The Biggest Problem with Your Pricing Model is Your Reserving Model

Southwest Actuarial Forum

June 3rd

Presenter: Chris Gross

CIG Capital Insurance Group DELIVERS MORE. Continuously.™

Gross Consulting

The Pricing Problem

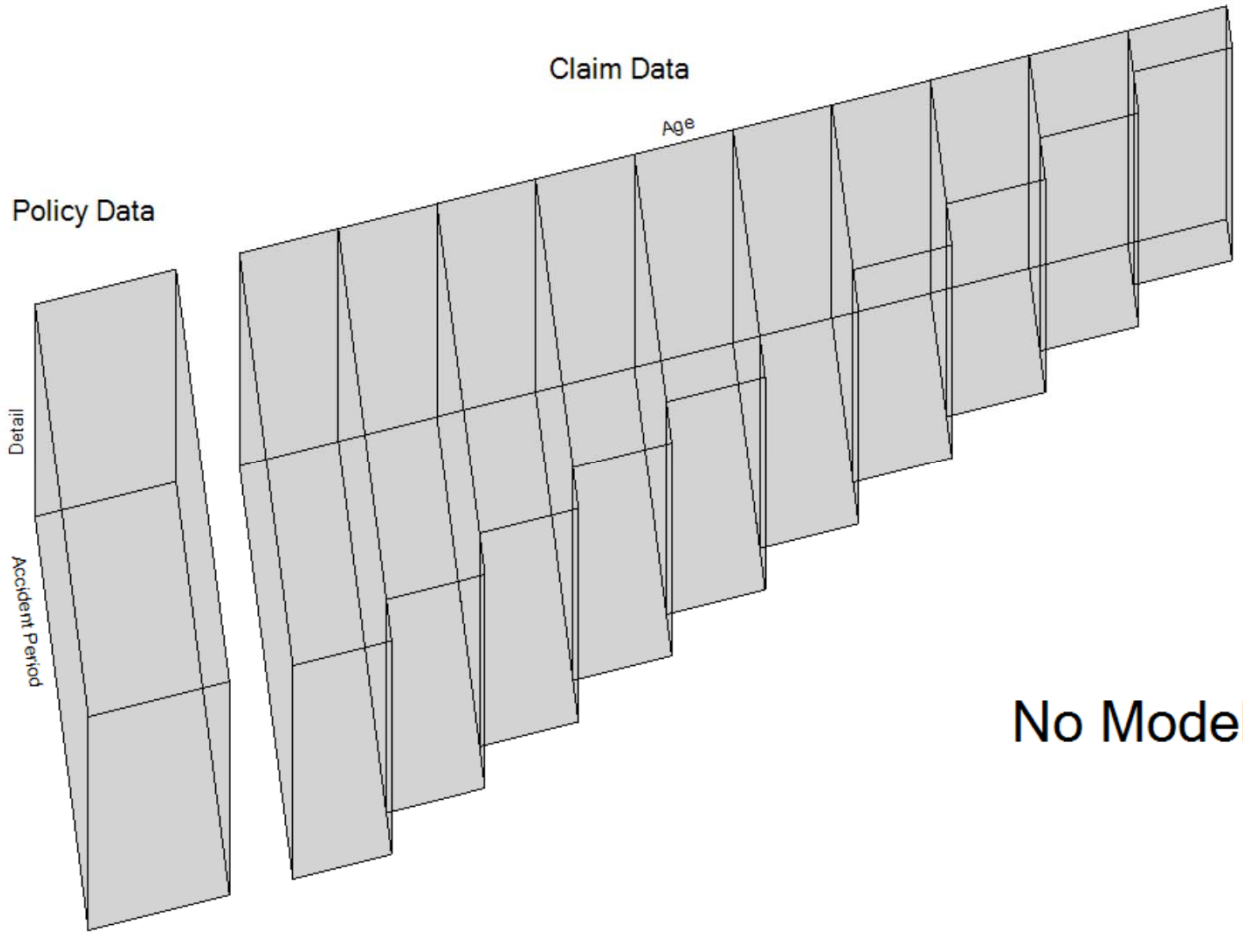
- Estimate discounted value of ultimate claim costs and expenses
- Estimate differences across available rating characteristics

The (incomplete) Solution

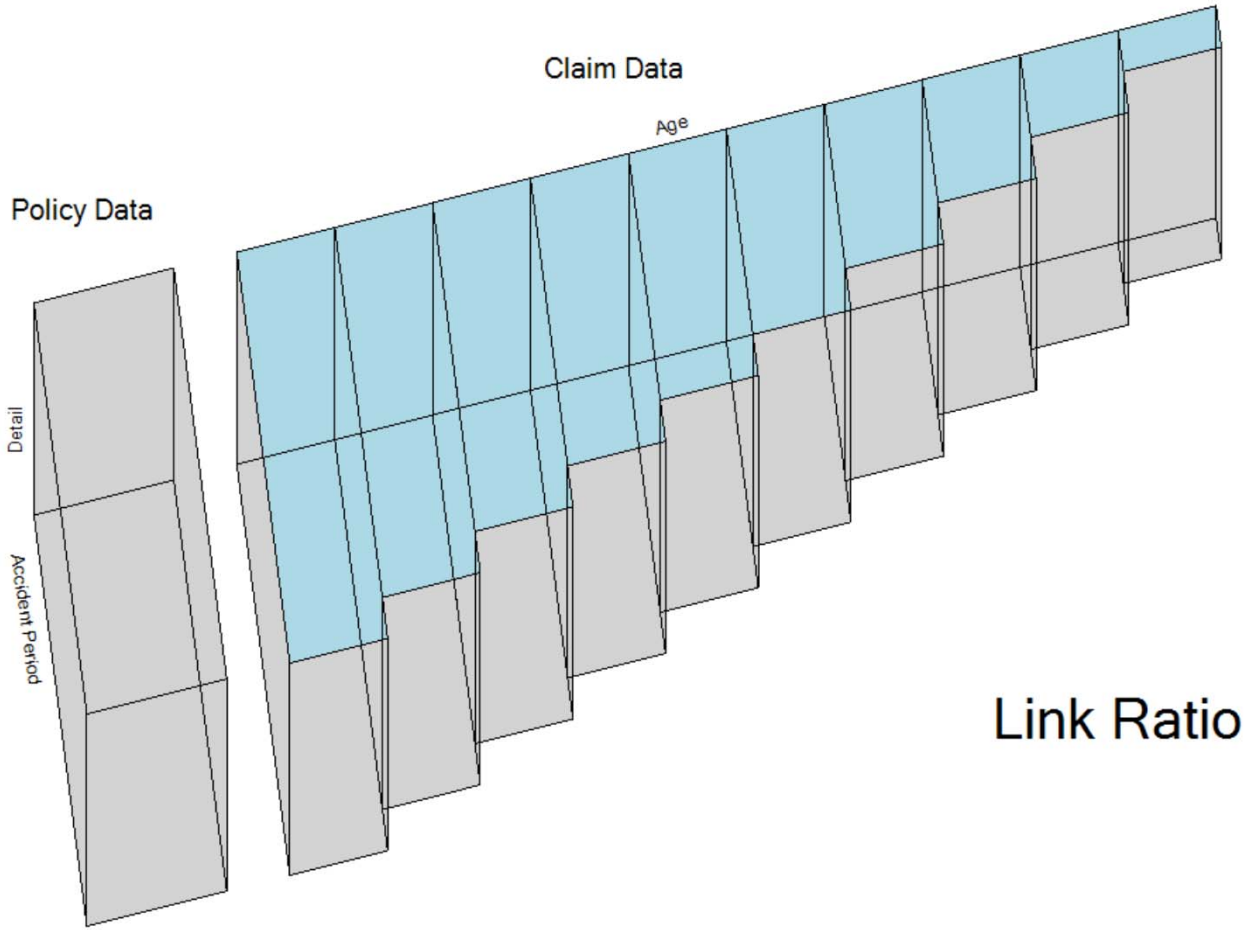
- Build models based on the current diagonal only
- Build models based on a common age of development

(incomplete) Treatment of Loss Development

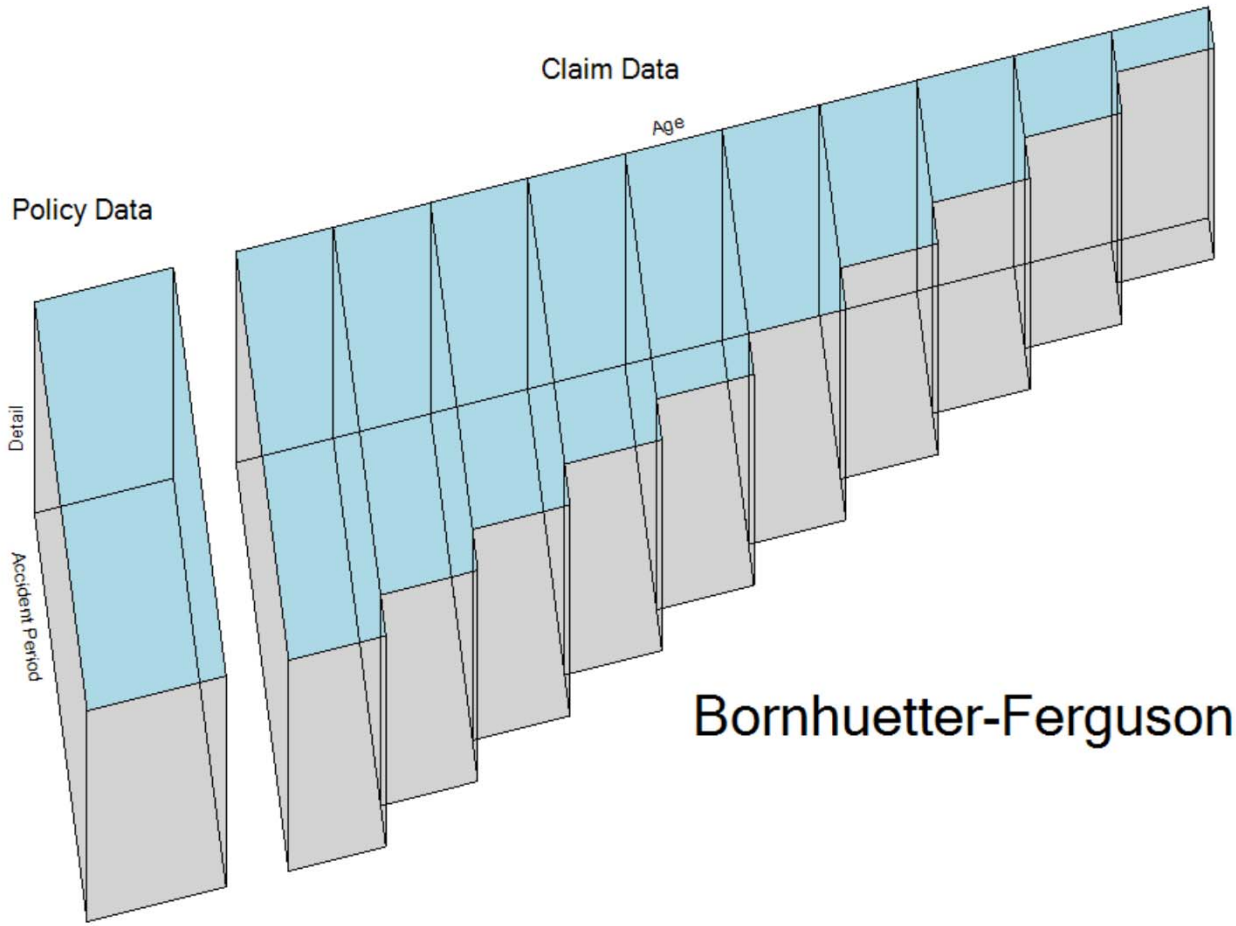
- Develop all losses with a factors based on age
- Reduce premium/exposure based on age
- Include policy effective date as a variable
- Only use the process to rank policies
- **Generally assumes all development is the same (wrong!)**



No Model



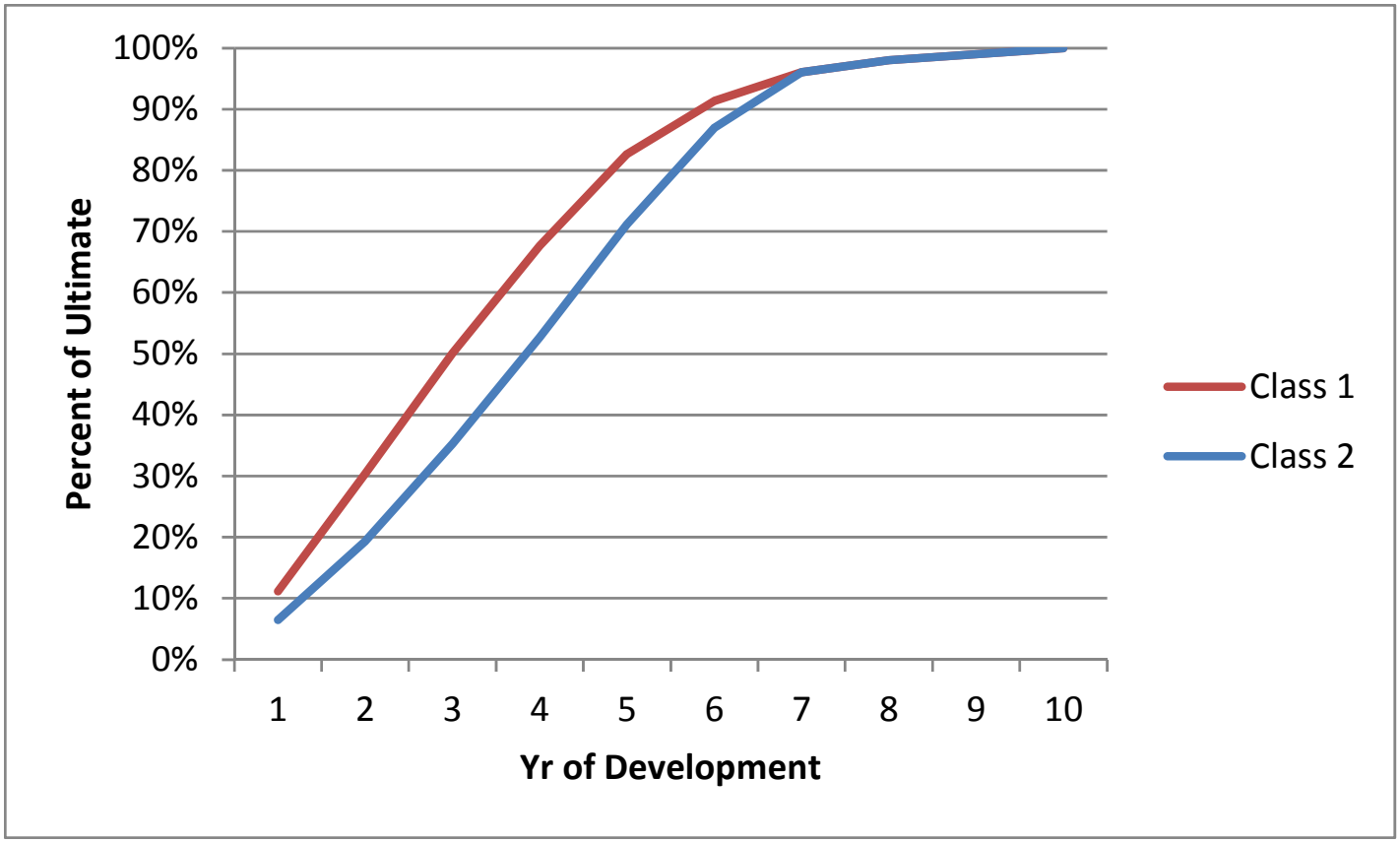
Link Ratio


Claim Data
Age
Policy Data
Detail
Accident Period
Bornhuetter-Ferguson

The Mix Problem… An Example

- Two classes of business
  - Class 1.
    - Faster developing
    - Lower ultimate loss ratio (60%)
  - Class 2
    - Slower developing
    - Higher ultimate loss ratio (90%)
- Class 2 has always been there, but only recently started growing significantly

