

# ACTUARIES AND CATASTROPHE RISK

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# Agenda

- Catastrophe Reserves
  - What OJK says...
  - How others interpret it...
  - *What is 'enough'?*
- Dynamic Financial Analysis (DFA) Modelling
  - How it works
  - How it fits into risk management
  - Challenges in implementation
  - *How to manage CAT risk?*
- Non-proportional Treaty Pricing
  - Process
  - Methods and Mechanics
- Challenges, pros and cons
- *How to price CAT risk?*
- CAT Risk and Reinsurance
  - Traditional methods
  - Non-traditional methods to also support business growth
  - *How to protect against CAT risk?*

# Key Questions and Outcomes

- *How much reinsurance is 'enough'?*
  - *How to manage CAT risk as an actuary?*
  - *How to price CAT risk?*
  - *How to use reinsurance to manage CAT risk?*
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1. Data Quality is vital – take it seriously and you will reap the rewards
  2. Question your data, models and assumptions intensely; precision may be reassuring but it's not necessarily more accurate
  3. No single method is perfect – learn them all but be aware of each one's strengths, weaknesses and limitations.
  4. Communication is as important (or more important) than the technical work.
  5. Understanding CAT risk means understanding stochastic calculations and thinking about distributions and the tail, not just focusing on the mean/average.

Section 1

# CATASTROPHE RESERVES

## What is a Catastrophe Reserve? According to the OJK...

3. *Perhitungan cadangan atas risiko bencana hanya dilakukan apabila:*
  - a) *Perusahaan tidak melakukan pertanggungan ulang atas risiko bencana; dan/atau*
  - b) *pertanggungan ulang atas risiko bencana yang dilakukan Perusahaan tidak mencukupi untuk menutup risiko bencana yang dihadapi.*
4. *Dalam hal pertanggungan ulang atas risiko bencana yang dilakukan Perusahaan tidak mencukupi untuk menutup risiko bencana yang dihadapi, cadangan risiko bencana dihitung dari selisih nilai yang tidak mencukupi untuk menutup risiko bencana tersebut*
  - **OJK Circular Letter 27/05.2017, Section VI (Catastrophe Reserves)**

# What is a Catastrophe Reserve?

## What the OJK's statement means

- Major advance; very few jurisdictions in Asia have an explicit CAT risk requirement:
  - Japan (explicit threshold, can only be drawn down on in particular circumstances)
  - Australia (explicit threshold – GPS116)
  - Singapore (proposed, awaiting final form)
- It's not clear what the OJK mean by *insufficient reinsurance*.

## How much reinsurance is 'sufficient'?

### Overseas view – Australia (GPS116 – Insurance Concentration Risk Charge)

- Most advanced view, may give an insight into what 'sufficient' means
- 3 key elements:
  1. **Vertical Requirement** – 1-in-200yr PML, over the course of a single year
  2. **Horizontal Requirement** – max(three 1-in-10yr losses, four 1-in-6yr losses), over the course of a single year
  3. **Other Accumulations** – non-modelled perils, 1-in-200yr PML, over the course of a single year
- Whole-of-portfolio approach i.e. all perils, occurring at any single location
- Need to consider portfolio growth, demand surge and claims inflation
- Gross less reinsurance recoverables and Net calculation
  - May not necessarily be the same if reinsurance programme doesn't apply equally to all perils across all regions
- Reinsurance impact needs to reflect both recoveries and reinstatement premiums (the cover must reinstate)
  - Aggregate covers may be included, subject to additional scrutiny by APRA

# How much reinsurance is 'sufficient'?

## How to work all this out?

- Catastrophe Modelling
  - Gives a very nice 'precise' answer
  - Need to critically examine the limitations and assumptions (implicit and explicit) of these models and assess the appropriateness of the result.
  - Need to understand the data being fed into these models (exposure, policy conditions). Garbage in = Garbage Out
  - What if the peril is not modelled?
- Scenario Analysis
  - More understandable, more 'relatable'
  - Relies even more directly on the data available and assumptions being made
- Applying the whole-of-portfolio requirement
  - Simulation-based approach

Section 2

# DYNAMIC FINANCIAL ANALYSIS AS APPLIED TO CATASTROPHES

## How DFA Modelling works

- **Quantifying the impact of the various items that drive insurance results**
- Simulate your gross losses
  - Need to make assumptions about the distribution/variability i.e. not just the mean
  - Apply for attritional, large, CAT losses separately
- Apply your reinsurance programme
  - Incorporate all features/covers
  - Incorporate the price
- Combined multiple classes of business to incorporate correlations and diversification benefits
  - Across LOB, geography
- Simulate and get a distribution of gross and retained losses
- Incorporate additional risks
  - Underwriting
  - CAT
  - Reserving
  - Asset
  - Operational

## Uses of DFA Modelling CAT-related Decision-Making

- How much capital do I need to support this business?
  - VaR, TVaR (at a given worst case scenario)
  - How does that compare with what I have available?
- Is my reinsurance programme adequate?
  - Does it give me enough vertical protection?
  - Does it give me enough horizontal protection?
  - Is it responding as expected? Are there any parts being under-utilised or over-utilised?
  - Am I getting the best price?
- How do I manage and monitor my CAT risks?
  - What if I change underwriting guidelines? RI programme?
  - How do other

## Uses of DFA Modelling

### Internal Decision-Making

- How much capital does each segment/portfolio take up? (especially taking CAT into account!)
  - Do I get a sufficient return on that capital?
  - Do I grow that segment? Or do I grow somewhere else?
- How do I align risk management with reinsurance and underwriting?
  - Enterprise Risk Management (ERM)
  - Risk Appetite, Risk Tolerance
- How do I identify new opportunities?
  - Incorporating new LOB/segments
  - M&A – assessing the price and profile of the combined entity, how to manage the integration to get to the profile you want

