Marrying Underwriter Intuition & Predictive Modeling - A Workers' Compensation Perspective

CAS RPM Seminar

Las Vegas Mar 10, 2008

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A Short Vignette

After Several Weeks of Analysis...

the Predictive Modeler and
the Underwriter

Meet...

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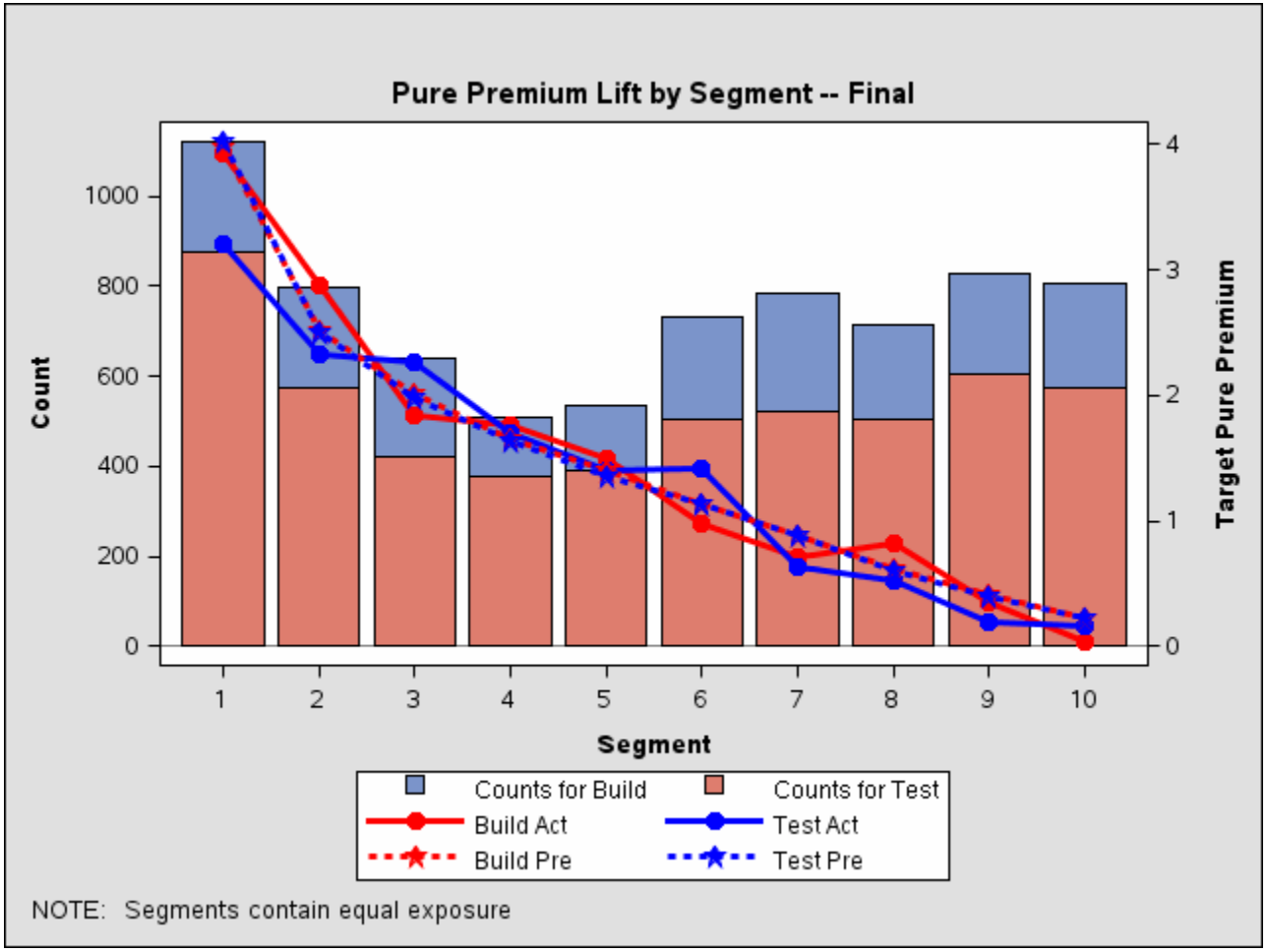
Initial Candidate Model Risk Factors

- Attorney count by county
- Hail size by county
- Late reporting >30 days
- Frequency –1 year back
- Principal factor – up to 3 term LR, up to 3 term PP
- Term sequence
- Binned Manual Premium
- Natural log (Class code/176 + 11,237)…(?!)

