The New NCCI ELFs

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Workers Compensation ELFs

Agenda

- Changes in methodology
- Impact on new ELFs
- Key drivers of the changes

Excess Ratio Calculations

$$R(A) = \sum w_i R_i (A/\mu_i)$$

R_i = excess ratio function for injury type i

$w_i = L_i / \sum L_i$

L_i = injury type i losses

μ_i = mean injury type i loss

ELF Changes

- Regular Annual Update
  update weights and ACCs (w_i, μ_i)
- Methodology Change
  - Update loss distributions (R_i)
  - Last done in 1997

Methodology Changes

- Data adjustment techniques
- State specific loss distributions
- Injury type groupings
- Fitting methodology
- Modeling occurrences

Data Adjustment
Basic Issues

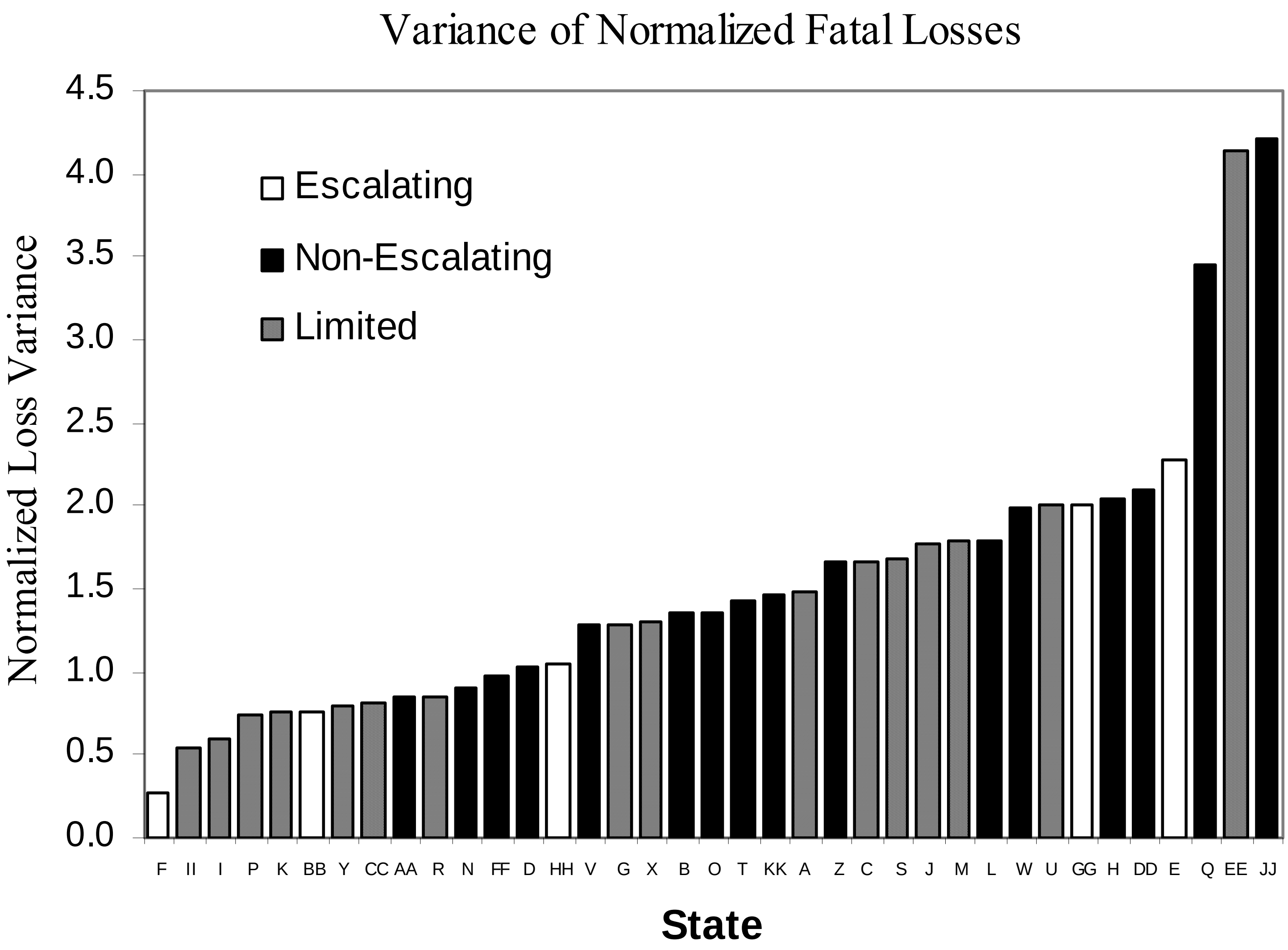
- Credibility
- Differences between states

Data Adjustment
Prior Approach

- Normalize by state mean: $x_i \mapsto x_i / \mu$

- Effectively controls for first moment, i.e. mean

Mean Normalization



Prior CW Approach

- Combine normalized claims into CW database
- State data gets weight proportional to number of claims in CW database
- Independent of injury type

Data Adjustment
Prior Approach

- Fit loss distributions to CW mean normalized database
- Assume state distributions differ only by a scale transform

The Usual Standardization

- Adjust by : $x_i \mapsto (x_i - \mu)/\sigma$

- Effectively controls for first two moments, i.e. mean and variance

Data Adjustment Techniques
Primary Approaches

- Mean normalization: $x_i \mapsto x_i / \mu$
- Logarithmic standardization:
  $x_i \mapsto (\log x_i - \mu)/\sigma$
- Power transform: $x_i \mapsto a x_i^b$

Data Adjustment Techniques
Secondary Approaches

- Median normalization: $x_i \mapsto x_i / m$

- Generalized standardization:

$$x_i \mapsto (\log x_i - p_{50}) / (p_{85} - p_{50})$$

Data Adjustment
Basic Idea

- Adjust the data to a common basis
- Combine all states adjusted data into a big database
- Adjust big database as appropriate for each state

Data Adjustment Techniques

- Conducted extensive testing
- Conclusions:
  - Logarithmic standardization for F, PT
  - Power transform for PP, TT, MO

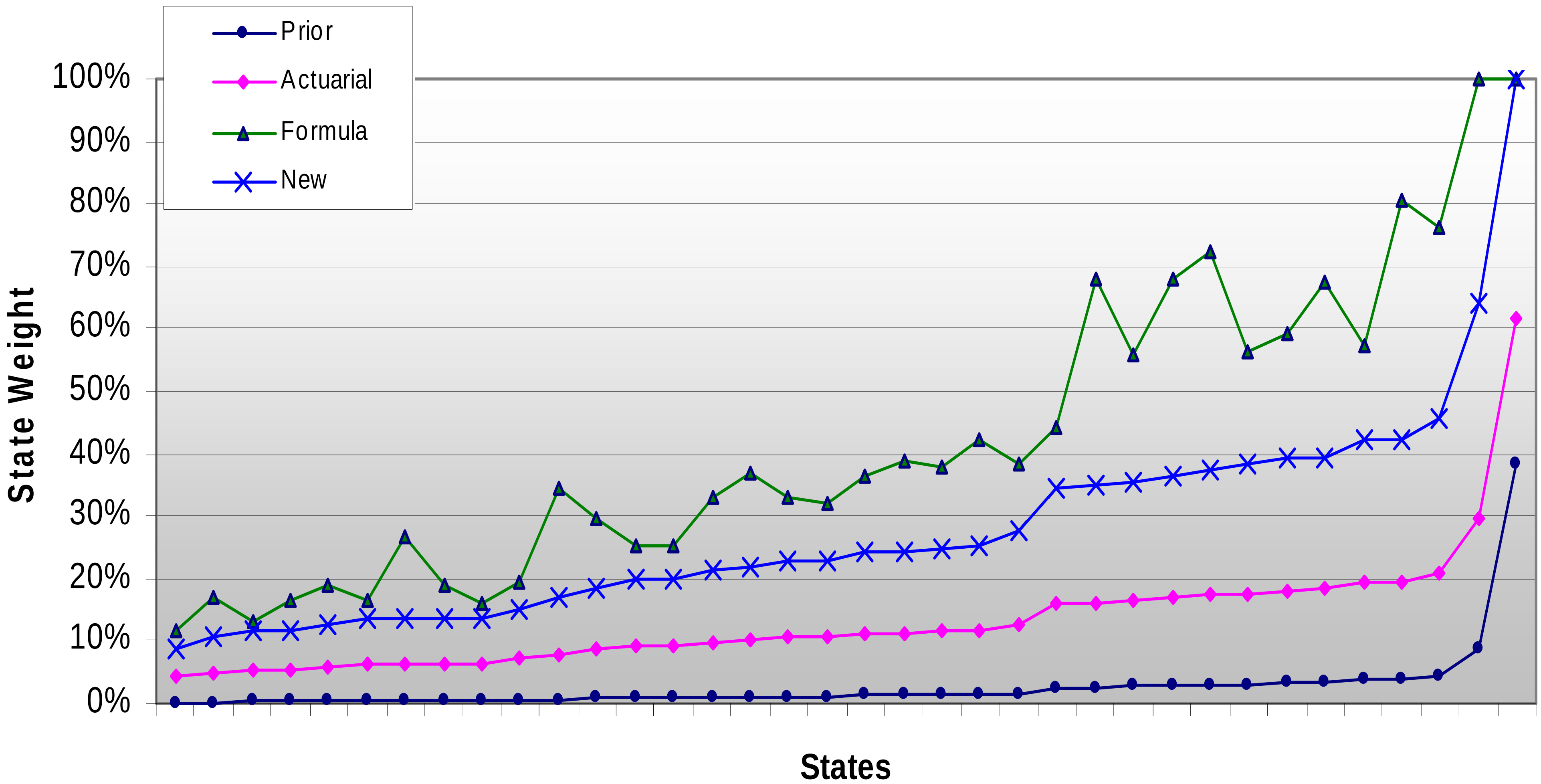
State Specific Distributions

- More sophisticated data adjustment techniques
- Give more weight to a state's own data
  - Still makes use of out-of-state data
  - How much state data is enough?

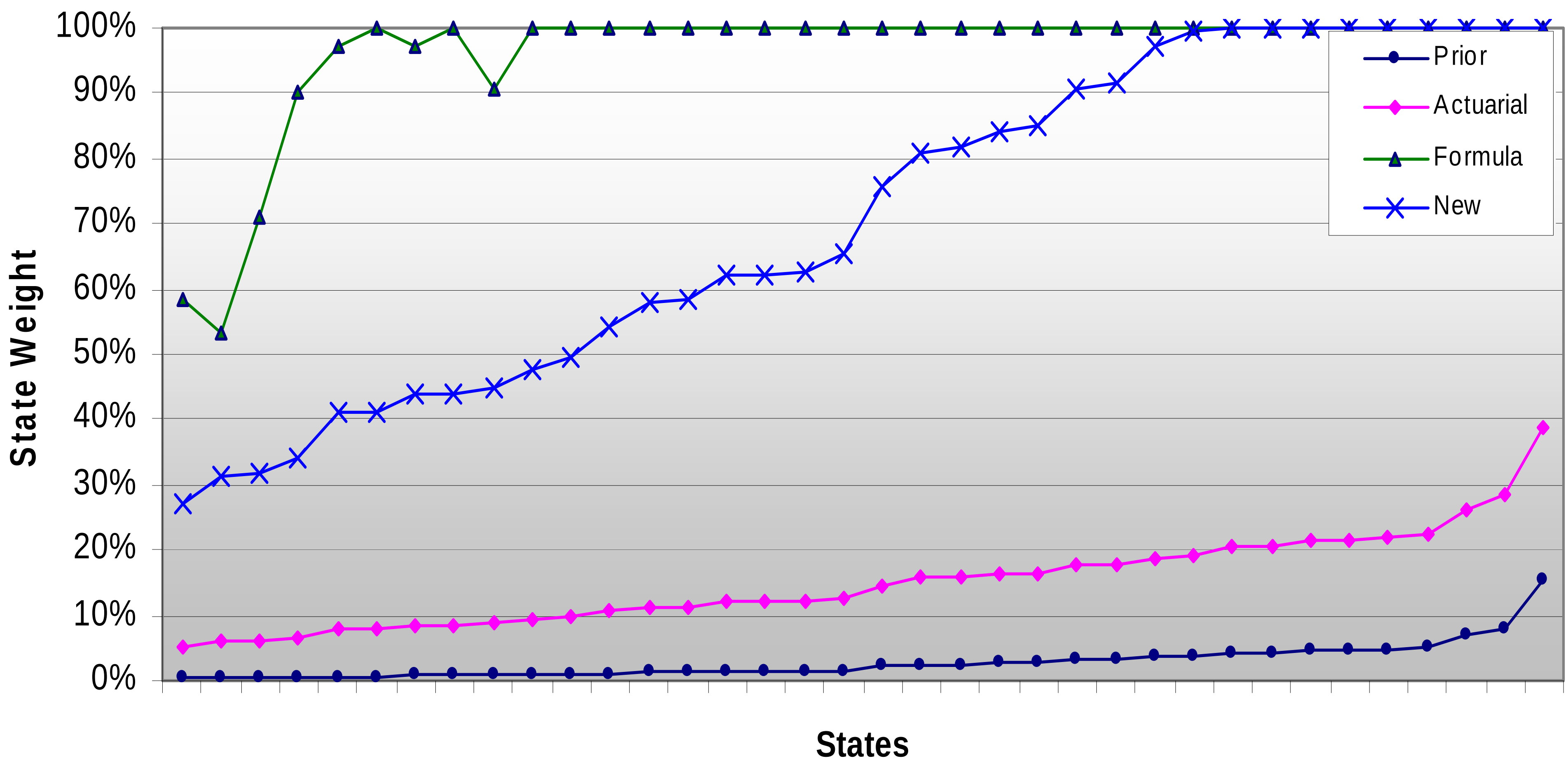
Determining the Weight

- Prior: $w = n / N$
- Actuarial: $w = \sqrt{n / N}$
- Formula: $w = \sqrt{n / N_F}$
- New: $w = \sqrt{n / N_J}$

State Pooling Weights
Permanent Total



State Pooling Weights
Permanent Partial



Standards for Full Weight

Injury Type	Full Standard
Fatal	2,000
PT	1,500
PP	7,000
TT	8,500
Med Only	20,000

Injury Type Groupings

- Separate PT from PP/Major
- Use 3 years of data for F, PT
- Combine PP/Major with PP/Minor
- This would be unaffected by any change in critical value methodology

Fitting Methodology

- Empirical distribution for small claims
- Mixed exponential for the tail
- Howard Mahler, PCAS 1998

Mixed Exponential

- $S(x) = \sum_{i=1}^{n} w_i e^{-\lambda_i x}$
- Semi-parametric distribution
- Excess ratio function of a mixed exponential is again mixed exponential

Mixed Exponential Tail Behavior

- Increasing mean residual life, i.e.

