Property Pricing when Including Catastrophe Perils

CAS RPM Seminar

March 16, 2022

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CREDENTIALIZATION

Certified Specialist in Catastrophe Risk (CSCR)

- Gain and demonstrate knowledge of practical applications in catastrophe modeling
- 4 courses & exams + Ethics Course
  - Waivers for Exam 1 include certifications from CPCU or LMA 1 & LMA 3
- Experienced Industry Professional Pathway available by nomination with 5+ years experience

Certified Catastrophe Risk Management Professional (CCRMP)

- Demonstrate advanced applications and methodologies of catastrophe risk management
- Experienced Industry Professional Pathway available by nomination
  - No exams yet

Joint endeavor between ISCM & iCAS

Over 150 credentialed professionals

Proof & recognition of expertise

Industry defined competencies

For more information visit CatRiskCredentials.org

Poll:

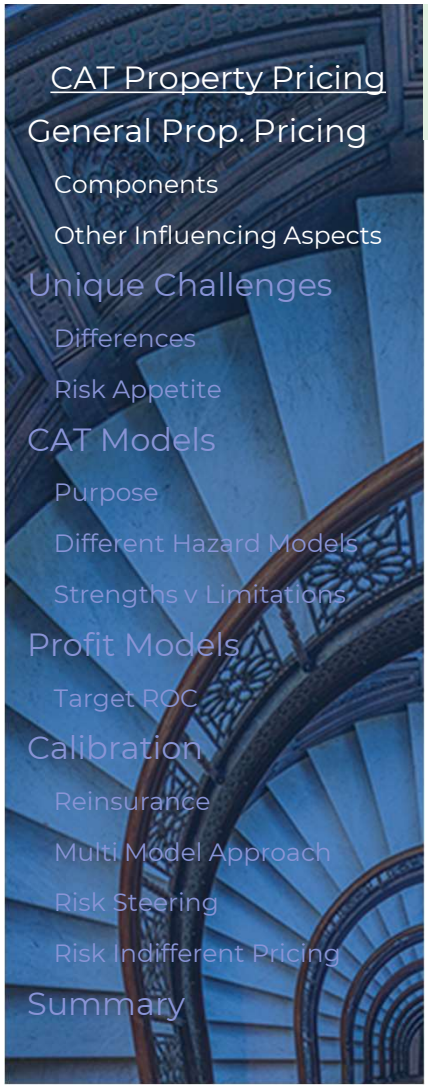
What segment of the insurance industry do you work in:

1) Primary Insurance company
2) Reinsurance company
3) Surplus lines
4) Broker
5) Other

Poll:

What is your role within your current company:

1) Pricing
2) Reserving/Claims
3) Underwriting/Underwriting support
4) Product Management
5) Other



Premium Components

Premium = Expenses + Expected Losses + Target Profit

- Expenses
  - External (Acquisition)
  - Internal (Operational and Claims Handling)
- Expected Losses – E[L]
  - All perils – Fire, Flood, Water, Freeze, Wind, Earthquake, etc.
  - Actual Claims vs Projected Losses
    - Historical Experience (lots of events / data)
      - ISO based loss reporting
      - Individual company loss history
    - Exposure Rated (limited data / events)
      - Individual large losses
      - CAT peril modeling
- Profit
  - Target Loss Ratios
  - Target Return on Capital Allocation

Other Influencing Aspects

Expenses

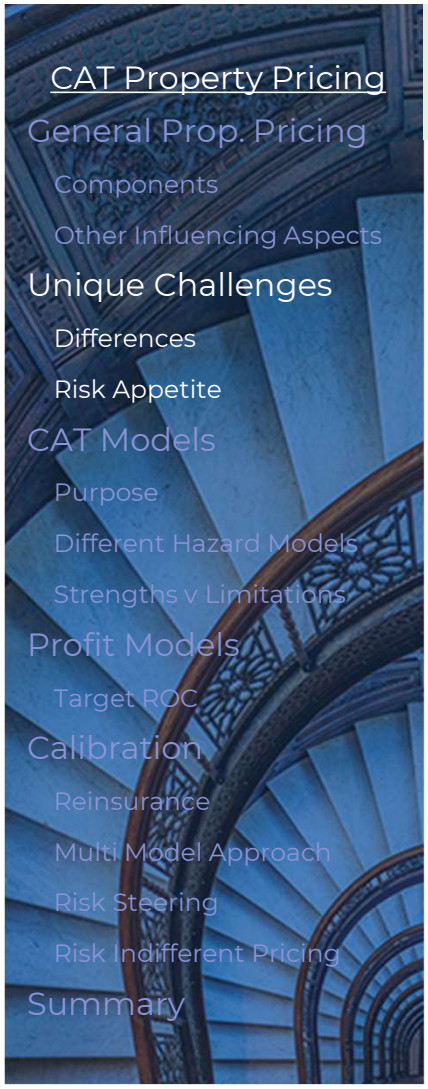
- Allocation by LOB
  - Claims handling - Attritional vs CAT shock

