STATE AUTO®
Insurance Companies

By-Peril Deductible Factors

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Agenda

- Introduction
- Univariate Analysis
- Regression Analysis
- Loss Elimination Analysis
- Results
- Q&A

1. Introduction

- HO Loss Performance
  - Bottom line of business
  - Lost money in 8 of last 10 years
  - Increasing losses from wind-hail perils
  - Experienced 35 of the 37 catastrophe events identified by Property Claim Services (PCS) in 2008

1. Introduction

- Industry’s Strategies to Improve HO line
  - Rate Increase
  - By-peril Models
  - Higher all-peril and wind-hail deductibles
  - ITV and home inspection
  - Reinsurance
  - Risk De-concentration

1. Introduction

- Challenges in by-peril models
  - Deductibles
  - Age-of-roof
  - Peril groupings
  - Territorial factors for cat-related perils
  - Many Others

2. Univariate Analysis

- Performance by Deductible: all-perils

Deductible	Relativity			
	Freq	Severity	PP	Loss Ratio
250	1.018	0.820	0.835	0.939
500	1.005	1.091	1.097	1.022
1000	0.887	1.710	1.516	1.150

2. Univariate Analysis

- Performance by Deductible: Fire

Deductible	Relativity			
	Freq	Severity	PP	Loss Ratio
250	1.075	0.778	0.836	0.941
500	0.942	1.080	1.017	0.947
1000	0.816	2.195	1.790	1.358

2. Univariate Analysis

- Performance by Deductible: Hail

Deductible	Relativity			
	Freq	Severity	PP	Loss Ratio
250	0.783	0.919	0.719	0.809
500	1.218	1.014	1.235	1.150
1000	1.364	1.200	1.637	1.242

2. Univariate Analysis

- Deductible and AOI Interaction

CovA Range	Average All-peril Deductible	Average Wind/Hail Deductible
A	359	576
B	381	863
C	431	1,219
D	483	1,570
E	547	2,016
F	666	3,249

CovA limits increase from A to F

2. Univariate Analysis

- Deductible and AOI Interaction

Ded	CovA	Relativity			
		Freq	Severity	PP	Loss Ratio
500	A	0.895	0.850	0.761	0.937
500	B	0.920	0.930	0.856	0.940
500	C	0.999	1.102	1.101	1.047
500	D	1.105	1.213	1.340	1.101
500	E	1.196	1.374	1.643	1.124
500	F	1.409	1.656	2.334	1.067
1000	A	0.683	1.170	0.799	0.999
1000	B	0.722	1.171	0.845	0.932
1000	C	0.845	1.638	1.384	1.302
1000	D	0.914	1.337	1.223	0.998
1000	E	0.953	1.947	1.854	1.261
1000	F	1.193	2.478	2.956	1.203

2. Univariate Analysis

- High deductibles performed worse than low deductibles
- High value homes tend to select high deductibles
- Deductible factors should vary by coverage A limits

2. Univariate Analysis

- Why do high deductibles produce bad loss ratios?
  - High deductibles were introduced to cat-prone area first
  - Agents tended to offer high deductibles to perceived high risks or those with prior claims
  - High deductibles are chosen by less risk-averse people

2. Univariate Analysis

- Why do high deductible produce bad loss ratios?
  - Deductible factors are underpriced for high value homes
  - “We pay your deductible up to $1000”
  - “If you argue really hard, you may get all of your sidings replaced (instead of just the one side that had hail damage)”

3. Regression Analysis

- Using net loss as the dependent variable
  - Trend and develop losses, or not
  - Cap and smooth large losses, or not
  - Frequency/Severity/Pure Premium (Poisson/gamma/Tweedie)
  - Dollar deductibles
  - Percentage deductibles
  - AOI and deductible interactions

3. Regression Analysis

- 1000 deductible is a surcharge compared with 250/500 purely based on data
- Have to force desirable results by constraints
  - Current rating factors
  - ISO factors
  - AIR simulated factors for wind-hail perils
  - Competitors' factors
  - Judgmental factors