  $E[X - x \mid X > x]$ is increasing in x

- Lots of moments

Mixed Exponential
Special Cases

- Pareto (Γ mixing distribution)
- Transformed Beta
- Weibull
- Burr
- Gamma

Goodness of Fit

- Only fitting the tail
- Semi-parametric mixed exponential's flexibility produced very good fits

Modeling Occurrences
Basic Goal

- Have per claim data
- Need per occurrence ELFs

Modeling Occurrences
First Approach

- $ELF_o = 1.1 \times ELF_c$
- Occurrence adjustment factor was independent of
  - Loss limit
  - Mix of injury types
- Could result in $ELF_o > 1$

Modeling Occurrences
Second Approach

- Occurrences cost 10% more than claims, i.e instead of $r = L/\mu$, use $r = L/1.1\mu$
- Adjustment factor still independent of
  - Loss limit
  - Mix of injury types

Modeling Occurrences
Prior Approach

- Fit loss distributions to mean normalized data
- But do not renormalize fitted distributions
- This provides what Gillam and Couret called a “natural contagion load” of:
  - 3.9% for Fatal
  - 6.6% for PT/Major
  - 0% for TT/Minor

Modeling Occurrences

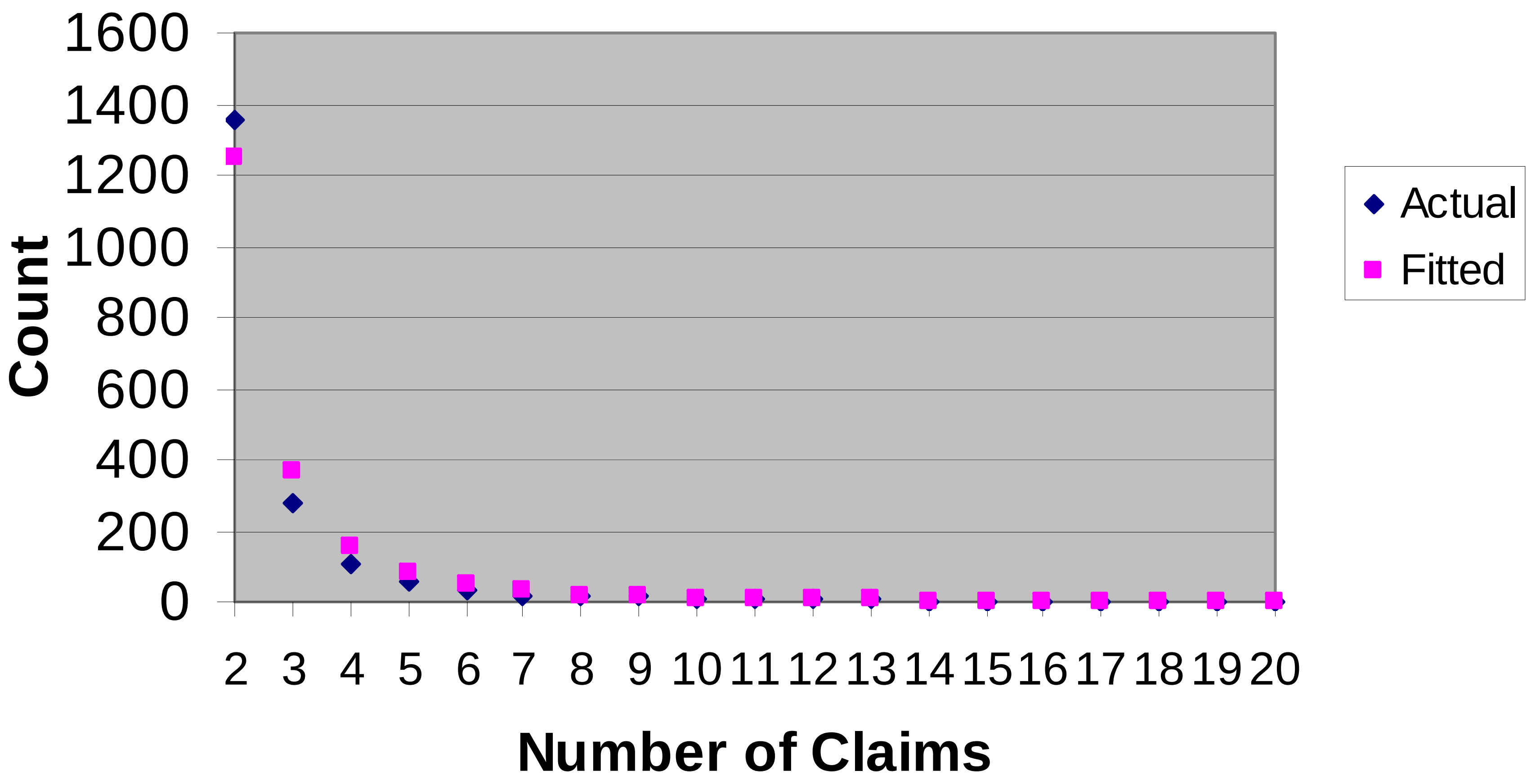
Hypothesis:

Multi-claim occurrences differ from single claim occurrences only in that they have more claims involved.

Modeling Occurrences
Collective Risk

- $M = X_1 + \cdots + X_N$ where
- N = number of claims per occurrence
- X_i = cost of i^{th} claim

Claims per Occurrence For Multi-Claim Occurrences



Based on PY 1997 WCSP data as of September 2002.

Distribution of Injury Types

Injury Type	Single Claim Occurrences	Multi-Claim Occurrences
Fatal	.1%	2.7%
PT	.1%	1.4%
PP	6.9%	12.5%
TT	14.6%	16.2%
Med Only	78.4%	67.3%

Based on PY 1997 WCSP data as of September 2002.

Multi-Claim Occurrences
Cost Compared to Singletons

Injury Type	Increased Cost	Sample Size
Fatal	29%	157
PT	85%	23
PP	122%	901
TT	223%	1015
Med Only	128%	4028

Based on PY 1997 WCSP data as of September 2002.

Multi-Claim Occurrences

- Mix of injury types more severe
- Same type of injury more severe

Modeling Occurrences

Revised Hypotheses:

- Multi-claim occurrences have different mix of injury types
- Injury type distributions for multi-claim occurrences differ only by a scale transformation

Modeling Occurrences

- X_i = cost of claim in multiple claim occurrence
- $M = X_1 + \cdots + X_N$
- S = cost of claim in single claim occurrence
- $T = r \cdot M + (1-r) \cdot S$ where
- r = probability occurrence is multi-claim

Antiselection in Retro Rating

- Previous provision of .005
- Not included in new ELFs

Large Losses

- Losses > $50M accounted for in separate CAT filing
- Losses $10M-$50M under represented in data
- New .003 provision to account for under represented large losses $10M-$50M
- Broadly grounded in several WC catastrophe models, and known large WC occurrences

Formula for the New Provision

- The provision (per-claim or per-occurrence) is
  - .003 up to $10M
  - zero for $50M or greater
  - declines linearly from .003 to zero between $10M and $50M
- Final ELF is 0.997 times the ELF before this adjustment, plus this adjustment

Published Excess Ratios for 20 States

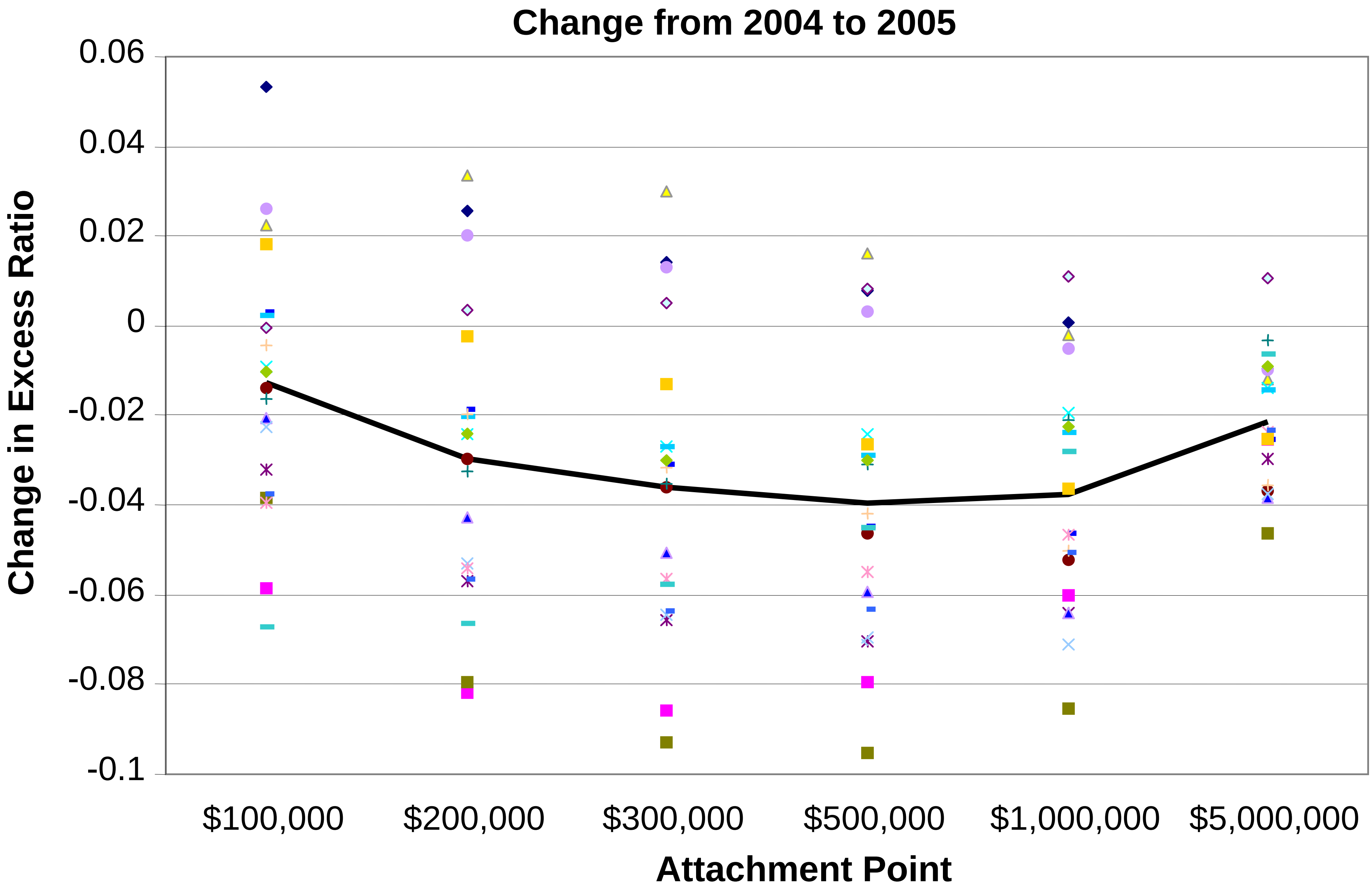
Change from 2004 to 2005

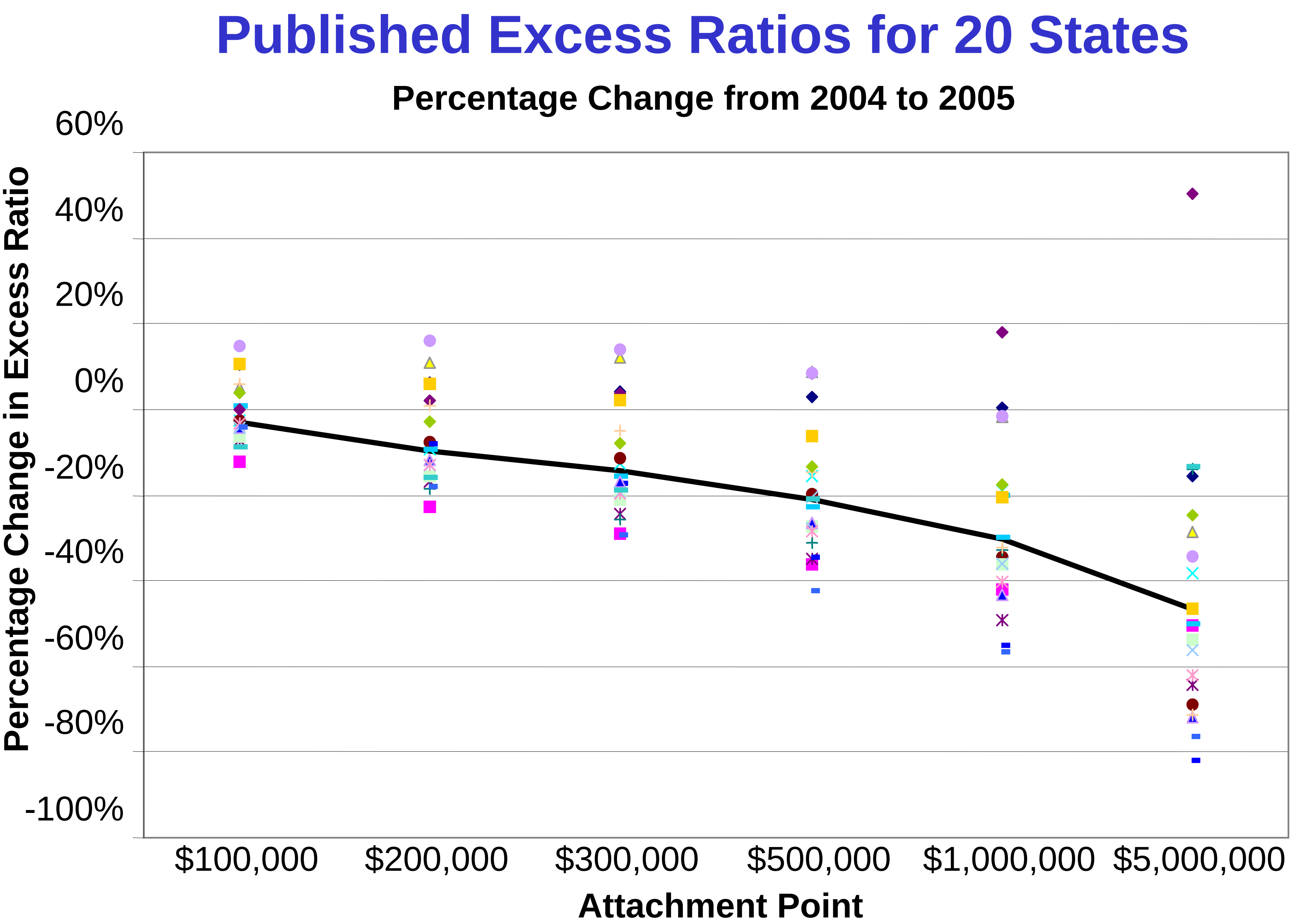
	Minimum	Maximum	Average Difference
$100,000	(0.069)	0.053	(0.013)
$200,000	(0.082)	0.034	(0.030)
$300,000	(0.093)	0.030	(0.036)
$500,000	(0.095)	0.016	(0.039)
$1,000,000	(0.085)	0.011	(0.038)
$5,000,000	(0.046)	0.010	(0.021)

Percentage Change from 2004 to 2005

	Minimum	Maximum	Average Difference
$100,000	-16%	11%	-3%
$200,000	-25%	11%	-10%
$300,000	-36%	12%	-14%
$500,000	-49%	9%	-21%
$1,000,000	-63%	18%	-30%
$5,000,000	-84%	45%	-47%

Published Excess Ratios for 20 States





Published Excess Ratios for 20 States
Percentage Change from 2004 to 2005
Percentage Change in Excess Ratio
60%
40%
20%
0%
-20%
-40%
-60%
-80%
-100%
$100,000
$200,000
$300,000
$500,000
$1,000,000
$5,000,000
Attachment Point