Different Development



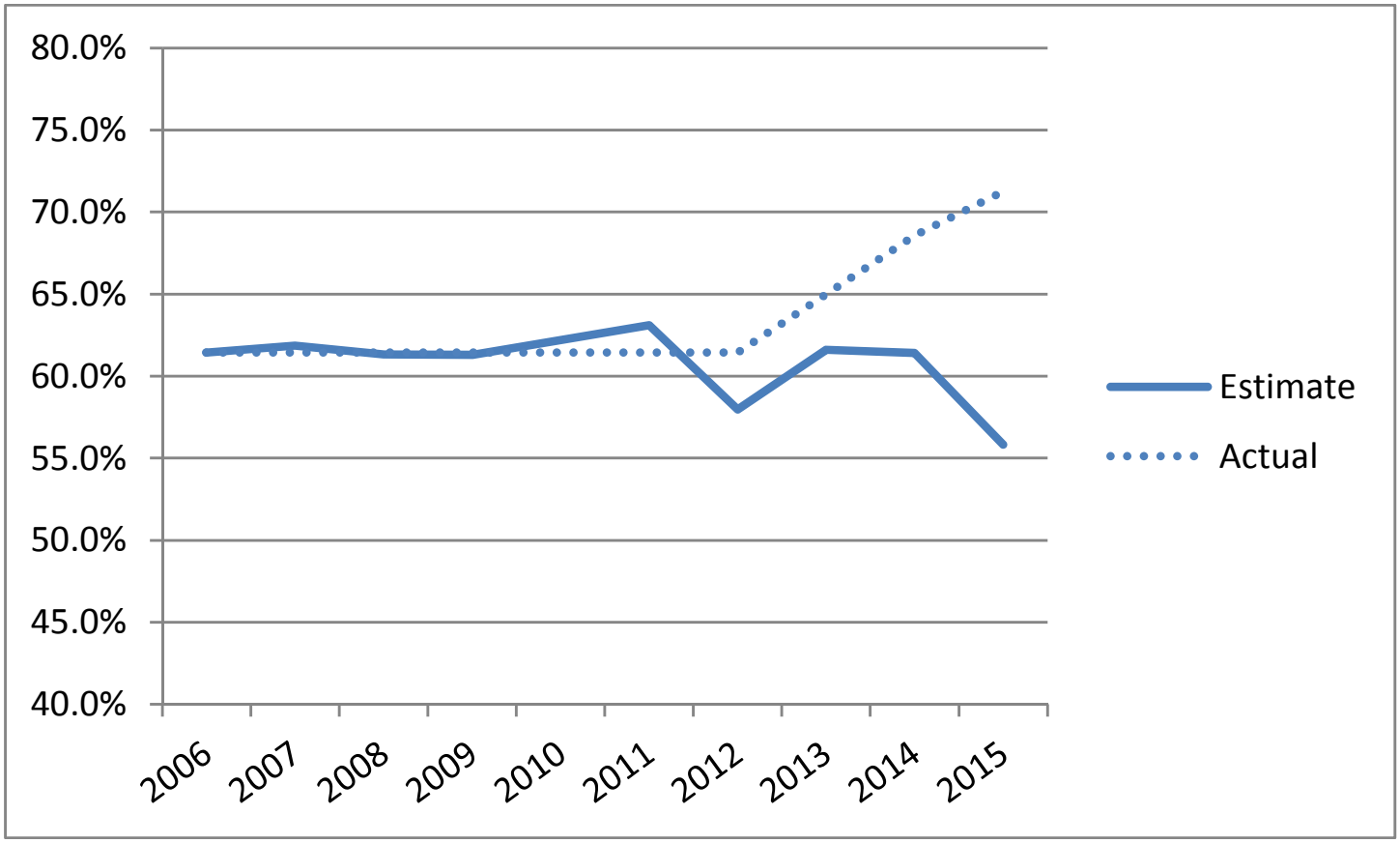
The Triangle

		Loss as of:									
Year	Premium	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10
2006	105	7.53	20.40	32.67	43.49	52.72	58.08	61.20	62.36	63.28	64.50
2007	105	8.06	20.72	32.65	43.52	54.68	60.16	63.87	64.15	63.71	
2008	105	6.48	19.23	30.80	42.47	52.70	58.32	60.99	62.91		
2009	105	7.21	19.21	30.81	42.44	52.93	59.64	61.78			
2010	105	7.43	21.88	34.36	43.89	53.76	59.81				
2011	105	6.76	19.19	33.07	43.90	54.42					
2012	105	7.11	18.49	30.01	40.40						
2013	120	8.44	22.18	37.25							
2014	140	8.65	25.87								
2015	160	9.81									

Development Factors

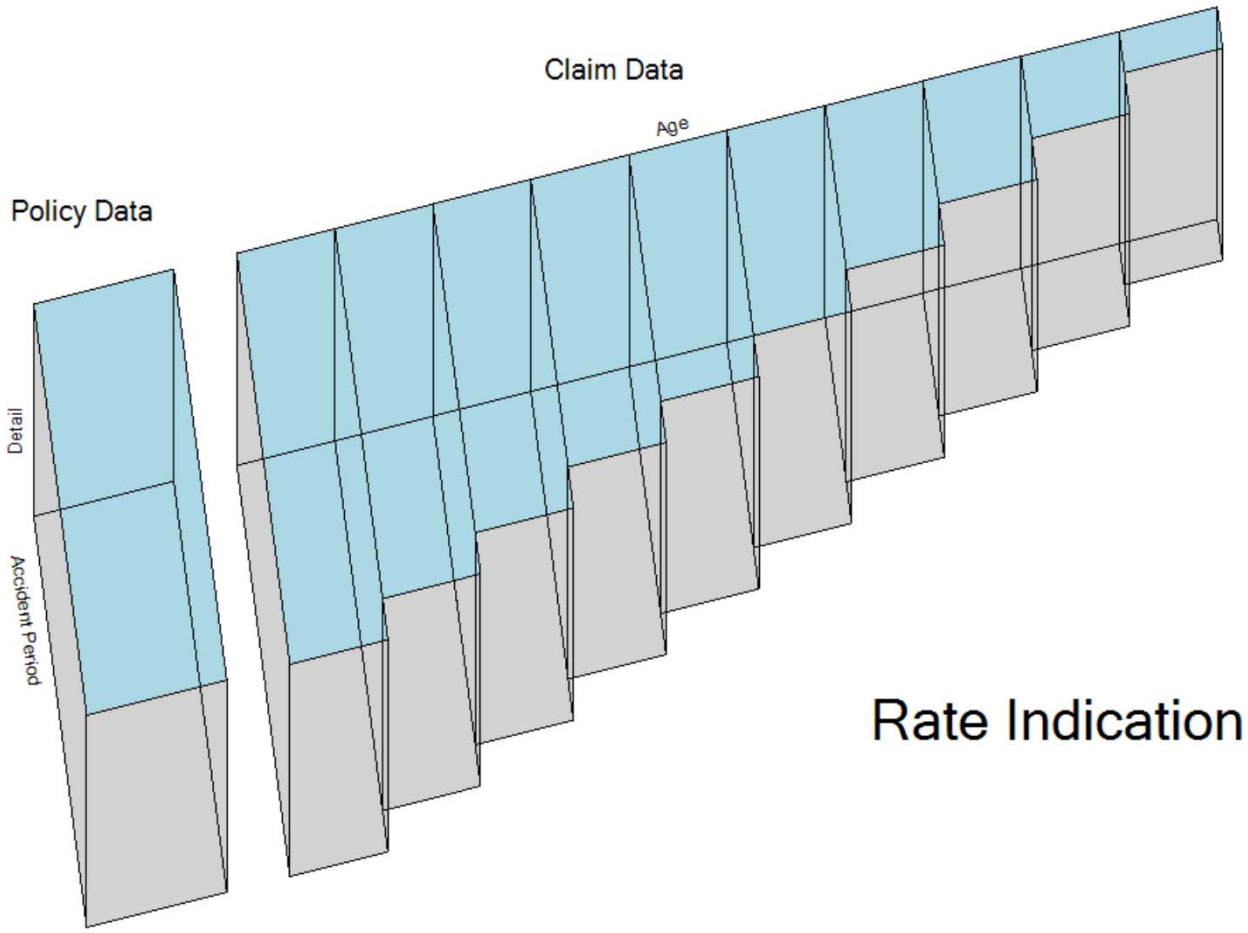
2006	2.709	1.602	1.331	1.212	1.102	1.054	1.019	1.015	1.019
2007	2.571	1.576	1.333	1.256	1.100	1.062	1.005	0.993	
2008	2.967	1.602	1.379	1.241	1.107	1.046	1.031		
2009	2.666	1.604	1.378	1.247	1.127	1.036			
2010	2.944	1.570	1.277	1.225	1.113				
2011	2.840	1.724	1.327	1.239					
2012	2.602	1.622	1.346						
2013	2.630	1.679							
2014	2.990								
Last 3	2.740	1.675	1.317	1.237	1.115	1.048	1.018	1.004	1.019
Cumulative	9.108	3.324	1.984	1.506	1.218	1.092	1.042	1.023	1.019

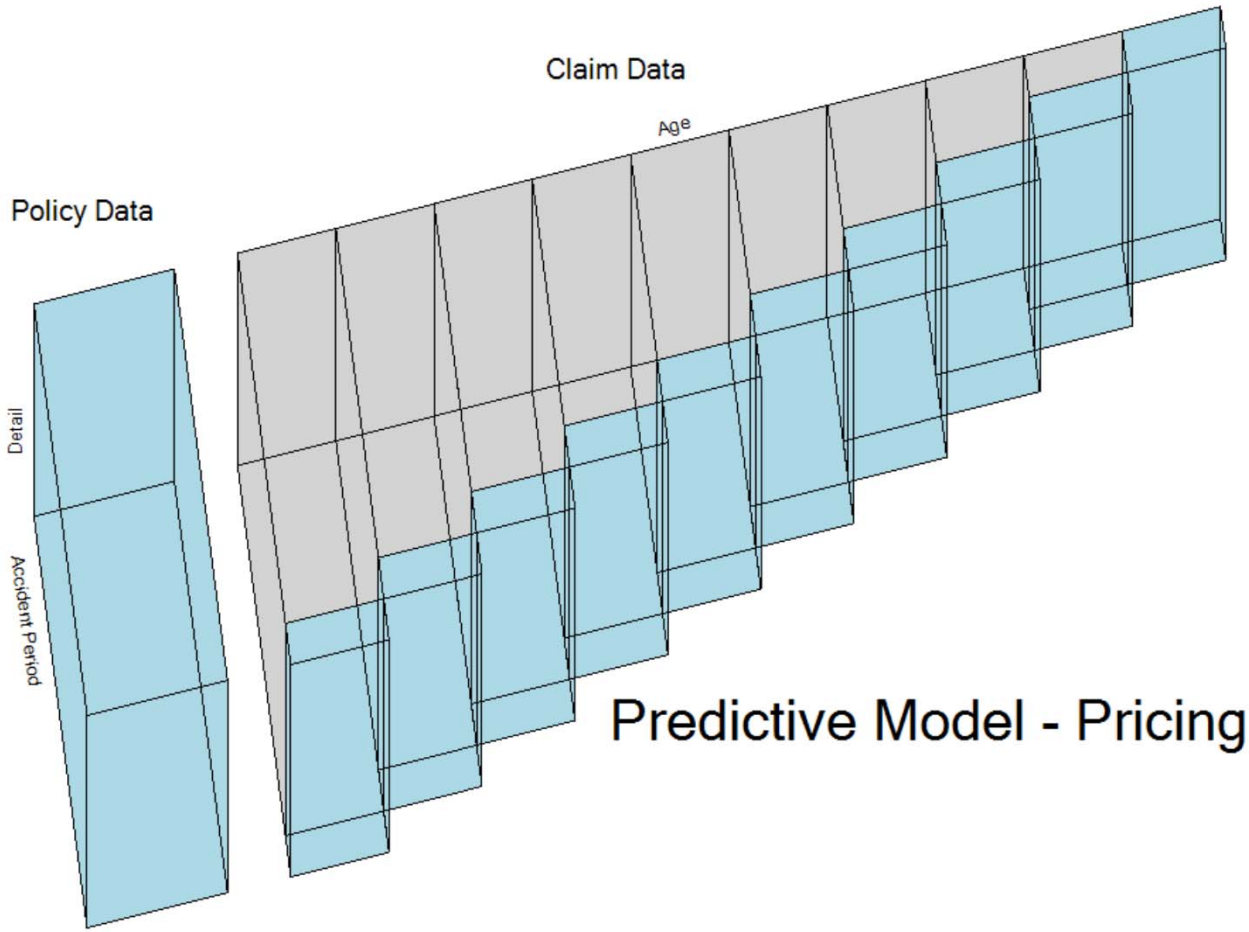
True Loss Ratio vs Estimate



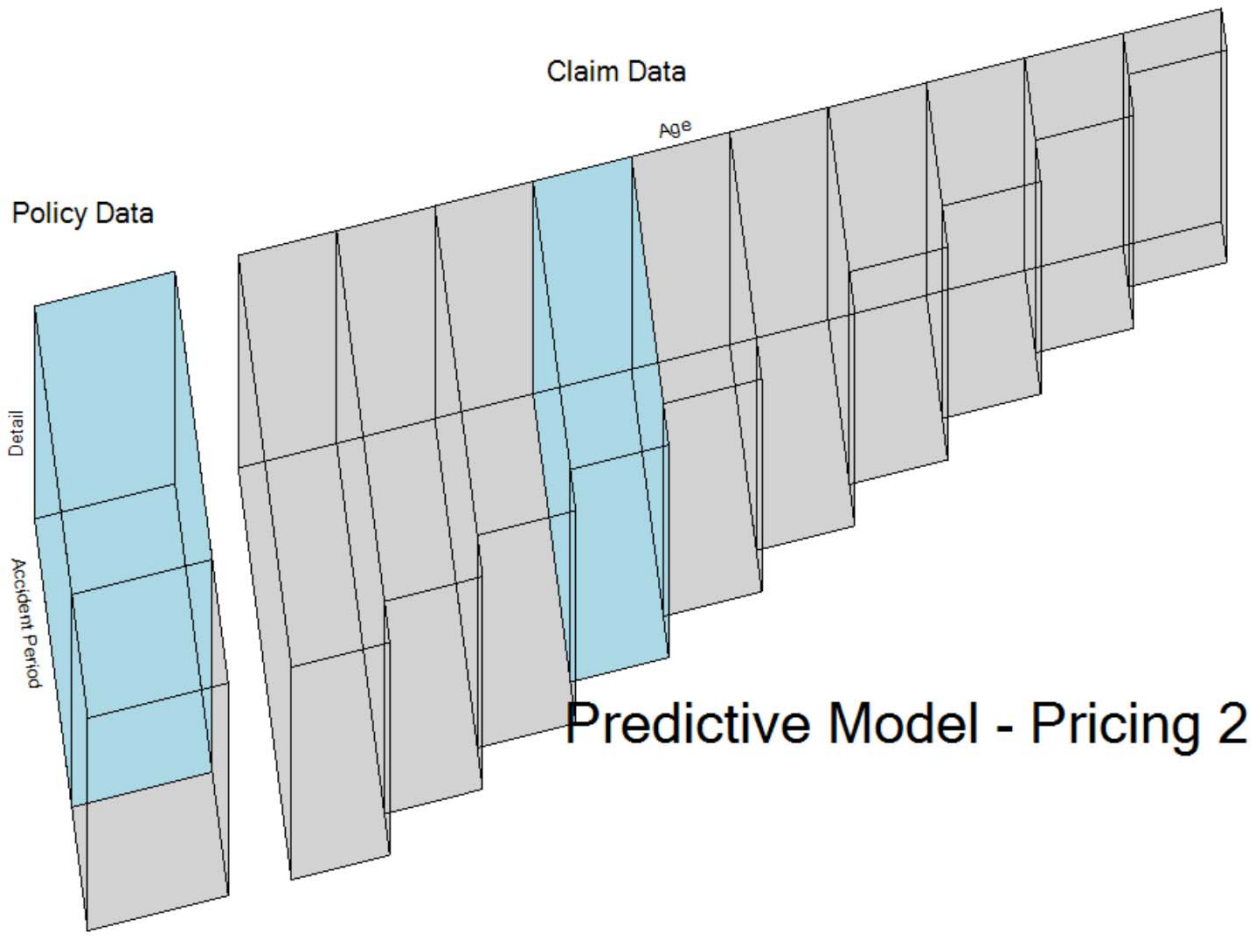
Potential Differences

- Industry classification
- Geography
- Deductible/Limit Profile
- Size of account
- Type of Claims
- Etc.