Initial Candidate Model



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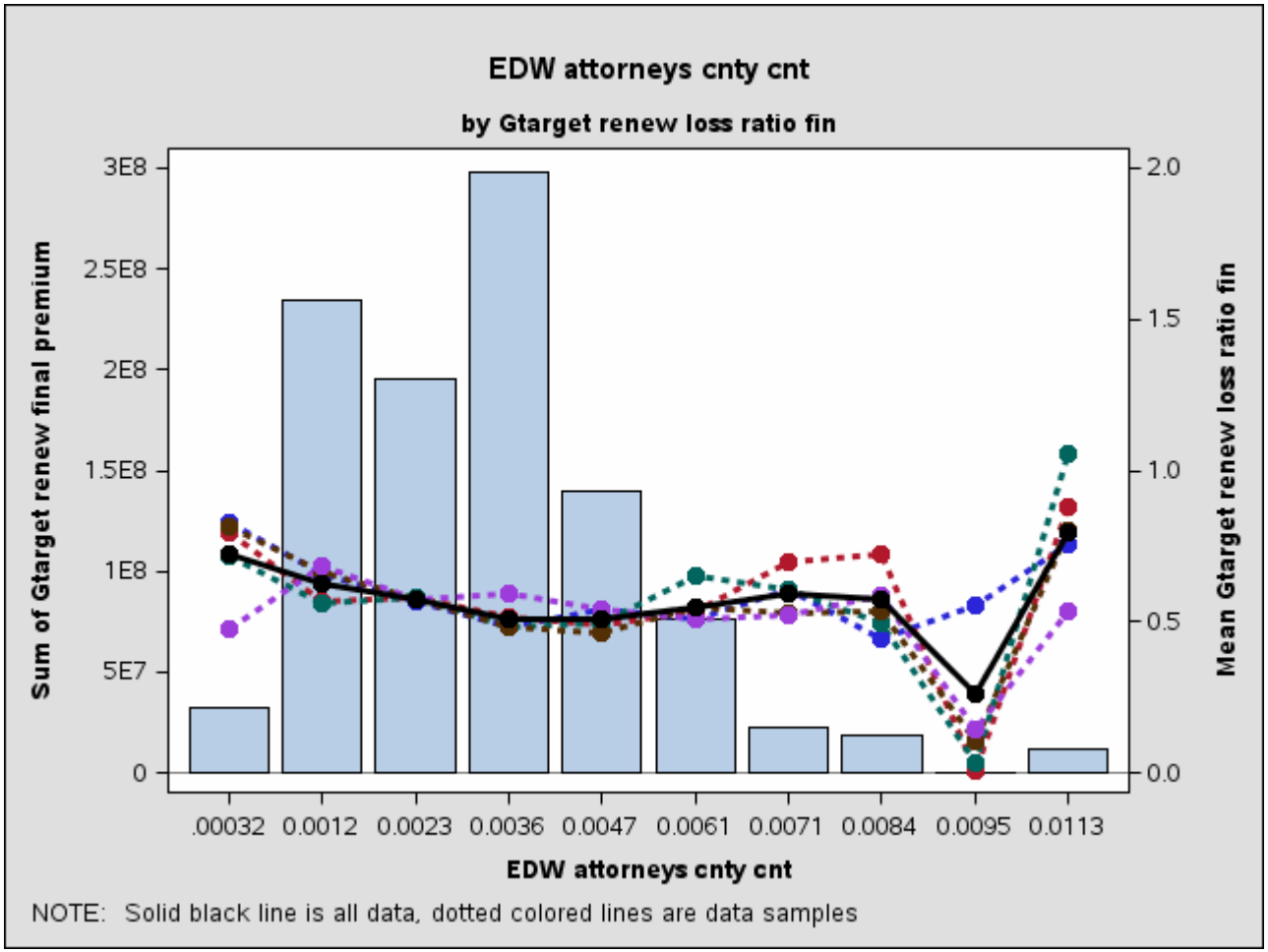
Number of Attorney's per County



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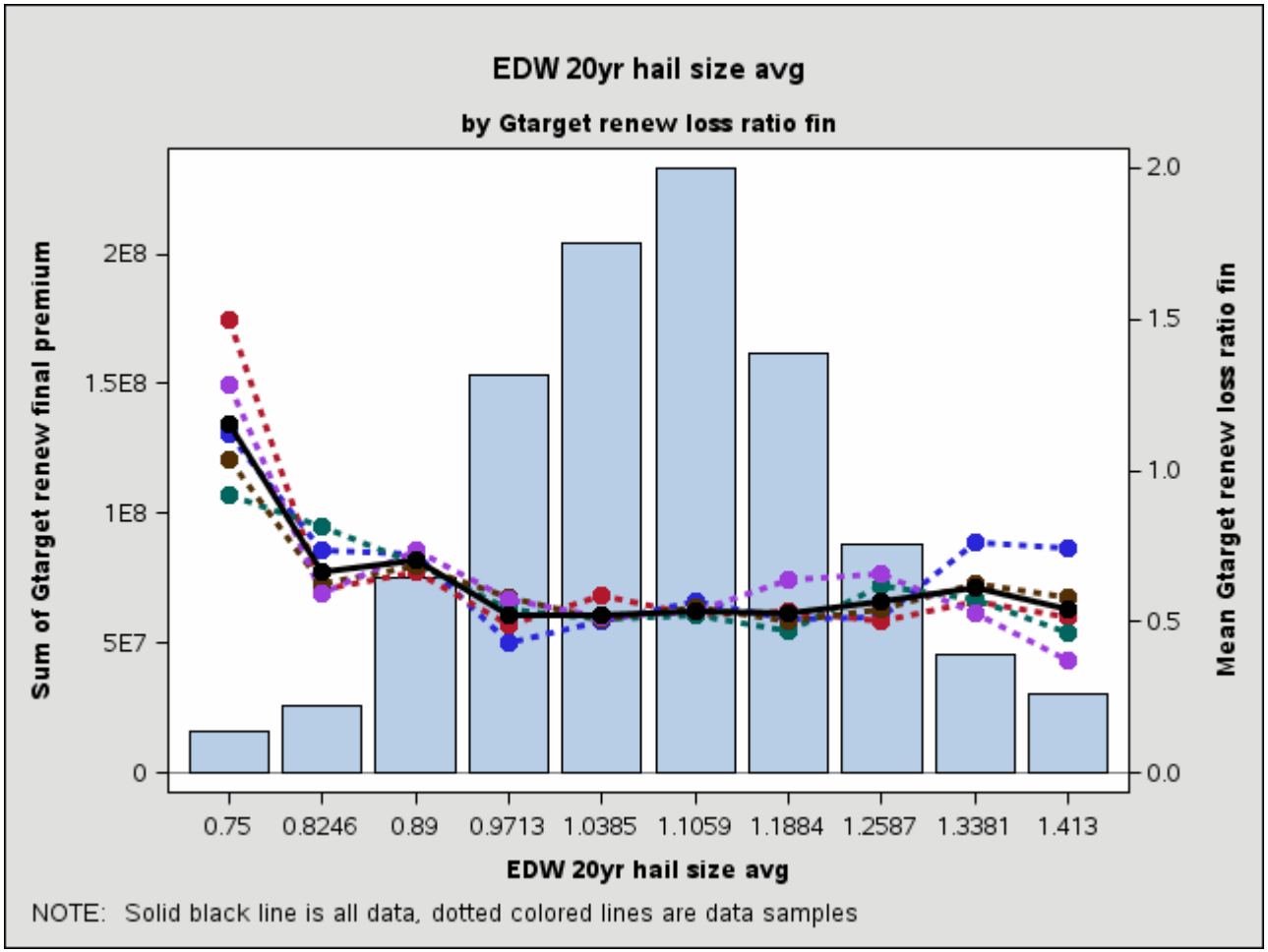
20-Year Average Hail Size



