Incorporating Severe Weather Data into P&C Rates

CAS Ratemaking and Product Management

Severe Weather Workshop

Commitment Beyond Numbers

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ACTUARIAL RESOURCES, INC.

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Incorporating Weather Activity into P&C Rates

- Weather – a constant thorn in the insurance industry's side
- Data is becoming increasingly detailed & complex
- Examples of uses in P&C ratemaking
  - Rate Indications
  - Territory Definition Analysis
  - By Peril Rating

Rate Indications

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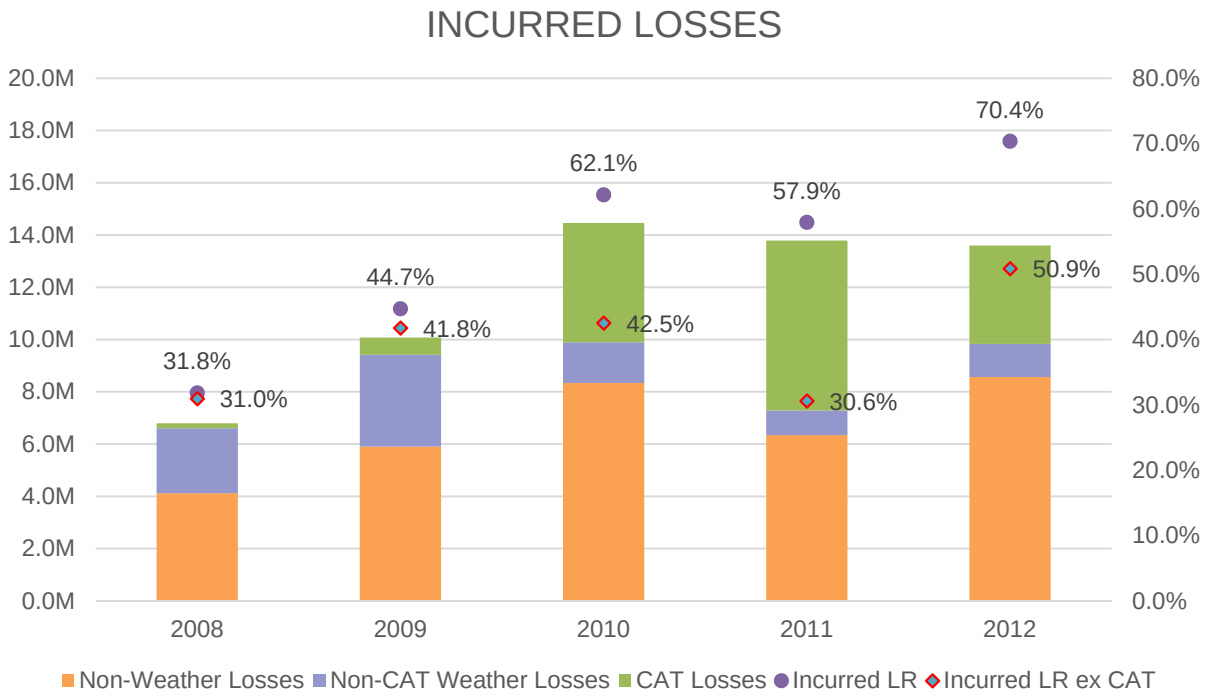
Loss Categories

- Types of Losses
  - Non-Weather losses
  - Non-Catastrophe Weather losses
  - Catastrophe losses



Loss Adjustments for Rate Indications

Non-Weather losses

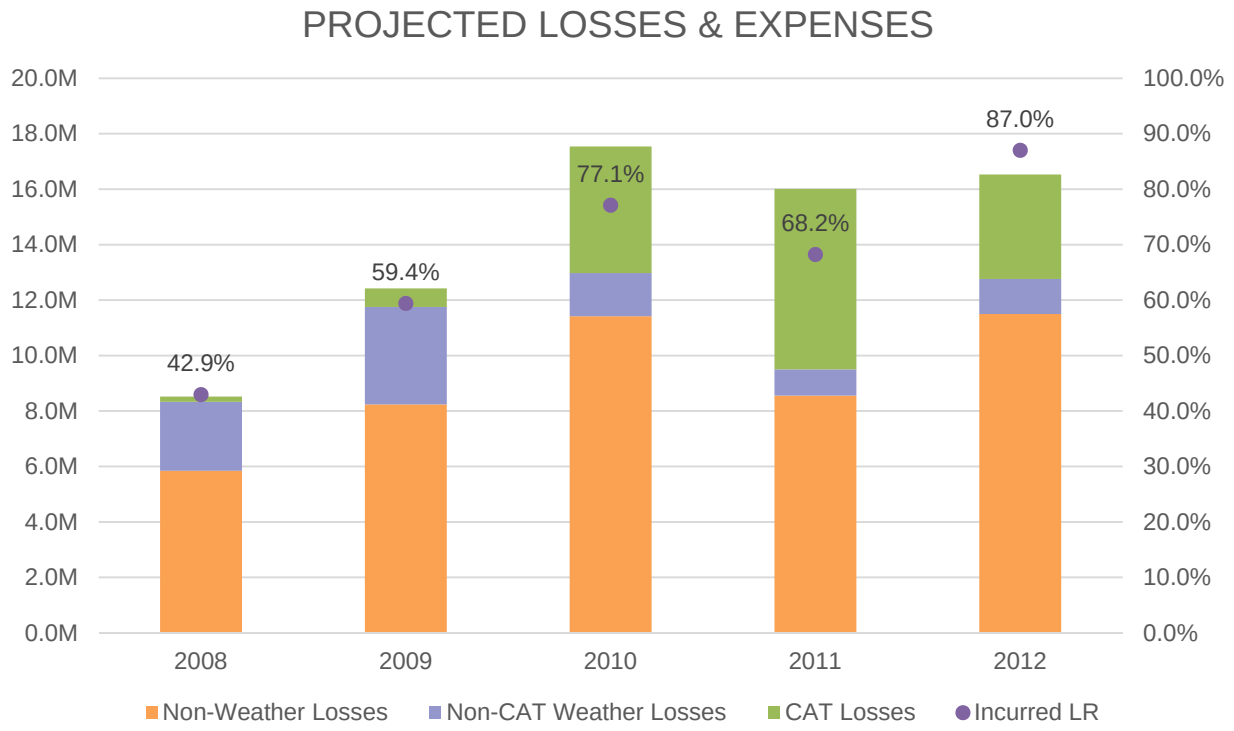
- Adjusted for Trend and Loss Development

Weather losses

- Averaging – calculate average ratio to Non-Weather Losses for 20 year period
- Capping Methodology – smooth losses across Accident Years
- ISO Methodology – Excess Wind and Water procedure
- Computerized models – use to determine Average Annual Loss (AAL)

Non-Catastrophe Weather Losses

- Loss Averaging
  - Reduces volatility



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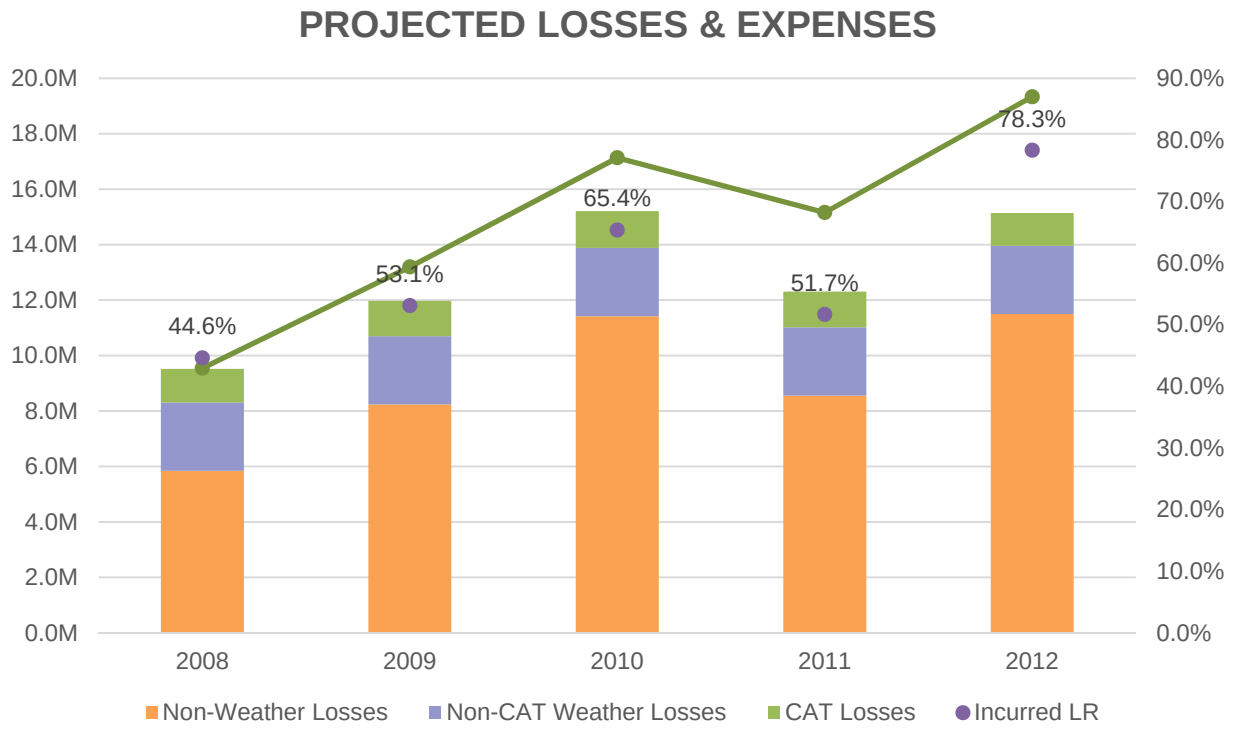
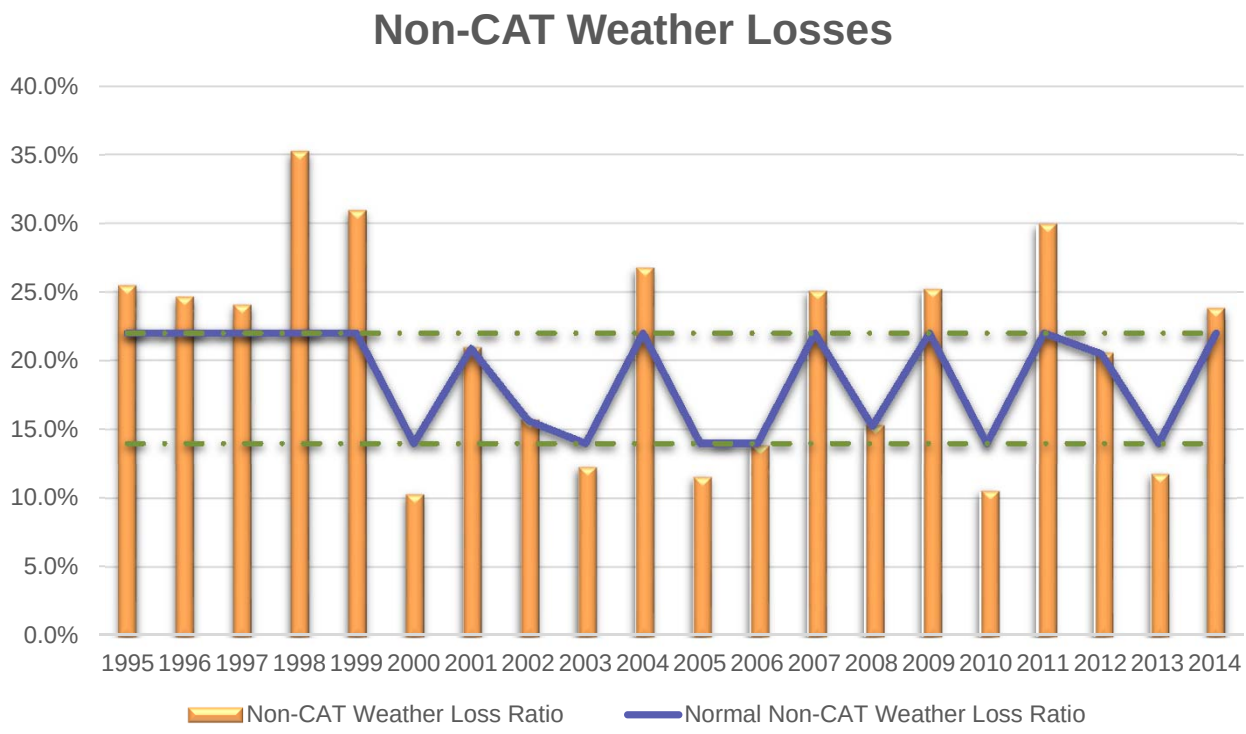