Published Excess Ratios for 20 States

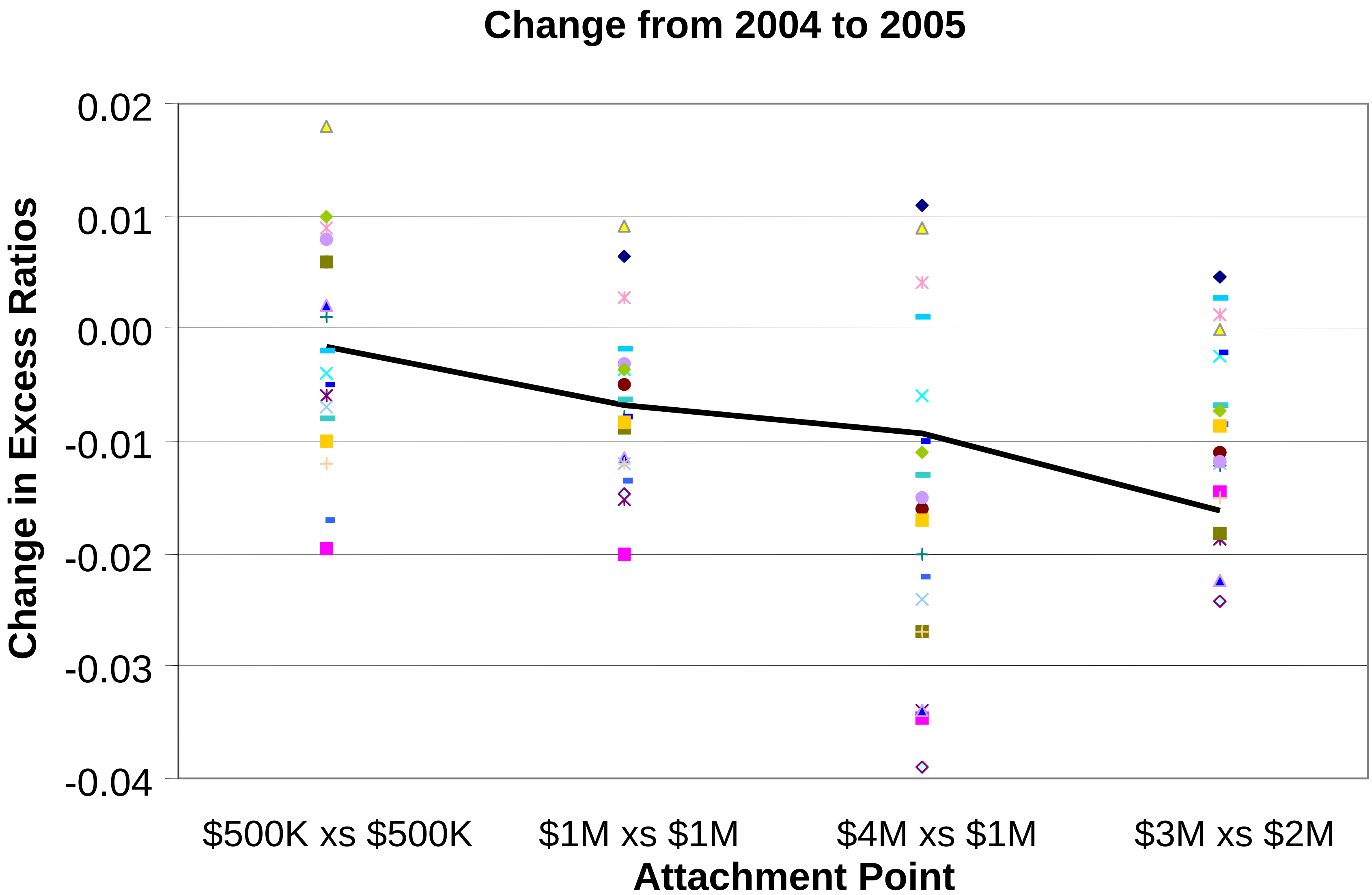
Change from 2004 to 2005

	Minimum	Maximum	Average Difference
$500K xs $500K	(0.020)	0.018	(0.002)
$1M xs $1M	(0.020)	0.009	(0.007)
$4M xs $1M	(0.039)	0.011	(0.016)
$3M xs $2M	(0.024)	0.005	(0.009)

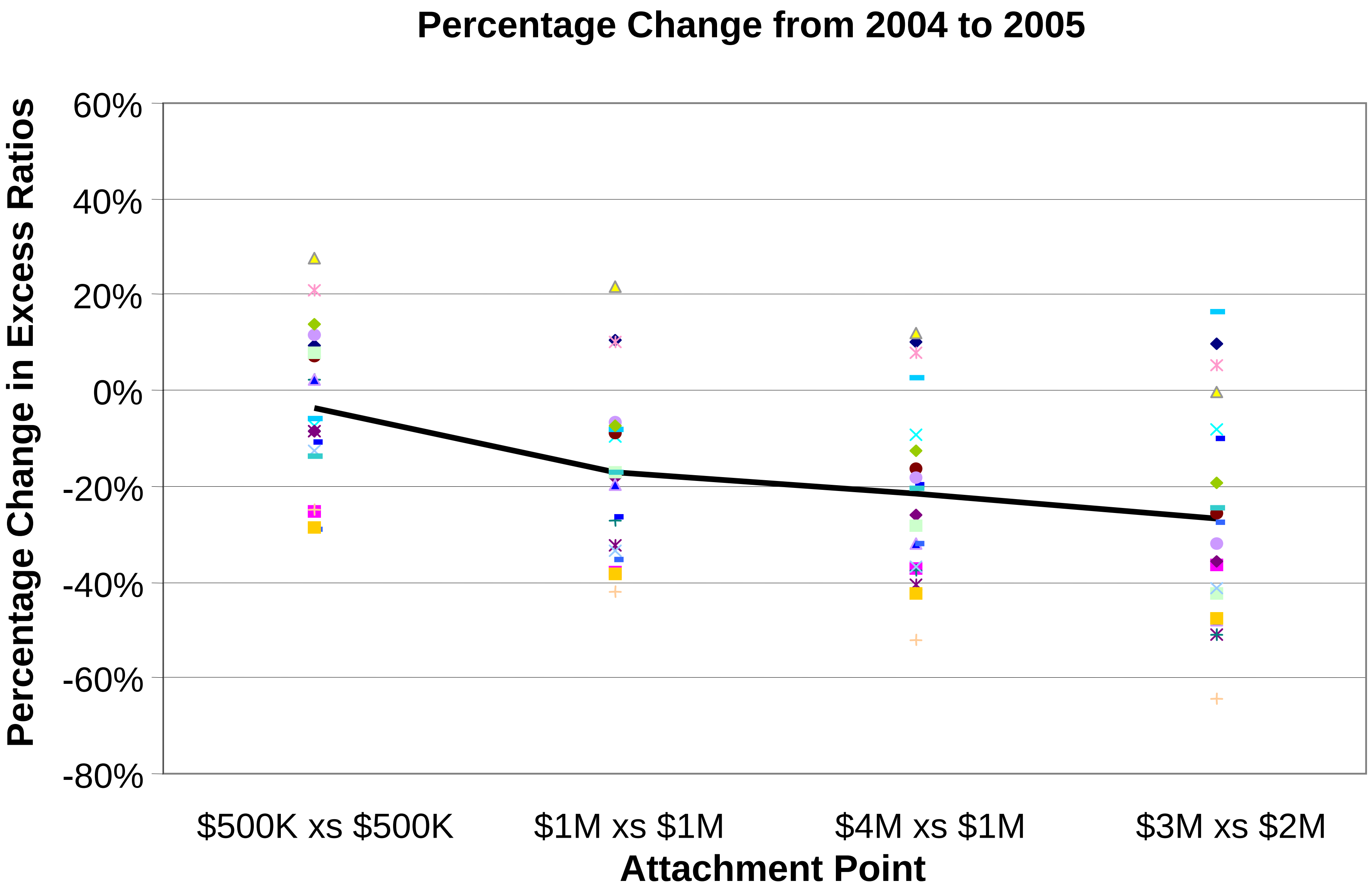
Percentage Change from 2004 to 2005

	Minimum	Maximum	Average Difference
$500K xs $500K	-29%	28%	-4%
$1M xs $1M	-42%	22%	-17%
$4M xs $1M	-52%	12%	-21%
$3M xs $2M	-64%	17%	-27%

Published Excess Ratios for 20 States



Published Excess Ratios for 20 States



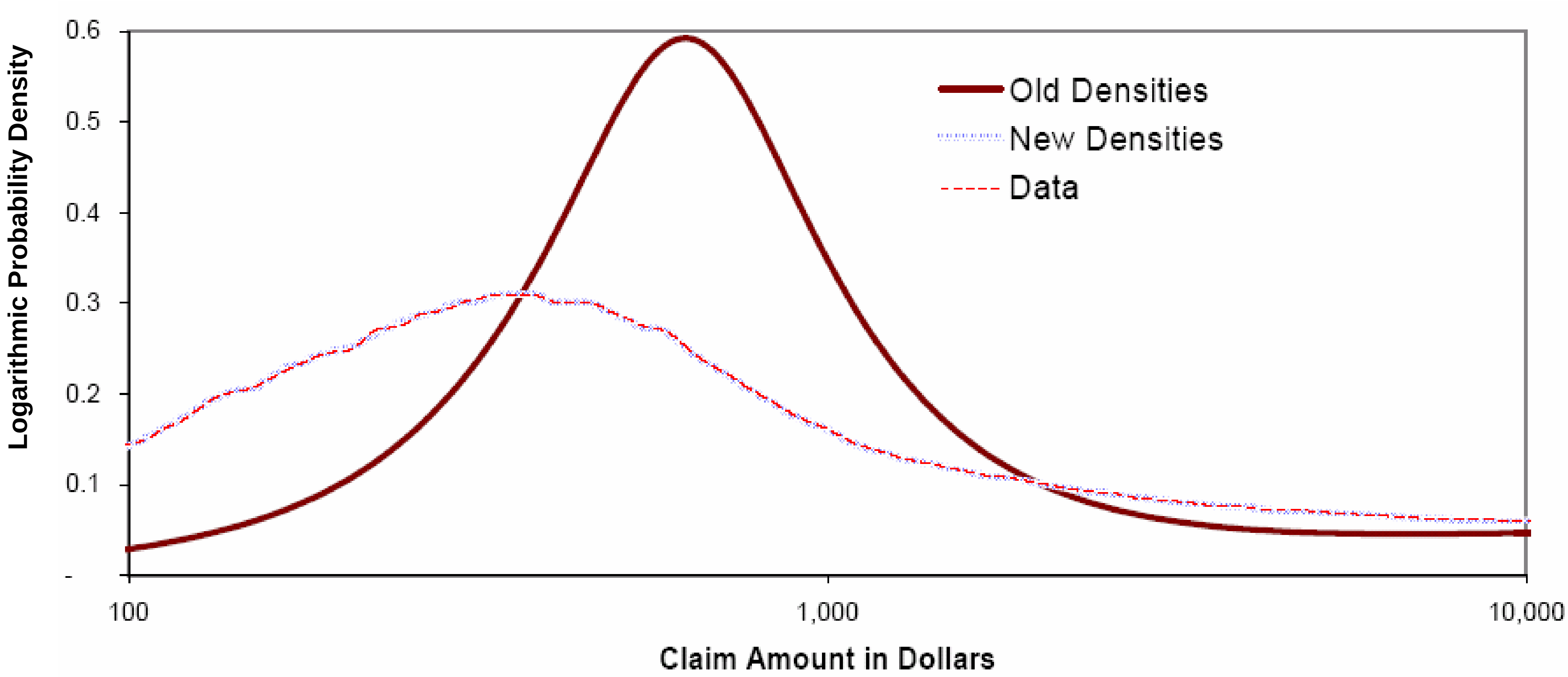
Reasons for Changes in ELFs

- New data
  (fit of new vs. old loss distributions)
- Development assumptions
- Tail assumptions
- Distributional assumptions
- Loss distributions not adjusted to reflect CAT exposure (Separate CAT filing)

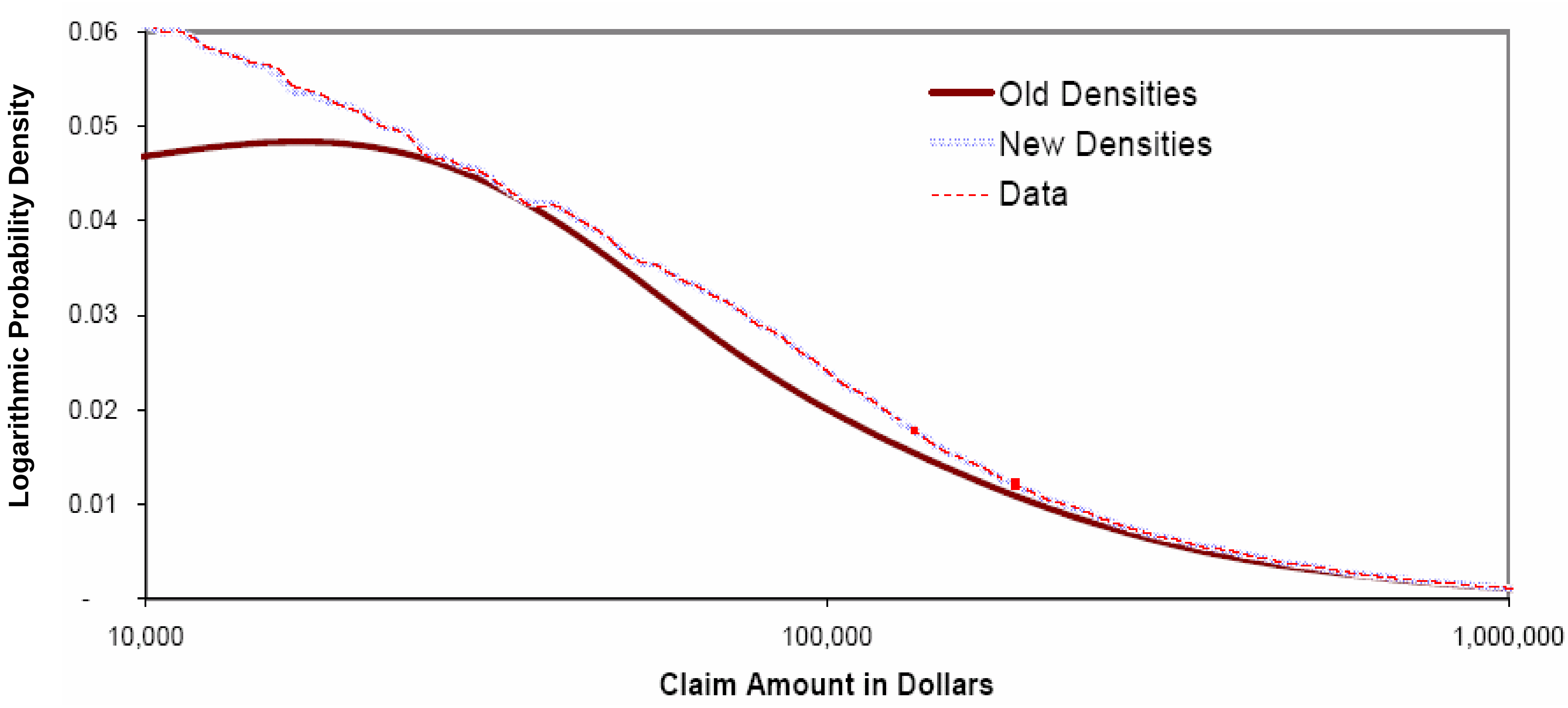
Data

- **New Data**
  - –Developed, dispersed
  - –3rd, 4th, 5th report for F, PT
  - –5th report for PP, TT, med only
  - –PY 97, 98, 99
- **Old Data**
  - –5th report
  - –Pre-reform