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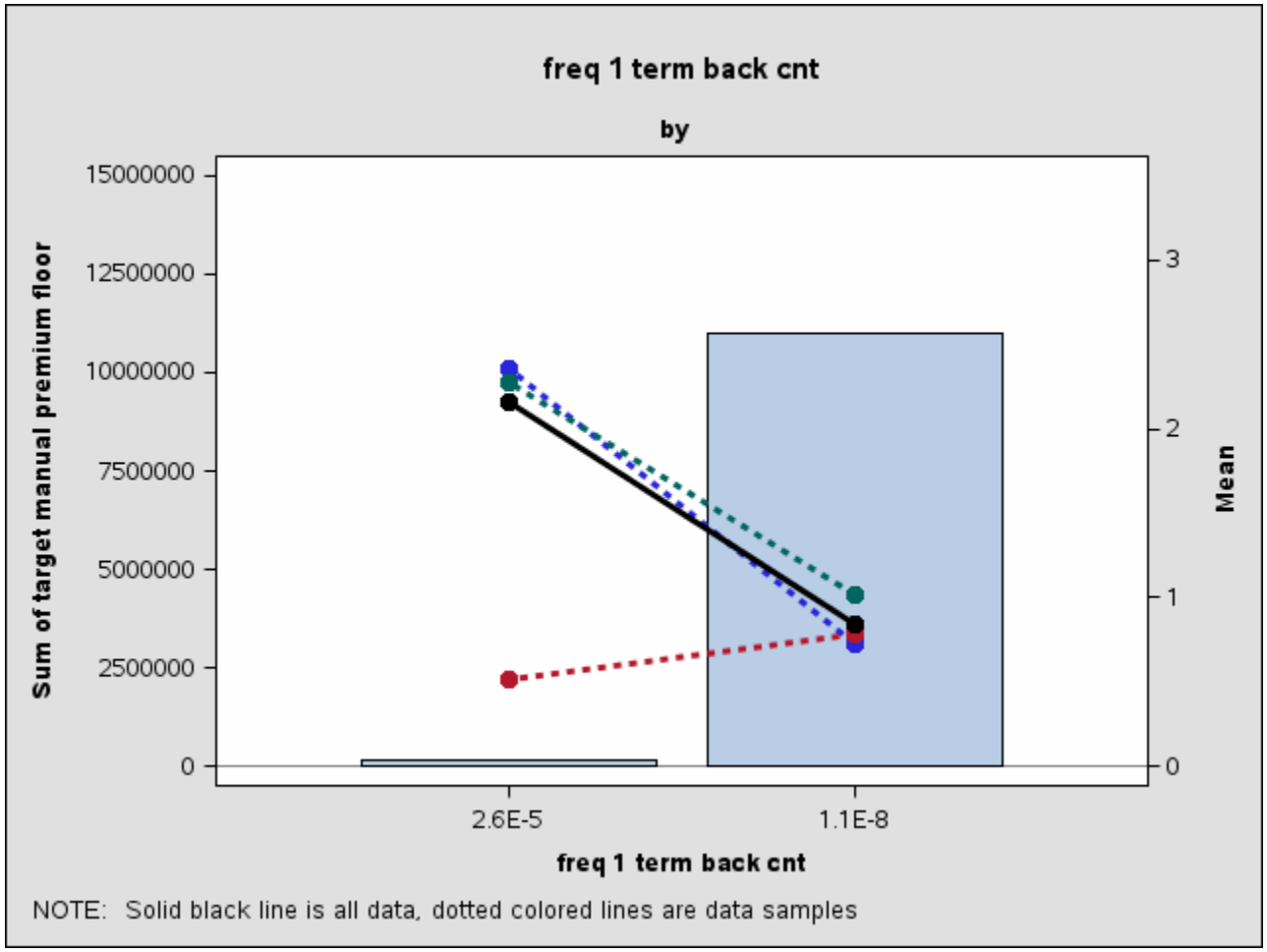
Frequency 1 Term Back