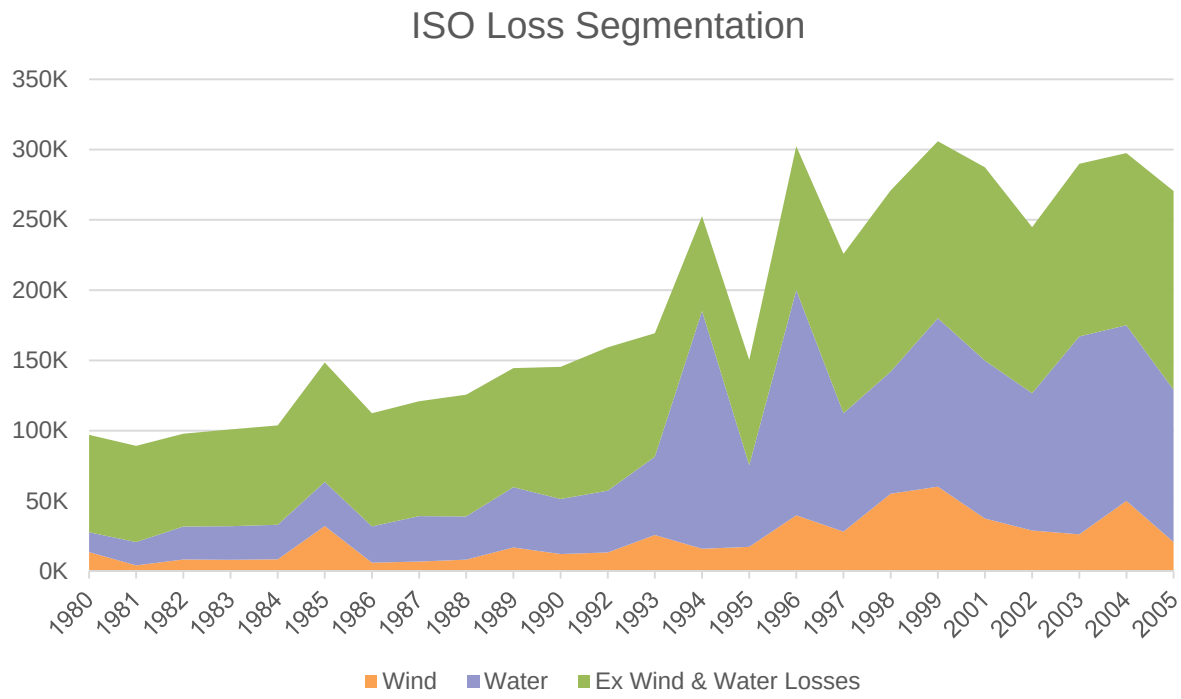
Weather Losses - Loss Smoothing Technique

- Requires more years of data (ideally 20+)
- Can be capped at maximum loss or maximum and minimum loss amounts



ISO “Excess Wind and Water” Procedure

- 2 Step Procedure
- Derivation of Excess Water Losses



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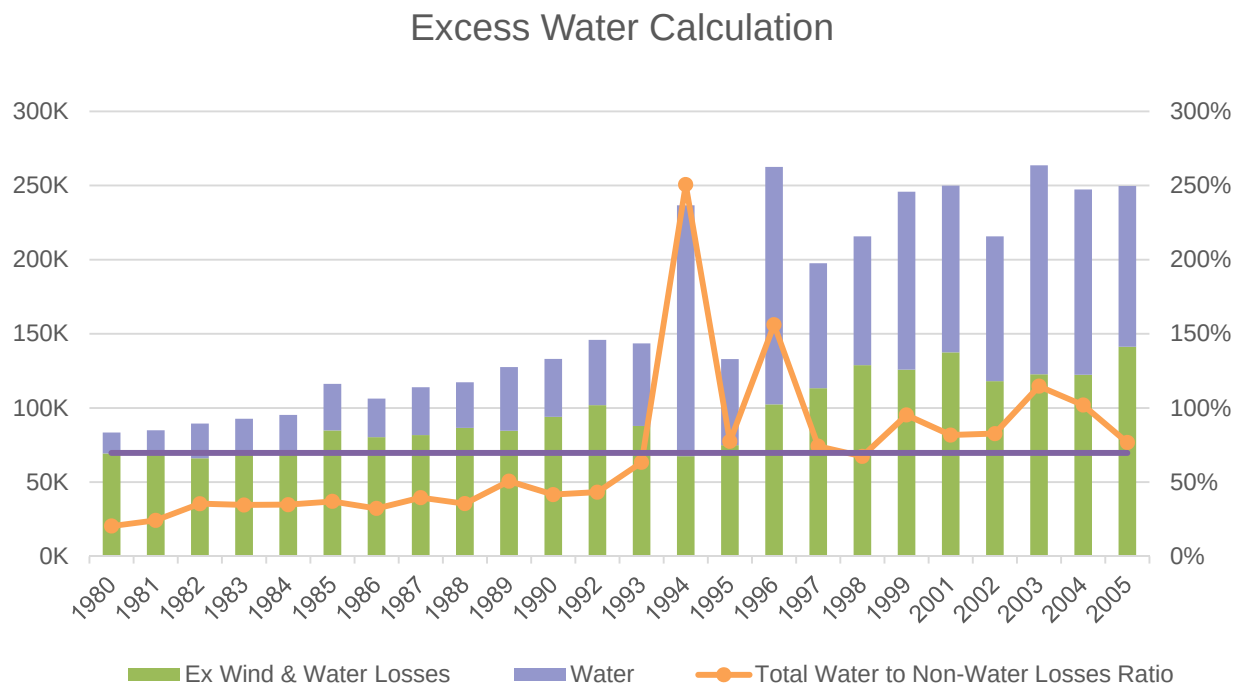

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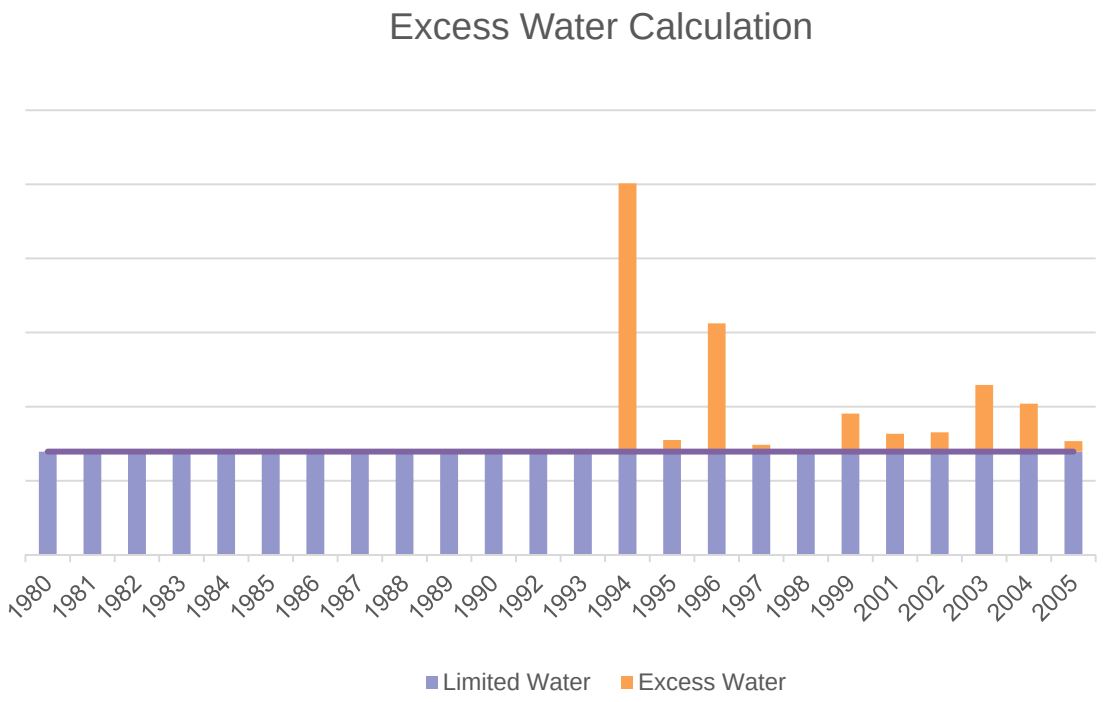