Comparison of Countrywide Distributions



Comparison of Countrywide Distributions



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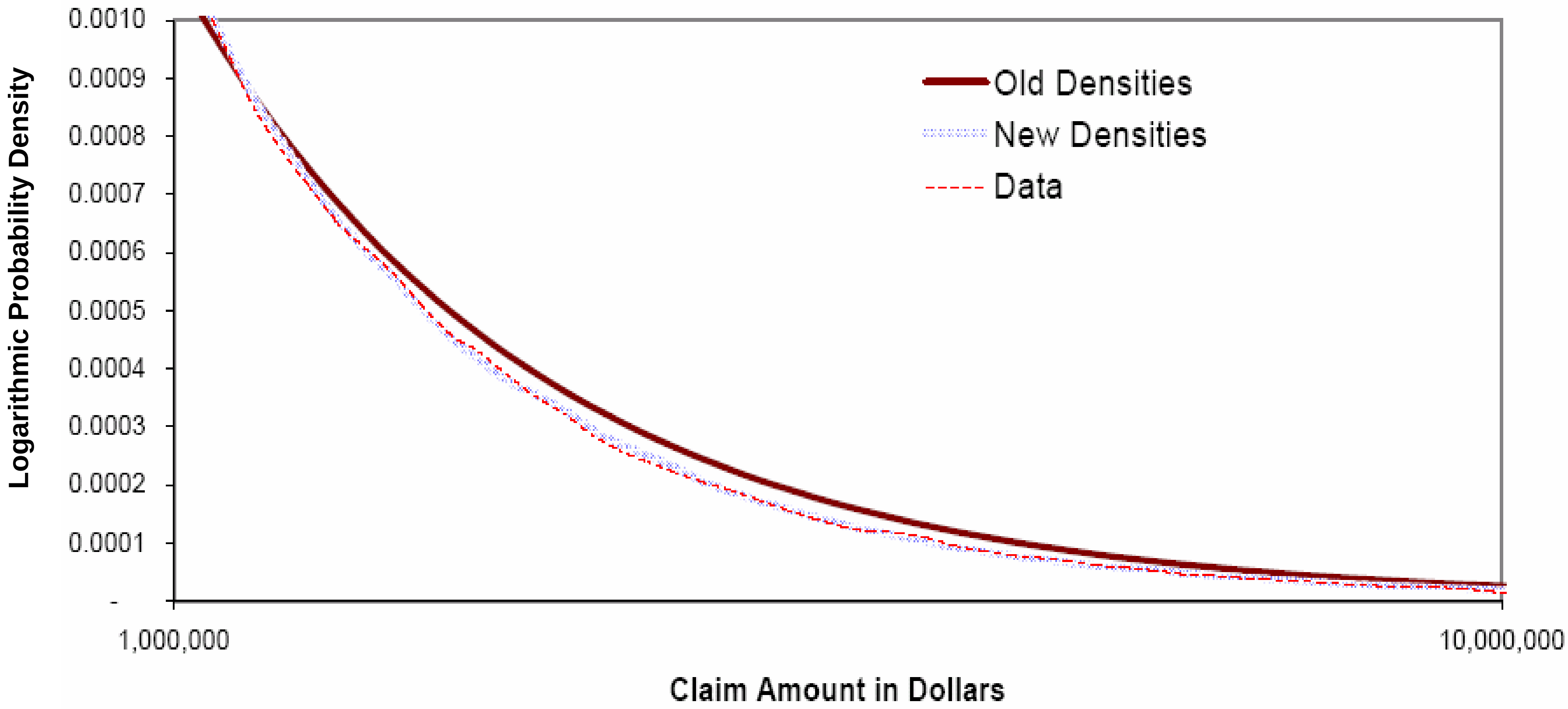
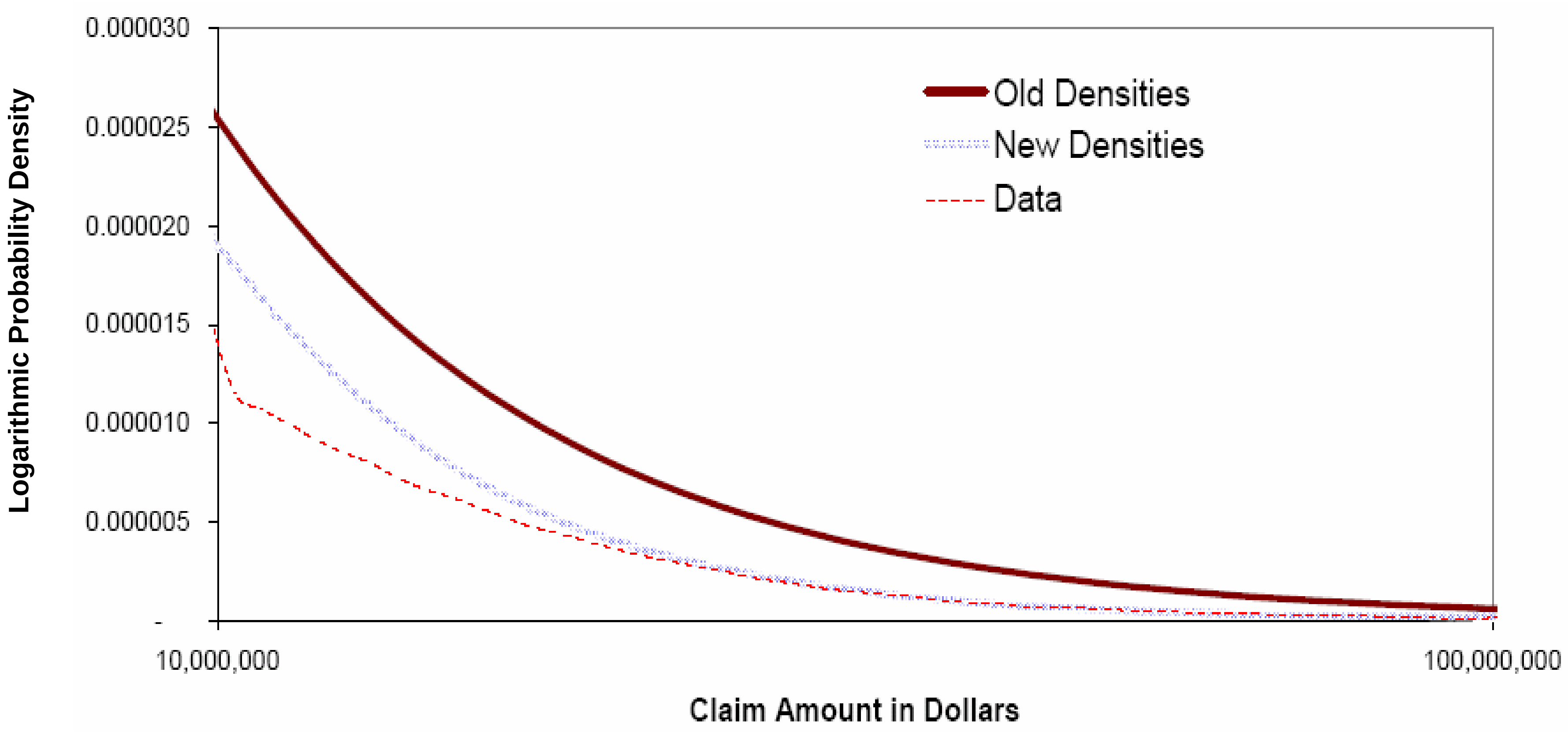
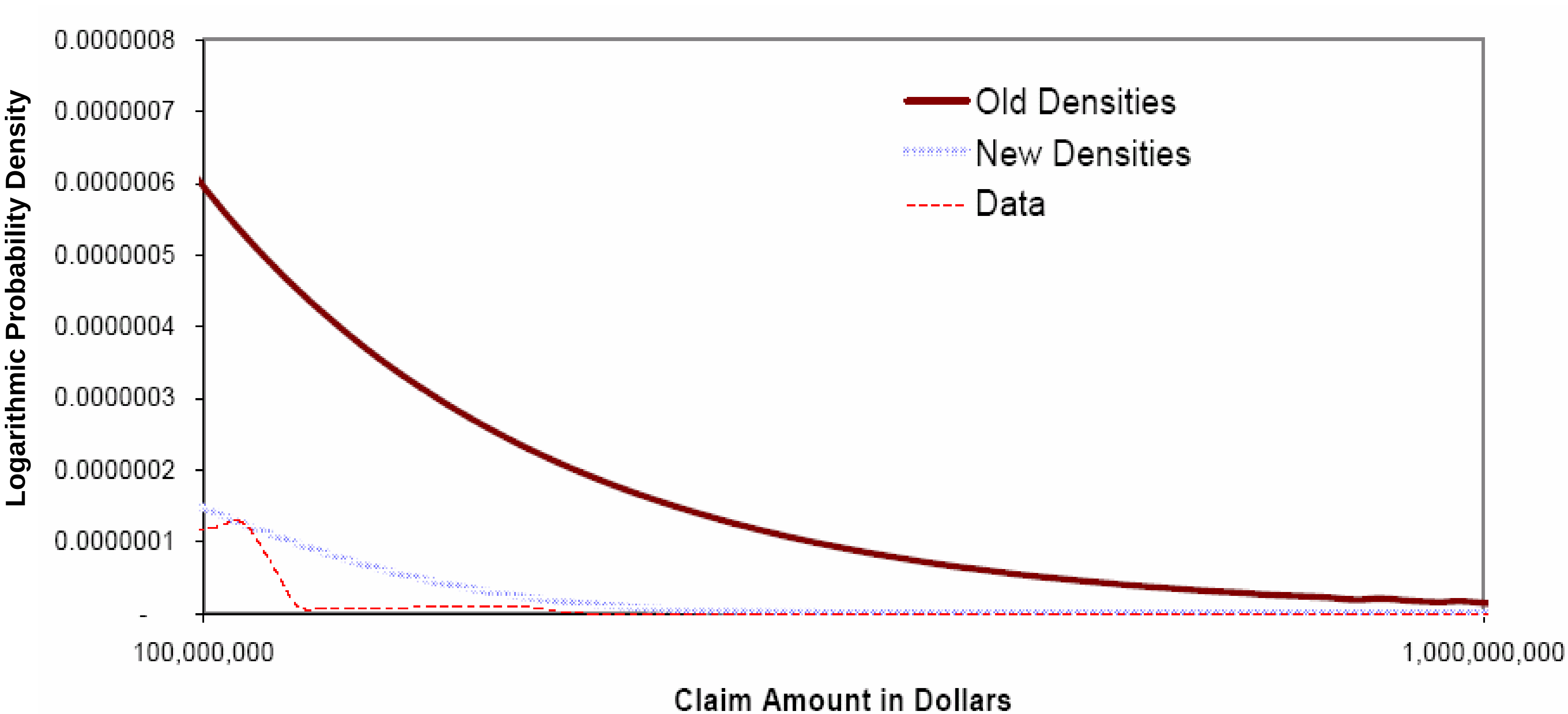


Comparison of Countrywide Distributions



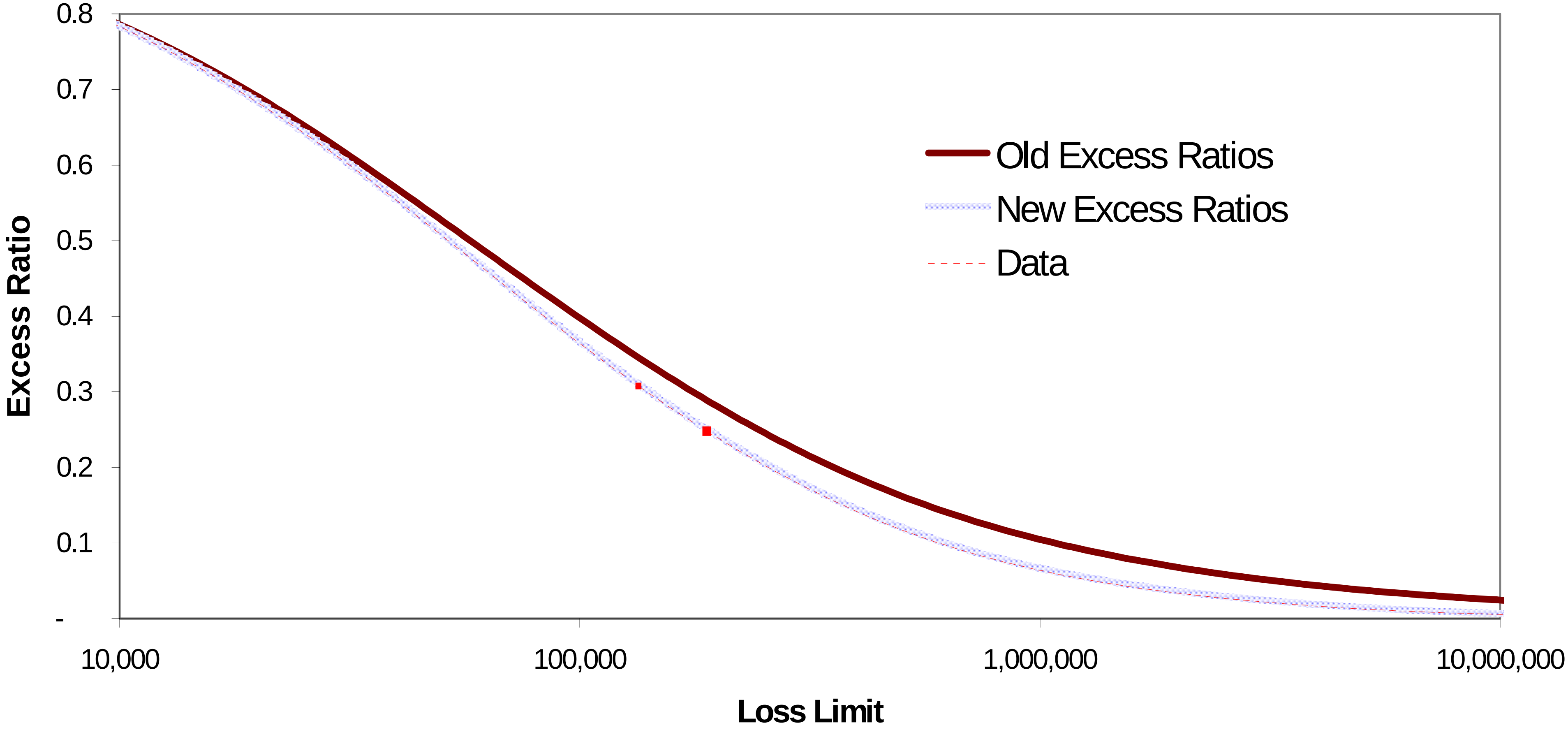
Comparison of Countrywide Distributions



Reasons for Improved Fit

- Empirical distribution used for small claims
- Mixed exponential fit to tail

Comparison of Countrywide Excess Ratios



Individual Claim Development

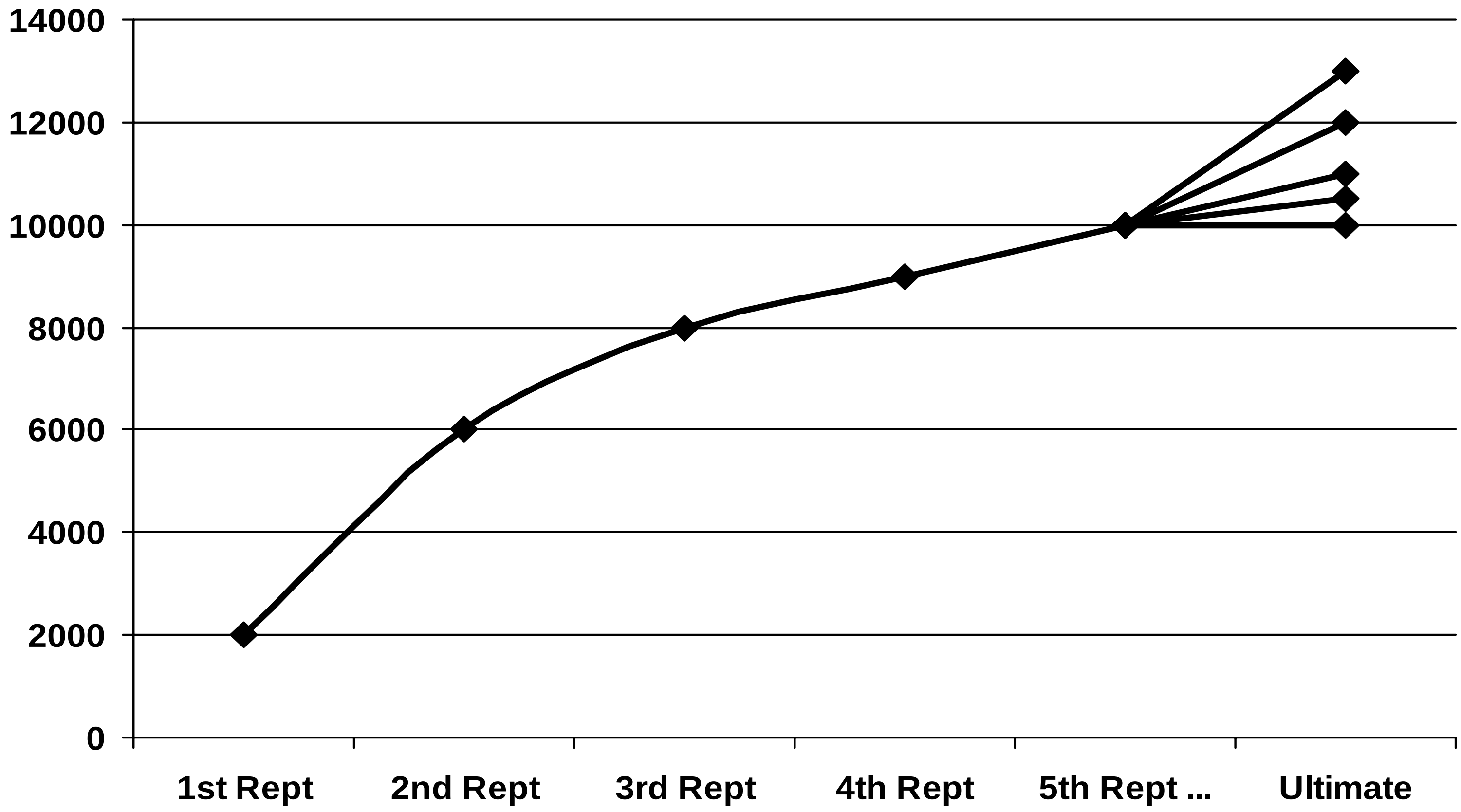
It is generally recognized that claims do not develop uniformly:

		uniform		nonuniform	
claim no.	**5th report**	**development**	**xs 125,000**	**development**	**xs 125,000**
1	100,000	125,000	0	150,000	25,000
2	100,000	125,000	0	100,000	0
3	100,000	125,000	0	95,000	0
4	100,000	125,000	0	155,000	30,000
	400,000	500,000	0	500,000	55,000