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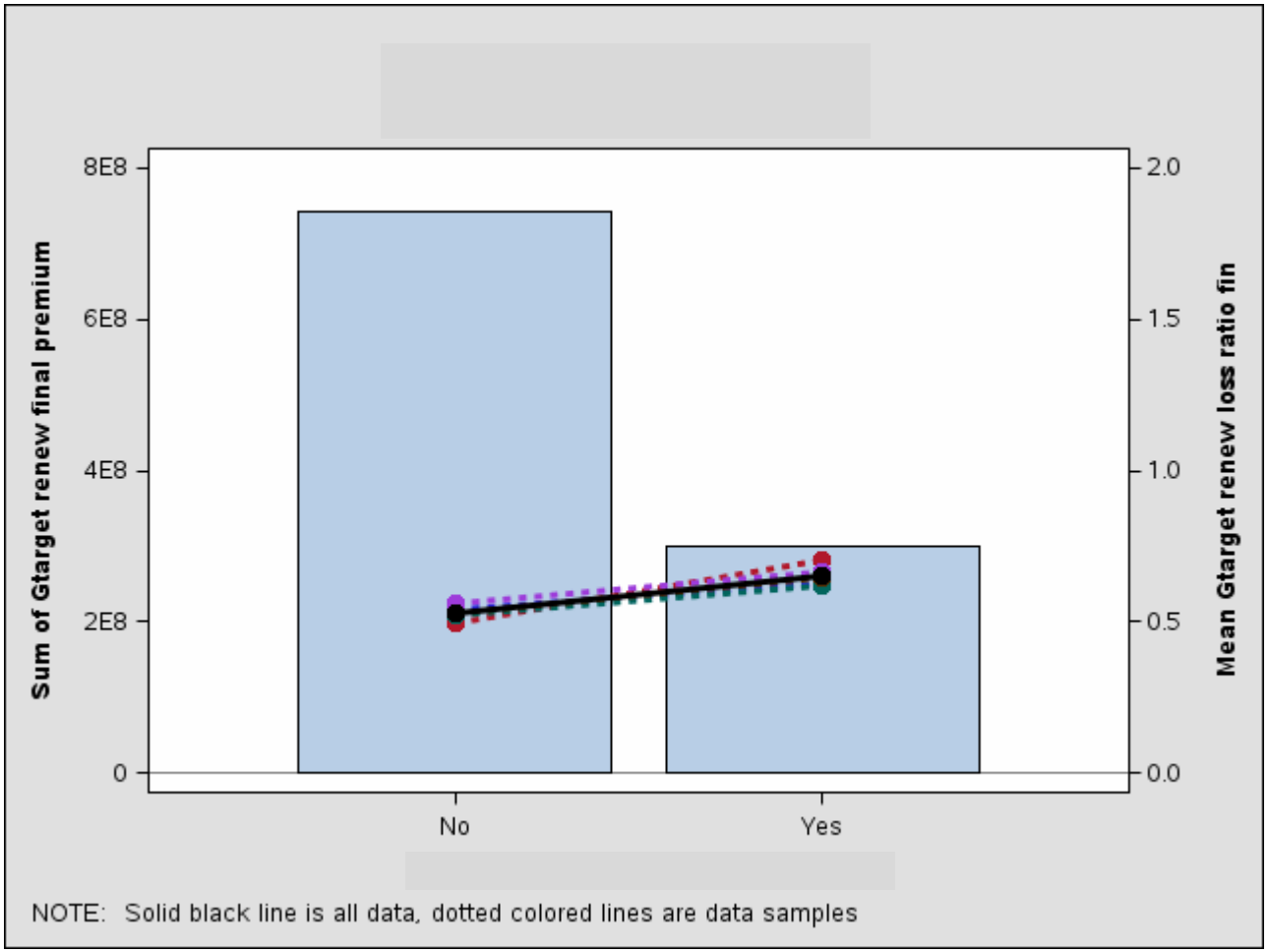
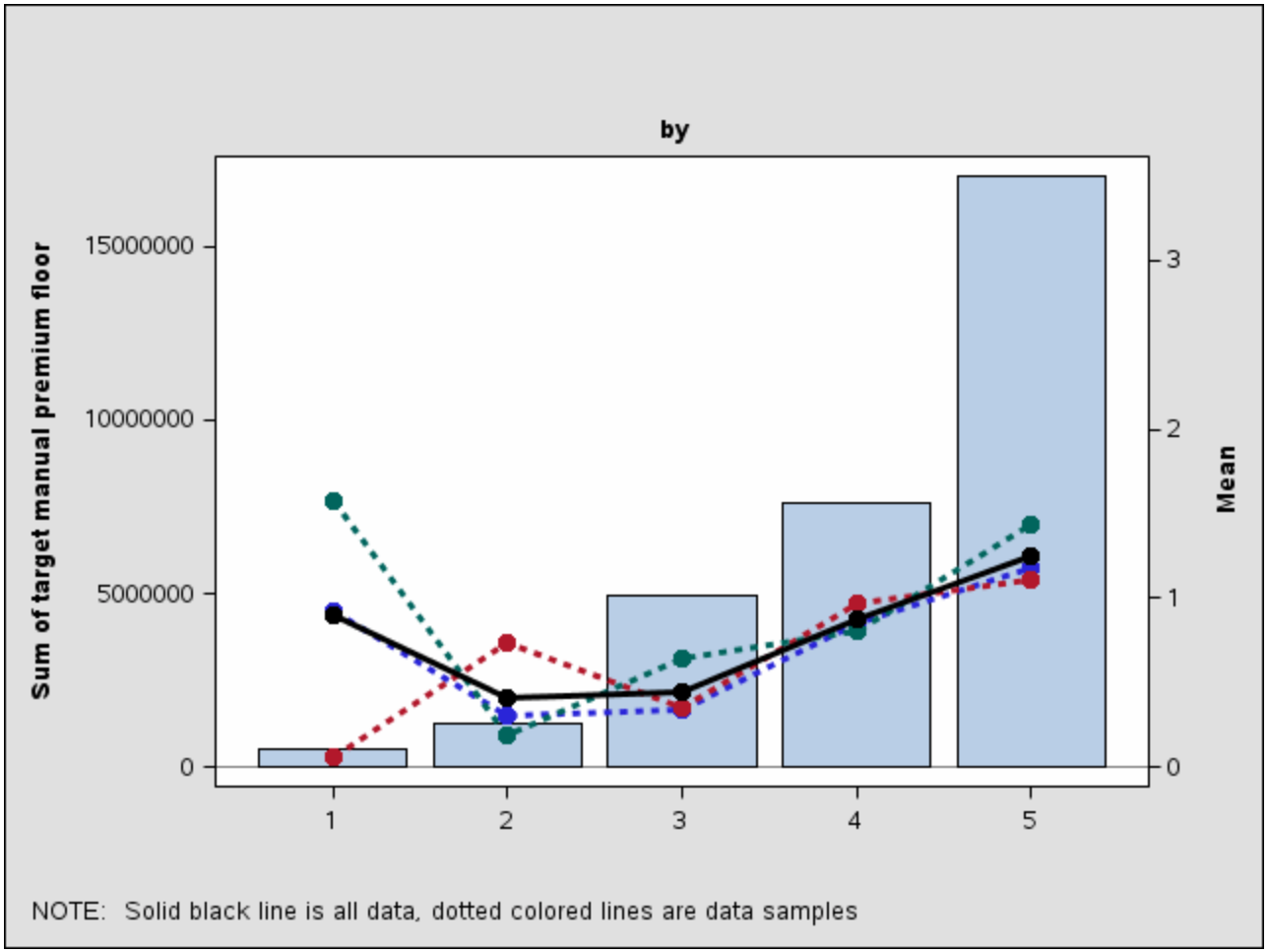
Late Reporting 30 days