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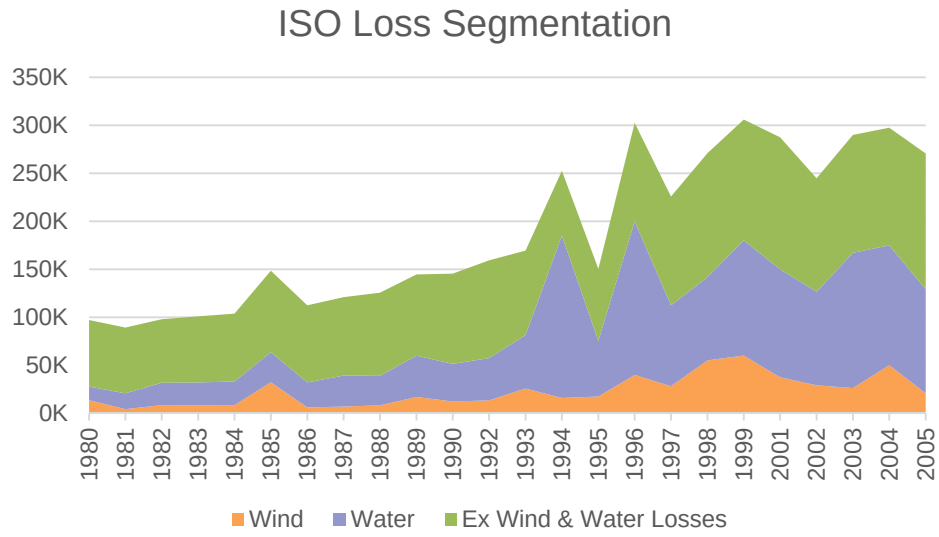

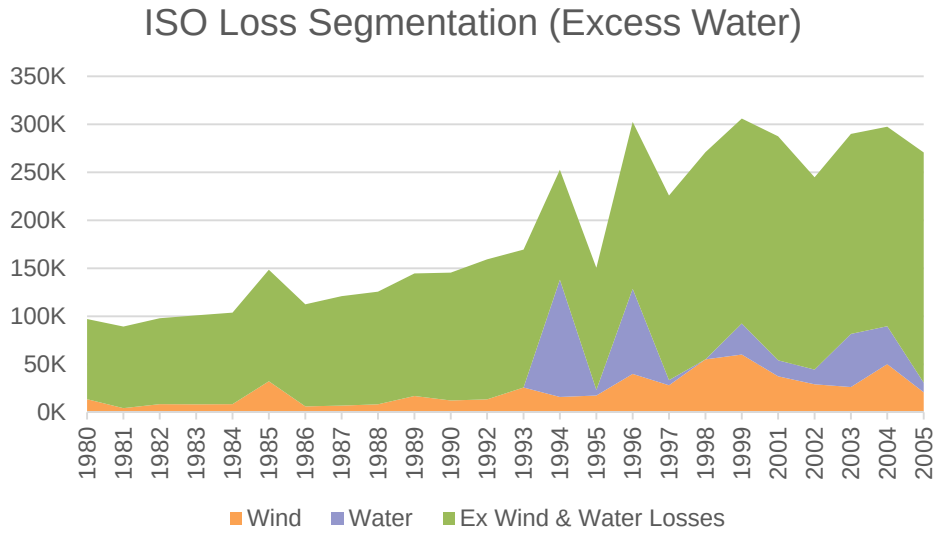

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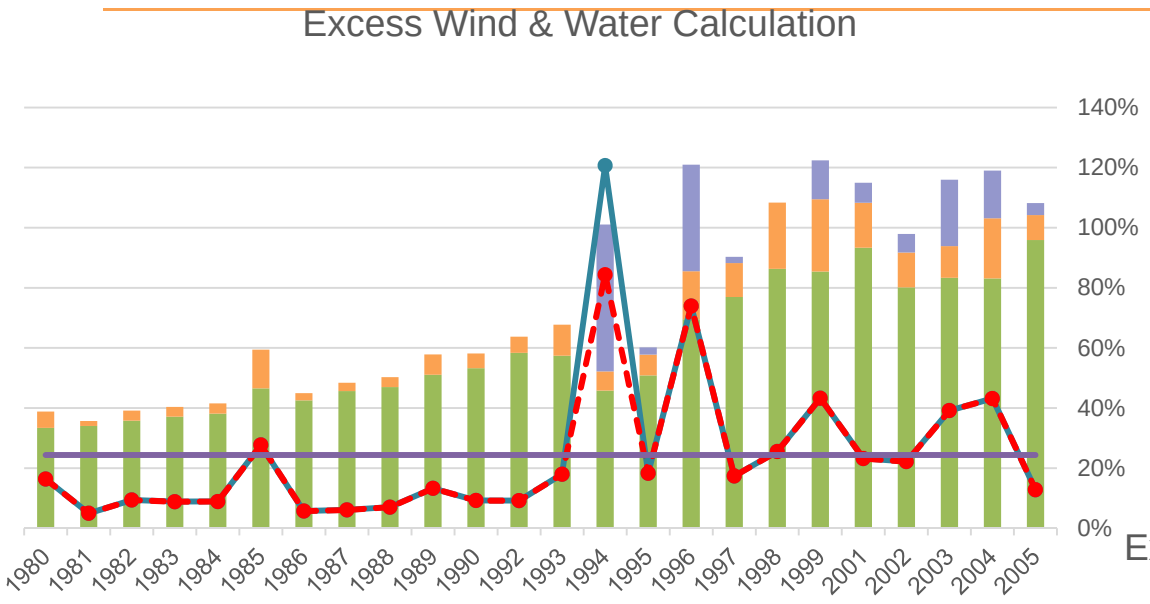
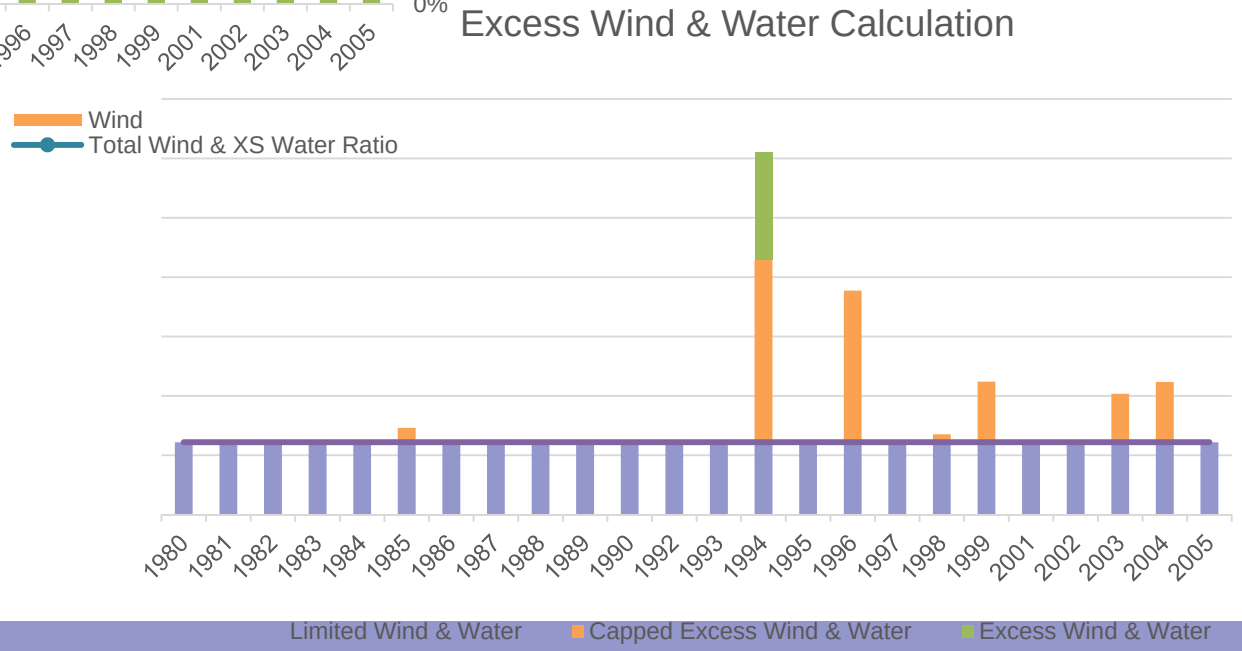




Computer Models

ZIPCode	Peril	Risk Count	RMSAAL	AIRAAL
15001	Hurricane	196	311.8727138	978.6411888
15001	TorHail	196	12070.56166	19402.62718
15001	Winterstorm	196	5521.367328	1560.474125
15003	Hurricane	22	35.71715848	114.2943422
15003	TorHail	22	1397.893995	1579.187759
15003	Winterstorm	22	605.1030471	130.1390673
15005	Hurricane	13	21.71038276	65.72526264
15005	TorHail	13	902.6221694	1228.54822
15005	Winterstorm	13	410.8470833	102.040543
15006	Hurricane	3	5.295910175	16.93067379
15006	TorHail	3	192.6225652	287.8122265
15006	Winterstorm	3	82.27662314	28.00704335
15009	Hurricane	55	75.6999803	248.2797458
15009	TorHail	55	3314.663306	3588.707777
15009	Winterstorm	55	1369.643857	322.1147208
VVVV	VVVV	VVVV	VVVV	VVVV

- Employ Simulation
- Calculate Average Annual Loss

State	Peril	Roof Count	RMS AAL	AIR AAL	Average	Model Pure Premium
PA	Hurricane	24,263	221,290	197,976	209,633	8.64
PA	TorHail	24,263	1,625,416	2,195,400	1,910,408	78.74
PA	Winterstorm	24,263	728,540	376,794	552,667	22.78