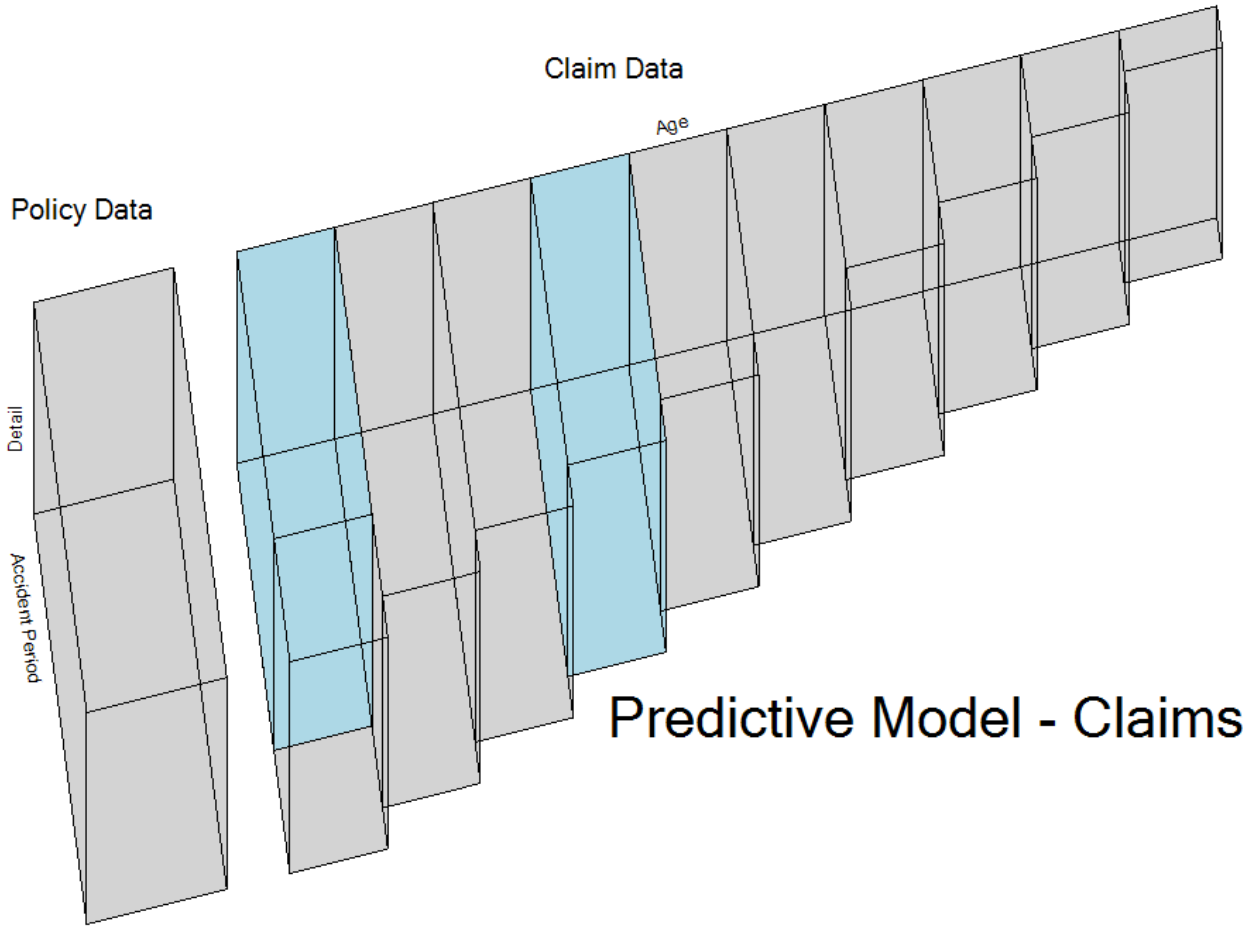

Claim Data
Age
Policy Data
Detail
Accident Period
Rate Indication



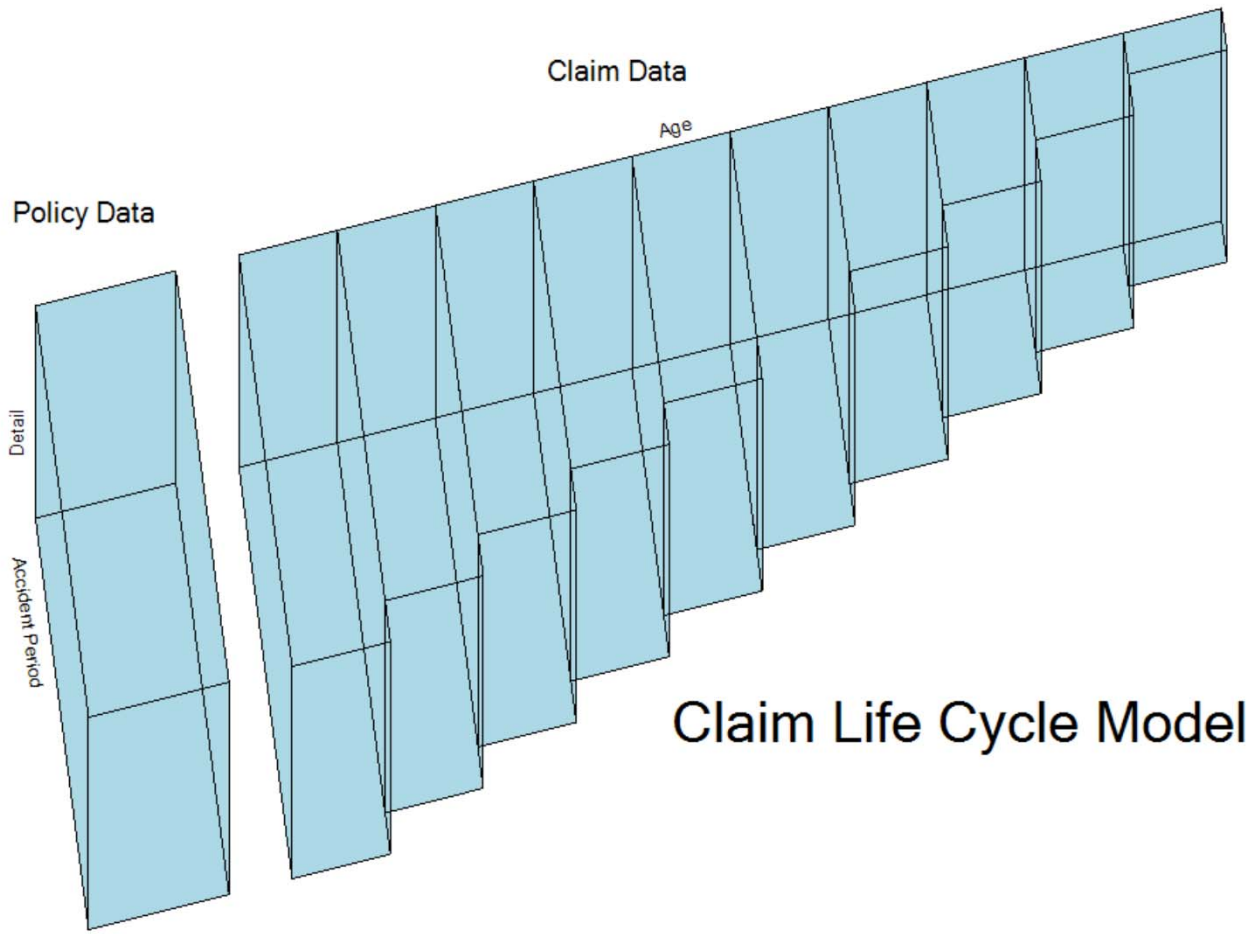
Predictive Model - Pricing



Predictive Model - Pricing 2



Predictive Model - Claims



Claim Life Cycle Model

Challenges to Building a Complete Model

- An age old problem
  - Loss development occurs over time, mature periods are old
  - Immature claims contain information
- Many facets of loss development
- Helpful to concentrate on a single time-step (e.g. beginning of quarter to end of quarter)

Data

Financial Data

- Beginning Case Reserve
- Ending Case Reserve
- Payment in Period

Timing Data

- Accident Quarter
- Report Quarter
- Valuation Quarter

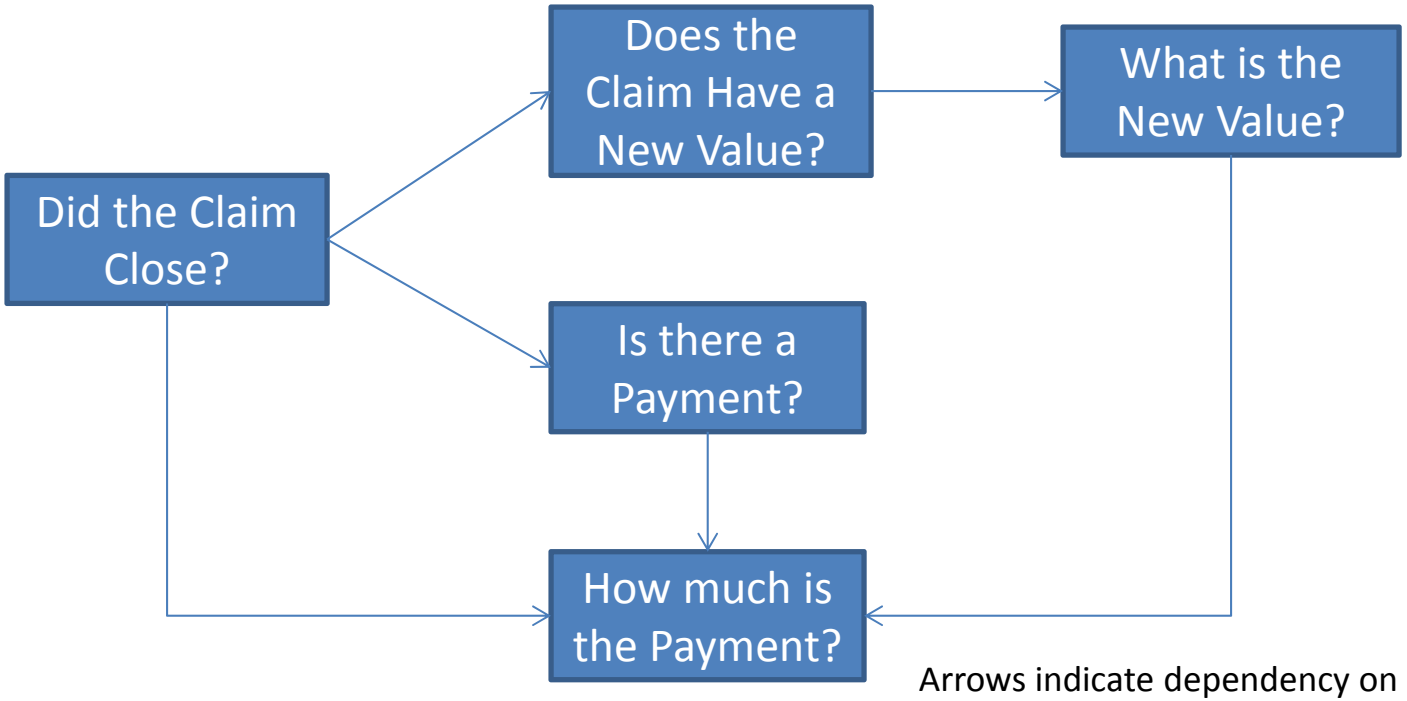
Exposure Characteristics

- Type
- Product
- ZIP Code

Claim Characteristics

- Loss Cause
- Loss Cause - Detail

Claim activity from the beginning of the quarter to the end of the quarter

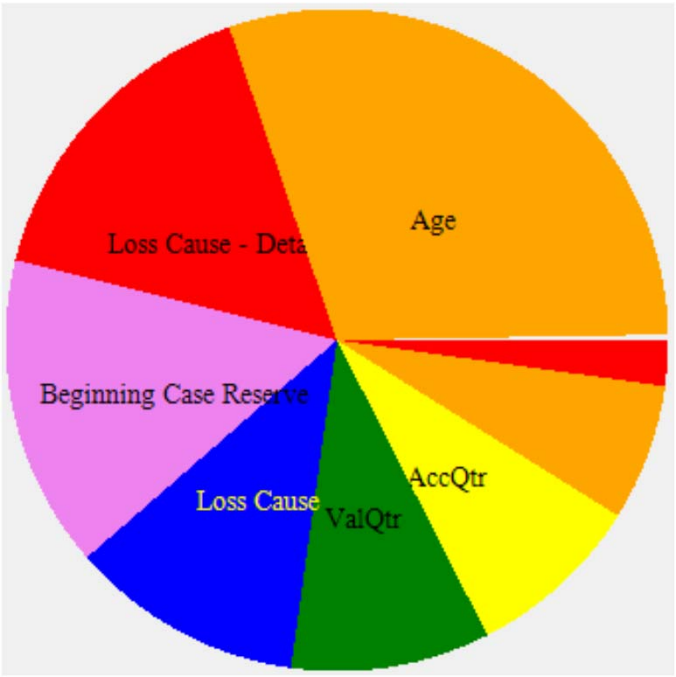


Arrows indicate dependency on other results

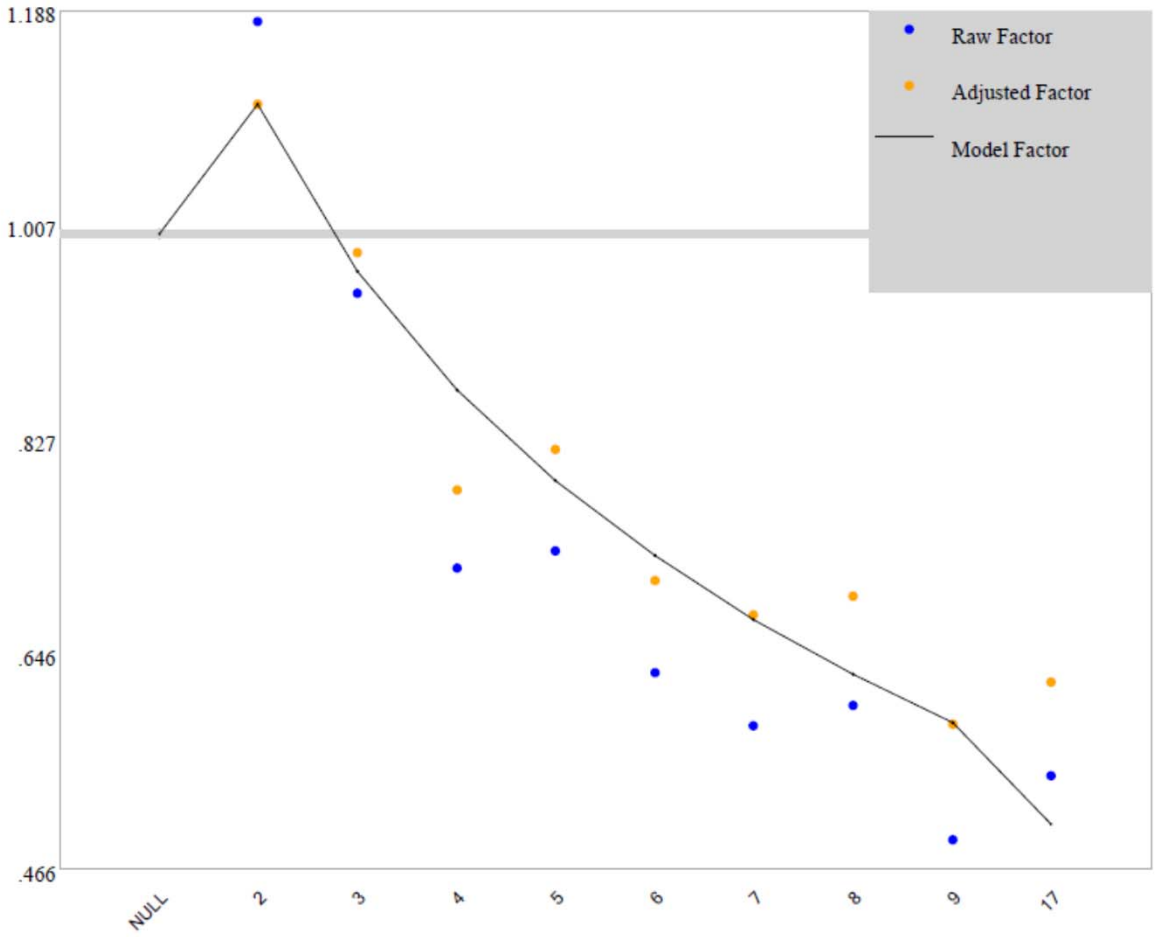
A number of available claim or exposure characteristics may have predictive value for any of these questions.