Binned Manual Premium



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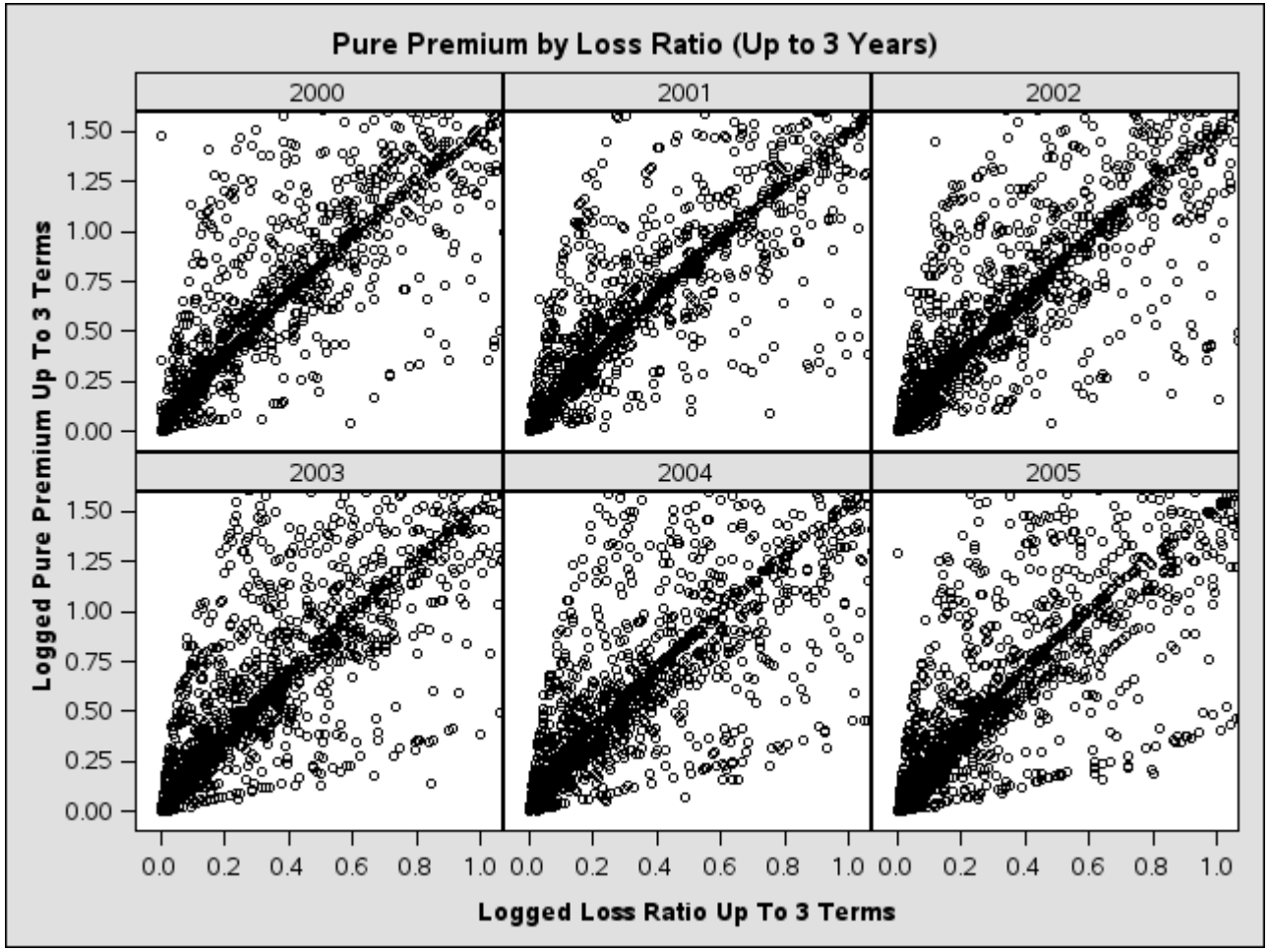
Principal Component