Catastrophes

ASOP 39 – Treatment of CAT losses in P&C Insurance Ratemaking

Identification of Perils

- Potential to display Contagion
- Infrequent occurrence

Identification of Losses

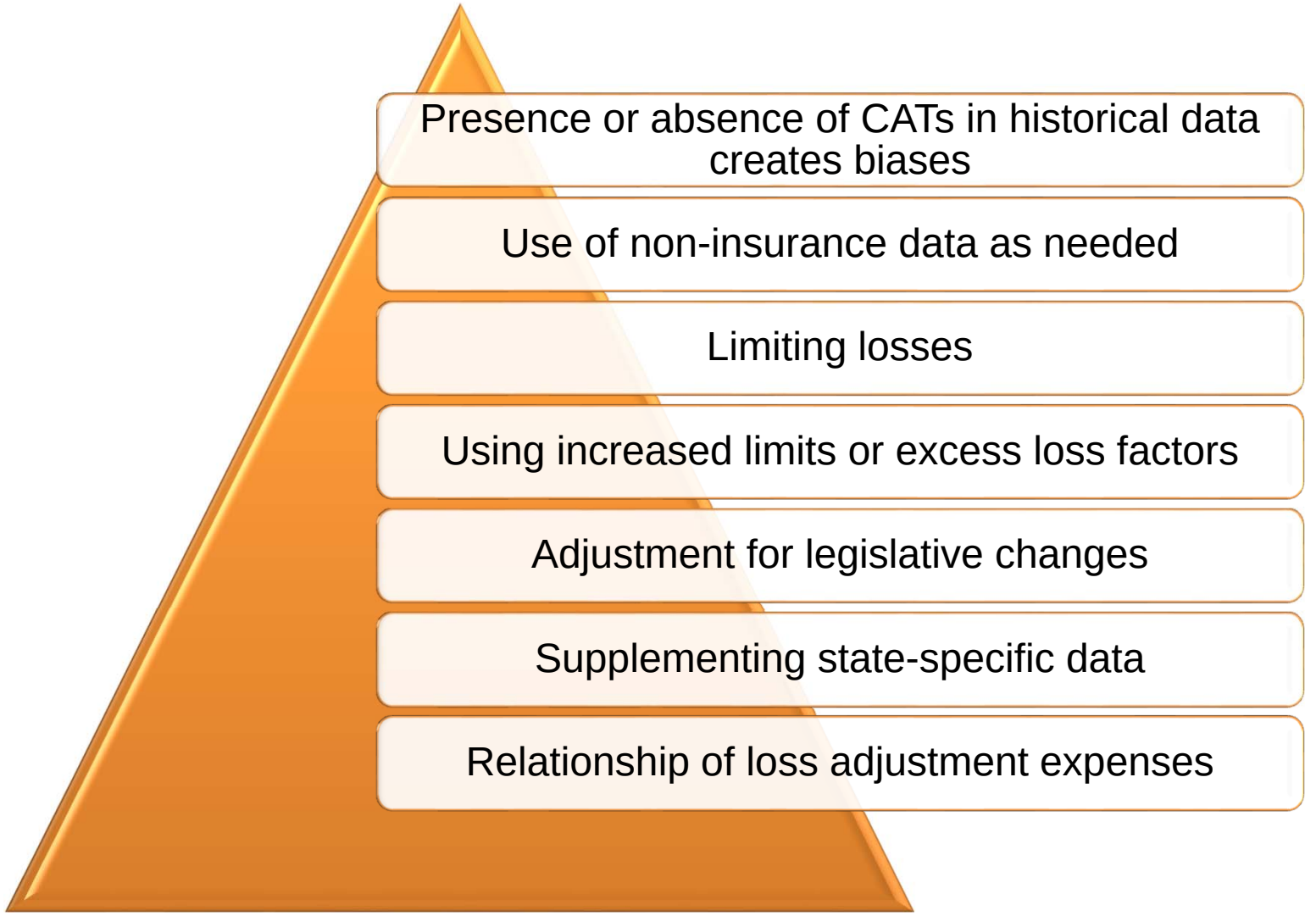
- Consistent definition

Applicability of Data

- Differences among elements of rate structure
- Adjustments to reflect future conditions

Use of non-insurance data

Catastrophes – Key Considerations



Historical Practices for CAT Modeling

Traditional practice

- Calculate long-term ratio of CAT losses to non-CAT losses over extended period
- Weather-related perils: hurricanes, tornadoes, snow storms

Issues

- Hurricanes Hugo, Andrew, and Iniki produced aggregate losses exceeding expected possibilities
- Ratios did not account for industry changes
  - Population shifts
  - Building code changes
  - Exposure concentration
- No provision for previously unknown CATs/events
- Underlying assumptions of model were not well known

Issues

- Impact of distributional changes or exposure concentration
- Impact of changes in coding or identification of CATs
- Frequency and severity trends are unknown
- Changes in premium adequacy over time
- Comparison to non-catastrophe losses
  - Includes multiple perils whose trends may not correlate with CATs

Territory Analysis – Severe Weather

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Territory Analysis – Severe Weather Impacts

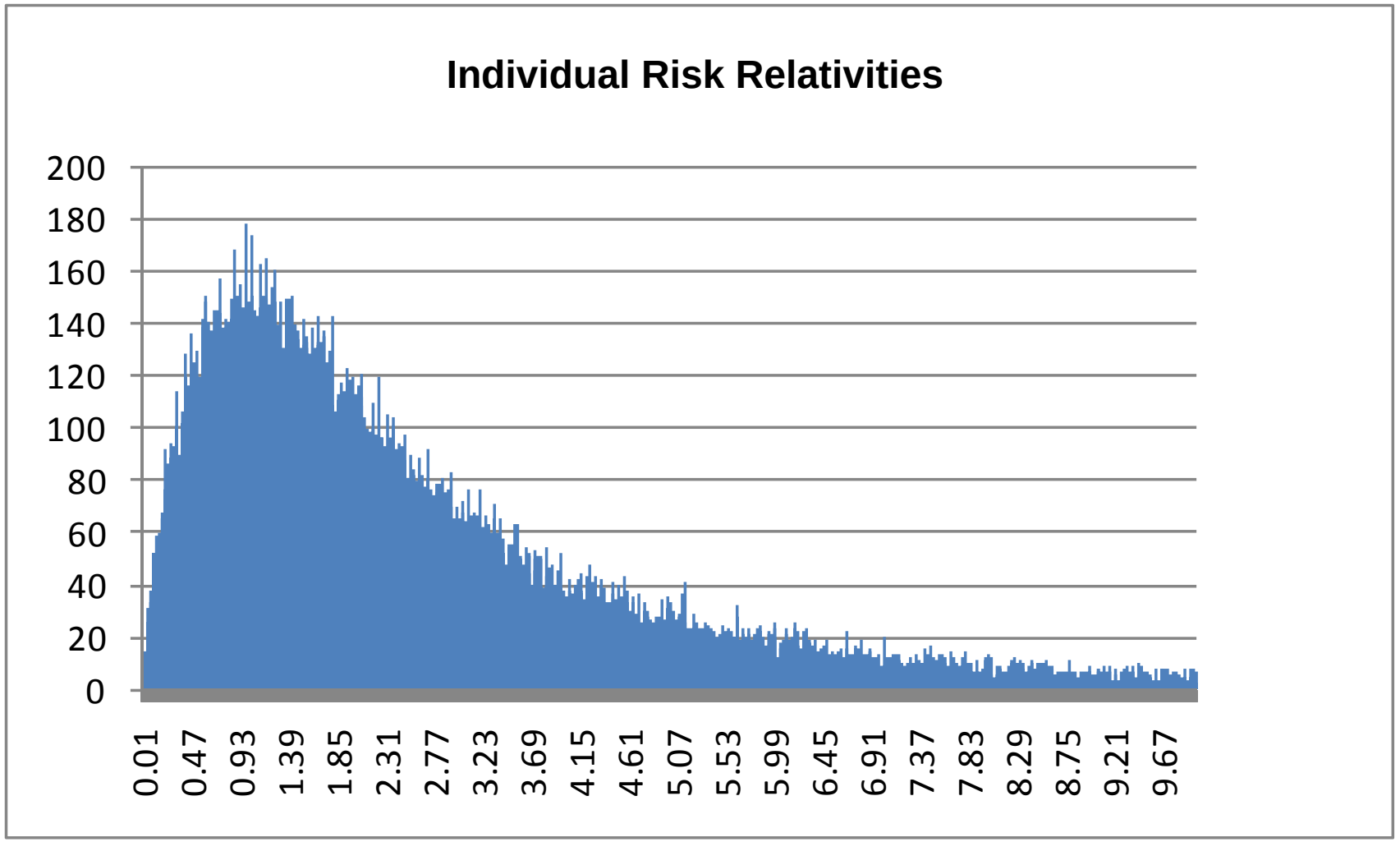
Purpose

- Identify territories with higher propensity for weather-related losses for rating and underwriting purposes

Process

- Generate pure premium by geography (can be ZIP of census level)
- Adjust pure premiums by geography for differences in risk distribution
- Cap Pure Premiums by zip for stability
- Smooth Pure Premiums
- Cluster final Pure Premiums

Distribution of Individual Risk Relativities



Calculation of Smoothed ARFs

ZIP Code	Percentage of Statewide Exposure	Center of ZIP Code Latitude	Center of ZIP Code Longitude	Original Data	Smoothed Data	Percentage of Exposures Used in Smoothing	Additonal Zips Used in Smoothing	Distance From ZIP Center Needed
66002	1.748	39.5596	-95.1316	2.701	3.115	12.776	31	26.5
66006	0.687	38.7883	-95.2047	4.099	3.569	12.787	12	15.5
66007	0.661	39.1397	-94.9416	2.609	2.924	13.489	16	11.5
66008	0.036	39.7163	-95.1746	3.143	3.364	14.379	38	34.5
66010	0.094	38.09	-94.9927	4.689	3.305	12.709	42	32.5
- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
67951	1.441	37.1692	-101.337	2.786	2.922	13.630	21	50
67952	0.104	37.3165	-101.2367	2.208	2.948	12.600	19	40
67953	0.031	37.2812	-101.7166	3.444	3.023	12.823	17	53
67954	0.203	37.1149	-101.6446	4.561	3.192	13.630	21	59.5

- Aggregate individual risks into zip code groupings for raw ARFs
- Individual zip codes lack credibility
- Use of additional zip codes in proximity for smoothing