Individual Claim Development

- Fit a distribution to 5th report to ultimate LDFs
- For each claim at 5th report choose 173 LDFs to get 173 scenarios for ultimate loss
- This smoothes the data considerably

Discrete Approach



Individual Claim Development

- Basically follow Gillam and Couret
- Know average LDF from ratemaking
- Used survival analysis to estimate CV of LDF distribution
- Used a discrete approach rather than continuous

Survival Analysis

- Origin: Model survival time of individuals on medical trials
- Interpret claim closure as “failure” or “death”
- Interpret incurred to date as “age” of claim
- Calculate survival function regarding open claims as right censored

Survival Analysis

Basic idea:

- Use all the data
- Can’t observe how long each patient will survive
- Can’t wait for all claims to close to get ultimate development

Survival Analysis

Advantages:

- Properly accounts for individual claim development
- Makes use of immature loss data
- Well accepted approach for handling censored data

Disadvantages:

- Requires individual claim loss data
- Need representative sample of large closed claims
- Assumes no development on closed claims
- No relationship with aggregate age to age LDFs

Survival Analysis
PROC LIFEREG

- log LDF = $\beta_0+\beta_1 x_1+\cdots+\beta_n x_n+\sigma\varepsilon$
- $\beta_0, \beta_1, \ldots, \beta_n, \sigma$ parameters to be fit
- $x_1, x_2, \ldots, x_n$ are covariates
- ε is error term
- Various choices for distribution of ε

Survival Analysis
PROC LIFEREG

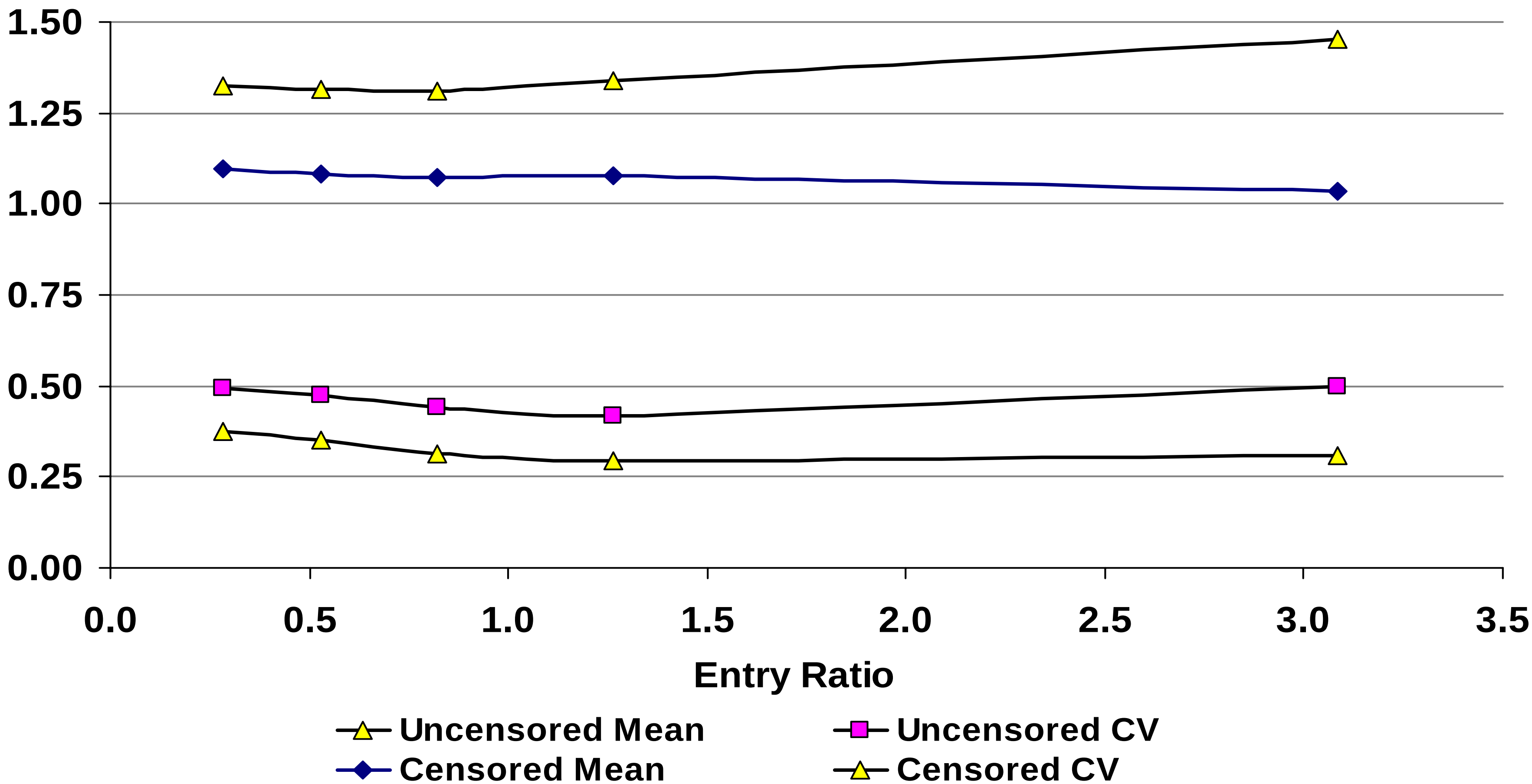
Choices for LDF distribution:

- Weibull
- Exponential
- Generalized gamma
- Loglogistic
- Lognormal

PROC LIFEREG
Data

- DCI data
- AY 1993-97 at 5th report
- Injury type breakdown:
  - 603 PTs
  - 6,235 PPs

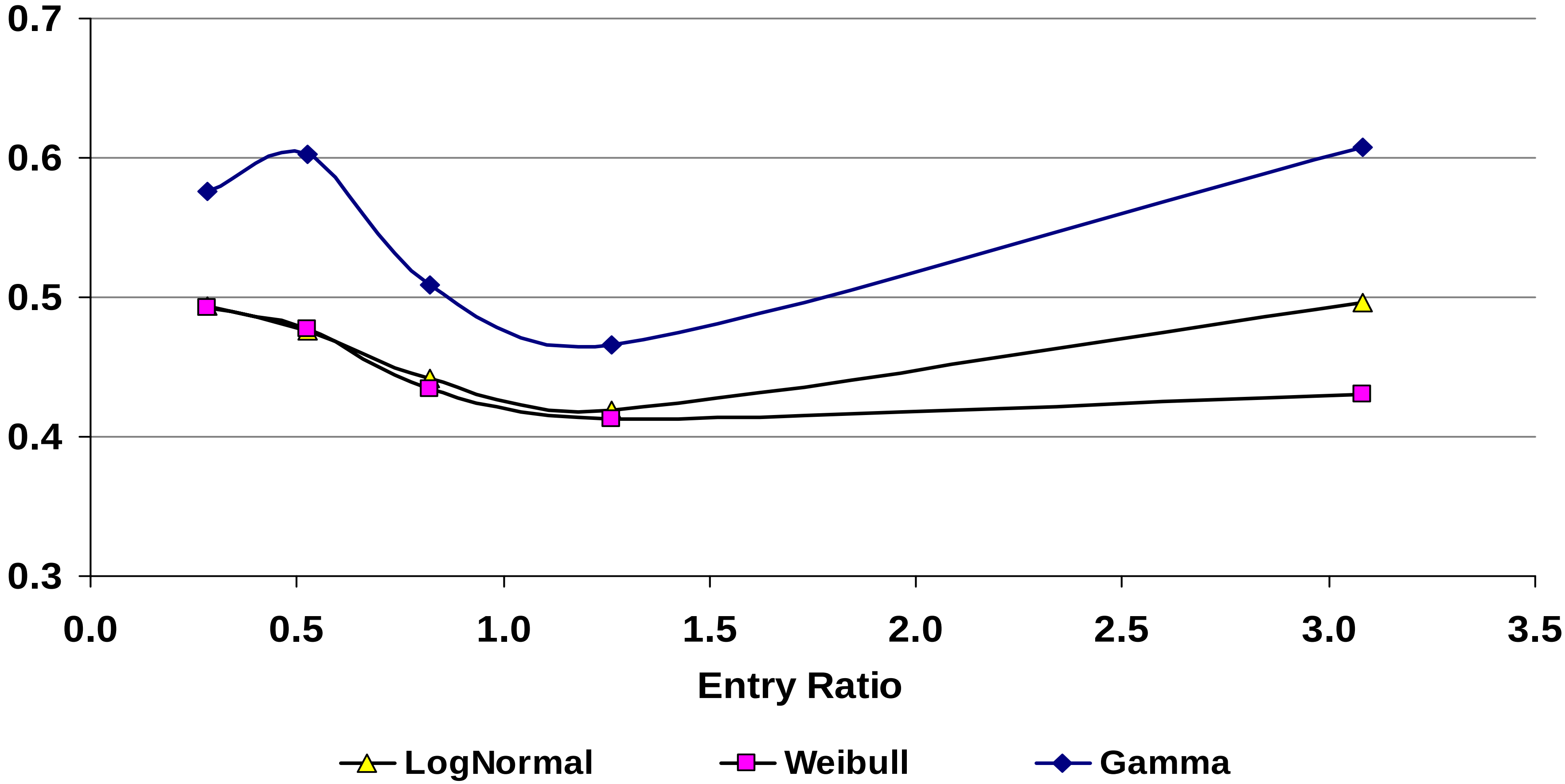
Effect of Censoring
Lognormal Distribution