4. Loss Elimination Analysis

- Key Assumptions
  - Ground-up losses depend only on coverage A limit (AOI group) and peril coverage, not on deductibles
  - Loss severities can be modeled by simple parametric distributions
- Methodology
  - Loss elimination factor is one minus the expected ratio of loss after deductible to ground loss
  - Calculation is based on numerical methods with maximum loss capped at twice the AOI

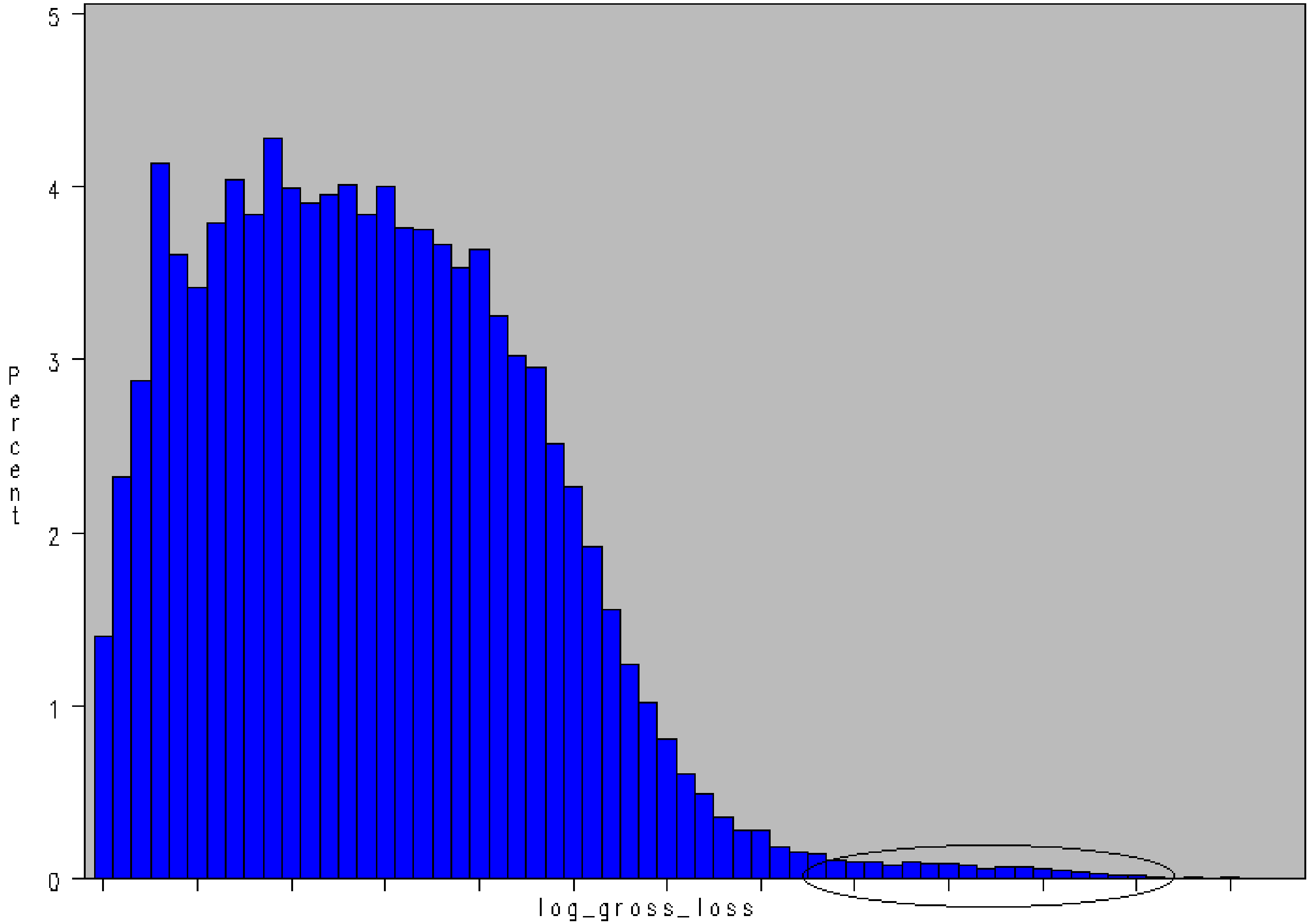
4. Loss Elimination Analysis

- Method I: Assume Gamma loss severities
  - Ground-up loss follows a Gamma distribution, parameters differ by AOI group and peril coverage
  - Apply smoothing technique to GLM outputs
- Advantages:
  - Gamma is the most common distribution to model severity, easy to explain
  - Utilize outputs from GLM so the result is coherent to others