Probability of a Claim Closing

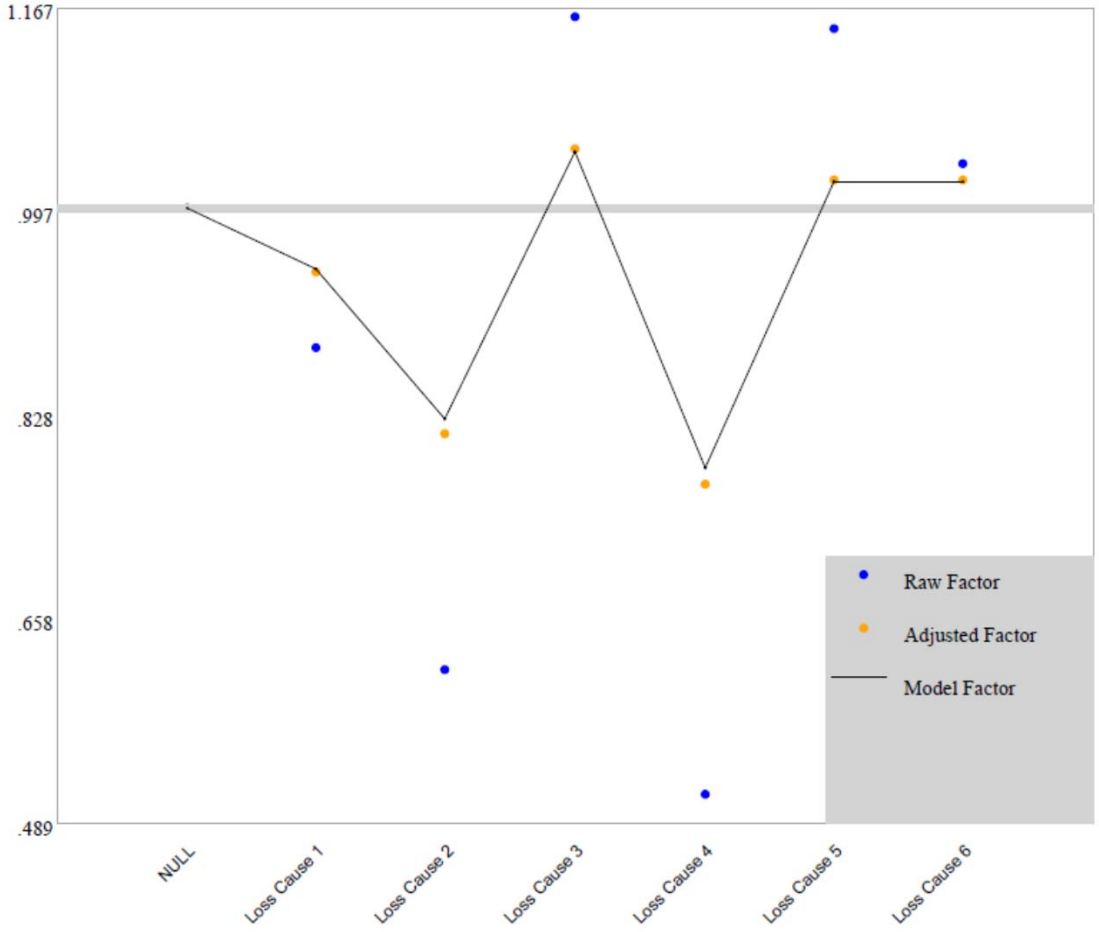
- Base probability of 71%
- Modification of this probability by various claim characteristic values that were found to have predictive value



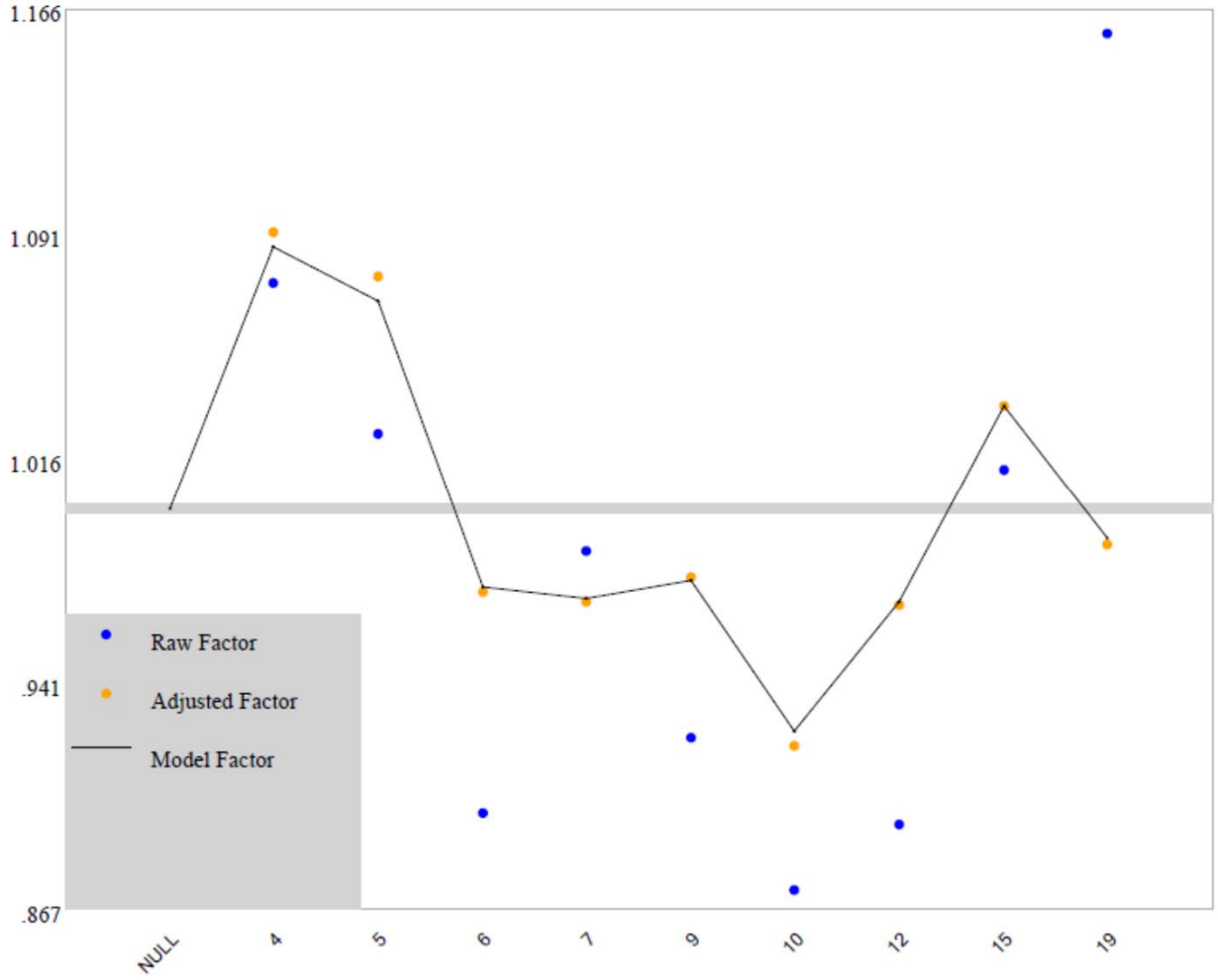
Close Probability – Claim Age



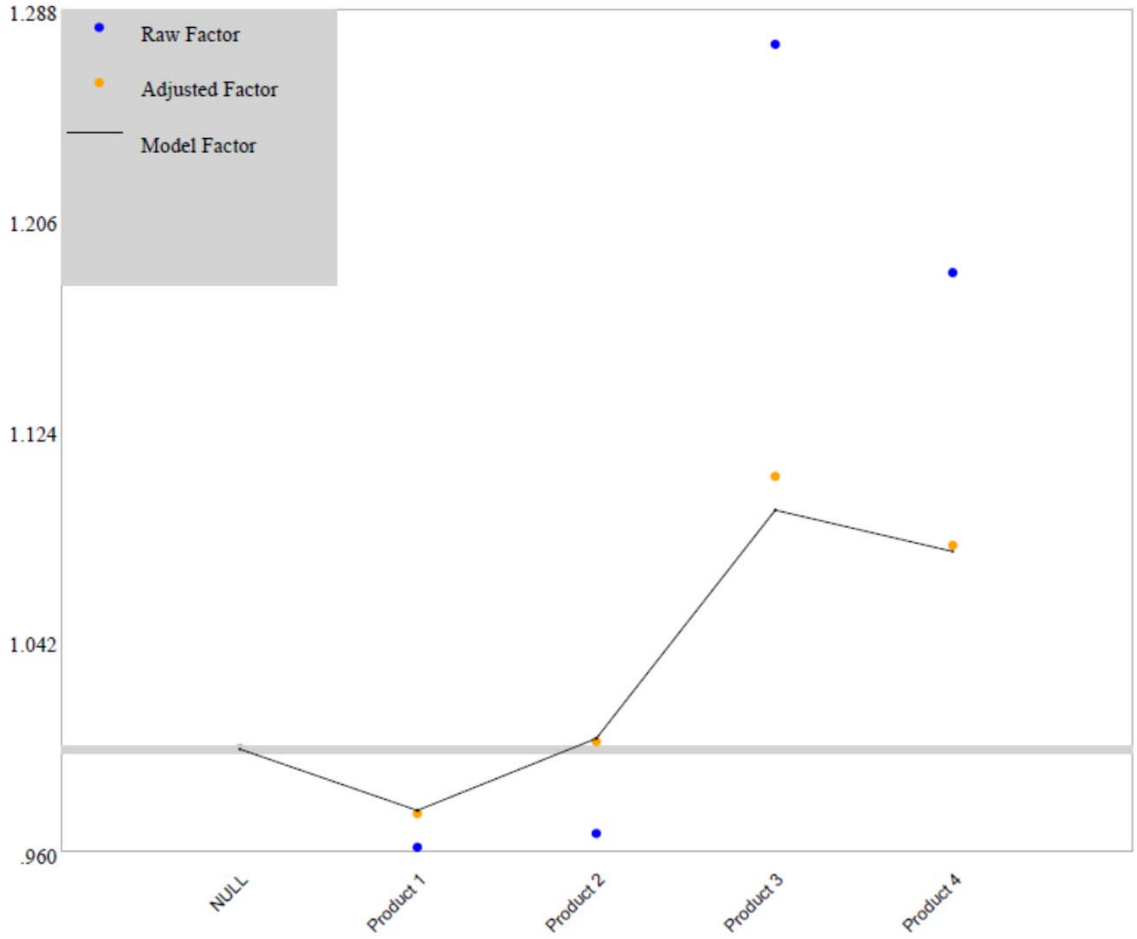
Close Probability – Loss Cause



Close Probability – Accident Quarter

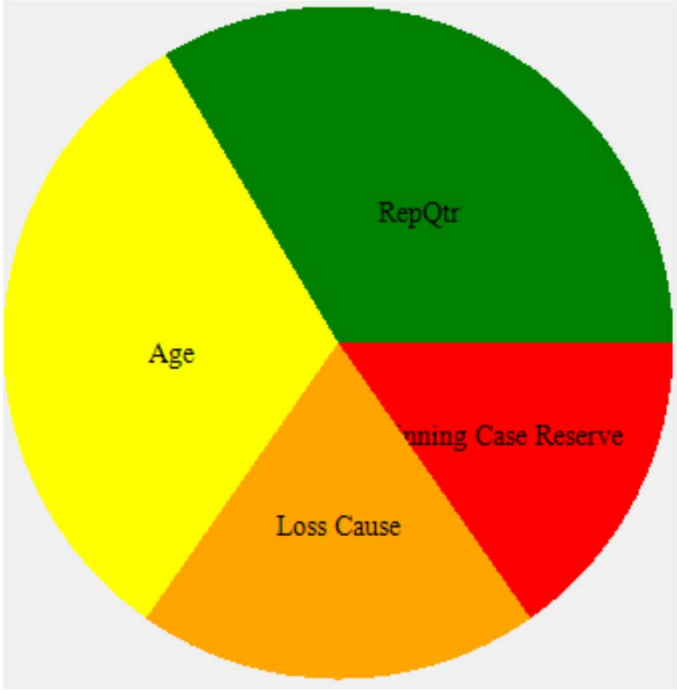


Close Probability - Product



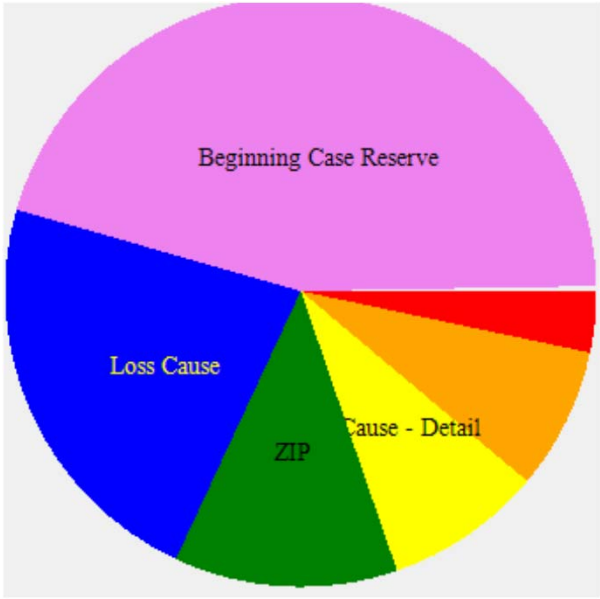
Probability of Change in Value (Given Not Closed)

- Base probability of 37%
- 4 characteristics found to be predictive

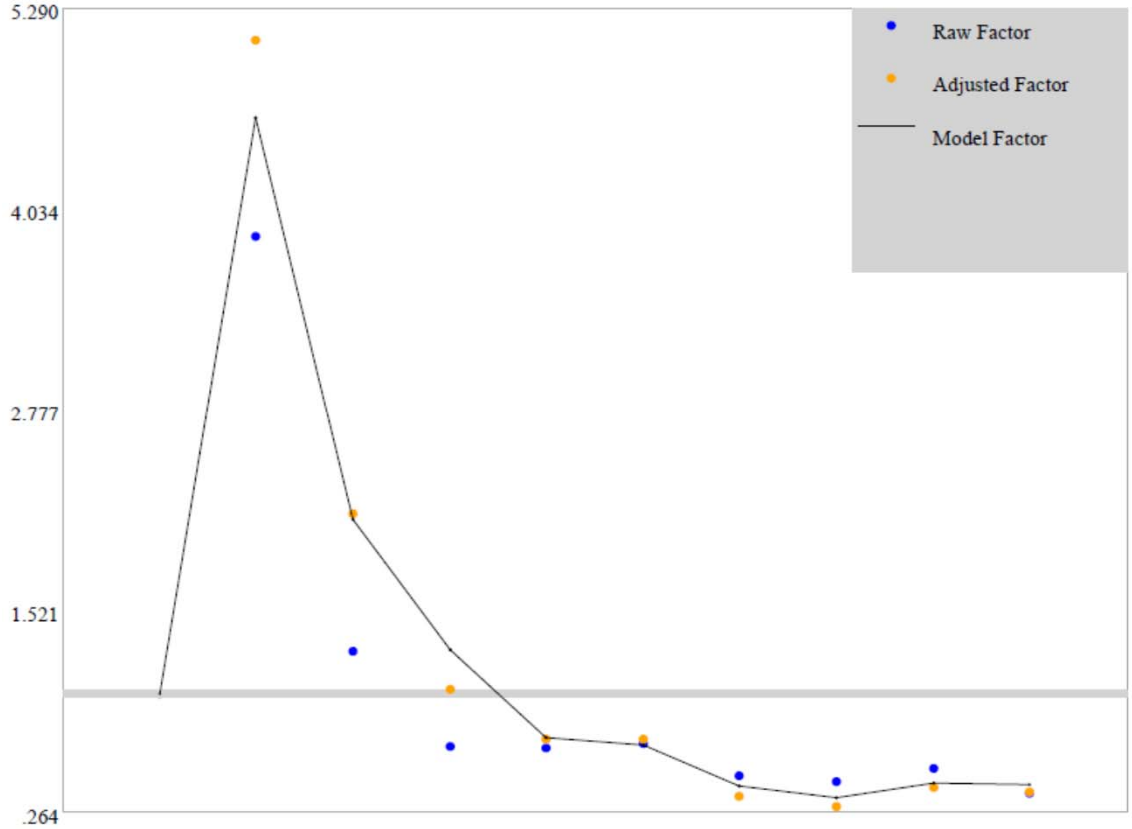


New Claim Value (Given Changed but Not Closed)