Expected Losses

- Exposure Base TIV
  - vs. Premium Based Loss Projections

Market Segment

- Admitted Carriers
  - Transpose Target Premiums into buckets of 'Like Kind & Quality'
  - Rate Change Management – Timing / Lag
  - Reinsurance Impact – Costs and Risk Management
- Surplus Lines Carriers
  - Opportunistic - Agile Pricing options v Prevailing Market opportunities
- Reinsurance
  - Agile pricing options v Elastic Market Demand & Diversified capital options
  - Most adept at setting Target Returns & Target Premiums



CAT – Unique Challenges

Volatility

- Potential for large loss accumulation – impacting profits or solvency

Market Cycles

- Different Phases for Different Market Segments
- Industry Denial or Convenient Memory Impact
  - 2006 to 2015 – 'Drought' of US Landfall Hurricanes
  - Last 5 years – Consecutive years with Major US Landfalls
- External Capital Agility v Other Investment Opportunities

Risk Appetite

- Balancing Act
  - Focus - Short Term v Long Term
  - Stability of results – between years
  - Target Returns - higher returns = taking on more risky business (i.e. CAT)

CAT – Unique Challenges

Risk Appetite (cont.)

- Requires Acknowledging Corporate Tolerance
  - CAT business is risky – Full stop
    - Can't have your cake and eat it too!
  - Pricing needs to be aligned with Corp Risk Appetite
    - C level alignment / signoff
  - Understanding the gap between actual experience & future possibilities
- Establishing Guardrails
  - Scenario Testing
    - Used to confirm Risk Tolerance
    - Independent from probabilistic fog – i.e. Real Risk Management
  - Simulations of Economic Outcome
    - Varying mix of business and pricing
    - Establishes reference points for finalizing pricing parameters
  - Pricing as portfolio steering option when integrated with Risk Appetite.

Natural Catastrophe Models and Property Insurance Pricing

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2022 RPM
March 16, 2022

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Agenda

- The origins of Natural Catastrophe models
- Different types of Natural catastrophe models and their uses
- Why some perils are modeled differently than others
  - Locational accuracy

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The origins of Natural Catastrophe models

- Flood “models” existed in the late 1800’s as a means to manage flooding of the Mississippi River
- Models as we know them now have been around for over 50 years, but their widespread use began after Hurricane Andrew
  - 1966 National Flood Insurance Program
  - California Earthquake models
- Hurricane Andrew exposed a weakness in that very few people knew that the potential $’s of damage possible
  - Historical losses simply do not provide enough information to assess the full range of losses / events that could happen
  - CA Wildfire

Types of Natural Catastrophe Models

POLL:

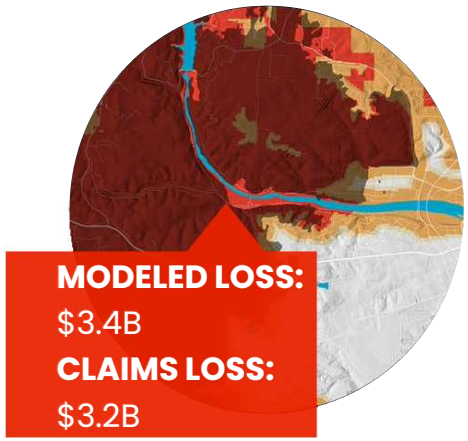
Which of the following is typically not a standard type of Natural Catastrophe model?