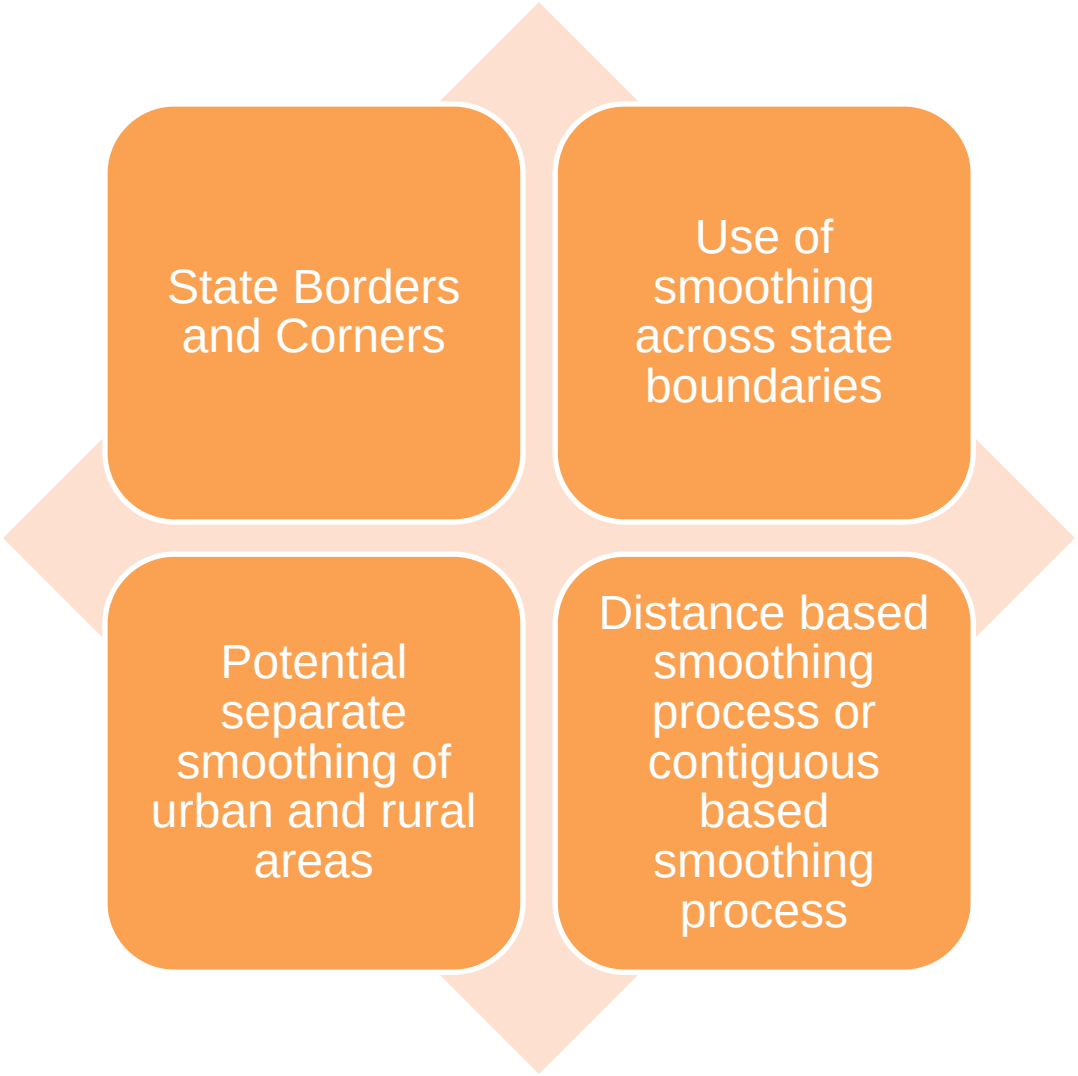
Smoothing

Data at the basic element level lacks "credibility"

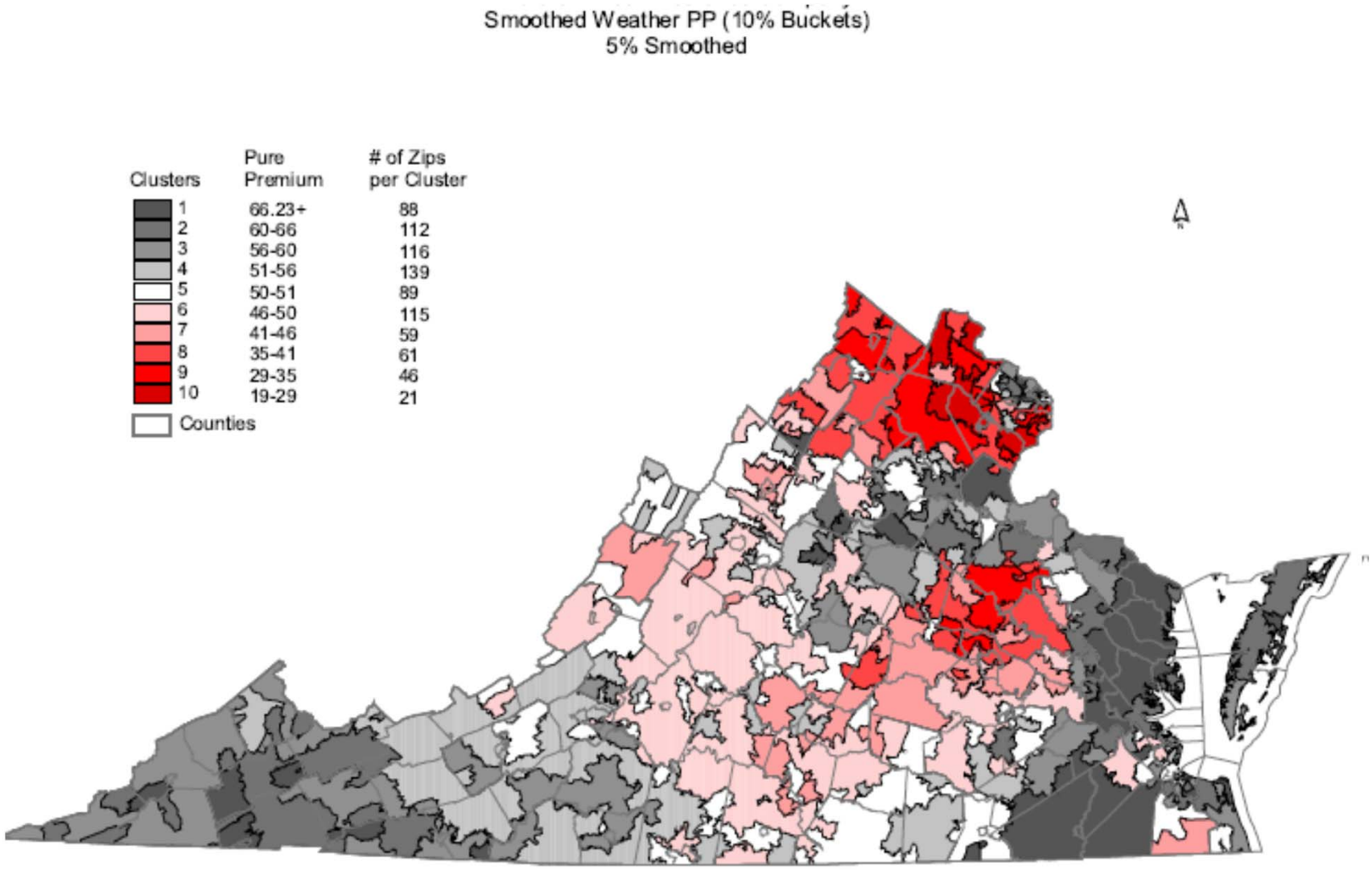
Smoothing process allows inclusion of more localized data rather than statewide information

Results in a rate or rate relativity for each individual zip code based upon the data within that zip code modified as necessary to include a credible number of observations

Smoothing Considerations



Smoothing Impact



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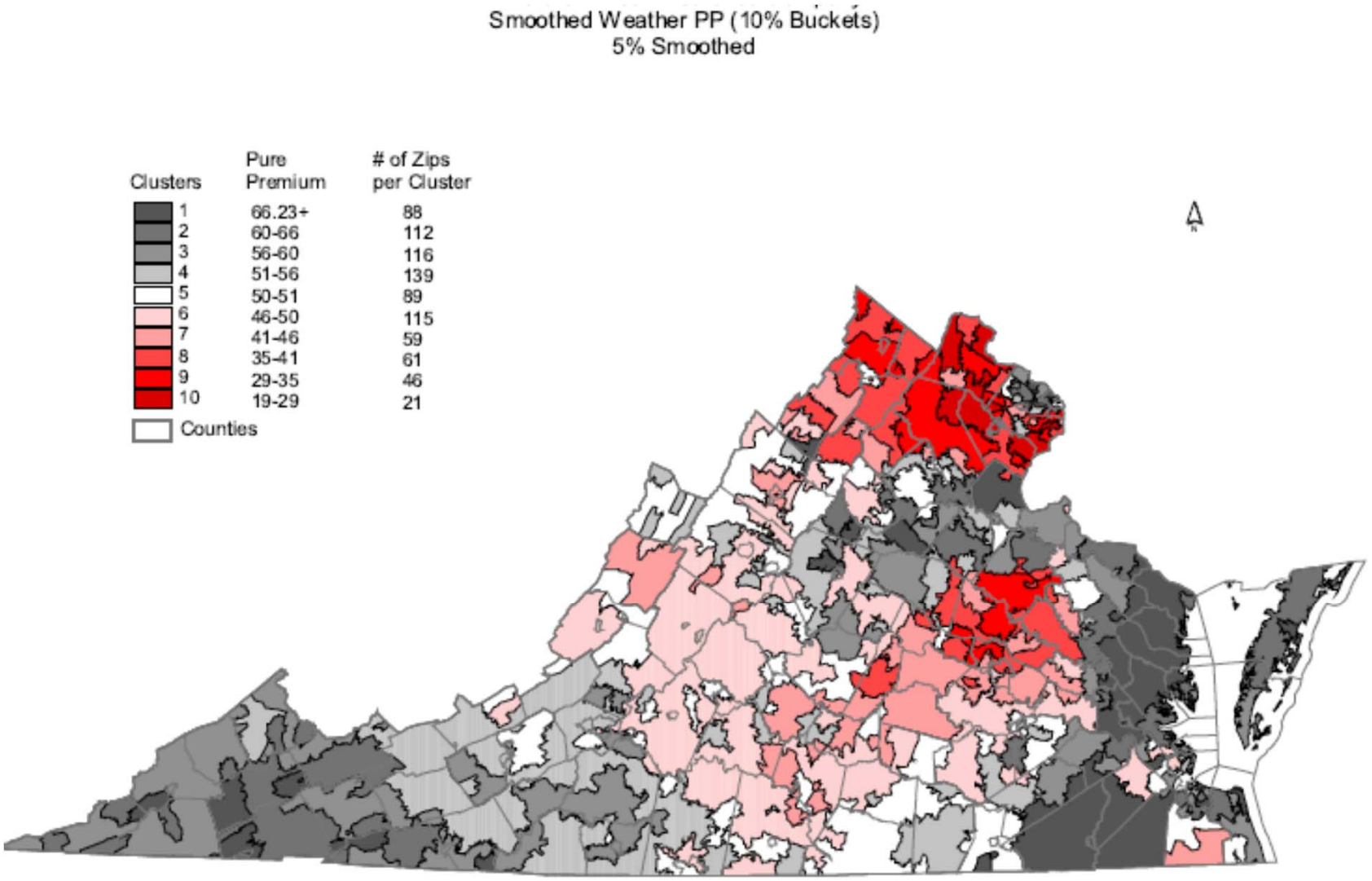