4. Loss Elimination Analysis

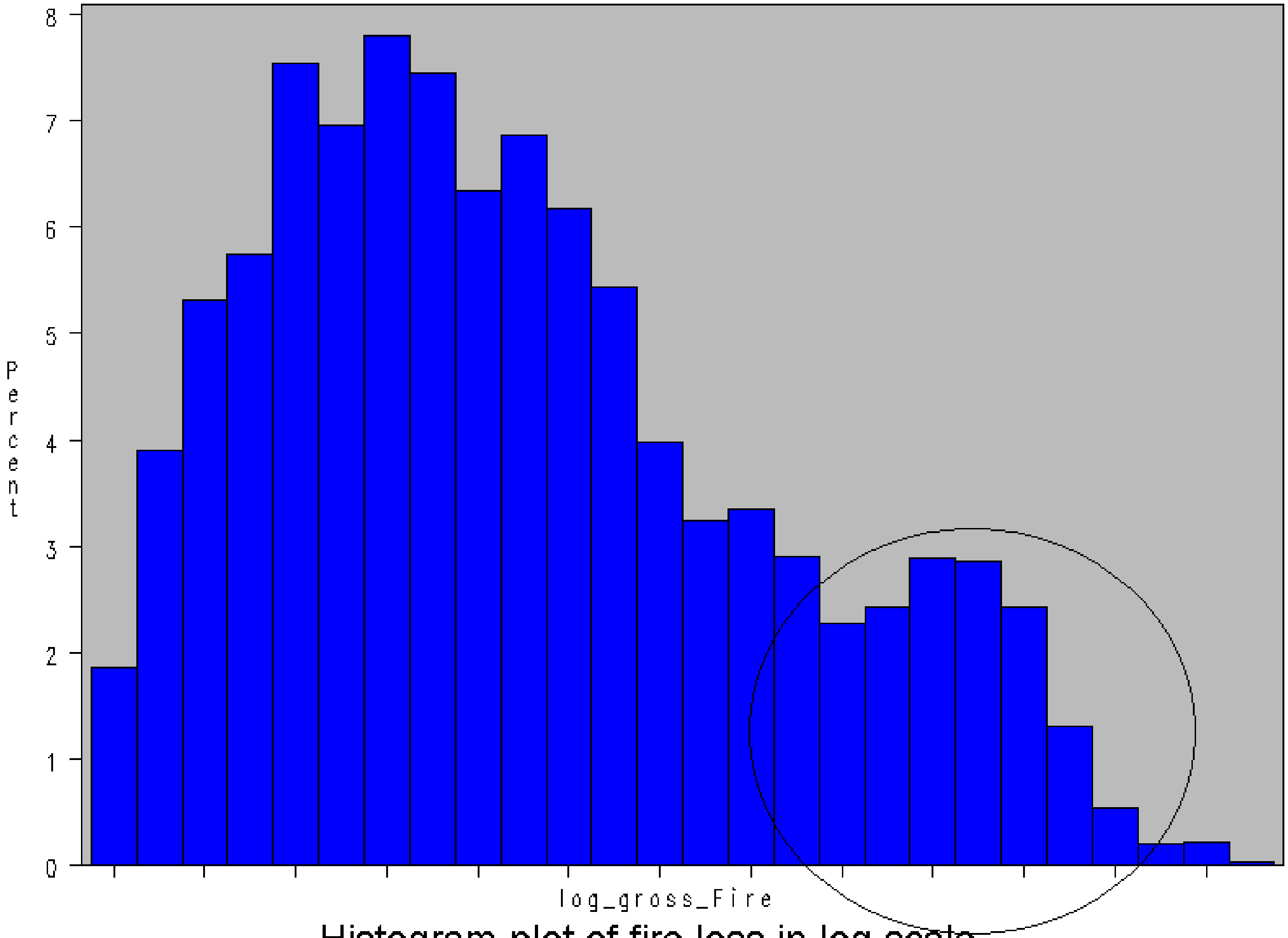
- Problems with Gamma distribution
  - Lack of goodness-of-fit with historical loss data
  - Severely underestimate the tail distribution for certain perils (guess which ones?)
- Alternative solution
  - Need to solve the two problems identified
  - Start with a histogram plot of historical losses in log scale, shown in the next few slides