1) Probabilistic
2) GLM
3) Deterministic
4) Forensic

Types of Natural Catastrophe Models

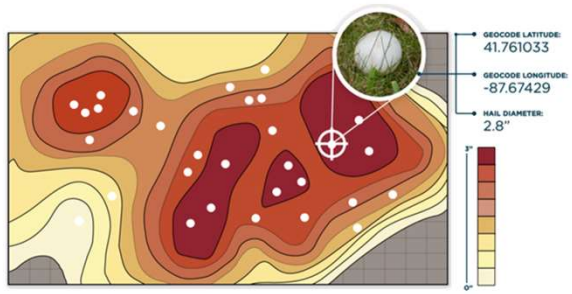
DETERMINISTIC

What could happen?



PROBABILISTIC

What if it happened?



FORENSIC

What did happen?

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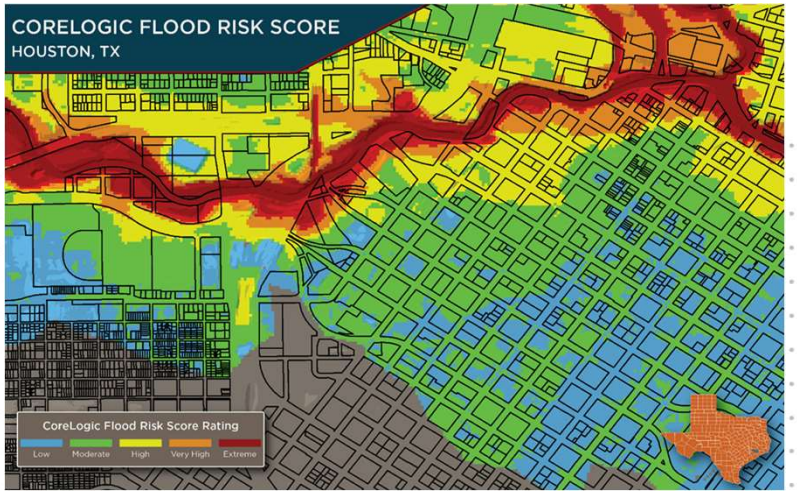
Deterministic Models

- Provides a score (1-100) that represents the relative risk for a specific peril, at a specific location
- May only be relative to the hazard/frequency of a damaging event, while some include a measure of estimated loss based on the structure present



Deterministic Models

Flood Risk Score example

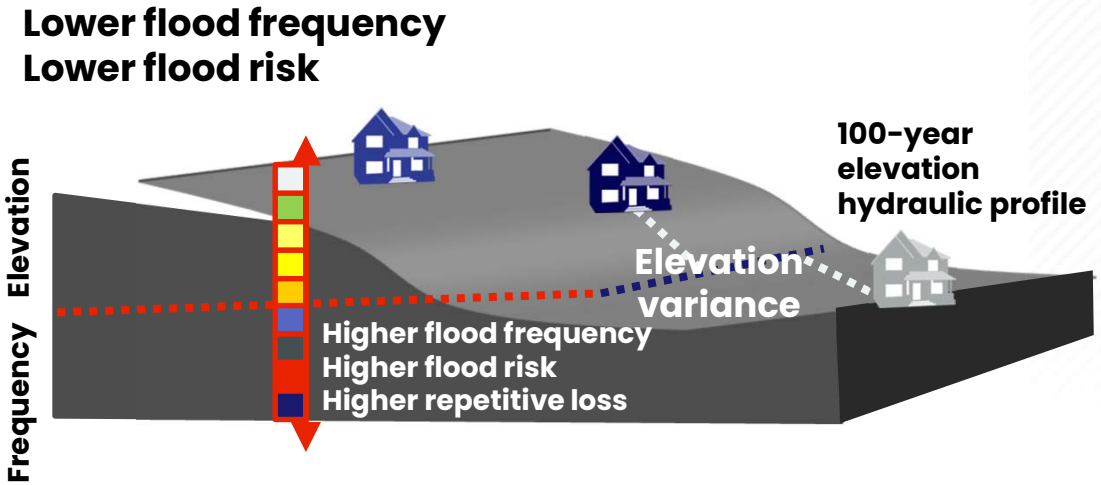
Create comprehensive spectrum of flood risk classifications

- Above/below 100-year flood elevation, up to 5,000-year flood event
- 10–100 score

Compare unknown (targeted property elevation) with known risk point (100-year flood elevation)

- Derive risk scores based on elevation variances (elevation difference between 100-year elevations and property elevations/first floor height)

The challenge: to build 100-year flood surface profile to cover national rivers, lakes, coastal zones and other water bodies