Calculation of Smoothed ARFs

ZIP Code	Coverage C Percentage of Statewide Exposure	Coverage A Percentage of Statewide Exposure	Coverage C Smoothed ARF	Coverage A Smoothed ARF	Total ARF (weighted by base rates and average total premium)
66002	1.748	2.059	3.115	1.273	0.812
66006	0.687	0.711	3.569	1.412	0.906
66007	0.661	0.707	2.924	1.462	0.904
66008	0.036	0.052	3.364	1.397	0.889
66010	0.094	0.078	3.305	1.291	0.830
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67951	1.441	1.535	2.922	1.283	0.809
67952	0.104	0.113	2.948	1.314	0.827
67953	0.031	0.039	3.023	1.319	0.832
67954	0.203	0.199	3.192	1.380	0.872

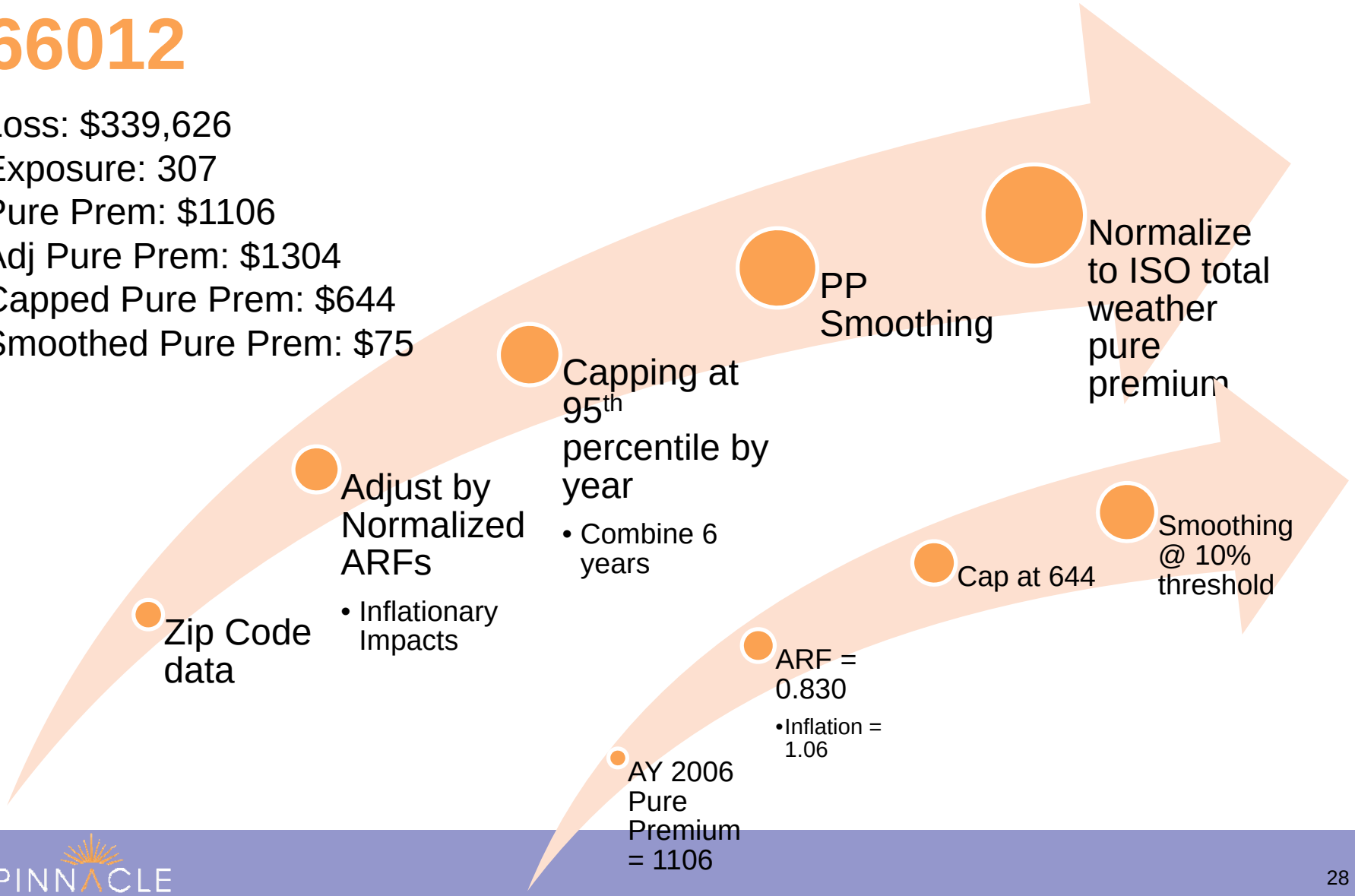
- Smoothed ARFs are combined

$$\frac{\text{(HPP ARF x HPP base rate) + (Structure ARF x Structure base rate)}}{\text{Average total premium}}$$