4. Loss Elimination Analysis



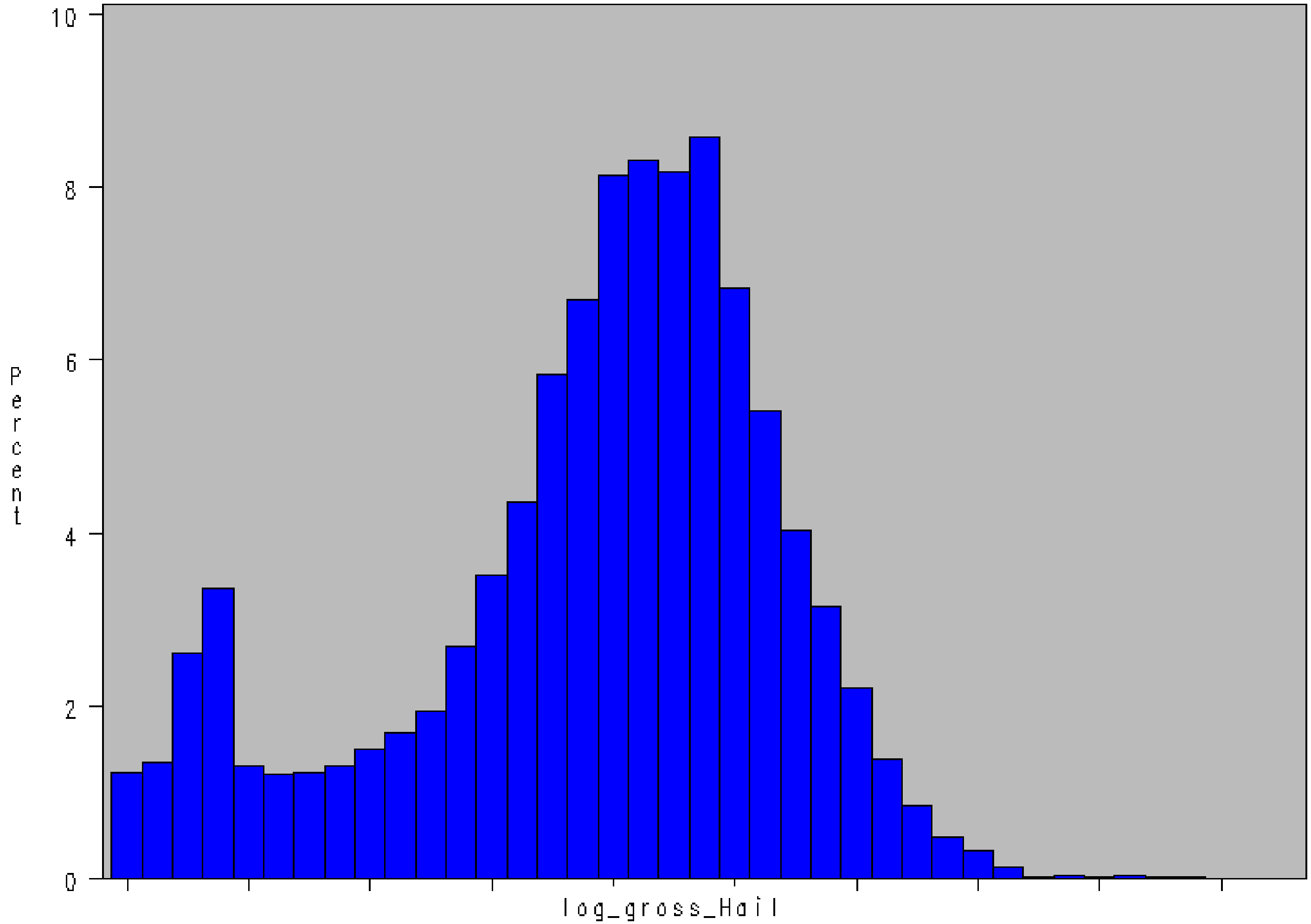
Histogram plot of ground up loss in log scale