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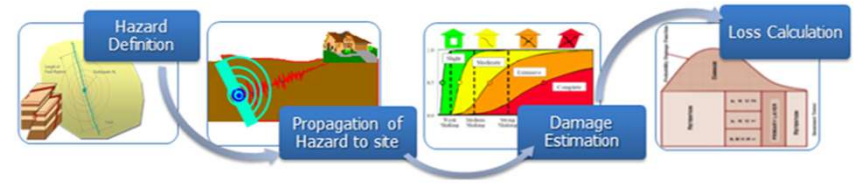
Probabilistic Models

- Start with a large event set (historical and simulated); each event has a frequency of occurrence
- Based on characteristics of the event at any location, the structure vulnerability and associated loss can be calculated



Event Catalog:
- Magnitude
  - How Big?
- Frequency
  - How Likely?
- Where?

Event Footprints:
- Ground Motion Distribution
- How Intense?
- Attenuation Functions
- Soil Maps
- Site Adjustments

Vulnerability:
- Construction
- Occupancy
- Coverage
- Sub-Peril (Shake, Fire, Sprinkler, tsunami)
- Demand Surge

Losses:
- Policy Terms
- Validation
- LAE, other adjustments

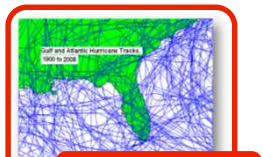
Probabilistic Models

Range of information provided

- Outputs include:
  - Event Loss tables and Yearly Loss tables
  - Average Annual Loss (AAL's) – the expected loss per year (average of all years)
  - Standard Deviation of AAL
  - Probable Maximum Loss (PML's) – the maximum loss expected at a given frequency (i.e. 100 year PML – 1% frequency)
  - Tail Value at Risk (TVaR) – average of all losses that could happen beyond a given frequency (average of the top 1% losses)

Probabilistic Example: North Atlantic Hurricane Model

Certified by the FCHLPM since the inception of the process in 1997



Hazard Definition

Historical Data:
-HURDAT2 (1900-2017)
-All historical events 1900-2018

Stochastic Event Set:
-Basin-wide simulation
-Captures the impact of spatial and temporal clustering
-Comprehensive, ~110,000 events

Two Frequency Models:
-Near-term view & Long-term view

Storm Surge and Inland Flood Model

Propagation of Hazard to Site

Wind Field Model:
-Pioneering 16-directional high resolution time stepping windfield model

-Local frictional impacts based on 30m land use/ land cover data

-2 second peak gust windspeeds

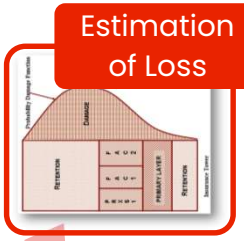
Hazard Report:
Wind Speed by Location

Estimation of Damage

Vulnerability Functions:
- By coverage, risktype, age and height of buildings
- Better hazard and financial loss risk characterization
- Storm surge vulnerability consistent with the US Inland Flood Model

Demand surge (on/off)