# Challenges of DFA Modelling

- Where to start?
  - Goals, purpose, uses
- Data Availability/Quality
  - Identify your limitations
- Making Assumptions
  - What do they mean? Are they reasonable?
- Explaining the results
  - How to show that they ‘make sense’?
  - How to justify the assumptions you’ve made?
  - How to communicate the implications to (non-technical) audiences?
- Time/Resources
  - Initial Build
  - Maintenance/Monitoring

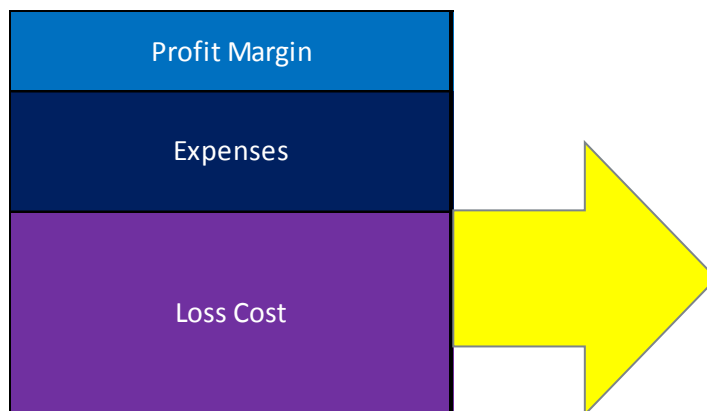
Section 3

# PRICING NON-PROPORTIONAL BUSINESS PRICING FOR CATASTROPHES

# Process and Mechanics

## Same Process, Different Mechanics

### Process



- The process is the same as for other insurance pricing
- Expenses include all acquisition and operational costs
- Profit Margin reflects the desired return on (ideally risk-adjusted) capital

### Mechanics

- *How to estimate the loss cost?*
- Start by estimating ground-up losses
- Apply non-proportional terms to estimate losses to the layer(s) of interest
  1. *Use historical experience*
  2. *Use exposure, as run through an exposure curve*
  3. *Use output from a CAT model (if CAT)*
  4. *Simulate ground-up losses based on historical data or CAT model output*

# Estimating Non-Proportional Loss Cost

## Method 1 – Experience Rating

- Approach:
  - *Estimate the frequency (1 loss will hit the layer in question every X years)*
  - *Estimate the severity (Assumed loss to hit the layer will be \$Y)*
  - *Assumed Loss Cost =  $Y/X$*
- Input Data:
  - Historical (Ground-up) Loss Data, adjusted for loss trend (inflation, exchange rate, material/labour cost), loss development (IBNR) and time value of money (if payments aren't all at much)
  - Historical and Future Exposure (restate historical exposure to future)
  - Non-Proportional Layers in Question
- Appropriateness for CAT:
  - For very low layers, there may be enough experience to make realistic assumptions

# Estimating Non-Proportional Loss Cost

## Method 2 – Exposure Rating

- Approach:
  - *Divide the exposure up into bands*
  - *Assume the total ground-up losses is known*
  - *Allocate the total losses according to a pre-defined curve*
  - *Read off the allocated cost for the layers in question.*
- Input Data:
  - Risk Profile (premium, TSI/PML, exposure by band)
  - Overall expected Loss Ratio
  - Exposure Curve
- Appropriateness for CAT:
  - Generally not appropriate as this approach works more for single losses and/or individual contracts

## Estimating Non-Proportional Loss Cost Method 3 – CAT Model Results

- Approach:
  - *Prepare input data for upload into CAT model*
  - *Run data through CAT model, generate OEP curve*
  - *Simulate CAT losses from model output*
  - *Apply layer structure to get expected losses to layers in question*
- Input Data:
  - Detailed exposure data (location, occupancy, construction type, mitigation measures, policy conditions)
  - CAT Model
  - DFA Model to read in model output and simulate losses
- Appropriateness for CAT:
  - Precise, subject to the accuracy of the underlying data and model availability/appropriateness

# Estimating Non-Proportional Loss Cost

## Method 4 – Simulate losses

- Approach:
  - *Fit a statistical distribution to historical losses (adjusted), both for frequency and severity*
  - *Simulate ground-up losses based on the current/prospective exposure*
  - *Apply layer structure to get expected losses in question*
- Input Data:
  - Historical losses and exposure, adjusted for inflation/trend
  - DFA Model to fit distributions, simulate losses and apply the layer structure
- Appropriateness for CAT:
  - Similar to Method 1, difficult to use given issues around frequency and estimating exposure

Section 4

# REINSURANCE SOLUTIONS MANAGING CATASTROPHE RISK

# Options for Reinsurance Coverage

## Traditional Options

- Vertical Coverage
  - Choosing a suitable upper limit for XL cover
  - Align with internal or external (regulator, rating agency) threshold
- Horizontal Coverage
  - Reinstatement terms (reloading cover)
  - Aggregate coverage (avoid paying retention multiple times)
  - Multi-year coverage (lock in rates, smooth experience out)

# Options for Reinsurance Coverage

## Less Traditional Options

- Manage CAT exposure
  - Whole Account Stop-Loss
  - Quota Share applied to unearned premium (facilitate strategic change)
- Manage solvency
  - Loss Portfolio Transfer (manage existing reserves)
  - Structured Quota Share/XL (loss-ratio based trigger – retain more when performance is good, ceded more when poor)
- Issues
  - Regulator
  - Data Quality and Availability
  - Due Diligence and Time
  - Rapid Exposure Growth