Note: Each point represents a quintile by claim count

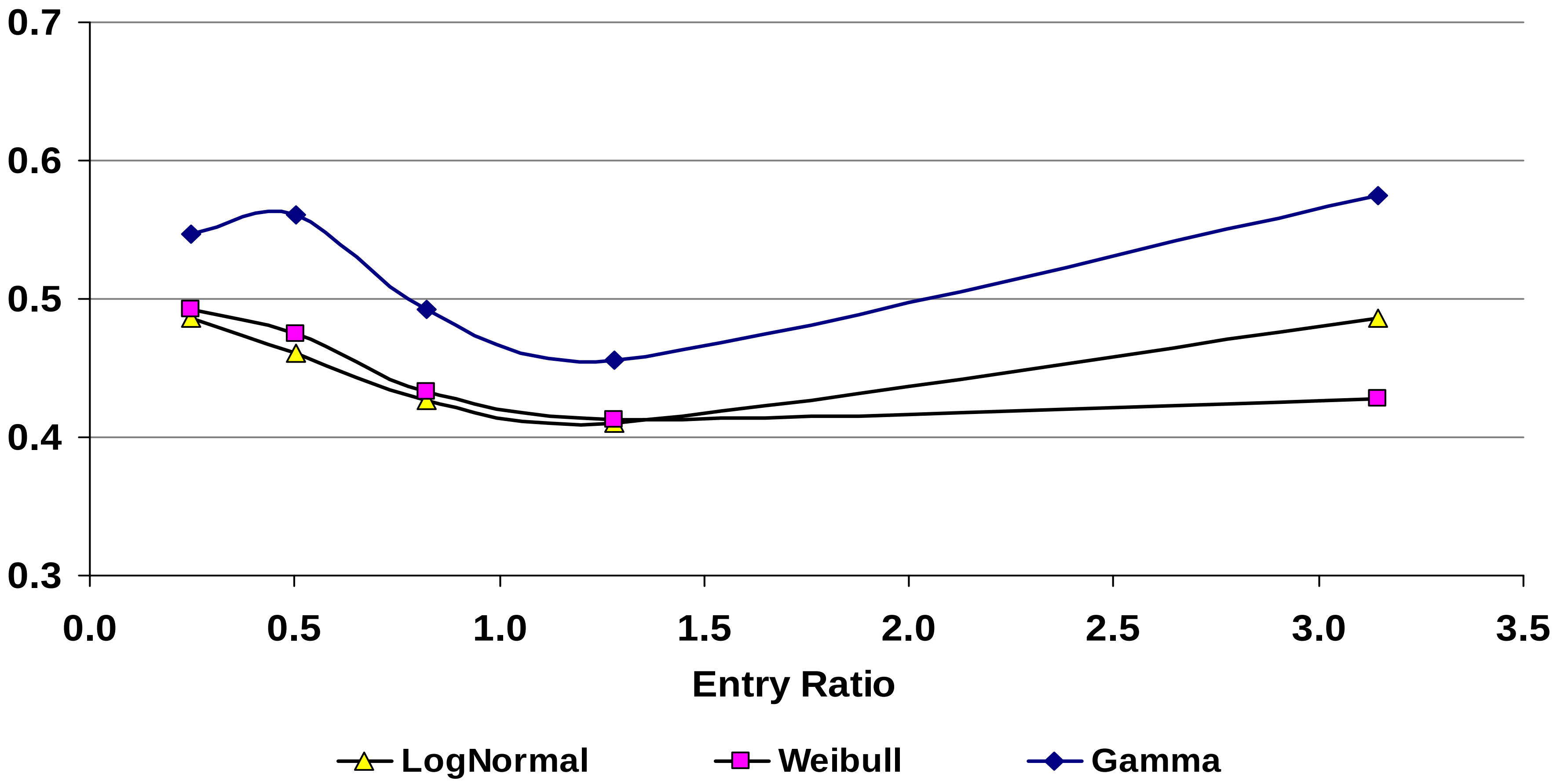
Individual Claim Development

LDF CV



Note: Each point represents a quintile by claim count

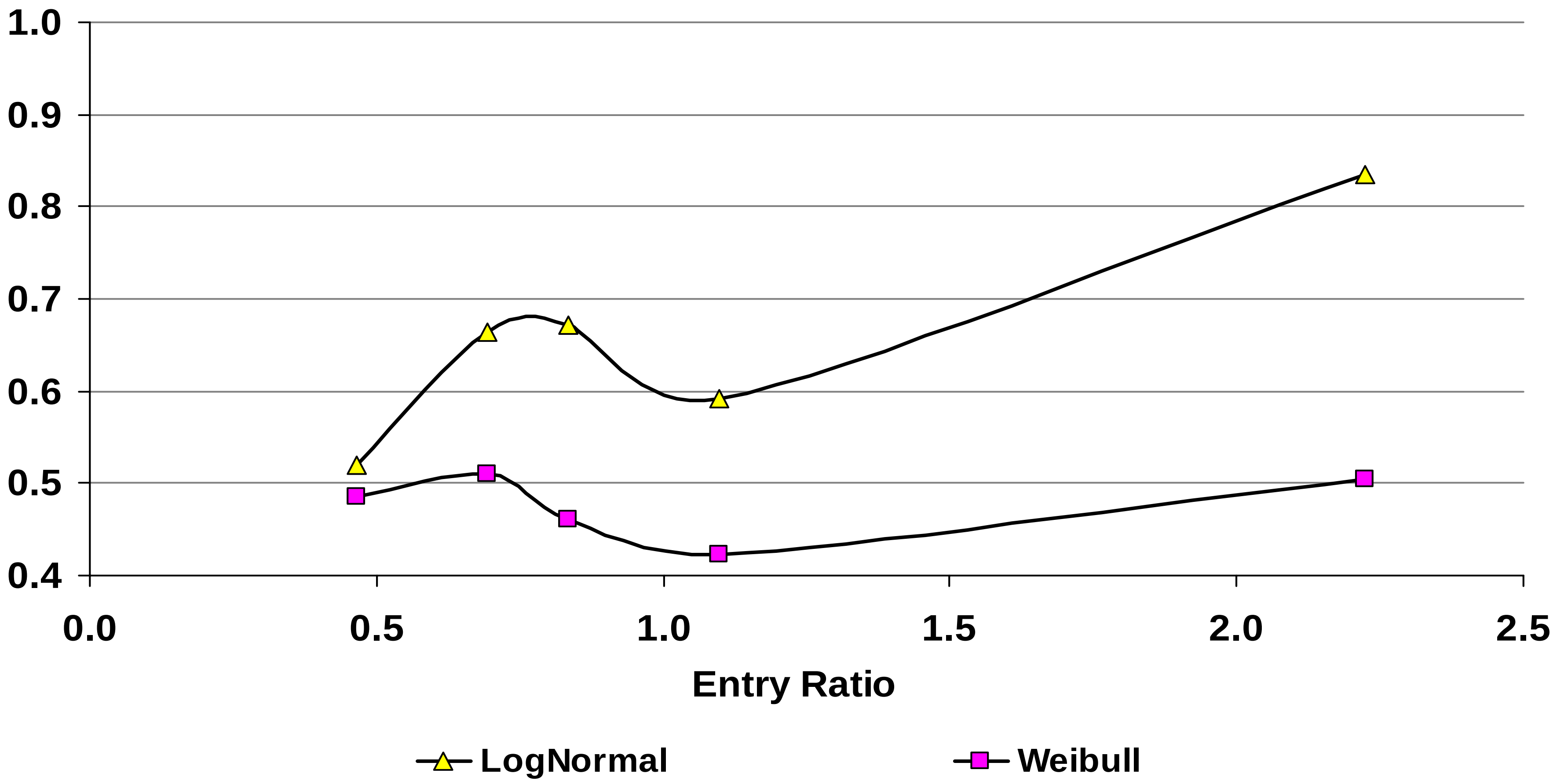
Individual Claim Development
LDF CV for PPD



Note: Each point represents a quintile by claim count

Individual Claim Development

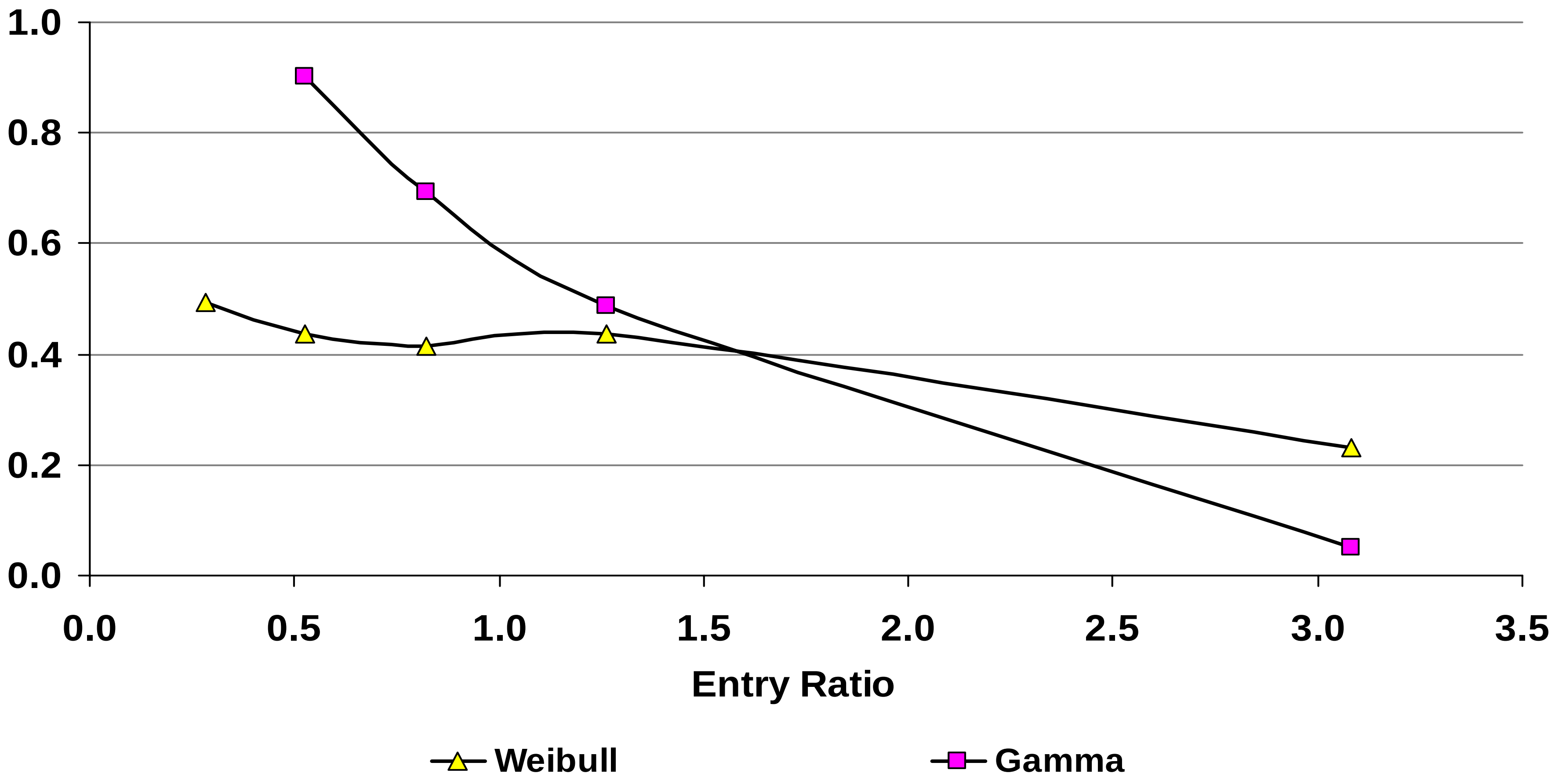
LDF CV for PTD



Note: Each point represents a quintile by claim count

Individual Claim Development

VolDB LDF CV



Note: Each point represents a quintile by claim count

Change in Dispersion CV

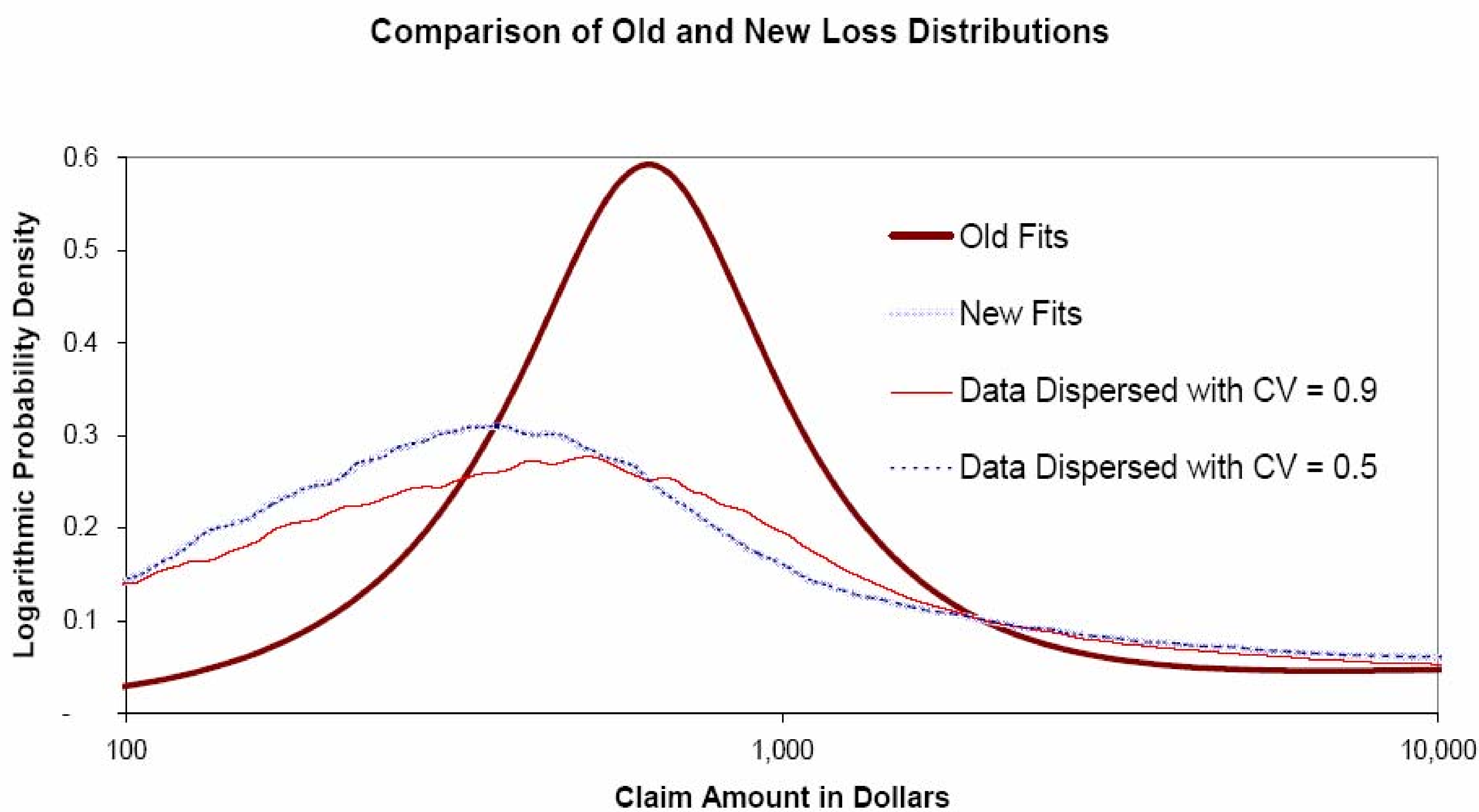
- Inverse Gamma used for distribution of LDFs as before.
- Lowered CV from .9 to .5.