4. Loss Elimination Analysis



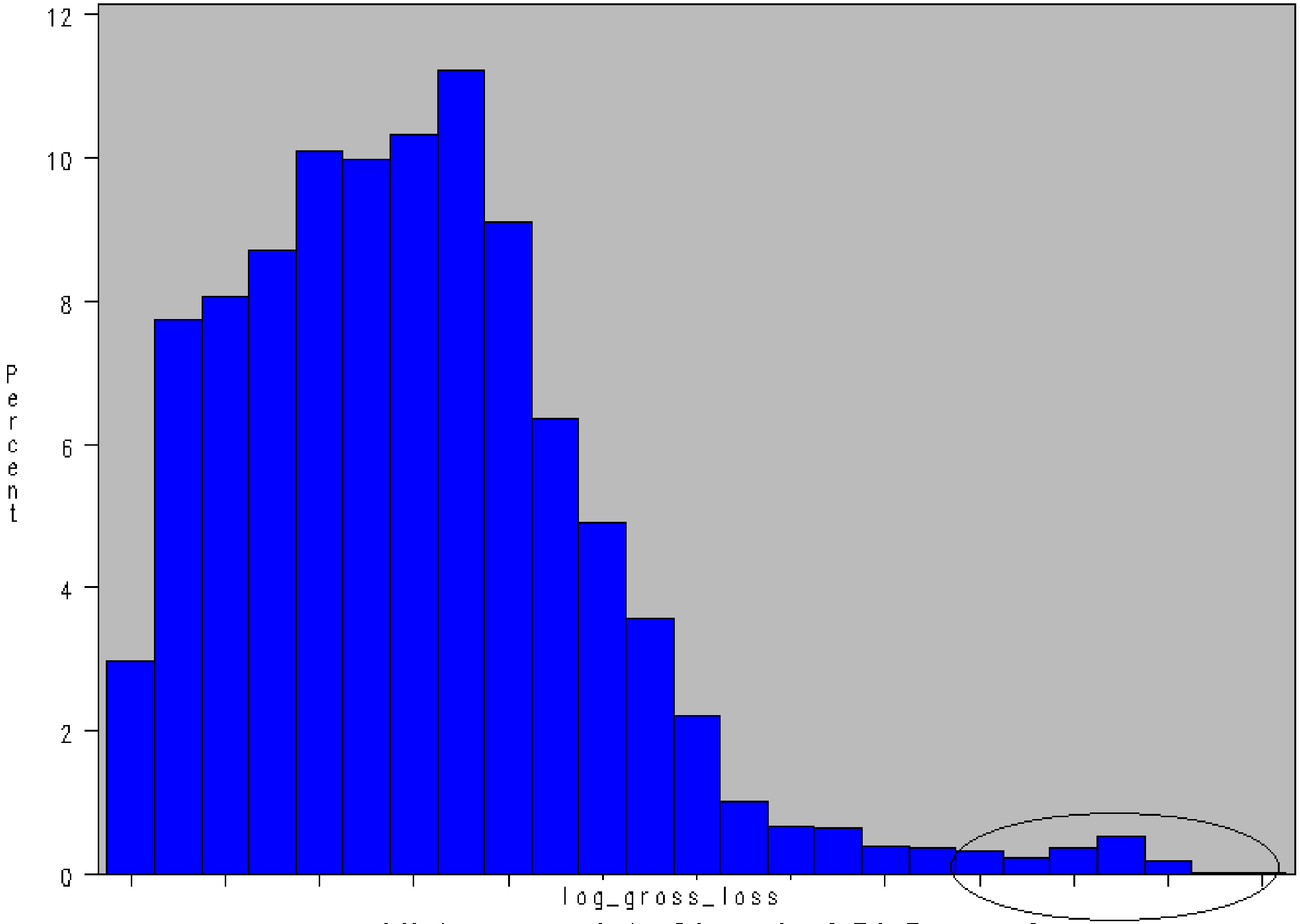
Histogram plot of fire loss in log scale