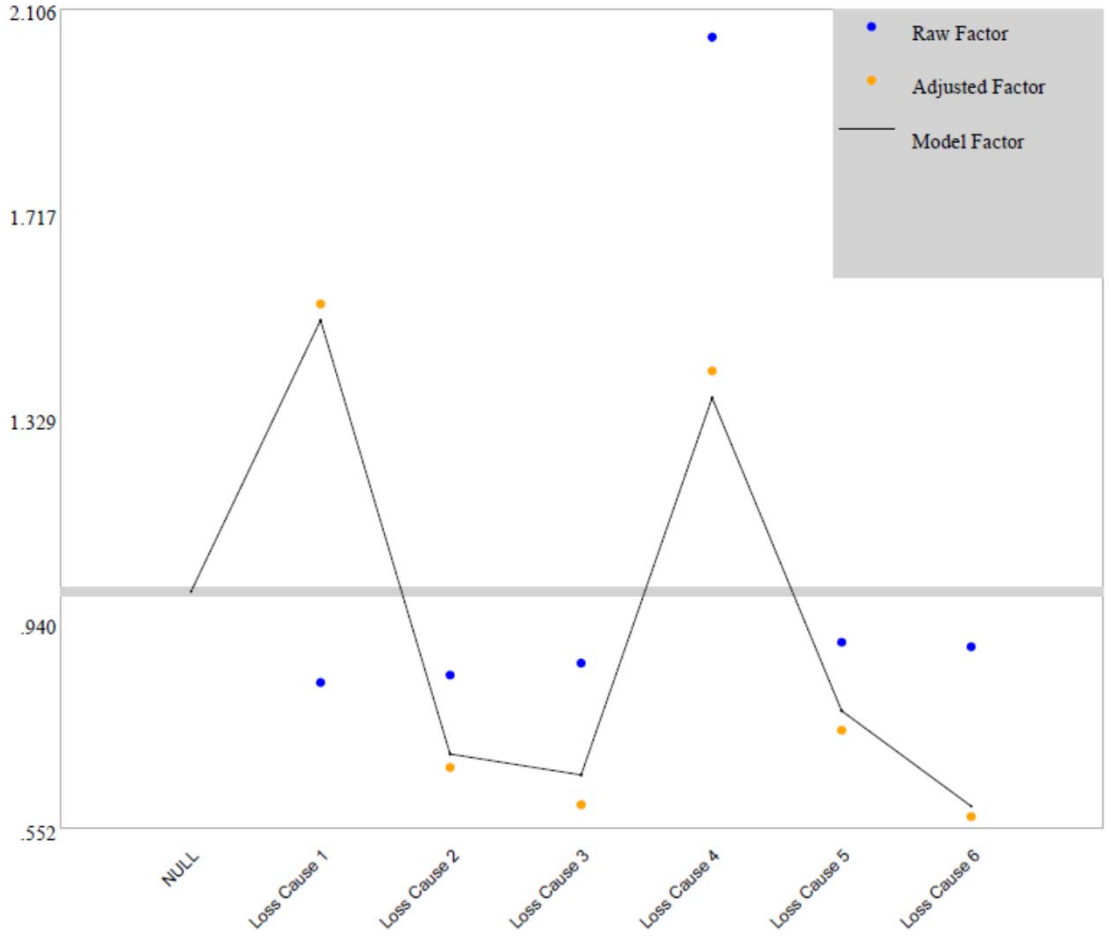
- Base factor of 1.98 to beginning case reserve
- Modification to this linear relationship, as well as five additional predictive characteristics



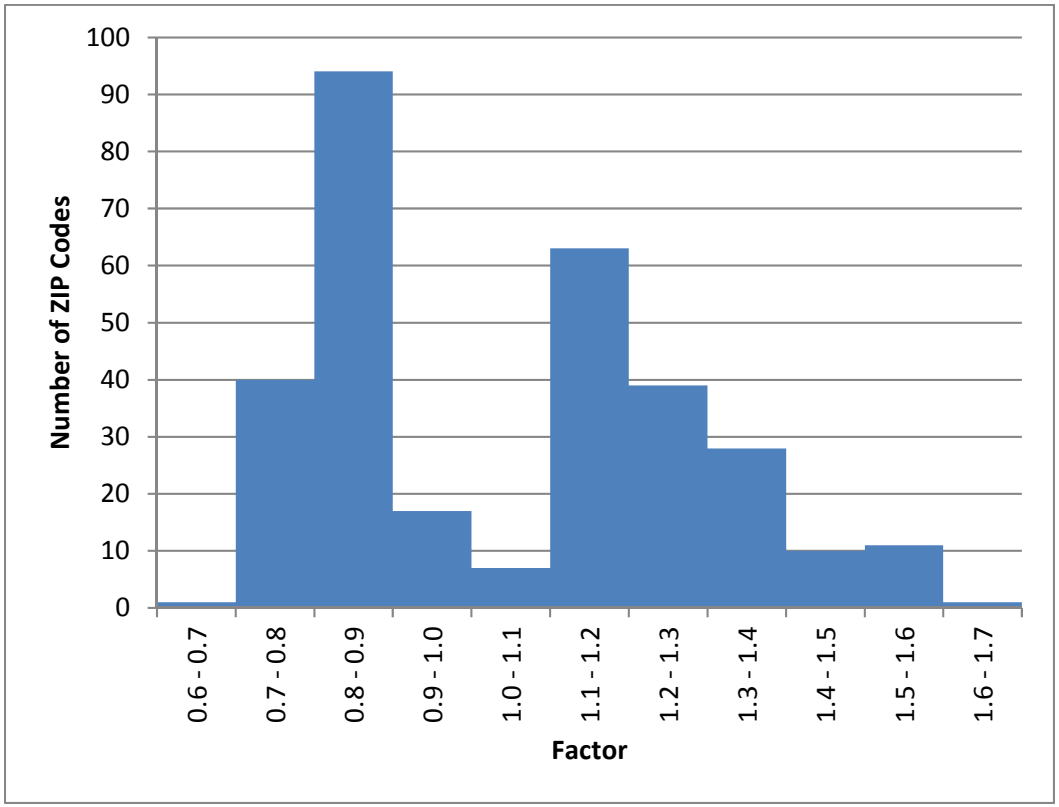
New Claim Value - Case Reserve



New Claim Value – Loss Cause



New Claim Value – ZIP Code



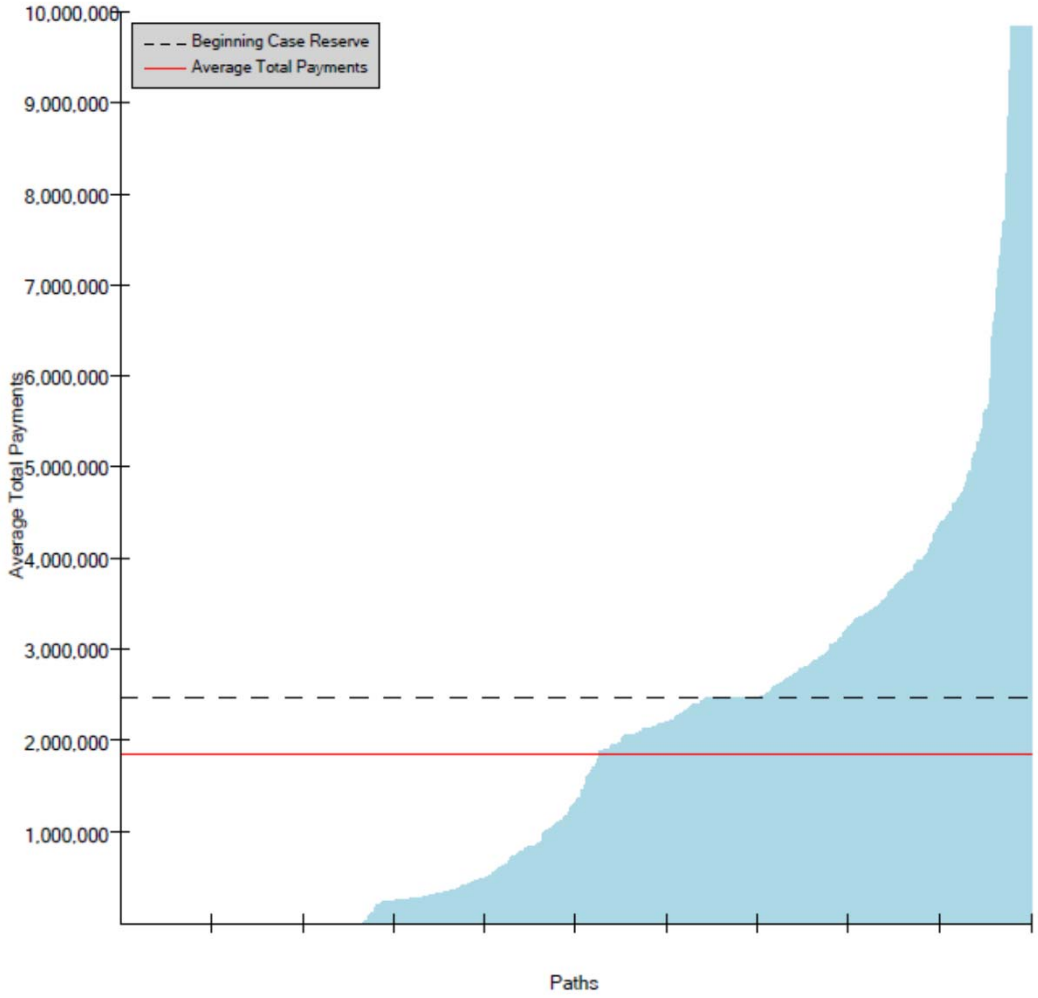
Bringing it together

- Simulation can be used to project activity in the next quarter
- It is necessary to project not only the predictive relationships, but also the residual error term.
- Chain through quarters using information from the previous simulated quarter.
- Store results, preferably at the claim level.

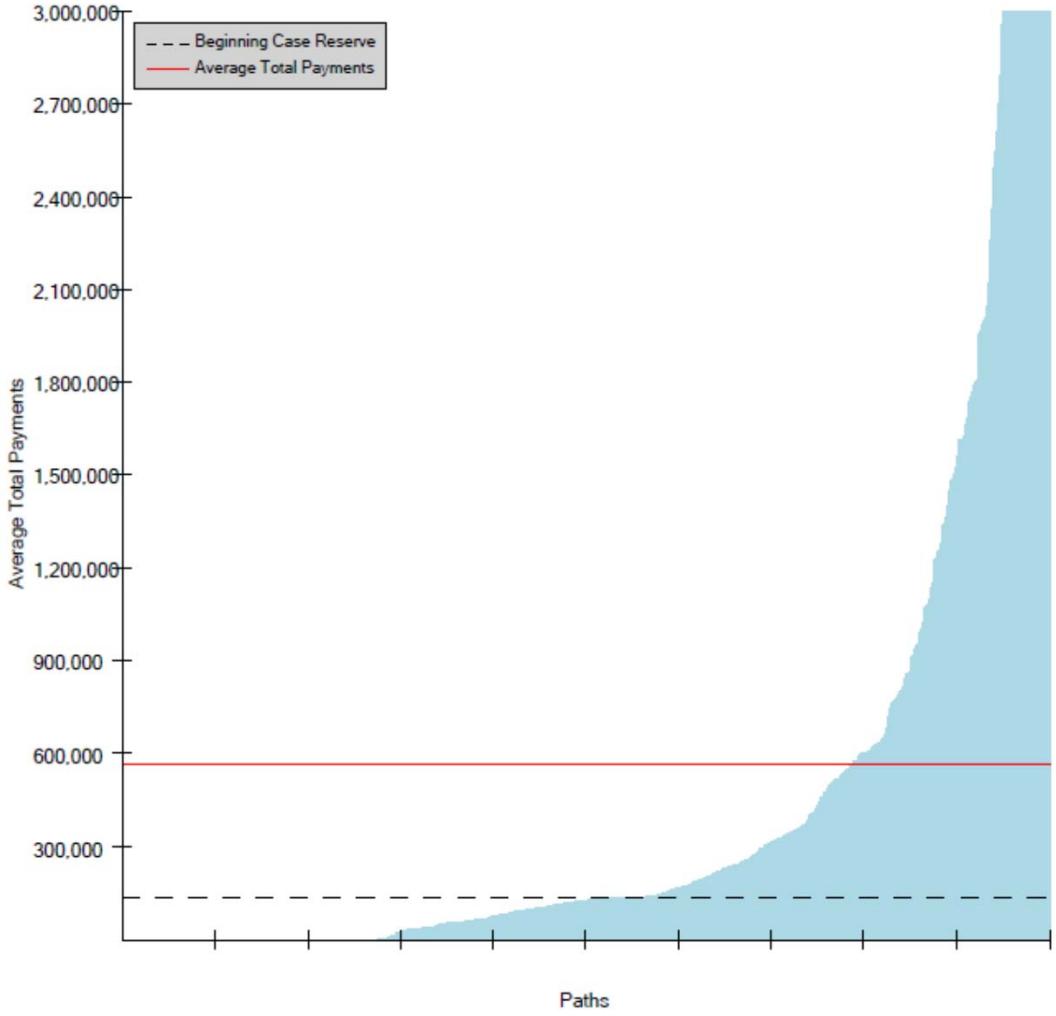
Simulate Going Forward

- Claim Development
  - Start with current inventory of open claims
  - For each open claim simulate a number of potential outcomes for the next time-step (using the claims' characteristics)
  - For those simulated claim-paths that are still open simulate forward another time-step.
  - Continue until all simulated claim-paths are closed