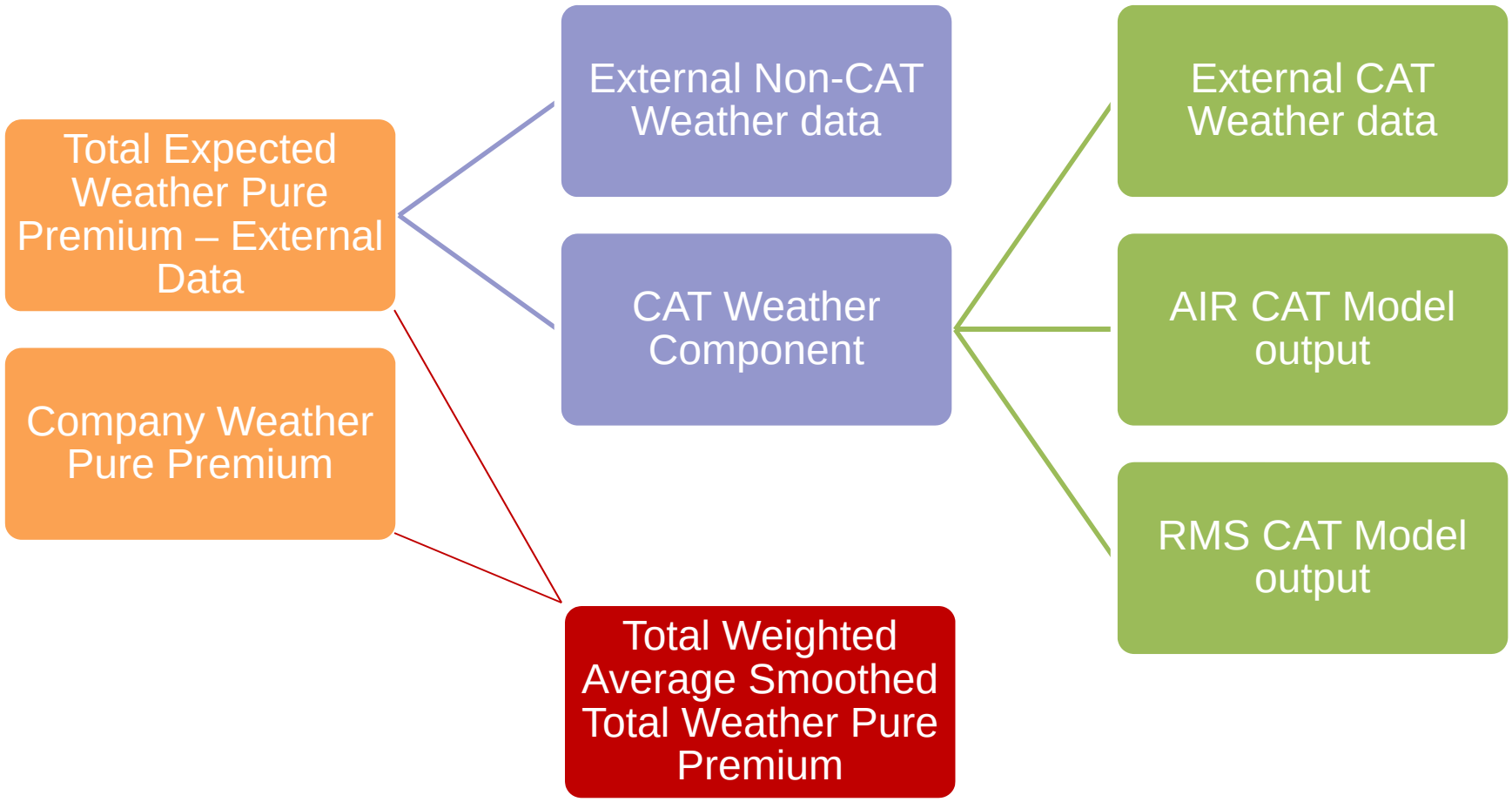
Pure Premium -

66012

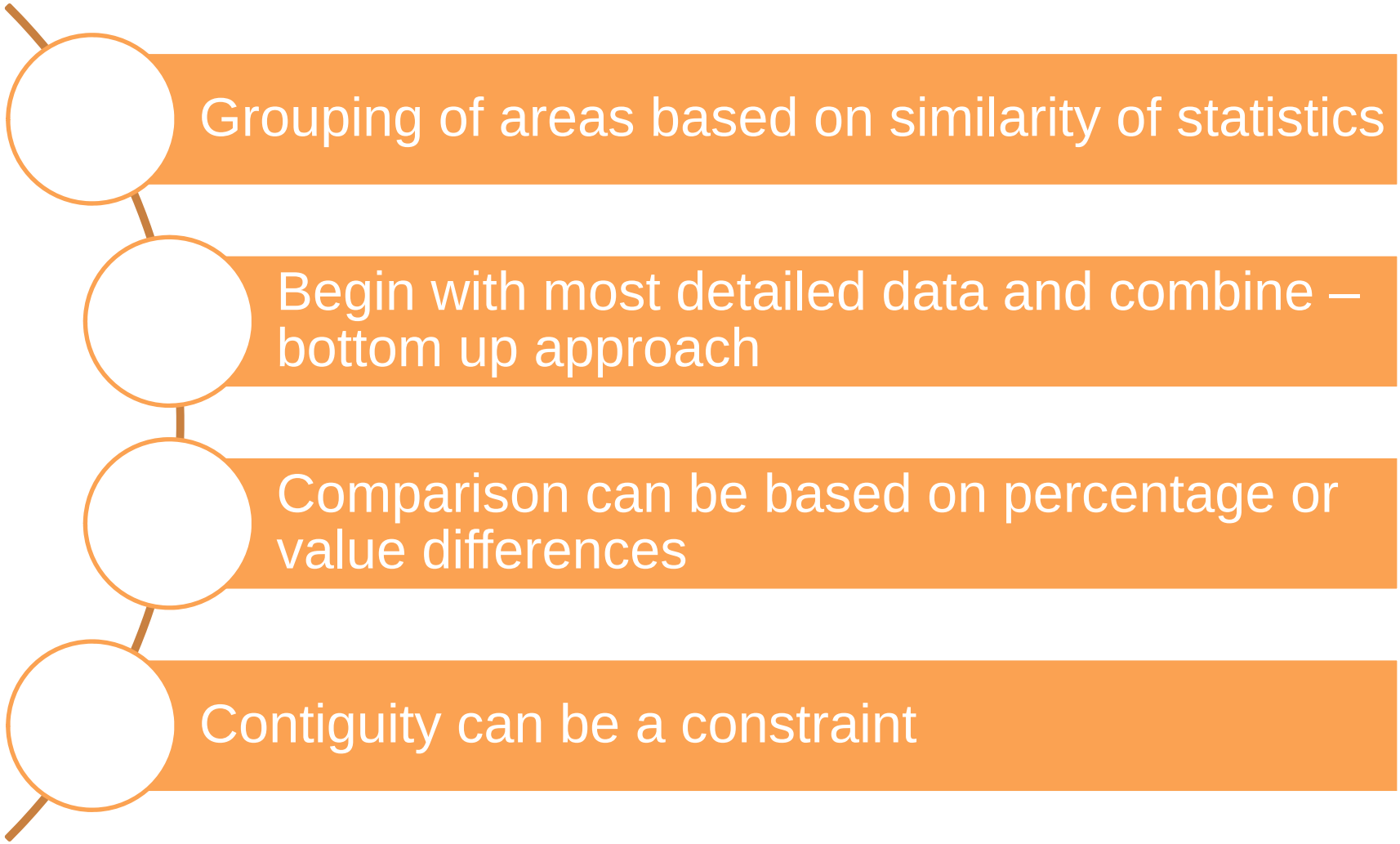
Loss: $339,626
Exposure: 307
Pure Prem: $1106
Adj Pure Prem: $1304
Capped Pure Prem: $644
Smoothed Pure Prem: $75