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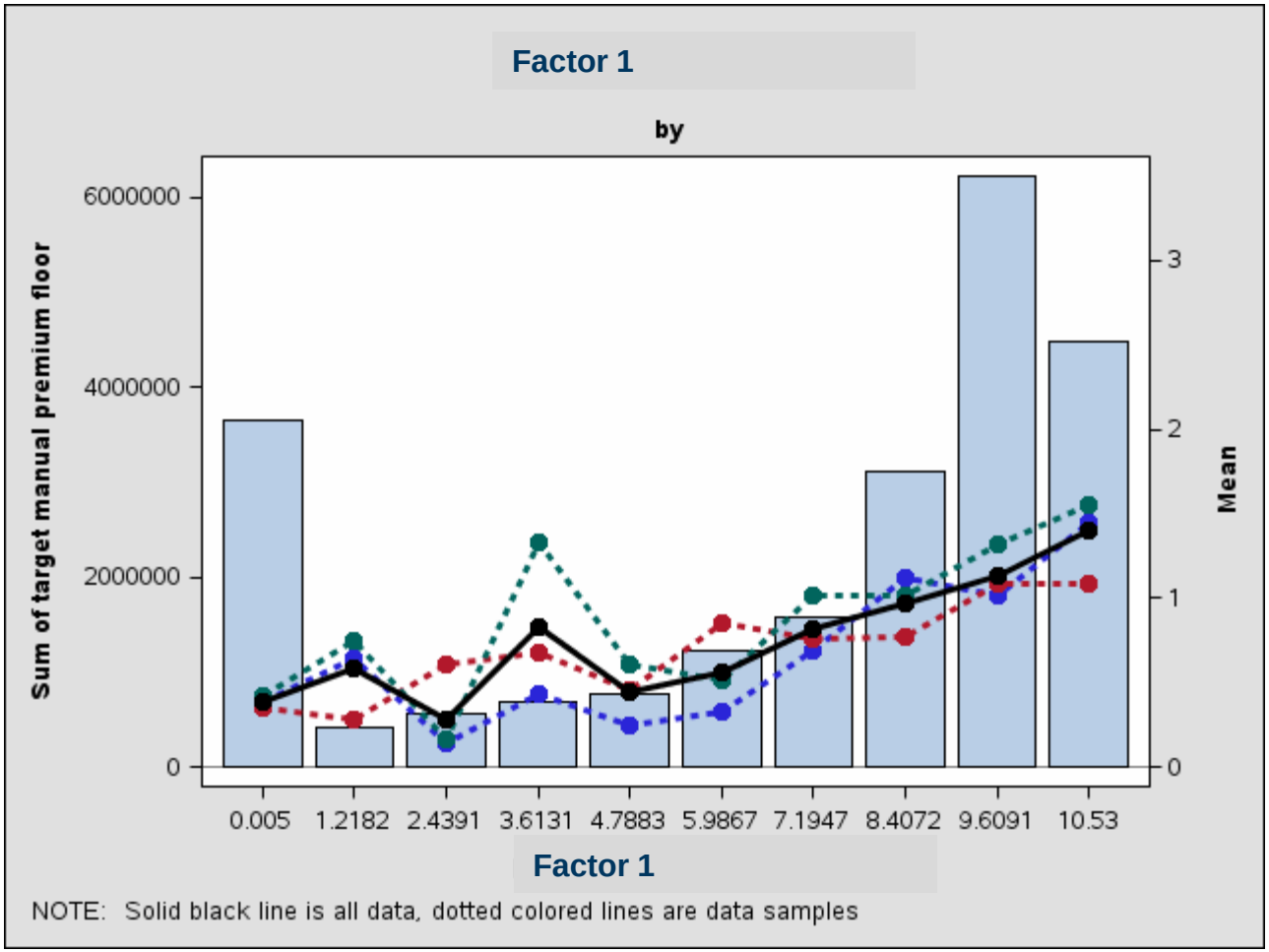
Principal Component