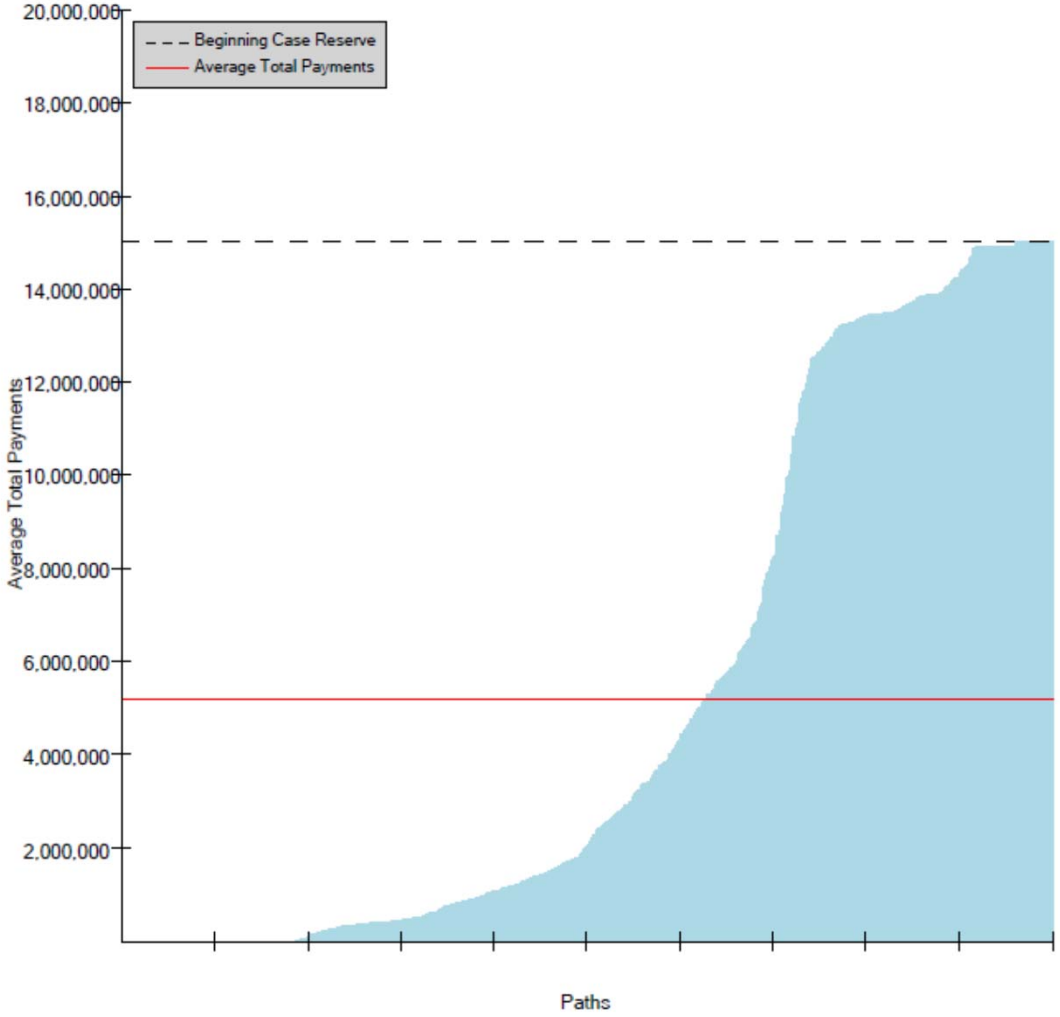
Claim 1

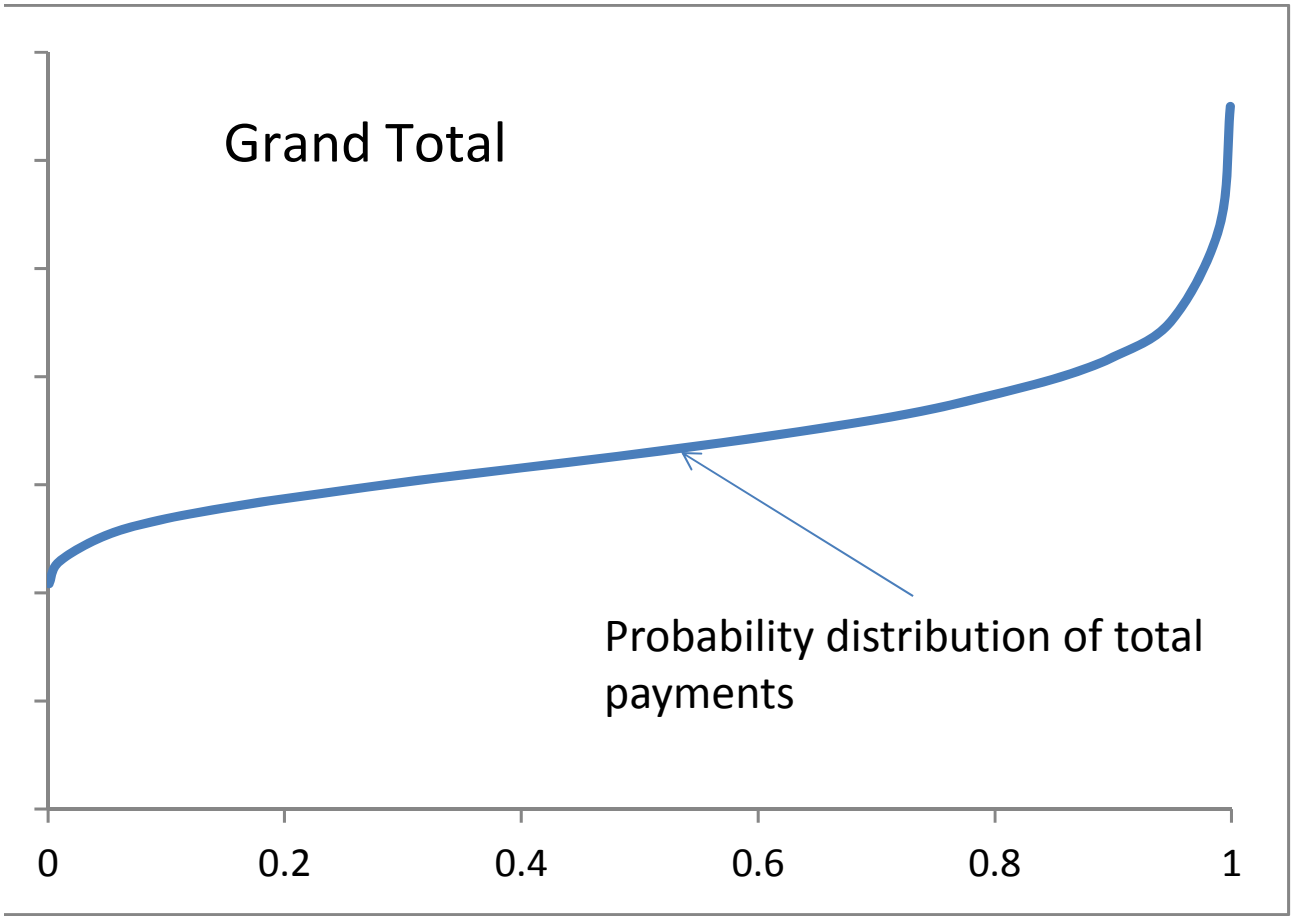

Beginning Case Reserve
Average Total Payments
10,000,000
9,000,000
8,000,000
7,000,000
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
Average Total Payments
Paths

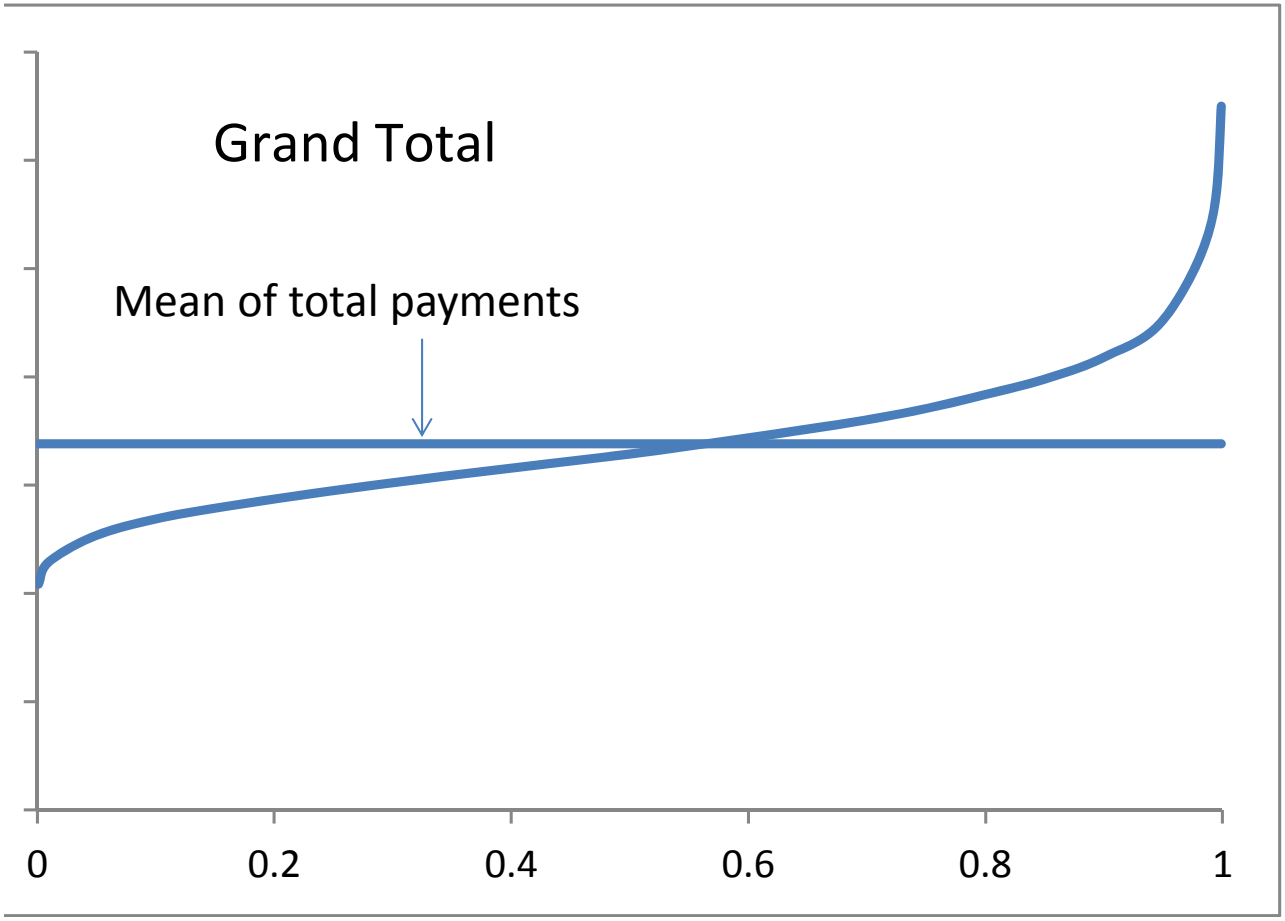
Claim 2

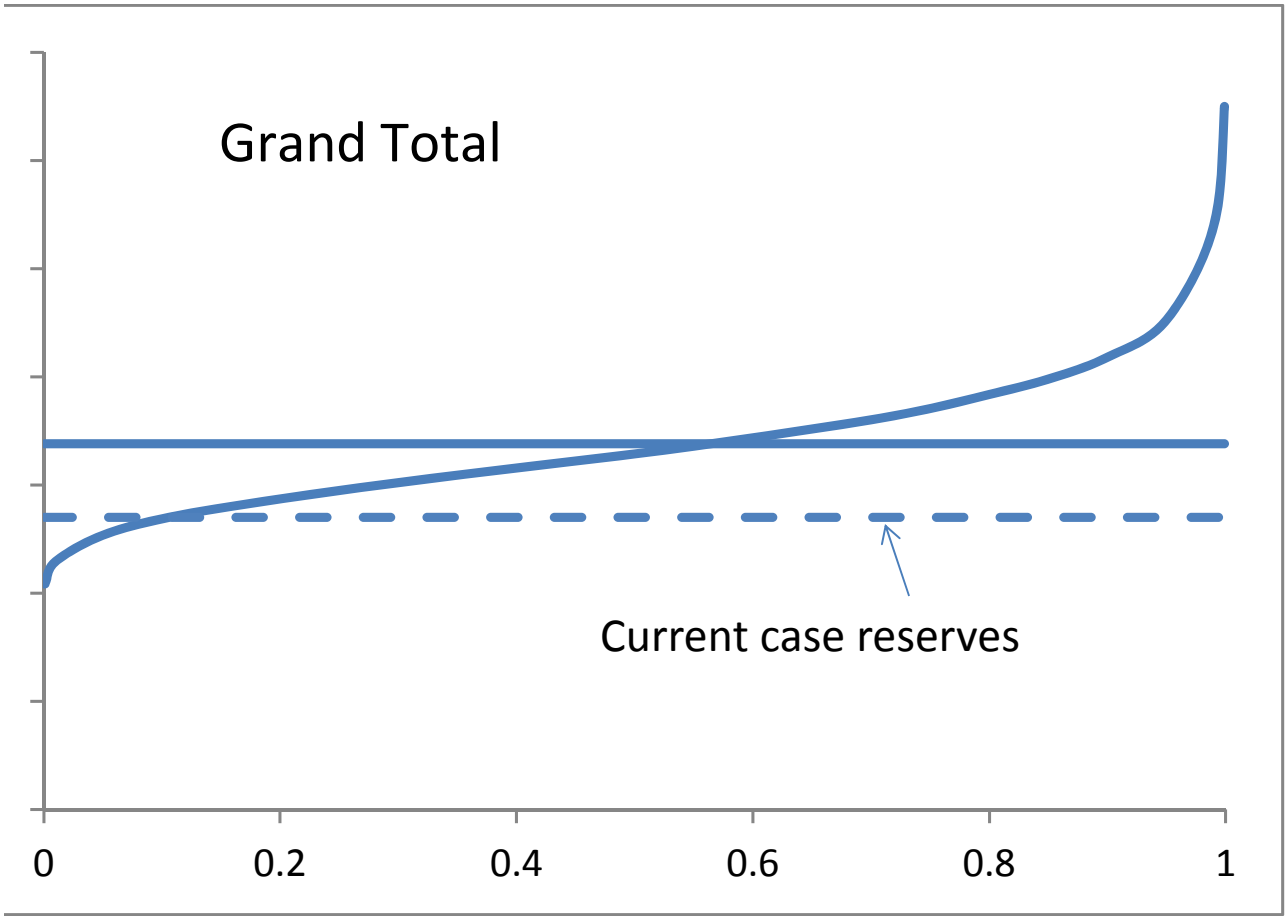

Beginning Case Reserve
Average Total Payments
3,000,000
2,700,000
2,400,000
2,100,000
1,800,000
1,500,000
1,200,000
900,000
600,000
300,000
Average Total Payments
Paths

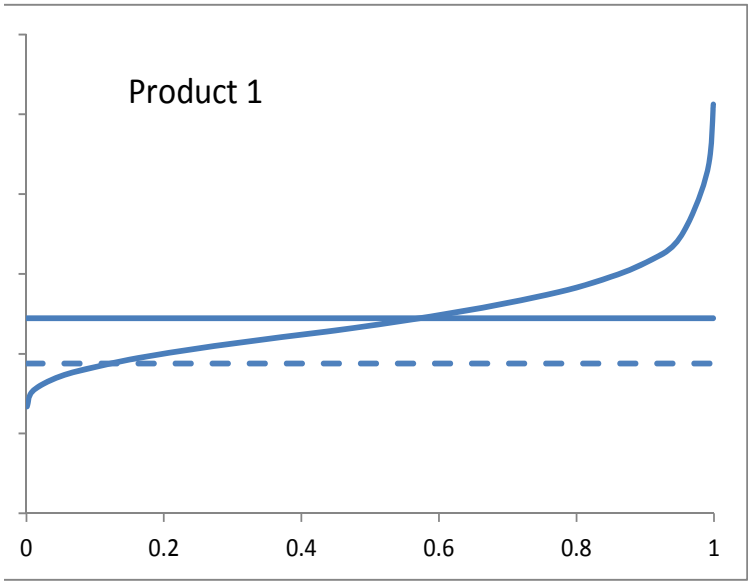
Claim 3

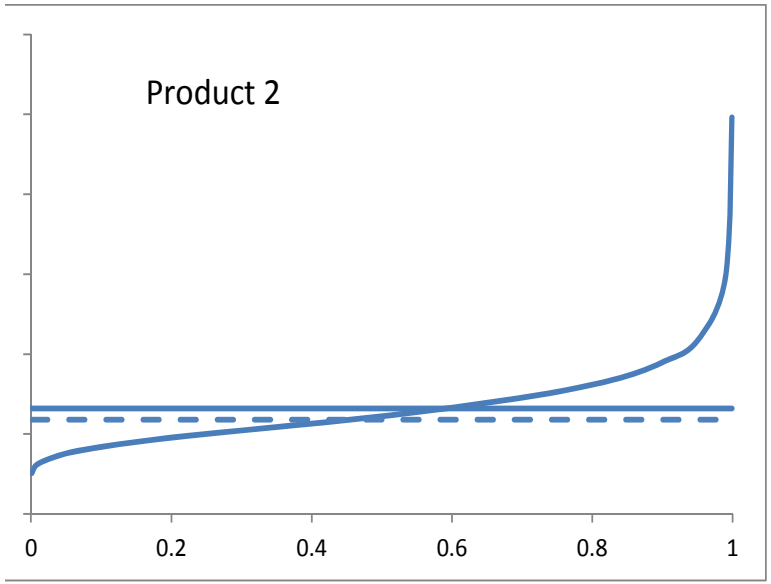

Beginning Case Reserve
Average Total Payments
20,000,000
18,000,000
16,000,000
14,000,000
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
Average Total Payments
Paths