PxPoint structure and parcel based geocoding



Estimation of Loss

Loss Data:
-Validated with historical loss data

Fit for Purpose Financial Model

High Definition Model Output
- Year Loss Table

300k Year Simulation

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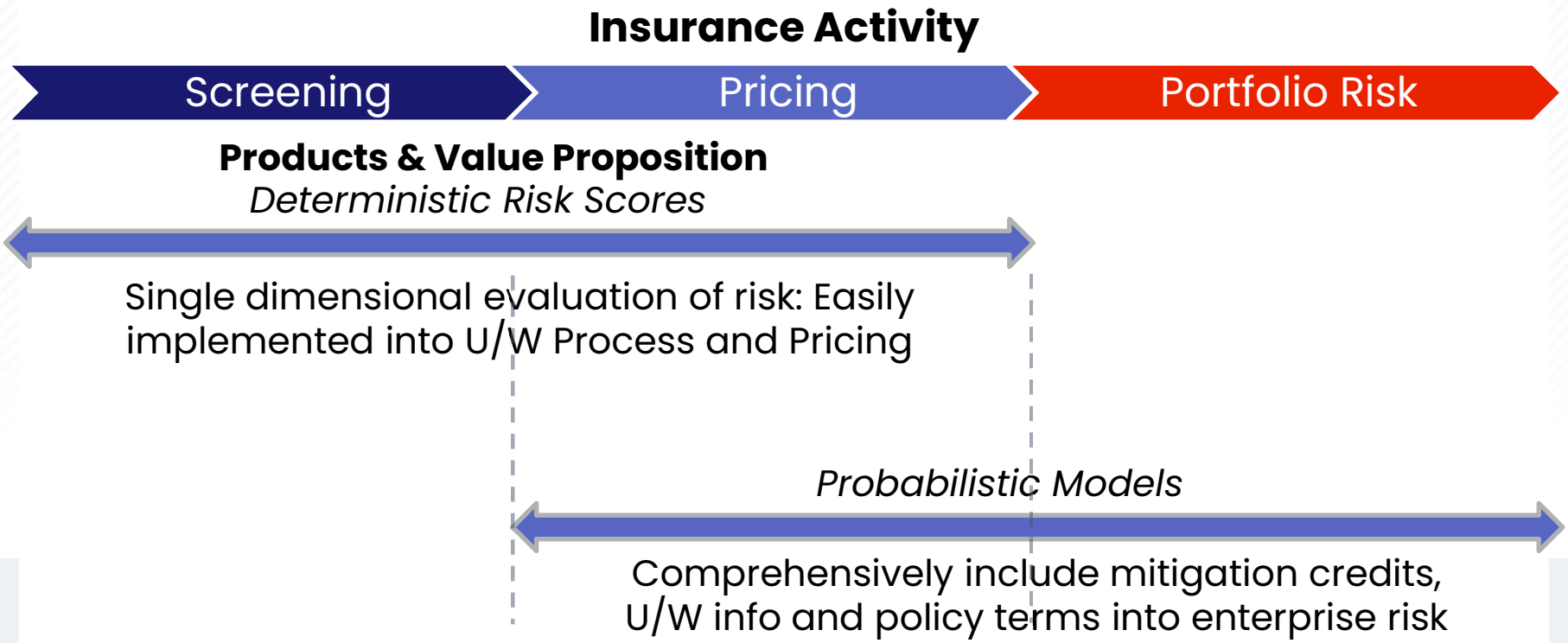
Natural Catastrophe Offerings to Insurers/Reinsurers

A Complete Suite of Products to Cover the Insurers' Needs



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Uniqueness of various perils

Large Footprint catastrophes

- Mostly infrequent
  - Earthquake
  - Severe hurricane
- Large impact area can lead to significant event losses
  - Large area leads to the potential for more structures damaged
- Need to utilize models that estimate AAL's and PML's to get a better view around what the loss potential is since event history at any location is sparse

Uniqueness of various perils

Smaller Footprint catastrophes

- Potentially more frequent
- Smaller geographic area affected
- Historical event experience is included when modeling the potential for future events
  - Hail

Uniqueness of various perils

Locational Accuracy

- Larger footprint events may not require the same level of locational granularity as smaller footprint events
- Most perils require accurate location / geocoding to ensure the best answer from the model
  - Flood (elevation changes)
  - Wildfire (distance to high risk vegetation)