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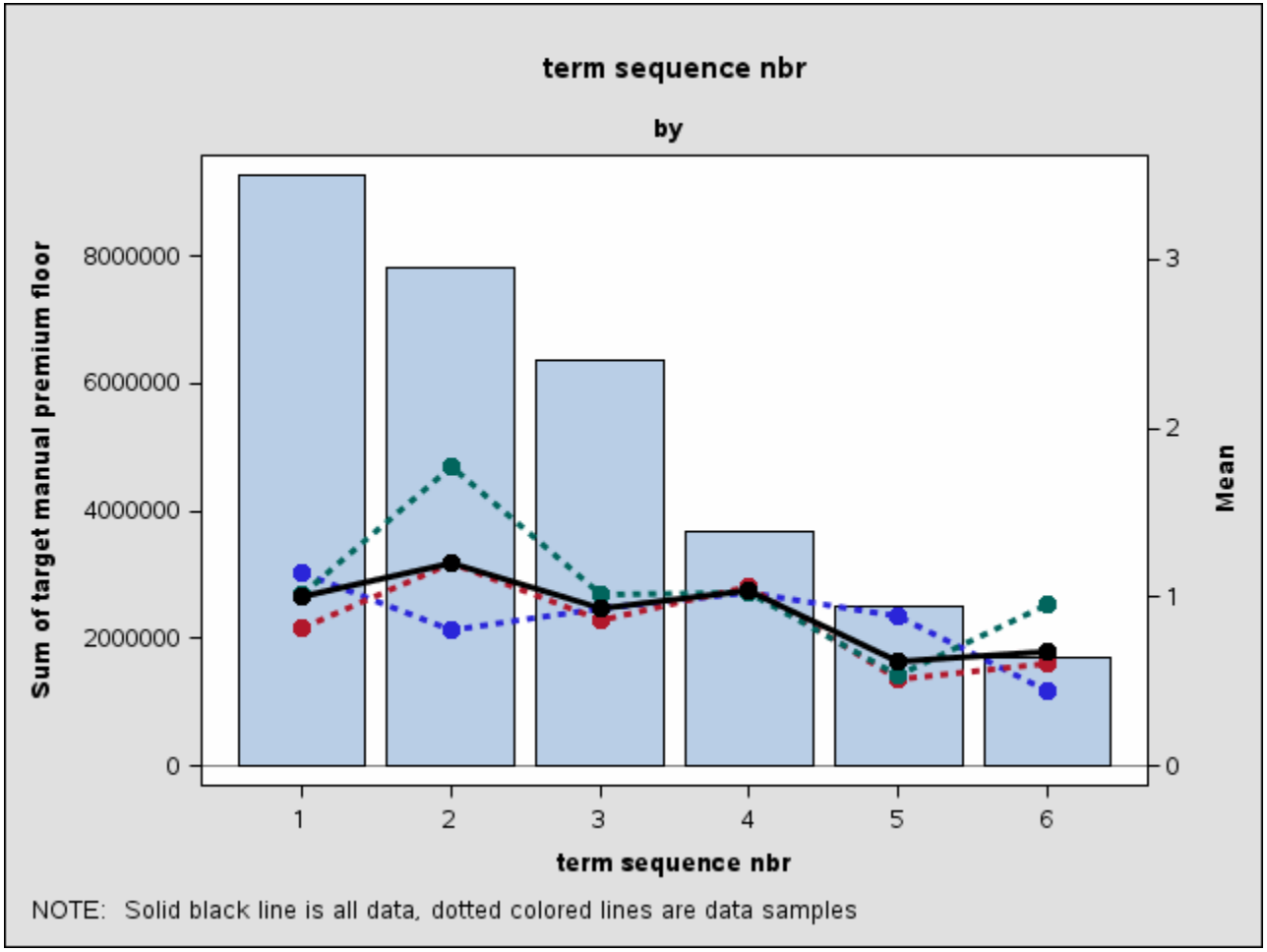
Term Sequence



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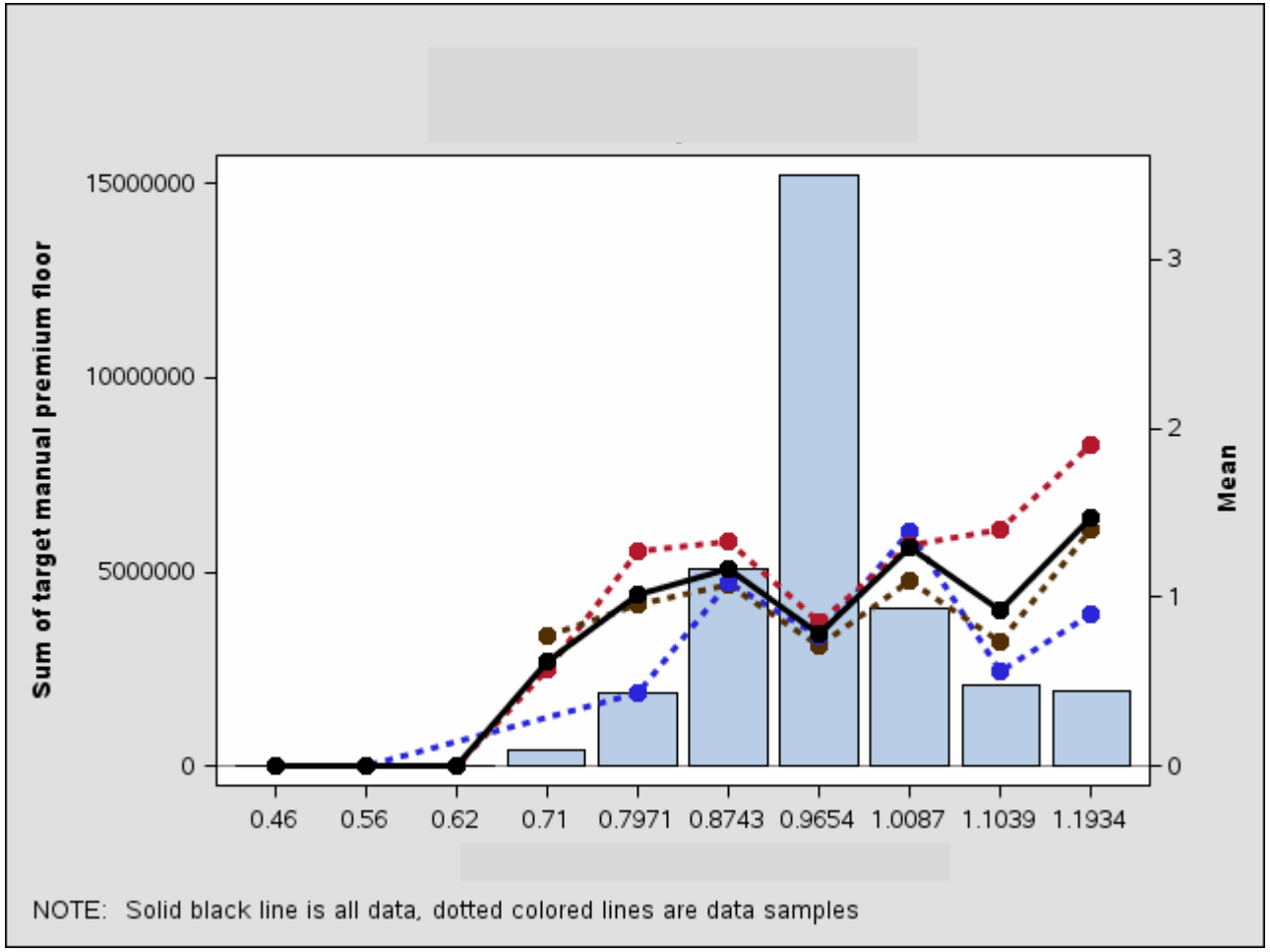
Natural Log of Class Code