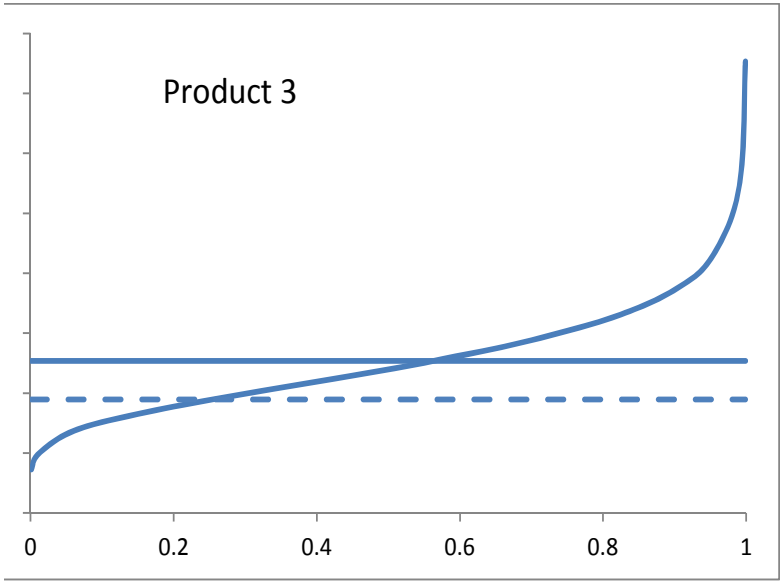

Grand Total
Probability distribution of total payments
0
0.2
0.4
0.6
0.8
1

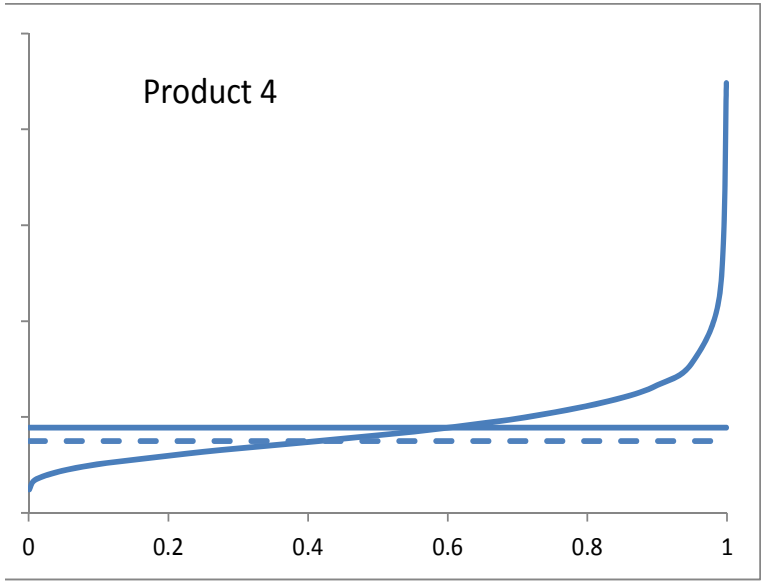

Grand Total
Mean of total payments
0
0.2
0.4
0.6
0.8
1

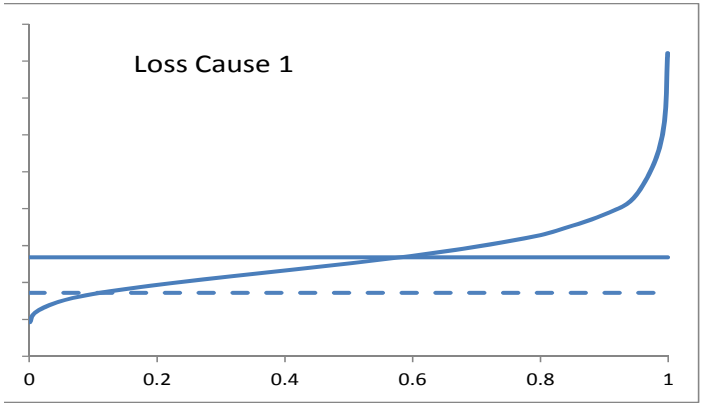

Grand Total
Current case reserves
0
0.2
0.4
0.6
0.8
1

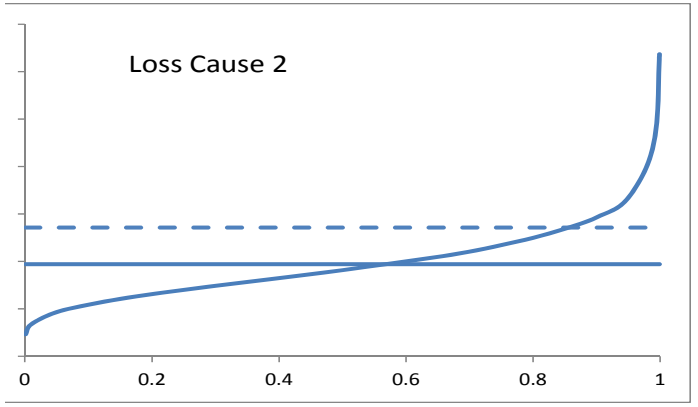

Product 1
0
0.2
0.4
0.6
0.8
1

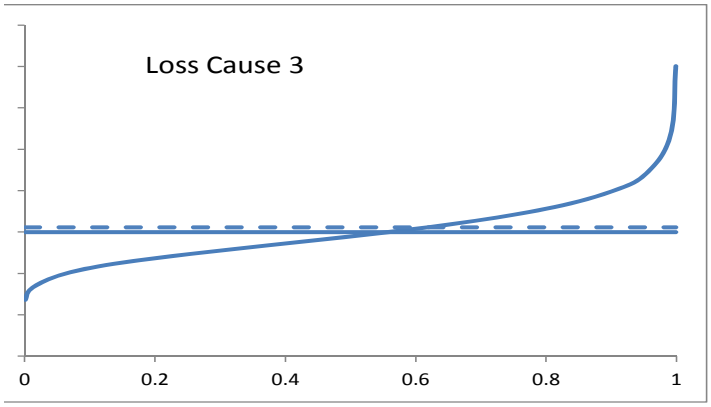

Product 2
0
0.2
0.4
0.6
0.8
1

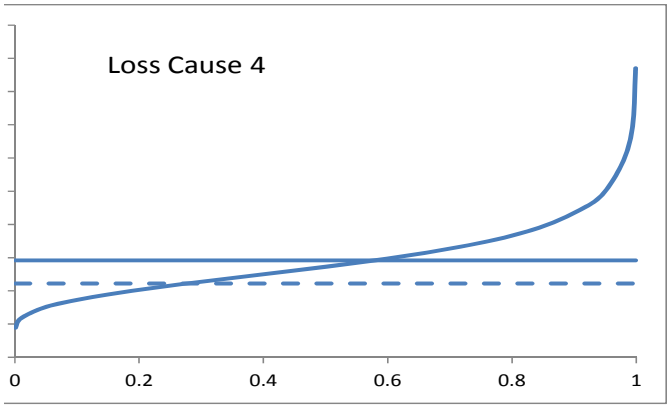

Product 3
0
0.2
0.4
0.6
0.8
1

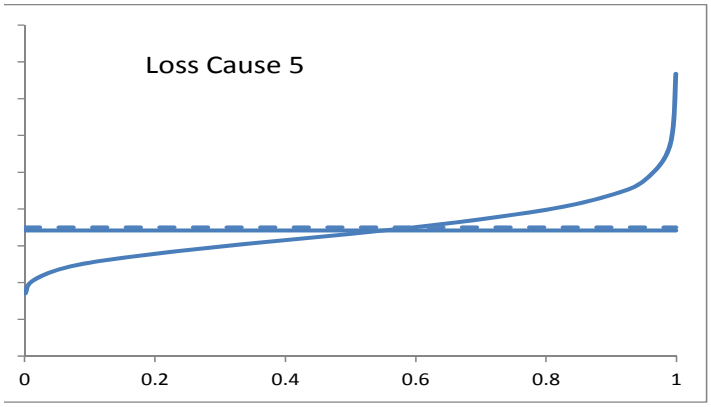

Product 4
0
0.2
0.4
0.6
0.8
1

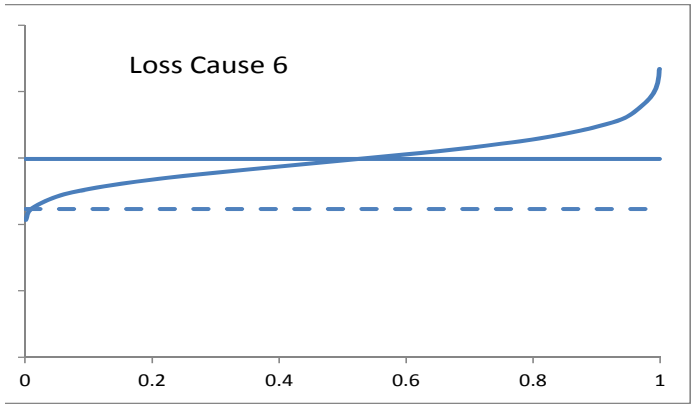












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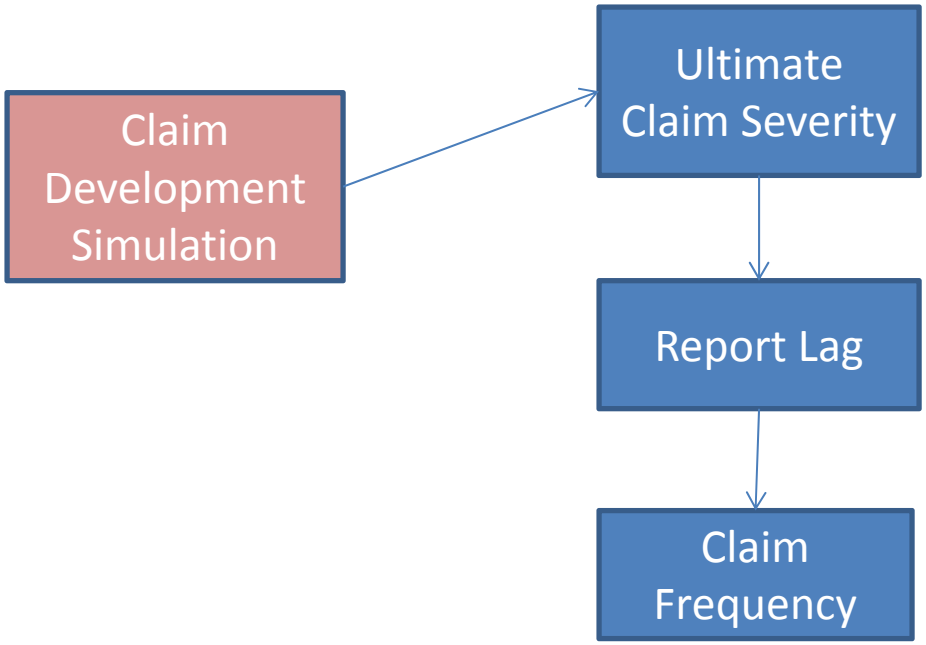
Emergence

- After simulating claim development to ultimate, model emergence
- Frequency
- Severity
- Report Lag

Claim Emergence



Arrows indicate dependency on other results

A number of exposure characteristics may have predictive value for any of these questions.

Emergence Simulation

- Use written policies (w/ characteristics) simulate remaining emergence.
- Generating loss date within this process allows accident period calculations
- Also get losses associated with unearned premium
- Inforce loss ratio distribution.

Case Study - Background

- Capital Insurance Group
- Reasons for interest in the approach
  - Validate ultimate selections made from traditional triangle-based methods
  - Insights that can be gained by applying predictive modeling to reserving
  - Triangle segmentation ideas
  - Support pricing predictive modeling by using estimated ultimate claims as the target variable

Case Study - Background

- Began the process in Q4 of 2015
- Analyzed Q4 2014 (1 Year Lag) to be able to compare against traditional approach
- Involved three individuals in the actuarial department
- Single line of business
- Longer-tailed LOB

Learning Curve

- Chris came for an initial in-house training session
- Met every couple of weeks to answer questions on software and get valuable feedback on progress

Learning Curve

- Main challenge was getting all the data into an acceptable format and gaining familiarity of the software functionality
- Easy to use and really fast automated results after getting over the initial learning curve hump

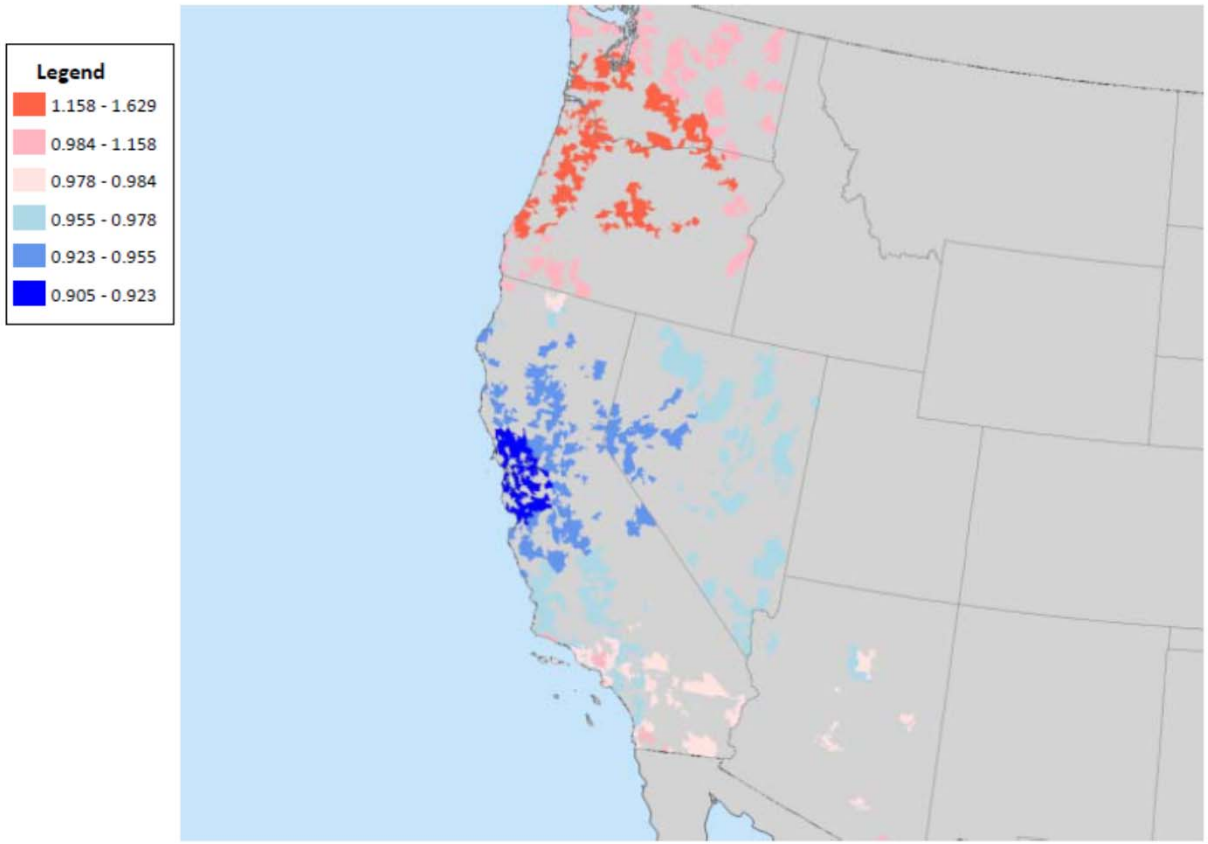
Case Study - Process

- Organized data
- Built and refined the predictive models
- Simulated development and emergence
- Analyzed output vs. current reserve model vs. actual development

Case Study – Selected Highlights

Characteristic: ZIP_CODE

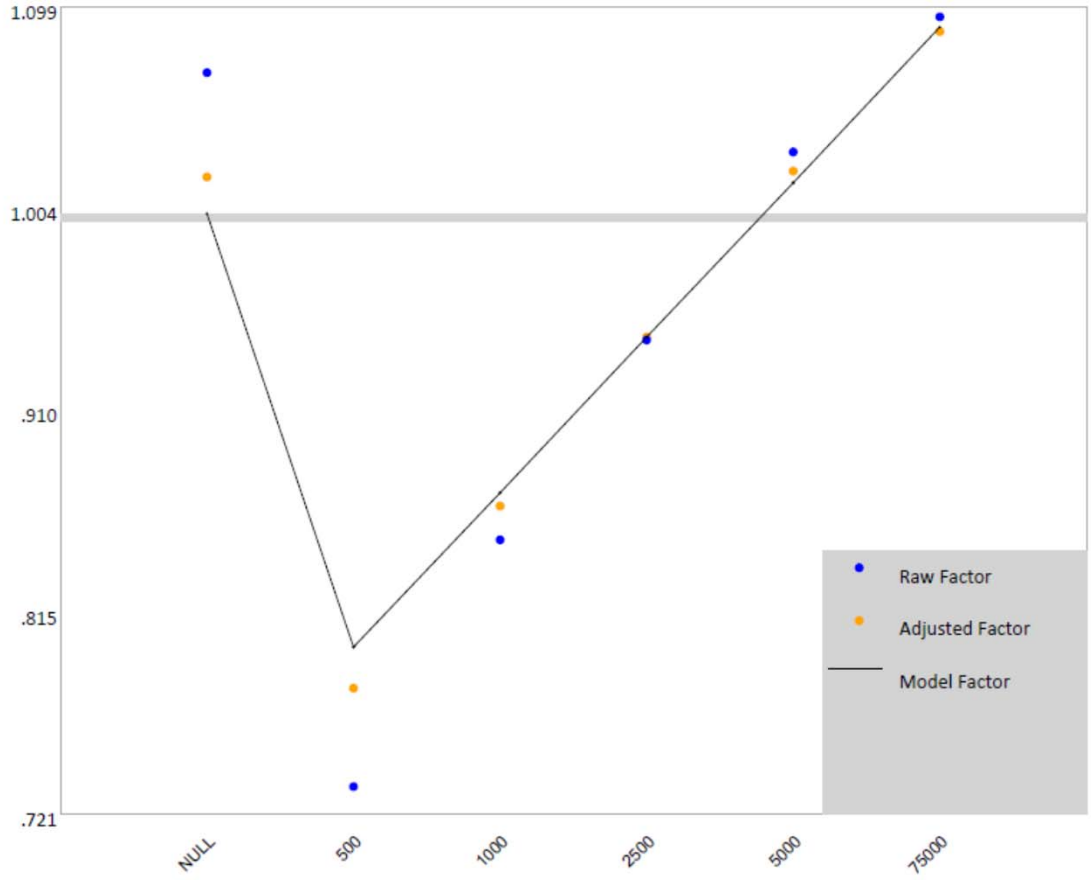
Pricing Comparison: CLCM-Based vs CaseIncured-Based