Total Weather Calculation

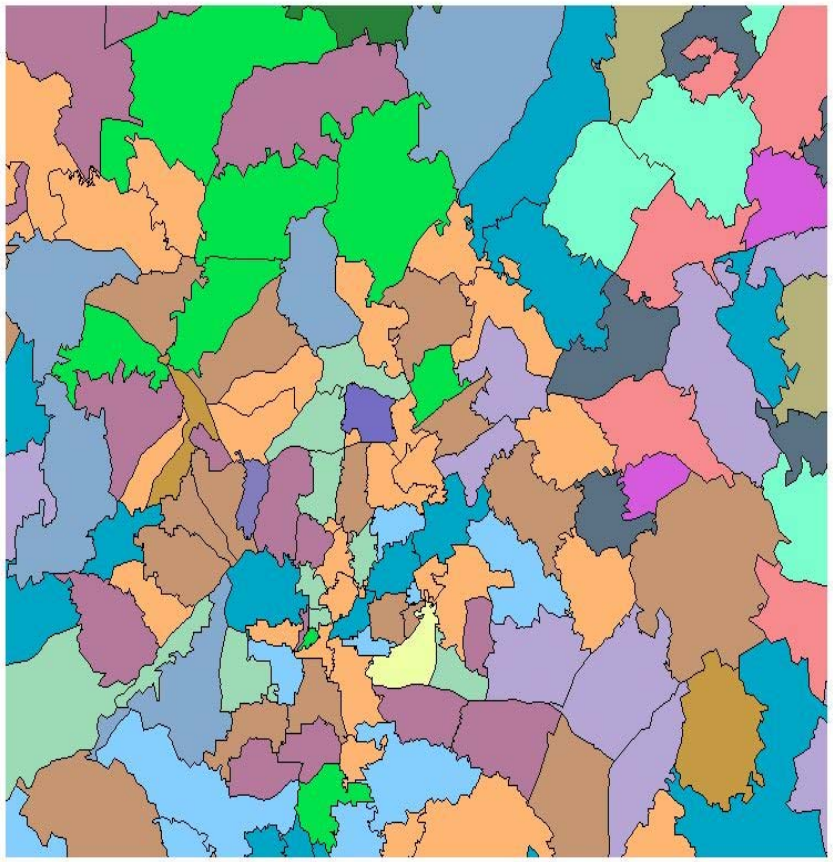


Clustering Process

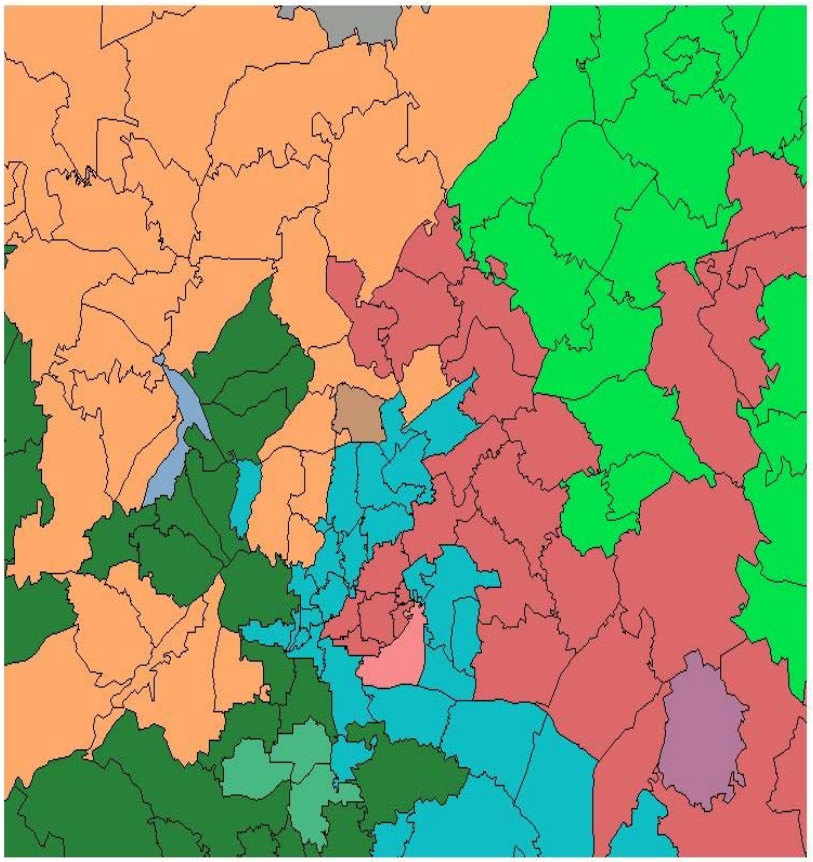


Non-Contiguous vs. Contiguous Clusters

Noncontiguous Clustering

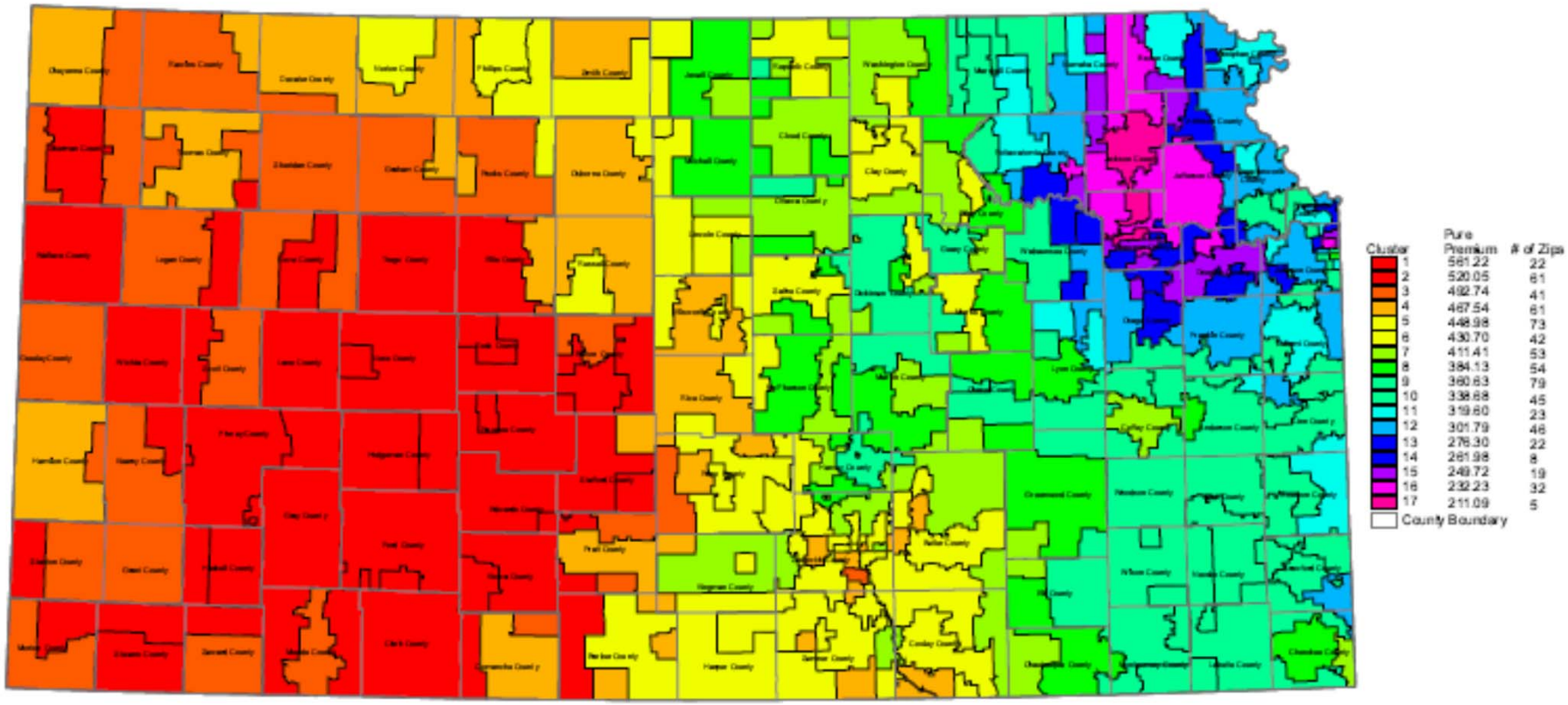


Contiguous Clustering



Final Territory Definitions

17 Cluster Scenario Adjusted
Total Weather Cat & Non-Cat
Kansas



By Peril Rating

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By-Peril Rating

- Why?
  - Effects of perils differ by coverage
  - Different loss distributions by coverage
- By-peril rating: develop premiums separately by coverage and cause of loss
  - Separate base rates, rating factors, territory definitions
  - Coverage breakdown
    - Structure
    - Contents
    - Liability

Potential peril breakdown

- Fire
- Theft
- Liability
- Medical
- Weather
- Water
- Wind
- Hail
- Lightning
- Catastrophes

Segmented Analysis

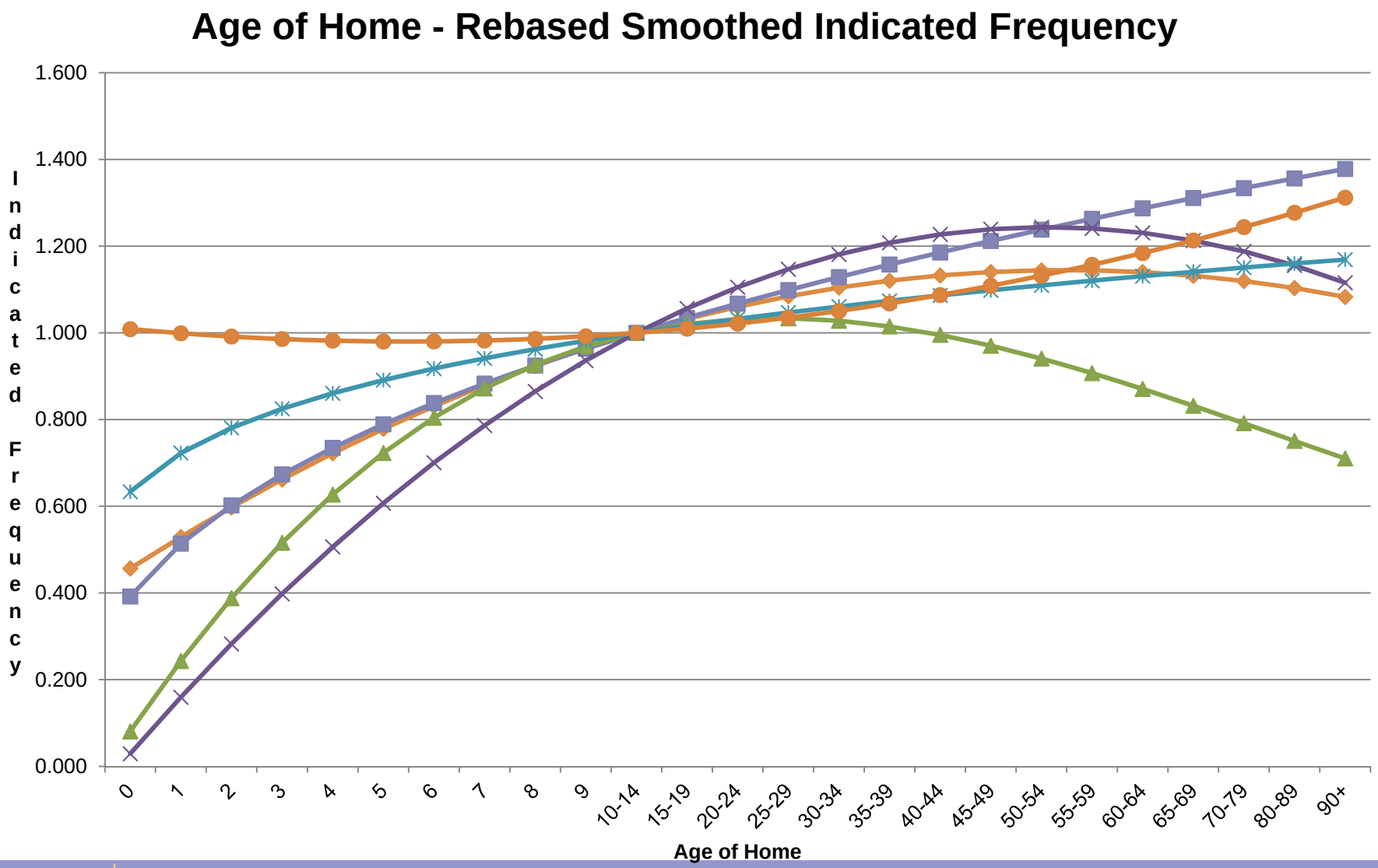
Many rating factors are specific to only one or two perils

- Protection Class - Fire
- Protective Devices – Fire & Theft
- Construction Type - Fire
- Age of Construction – Structure related

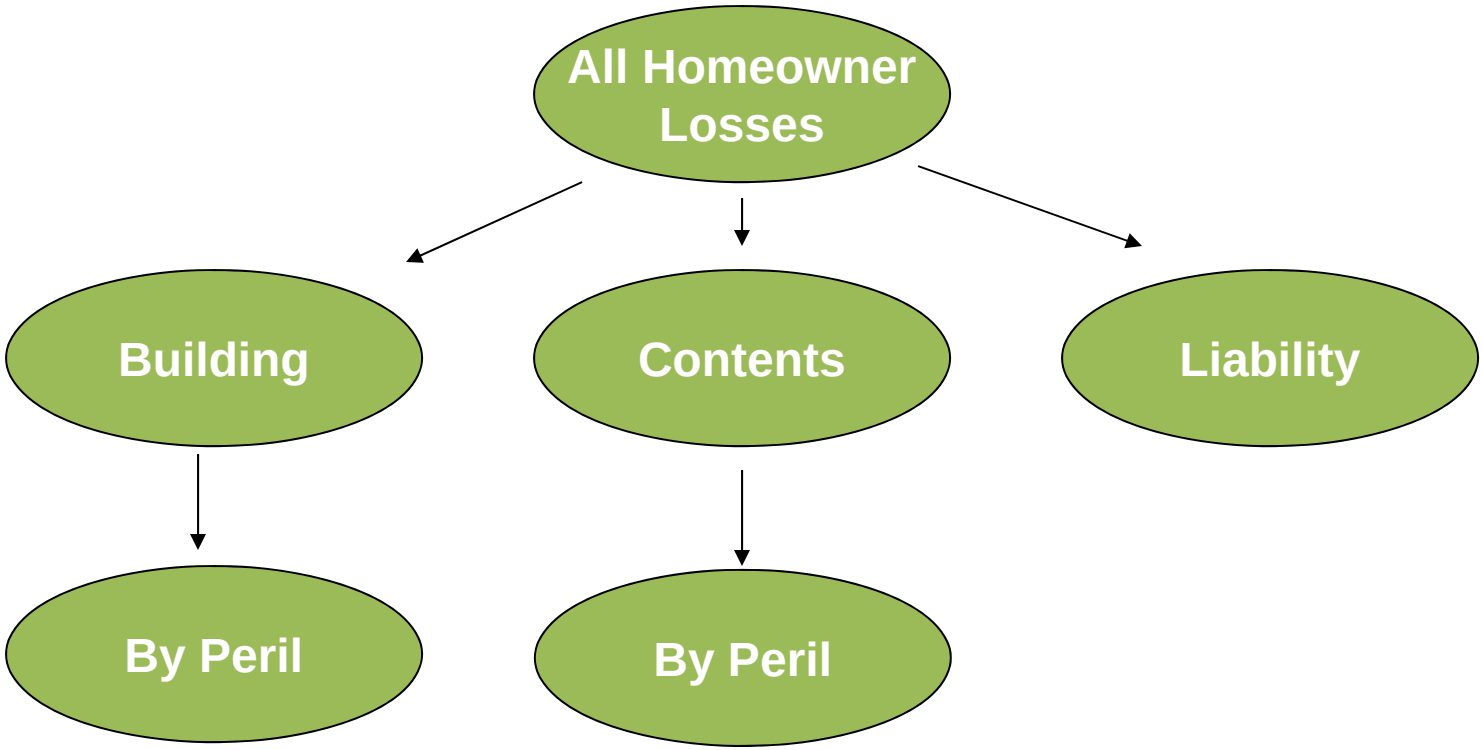
Many rating variables have no apparent relation to one or more loss types

- Protection class
- Construction type
- Amount of insurance
- Deductible amounts

Age of Home – Smoothed Indicated Frequency



Segmentation of Analysis



Thank You for Your Attention

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