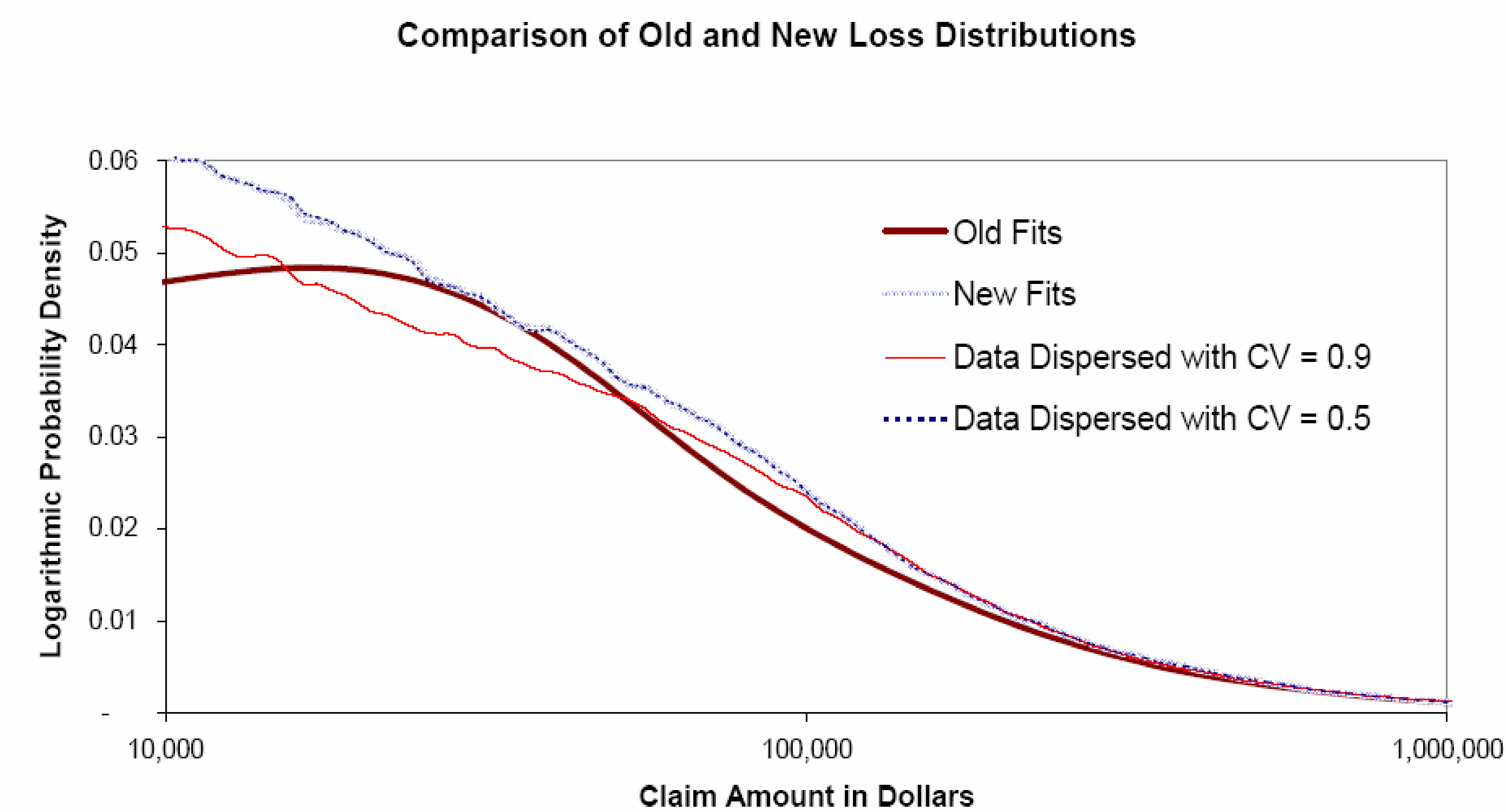
Impact on ELFs

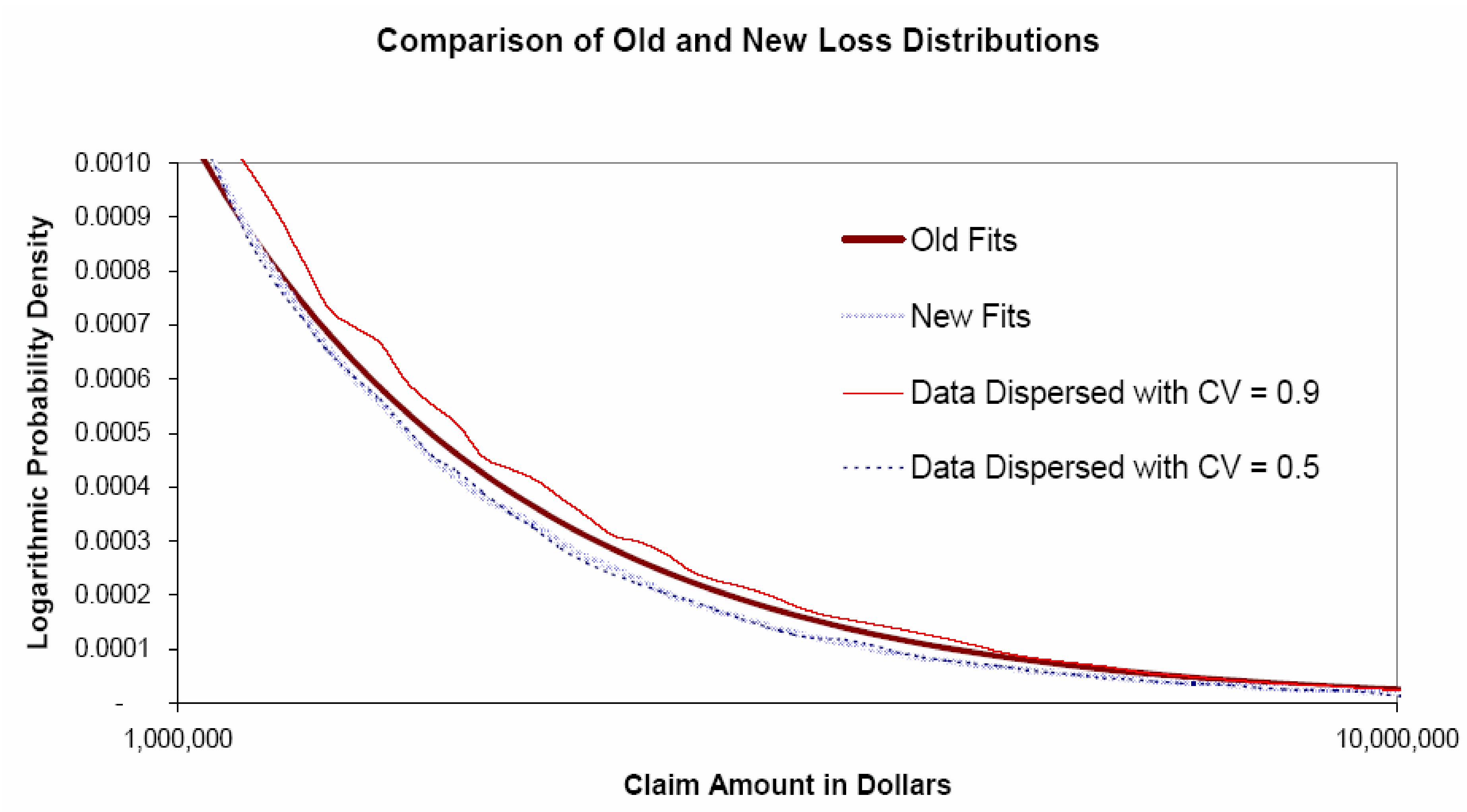
- Noticeable but partial explanation of general decline in ELFs
- Less relevant at the highest loss limits.

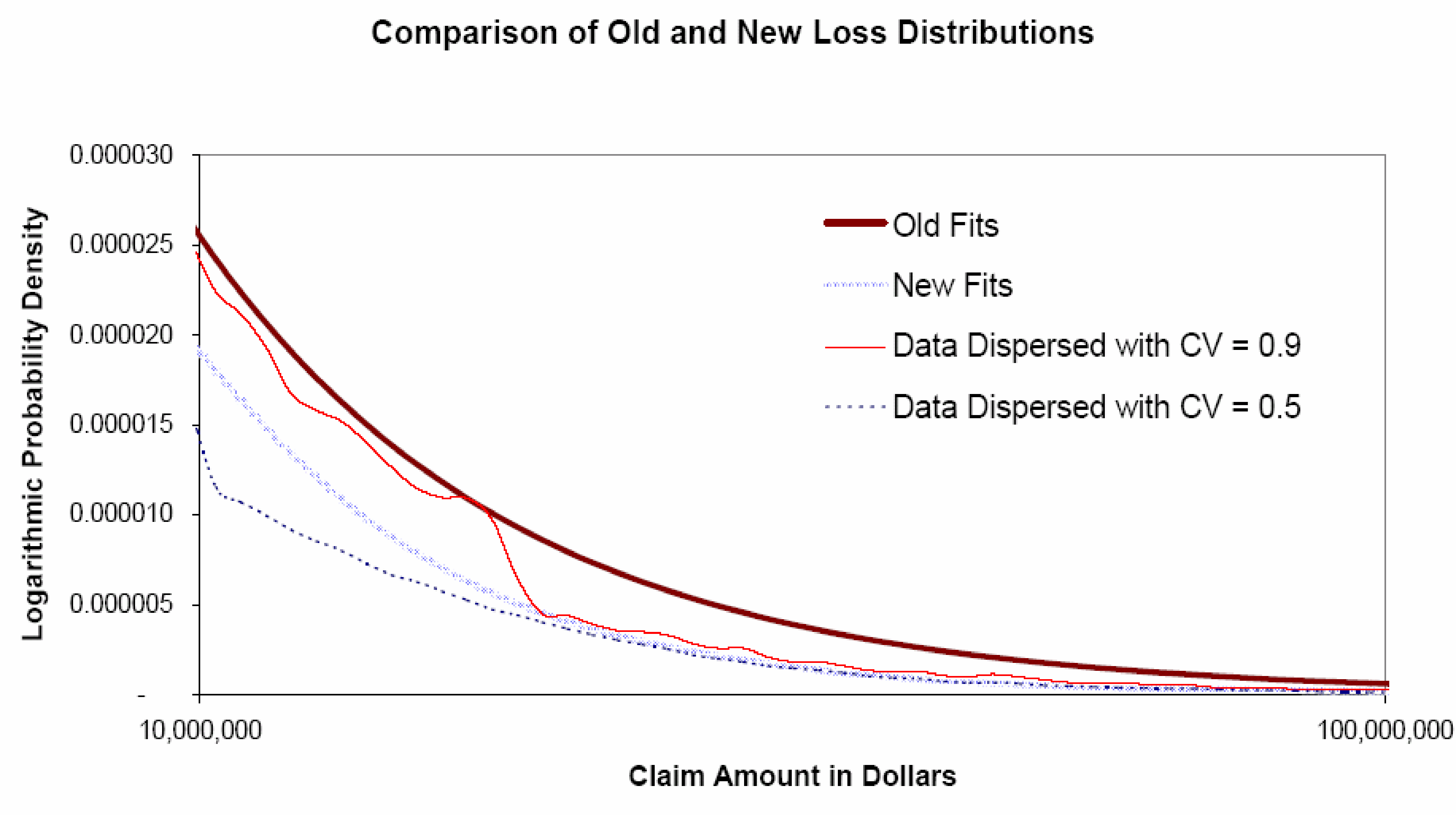
Current Excess Ratios as a Percentage of Prior Excess Ratios

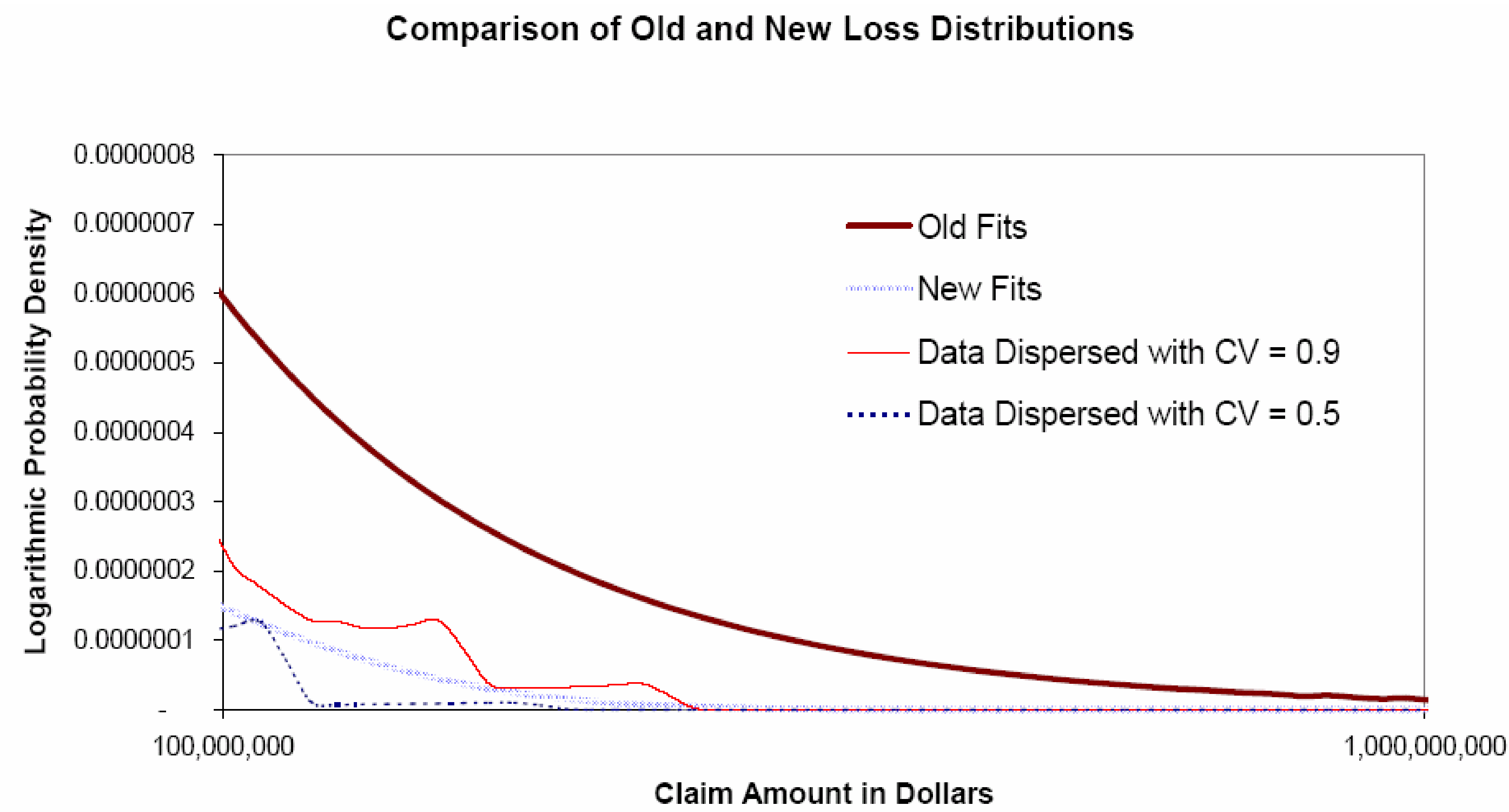
	Dispersion CV	
Loss Limit	**0.5**	**0.9**
0	100%	100%
1,000,000	68%	82%
5,000,000	41%	56%
10,000,000	28%	43%


Comparison of Old and New Loss Distributions
Logarithmic Probability Density
0.6
0.5
0.4
0.3
0.2
0.1
-
100
1,000
10,000
Claim Amount in Dollars
Old Fits
New Fits
Data Dispersed with CV = 0.9
Data Dispersed with CV = 0.5


Comparison of Old and New Loss Distributions
Logarithmic Probability Density
0.06
0.05
0.04
0.03
0.02
0.01
-
Old Fits
New Fits
Data Dispersed with CV = 0.9
Data Dispersed with CV = 0.5
10,000
100,000
1,000,000
Claim Amount in Dollars


Comparison of Old and New Loss Distributions
Logarithmic Probability Density
0.0010
0.0009
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
-
1,000,000
10,000,000
Claim Amount in Dollars
Old Fits
New Fits
Data Dispersed with CV = 0.9
Data Dispersed with CV = 0.5


Comparison of Old and New Loss Distributions
Logarithmic Probability Density
0.000030
0.000025
0.000020
0.000015
0.000010
0.000005
-
10,000,000
100,000,000
Claim Amount in Dollars
Old Fits
New Fits
Data Dispersed with CV = 0.9
Data Dispersed with CV = 0.5



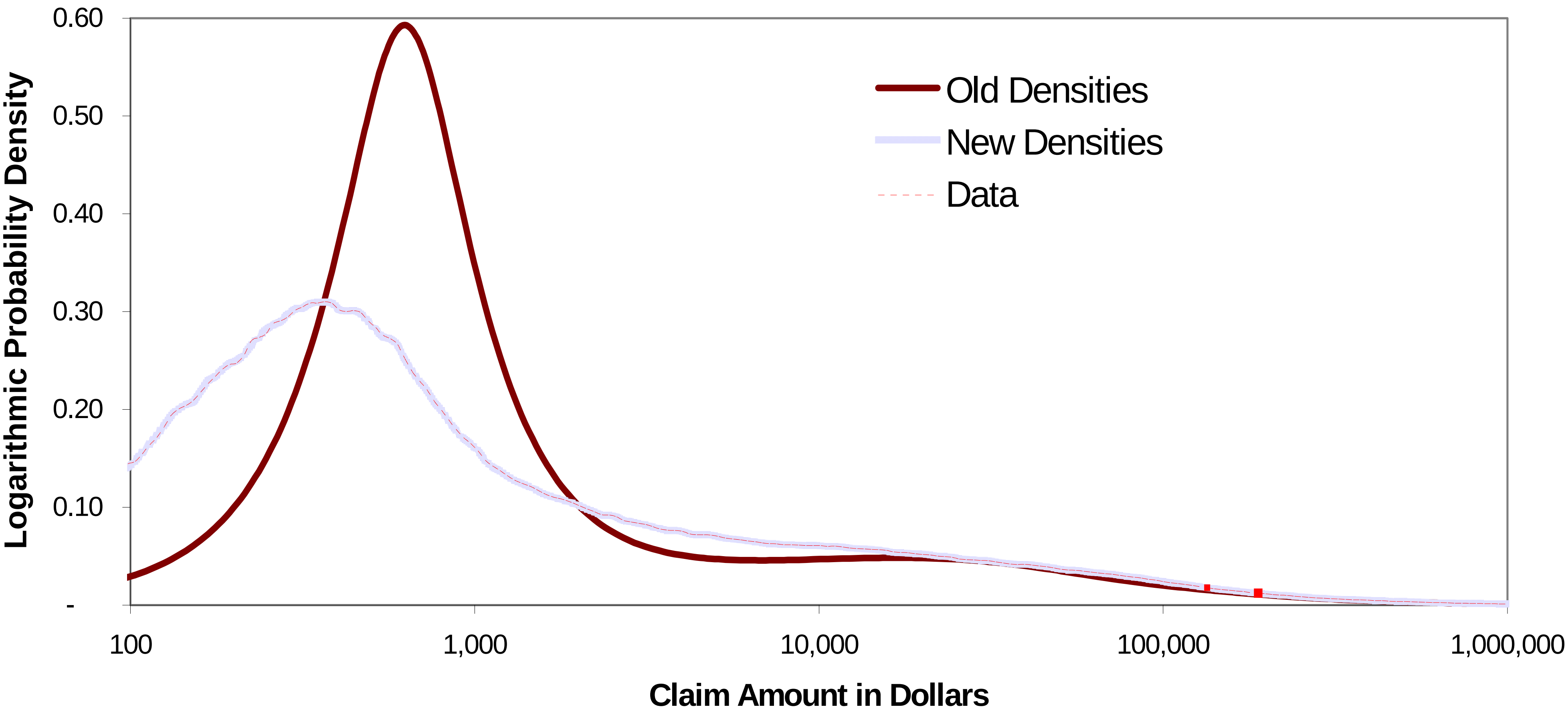
Comparison of Old and New Loss Distributions
0.0000008
0.0000007
0.0000006
0.0000005
0.0000004
0.0000003
0.0000002
0.0000001
-
Logarithmic Probability Density
Old Fits
New Fits
Data Dispersed with CV = 0.9
Data Dispersed with CV = 0.5
100,000,000
1,000,000,000
Claim Amount in Dollars