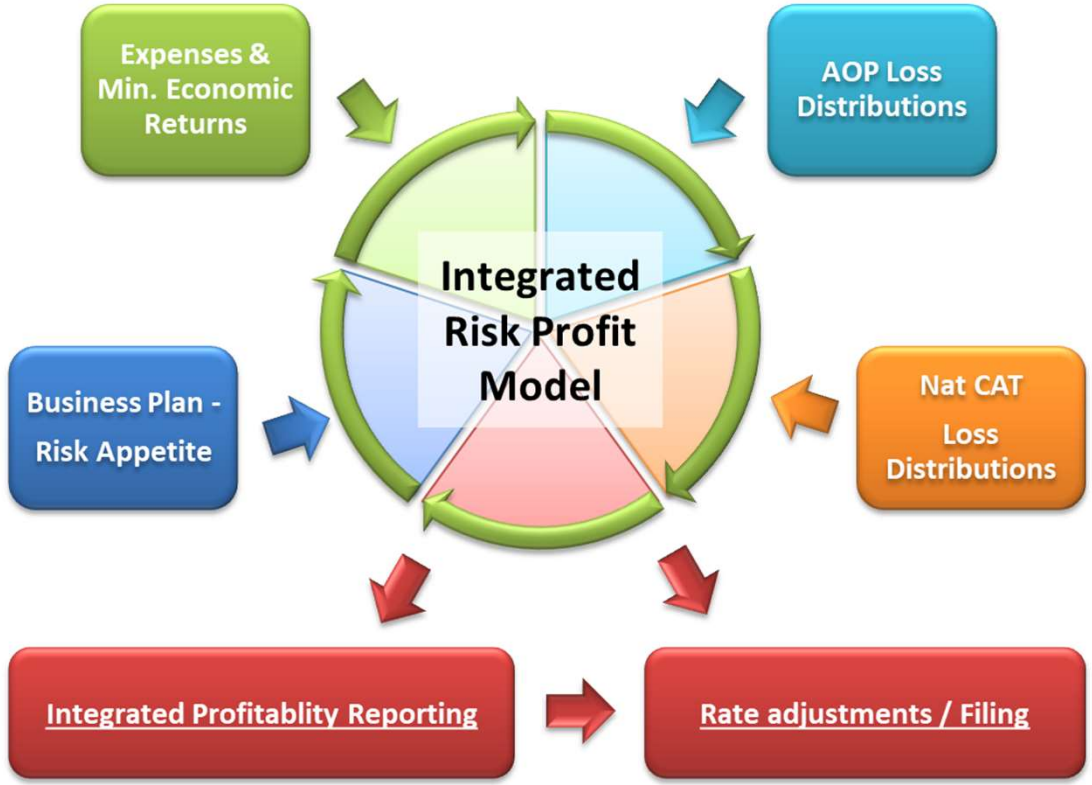
CAT Models – User Perspective

Probabilistic Models

- What need do they fulfill?
  - Traditional / Experience Analytics are not sufficient for projections
- Intended to be More Informative than Predictive
  - E.g. Post Event Loss estimation is not based solely on output
- Additional Tools in the Quiver
  - Risk Management - Manage Potential Loss Aggregation
    - Capital & Reserve Allocations
  - Pricing – that Aligns with Risk Management
- Differences
  - Perils – E[L], Variance, Tail Statistics …
    - Footprint – Larger vs. Smaller
    - Granularity of exposures vs. granularity of the model
  - Model Vendors
    - Scientific Consensus but implementation differs
      - E.g. Condensing peril to primary loss drivers
      - E.g. Validation / Calibration - Convergence criteria

Understanding these Nuances is critical when using Cat models in pricing

Integrated Capital / Risk Pricing Model



Risk Capital Pricing Models

Premium = Expenses + Expected Losses + Target Profit

- Expenses
  - Allocation by LOB
  - Claims handling - Attritional vs CAT shock
- Expected Losses - Loss Distributions
  - Individual Policy Losses
    - Attritional (Experience Rating) & Large Loss (Exposure Rating)
  - Catastrophe Losses – multi-policy losses
    - Know what models include or do well and vice versa (spend time on this)
      - Think sensitivity testing, etc.
    - Large Events – model adjustments
    - Smaller Events – Blended model with higher frequency historic losses
- Target Profit / ROC Considerations
  - Volume – Estimated Claims / Expected Losses
  - Variability of Loss Estimates
    - Loss Pick – General variance from Expected Losses (e.g. Std Dev)
    - Risk of Extreme events – Tail Distribution Statistics (e.g. TVaR, xTVaR)

Risk Capital Pricing Models

Relative Target Rate of Returns

- Estimated Losses = E[L]
  - This can be set aside directly from Premiums so return could be very low
    - Opportunity analogy - Checking Account Interest
- Variability of E[L]
  - Volume variability – Low Variation so required return can be medium
    - Opportunity analogy - Returns on Government Bonds
  - Extreme Event Variability – High Variation so higher return required
    - Opportunity analogy - High Risk Stock Returns

By Loss Category

- Higher Risk
- Higher ROR

	Relative Rate of Return Requirements by Loss Category			
Reserve Component	AOP		CAT	
	Attritional	Large Losses	Small	Major
E[L]	Low to zero	Low to zero	Low to zero	Low to zero
Variance in E[L]	Low to medium	Medium	Medium	Medium
Extreme Event	NA	NA	High	Very High

Risk Capital Pricing Models – Weighted Average

Example:

- Volume Profit
  - General Construct = min [x% , $\sum f_x$ (Loss Distribution)]
    - Where x and f_x can vary by peril / categories
  - Simplified Form (as multiple of E[L])
    - a% * Attritional + b% * Large Loss + c% * Small CAT + d% * Large Cat
- Extreme Event Profit
  - General Construct = min [y% , $\sum g_x$ (Loss Distribution)]
    - Where y and g_x can vary by peril / region
  - Simplified Form (as multiple of $TVaR_{100}$)
    - E.g. Hurricane = a% * US + b% * FL + c% * Gulf + d% MidAtl
    - E.g. Quake = v% * US + w% * CA + x% * PNW + y% * NM + z% * SE
  - Factors based on All Perils convolution and independent peak regions

Calibration

Reinsurance – NOT just an additional Expense

- When to use?
  - When the cost is cheaper than holding the risk
- For simple CAT XOL, where to attach and how much limit?
  - Again, comparing to your risk pricing model can inform.
- Concept Example: 2 parameter profit model (CAT contribution only)
  - a * E[L] + b * $TVaR_{100}$
  - 2 CAT XOL reinsurance treaties purchased
    - $Price\ XOLx = aE[L]^x + bTVaRx_{100}$
    - Price, E[L] & $TVaR_{100}$ are known for both layers – solve for a & b.
  - Represents market check for a segment of your total CAT Curve
- Validation / Calibration
  - Check factors a & b across the full portfolio (not just the purchased layers)
    - How does current reinsurance market cycle compare to your long term targets?

Calibration

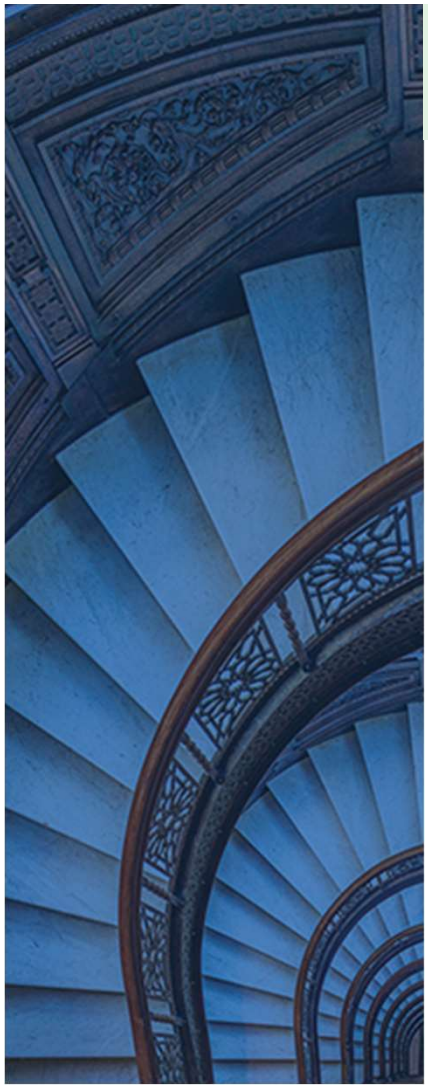
Multi-Model Approach – NOT just averaging E[L]s

- Remember – each CAT model uses slightly different processes
  - We need to be aware of and understand those differences
- Reinsurance Consensus Pricing
  - Despite multiple reinsurers / models, there is still only one price
- Multiple Models
  - E[L] model 1 ≠ E[L] model 2
  - $TVaR_{100}$ model 1 ≠ $TVaR_{100}$ model 2
  - ∴ Volume & Extreme factors will not be the same either
- Blending Multiple models
  - Calculate premium using each model and their unique factors
  - THEN blend the resulting target premiums – not just one statistic

Calibration

Risk Steering & Indifferent Pricing

- Balancing Portfolio Distribution
  - Steering business through adjusting regional & pricing parameters
- Principles – Relativity Parameter Calibration
  - Based on Company Risk Appetite
  - Price to be otherwise indifferent to deploying capacity
    - Between perils (think attritional vs Cat losses)
    - Between Different Cat perils
    - Between different regions (within in specific Cat Peril)
- Regional Risk Accumulation
  - Scarcity of capacity
    - Risk Appetite for Maximal loss
    - Availability of reinsurance to further Cap CAT losses
- Example: 1 risk using 250 $TVaR_{100}$ vs 5 risks with 250 $TVaR_{100}$ in total



Summary

Questions?