4. Loss Elimination Analysis



Histogram plot of hail loss in log scale

4. Loss Elimination Analysis



Histogram plot of loss in AOI Group A

4. Loss Elimination Analysis

- It is evident that one single distribution may not describe the distribution well
- We propose a mixture distribution of Gamma and Lognormal.
- Smaller, common losses are modeled by gamma and larger losses by lognormal

4. Loss Elimination Analysis

$$f(x,d,\pi,\alpha,\beta,\mu,\sigma) = \pi \cdot g(x,d,\alpha,\beta) + (1-\pi) \cdot l(x,d,\mu,\sigma), \quad x > 0$$

- Above gives the probability density function of the mixture distribution
- π is the probability of a "small" loss, *d* is the deductible. Alpha, beta, mu and sigma are parameters for gamma and lognormal.
- Functions g( ) and l( ) are truncated gamma and lognormal densities

5. Results

- Adopt Maximum likelihood Estimation (MLE) method for parameter estimation
- For some data, convergence may require good initial values
- Need sufficient amount of loss data for credible estimation (say 200 losses)

5. Results

Data*	π	α	β	μ	σ
Fire Overall	0.785	0.51	98000	13.8	0.83
Hail Overall	0.148	1.19	4200	11.1	0.61
Fire Group_2	0.74	0.54	88000	13.5	0.42
Fire Group_10	0.83	0.35	124000	13.9	0.61
Fire Group_18	0.92	0.43	161000	14.6	0.54

*** Data values are augmented and estimates are approximate**

5. Results

- Dollar Deductible Factors for Peril 1

AOI Group	**$1000** Deductible Factors		**$5000** Deductible Factors	
	GLM Gamma	Mixture	GLM Gamma	Mixture
2	0.981	0.985	0.854	0.888
10	0.986	0.987	0.884	0.908
18	0.989	0.988	0.913	0.910

* **Base deductible is $500**

5. Results

- Dollar Deductible Factors for Peril 2

AOI Group	**$1000** Deductible Factors		**$5000** Deductible Factors	
	GLM Gamma	Mixture	GLM Gamma	Mixture
2	0.860	0.852	0.245	0.340
10	0.894	0.888	0.352	0.428
18	0.935	0.927	0.535	0.589

* **Base deductible is $500**

5. Results

- Percentage Deductible Factors

AOI Group	**1%** Deductible Factors for Peril 1		**1%** Deductible Factors For Peril 2	
	GLM Gamma	Mixture	GLM Gamma	Mixture
2	0.990	0.992	0.925	0.919
10	0.977	0.978	0.830	0.829
18	0.960	0.961	0.765	0.767

* **Base deductible $500**

5. Results

- Percentage Deductible Factors

AOI Group	**5%** Deductible Factors for Peril 1		**5%** Deductible Factors For Peril 2	
	GLM Gamma	Mixture	GLM Gamma	Mixture
2	0.889	0.914	0.359	0.419
10	0.848	0.874	0.238	0.341
18	0.796	0.825	0.187	0.348

* **Base deductible $500**

5. Results

- Mixture model has 3 more parameters than a gamma distribution
- Deviance statistics for each AOI group is greater than 30 with p-value less than 0.001
- Significant improvement on high deductible factors comparing with actual

5. Results

- Conclusions
  - Deductible factors vary significantly among perils
  - As Coverage A limit increases, dollar-deductible factor increases while percentage-deductible factor decreases (certain perils may be different)
  - Mixture distribution improves the fitting of deductible factors for high deductibles

Q & A

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