typical formula used is as below -

$$\hat{X} = Z \cdot X + (1 - Z) \cdot M$$

Where-

- $\hat{X}$: Credibility-adjusted estimated Assumption
- X : Individual experience (e.g., observed experience)
- M : Manual or collective estimate (e.g. Climate and ESG Adjusted estimate)
- Z : Credibility factor (between 0 and 1)



Z factor can be computed using Bühlmann Credibility model where

$$Z = \frac{n}{n + \sigma^2 / \tau^2}$$

σ^2 : Variance of Own Experience , τ^2 = Mean of own experience

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