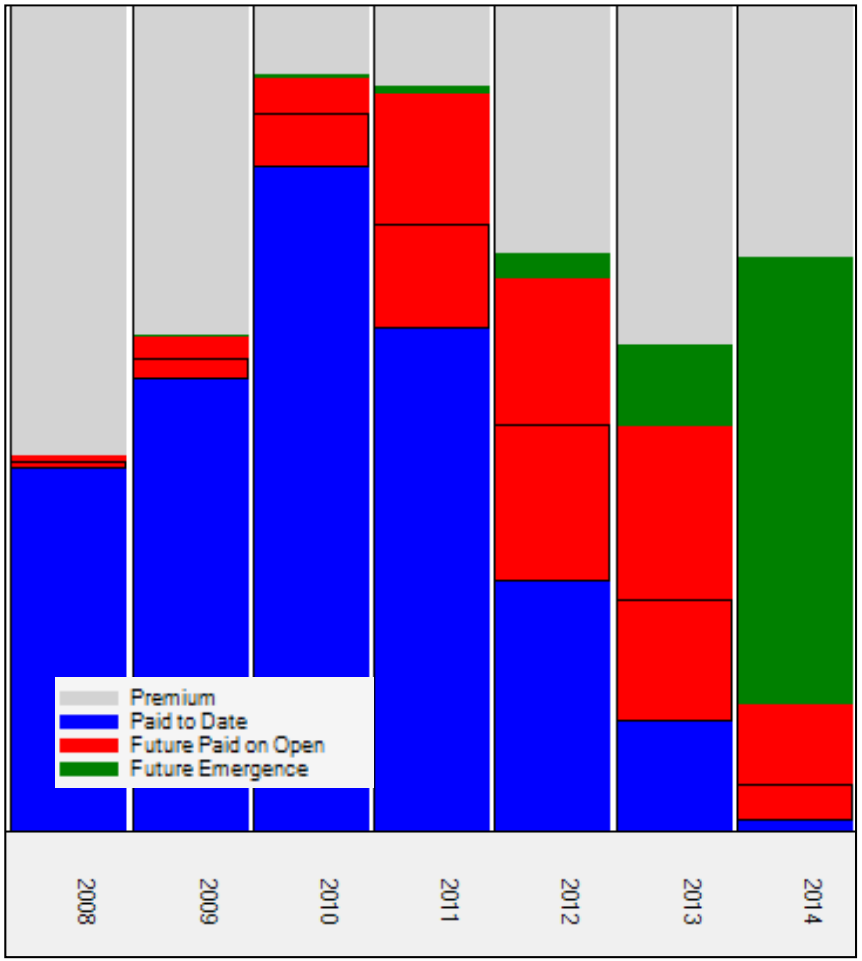
Case Study– Selected Highlights

Characteristic: DEDUCTIBLE

Pricing Comparison: CLCM-Based vs CaseIncured-Based



Case Study– Selected Highlights



Case Study – Overall Impressions

- Challenges
  - Reconciliation with other analysis
- Value
  - Depth of information available
  - Statistically significant segmentation
  - Visual aids for decision making are an invaluable part of the process
  - Easy to evaluate performance of one model iteration to the next

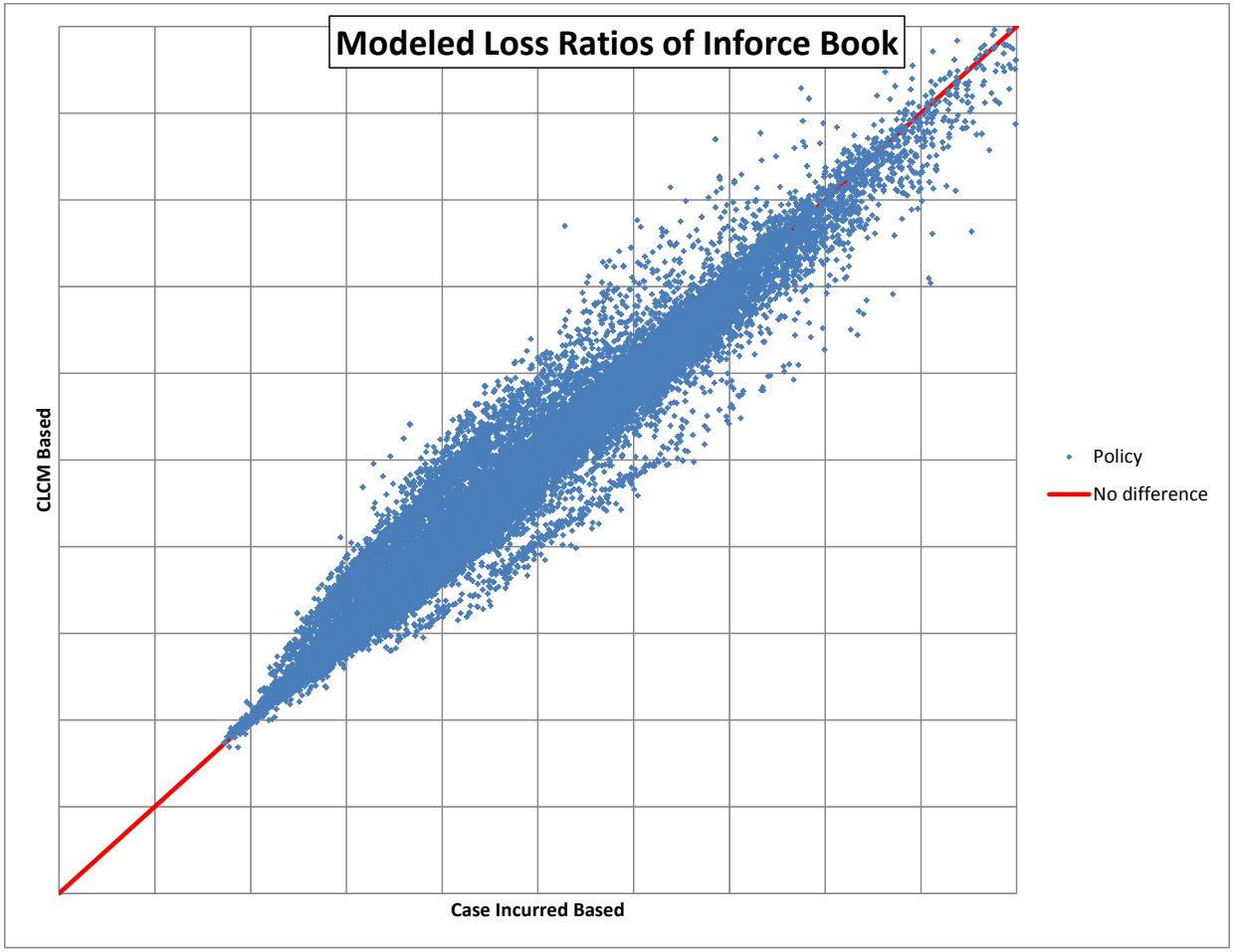
Case Study – Thoughts for the future

- Reserving
- Pricing
- Other

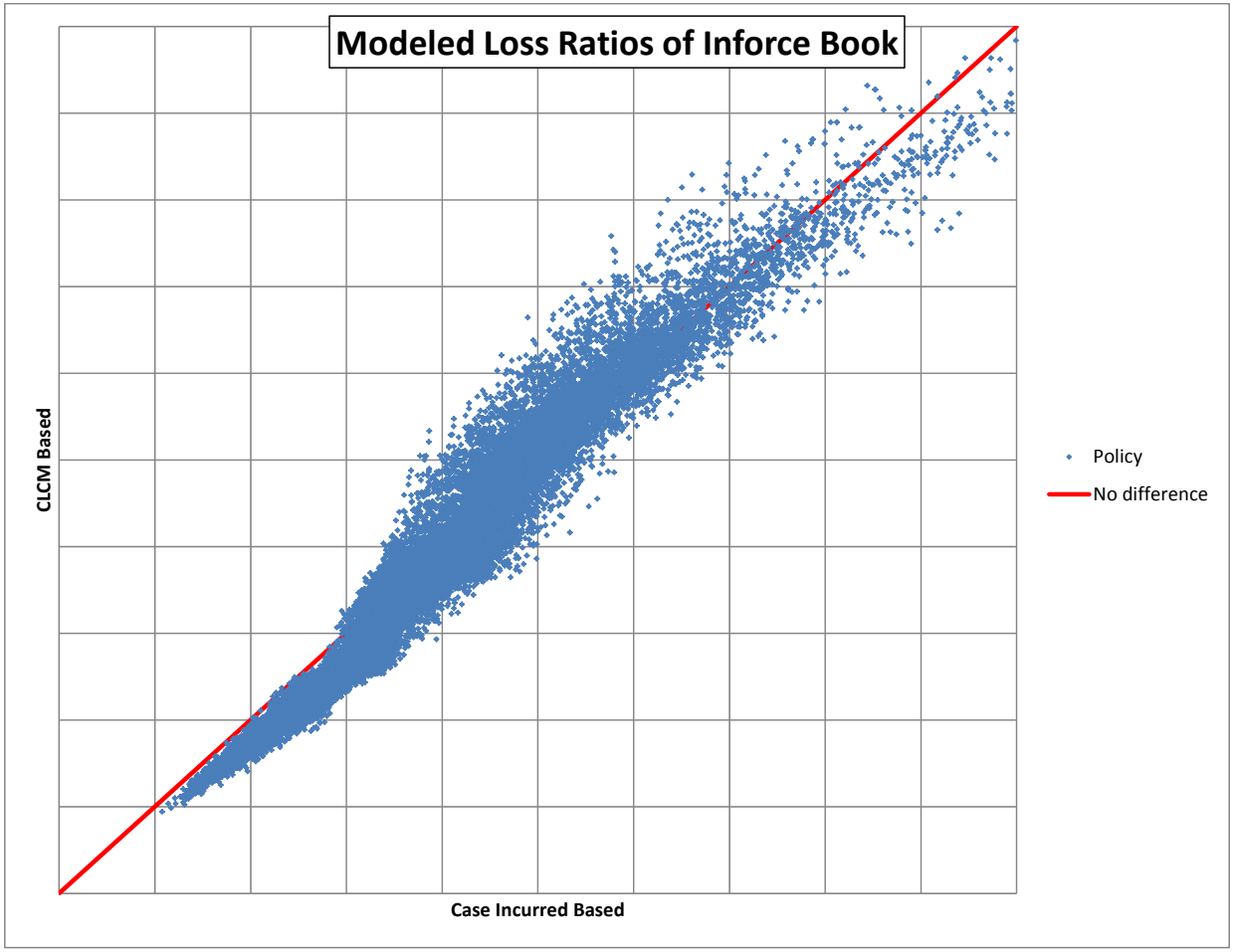
Additional Comparisons of "Traditional" Predictive Modeling for Pricing vs. Claim Life Cycle Model

- 3 other real examples
- Using the same rating variables
- Only difference is use of CLCM ultimate vs Case-Incurred.
- Compared modeled loss ratio by policy from the current inforce book.

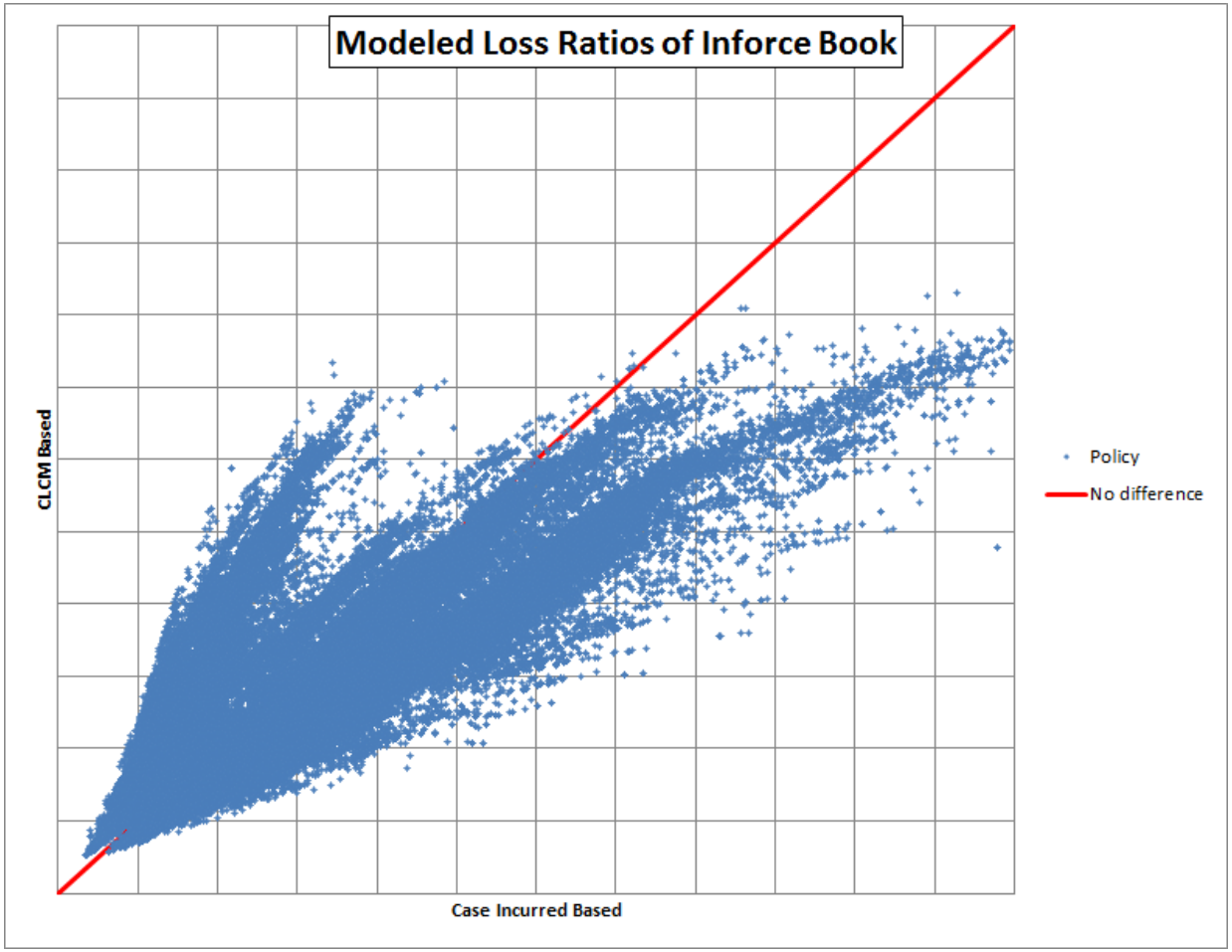
Example 1


Modeled Loss Ratios of Inforce Book
CLCM Based
Case Incurred Based
Policy
No difference

Example 2


Modeled Loss Ratios of Inforce Book
CLCM Based
Case Incurred Based
Policy
No difference

Example 3


Modeled Loss Ratios of Inforce Book
CLCM Based
Case Incurred Based
Policy
No difference

Some Observed Differences

- Geography
- Industry Classification
- Size of Account
- Agency
- Deductible/Limit
- Year Built

Conclusion

- Reserve development matters for pricing!
- Different exposures develop differently!
- Models that do not reflect these differences will be inferior!