Impact of the Tail

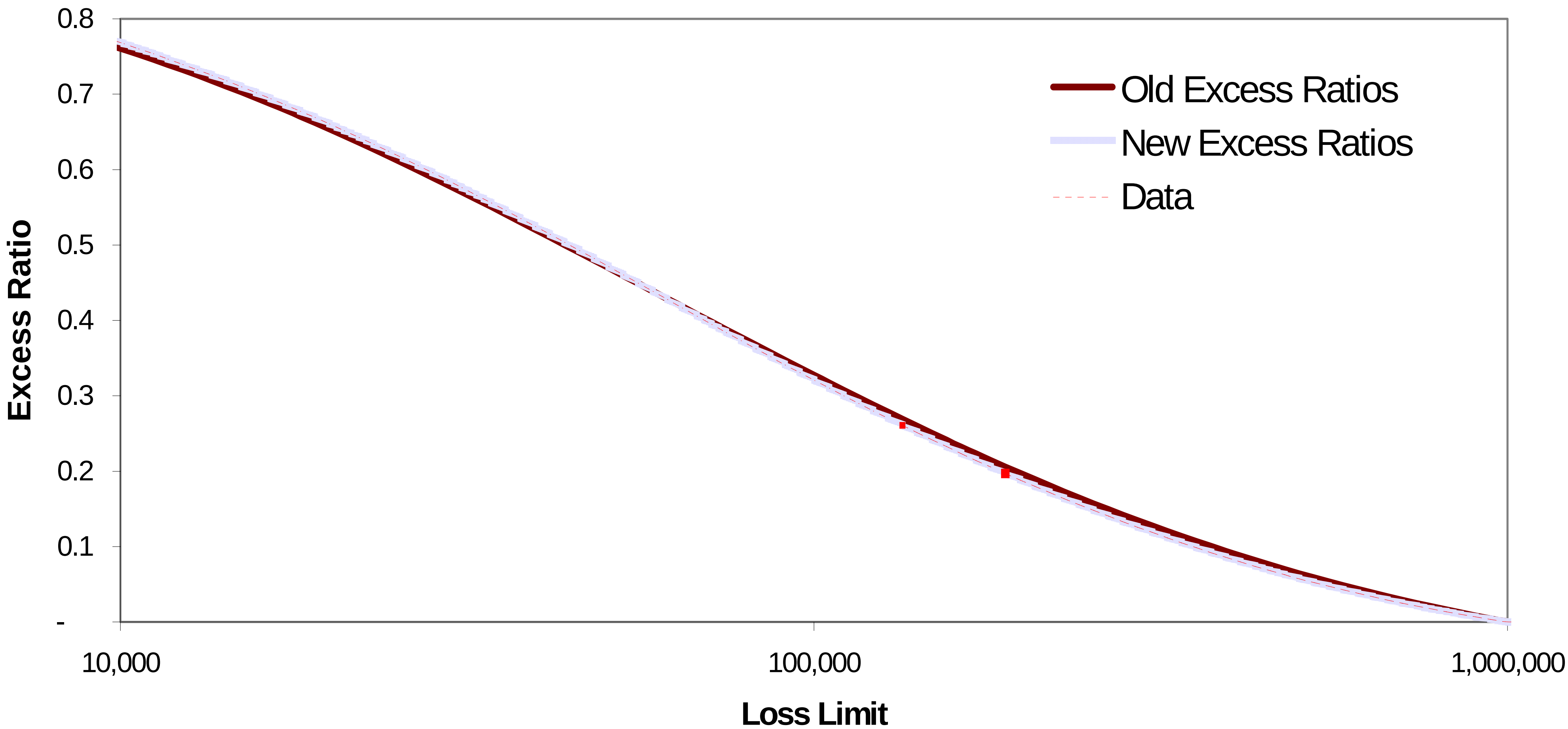
- Portion of change in ELFs due to tail assumptions

- We truncated at $1M and looked at the conditional densities

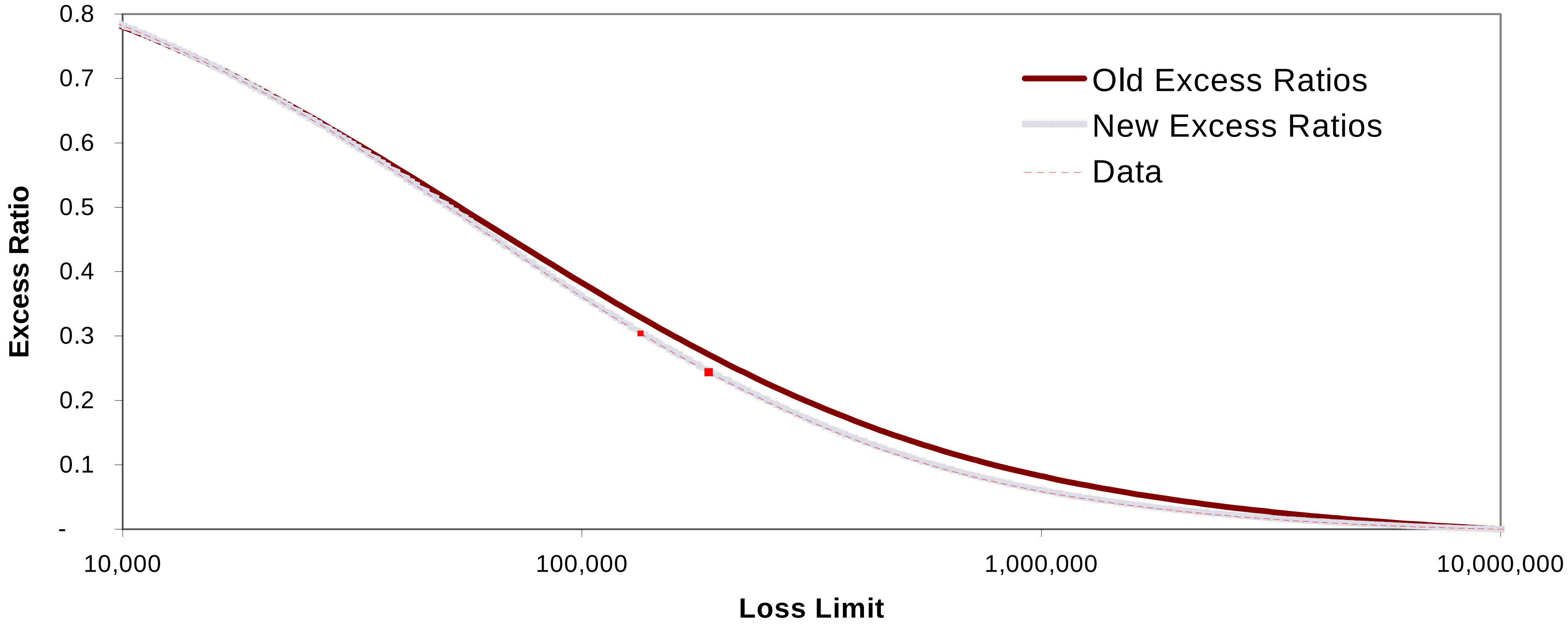
Comparison of Countrywide Truncated Densities



Excess Ratios of Countrywide Truncated Densities



Excess Ratios of Truncated Densities Truncated at $10M



Impact of the Tail

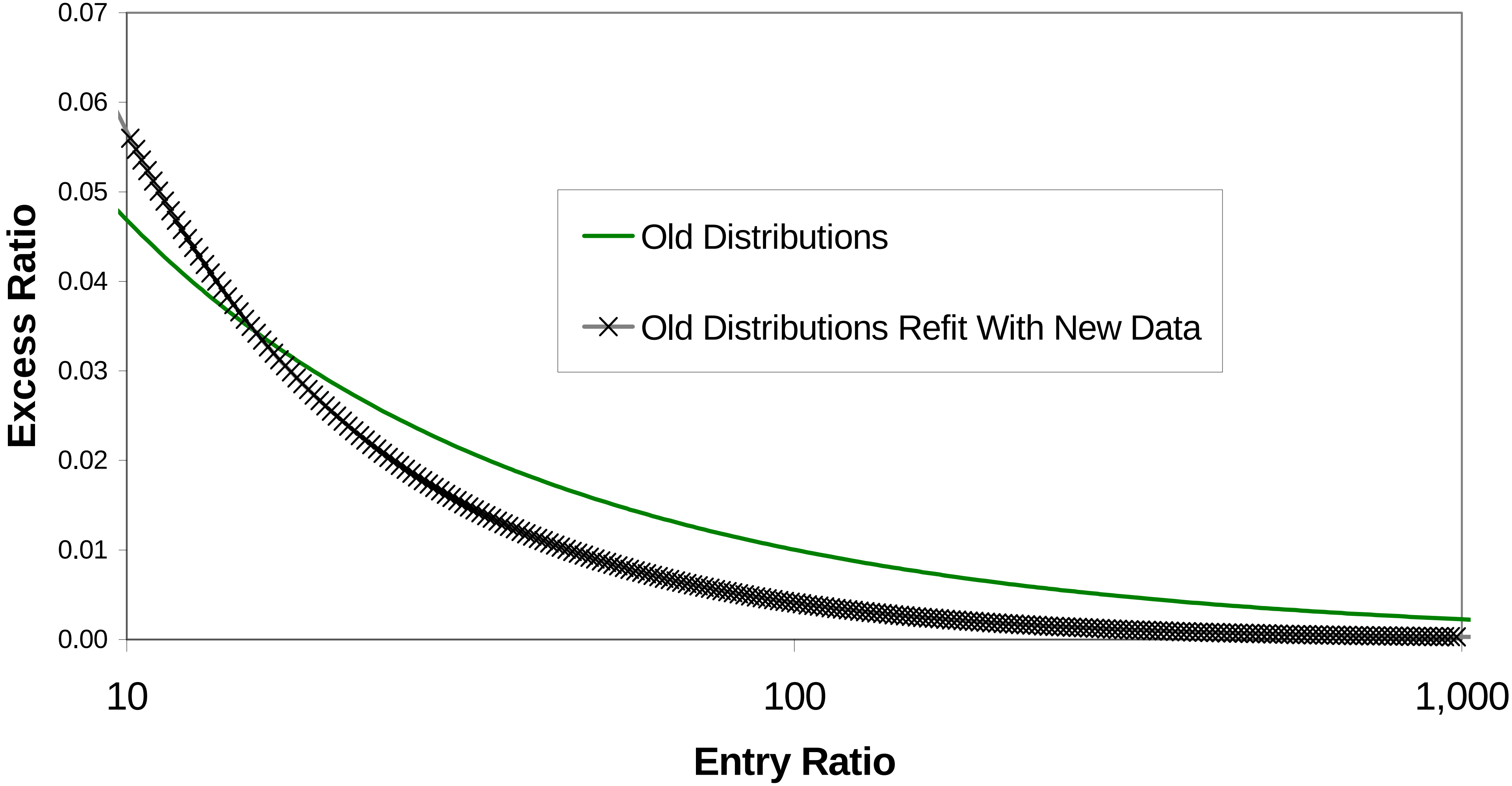
Difference between Prior ELFs and Current ELFs

	Loss Limit		
	$100,000	**$500,000**	**$1,000,000**
Uncensored	0.031	0.042	0.038
Censored at $10 Million	0.020	0.026	0.022
Censored at $1 Million	0.006	0.006	0.000

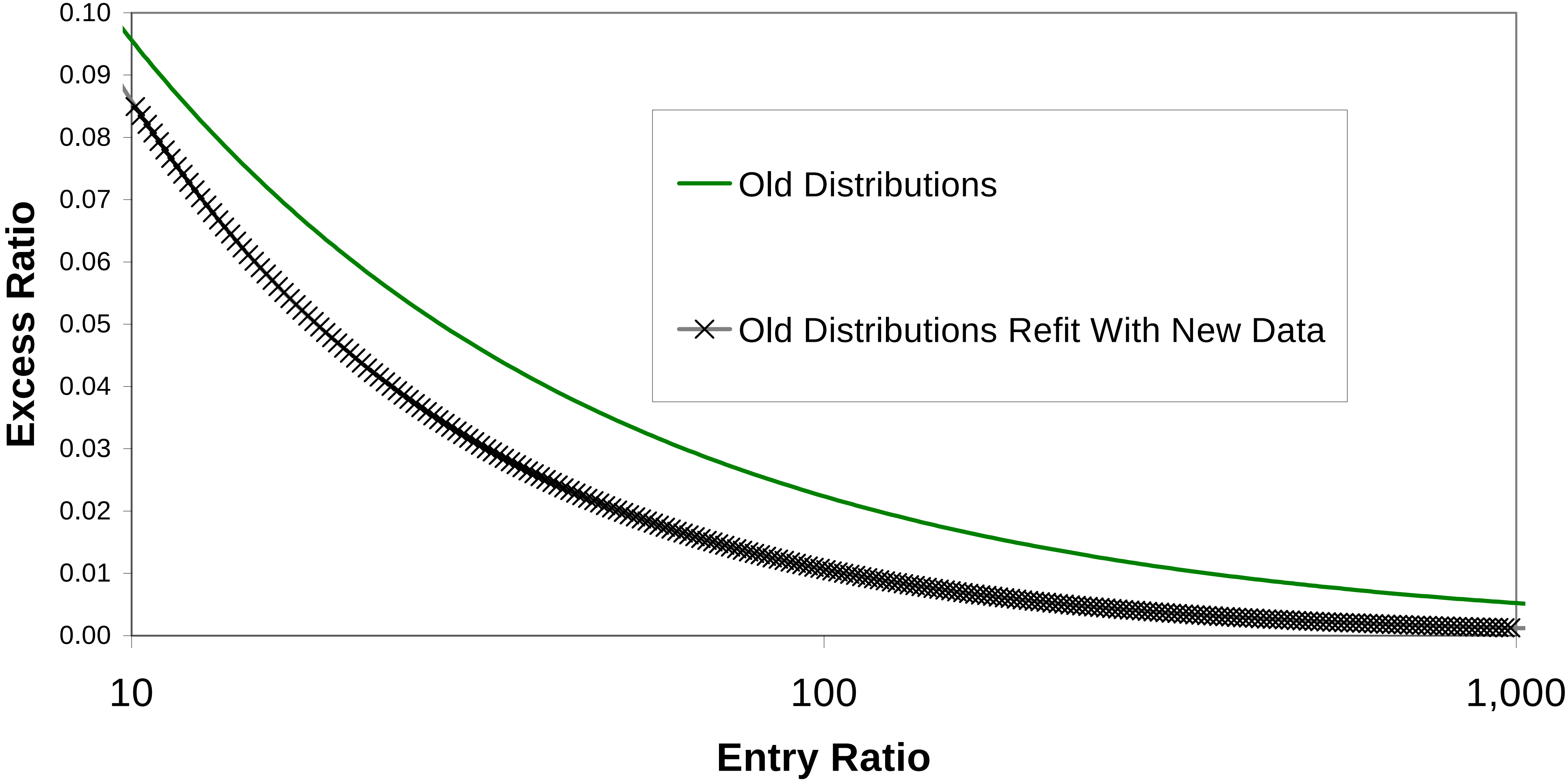
Distributional Assumptions

- Old distributions were transformed betas
- New distributions are empirical with mixed exponential tail
- Impact of choice of distribution on ELFs
- We refit old distributions to the new data

Countrywide Excess Ratios for Fatal Claims



Countrywide Excess Ratios for PT Claims



Countrywide Excess Ratios for PP Claims