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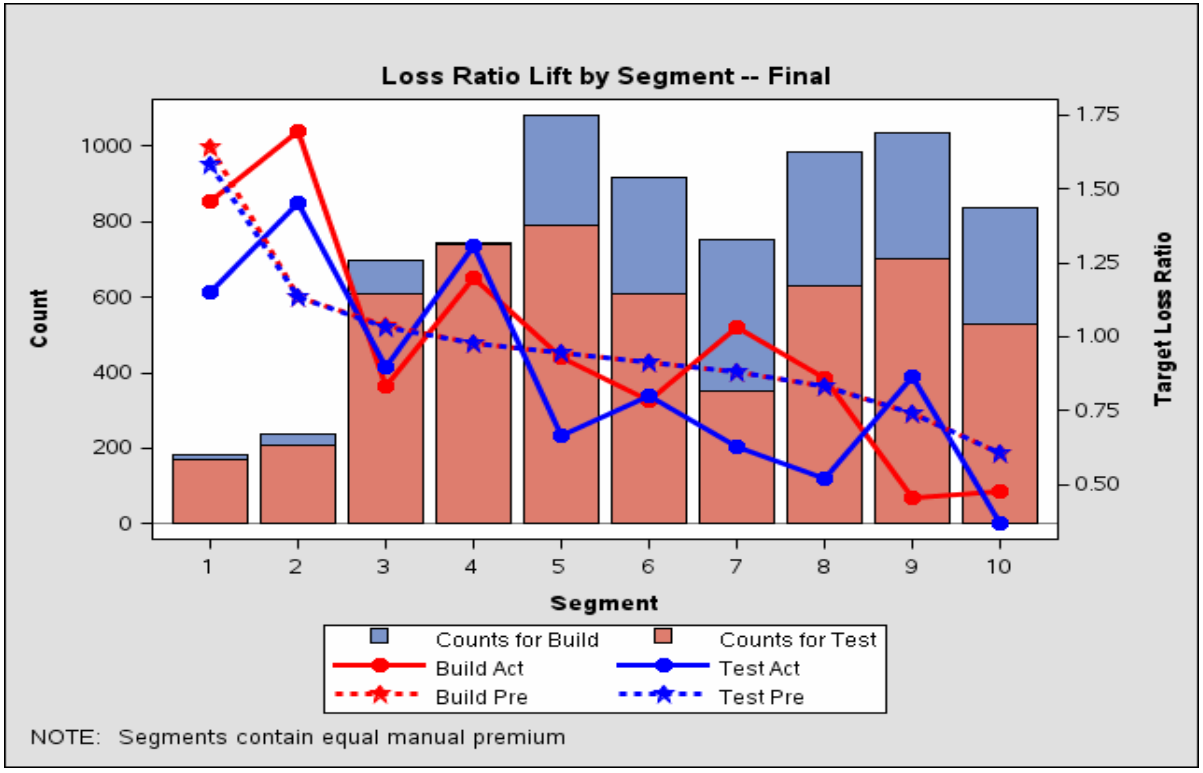
The Modeler Modifies Constraints and Assumptions

- Changed target to loss ratio
- Minimum premium floor
- Implied exposure for minimum premium
- Syncs risk variables to time of score (60 days prior to inception)
- Creates surrogates for risk factors not available in production
- Tries several other transformations or constructions of variables based on underwriter inquiries
- Changes target to score prior to schedule rating and after experience modification
- Changes independent variables to exclude ALAE

What happened???

Upon converting to Loss ratio...

the Predictive Modeler finds an interesting quirk…



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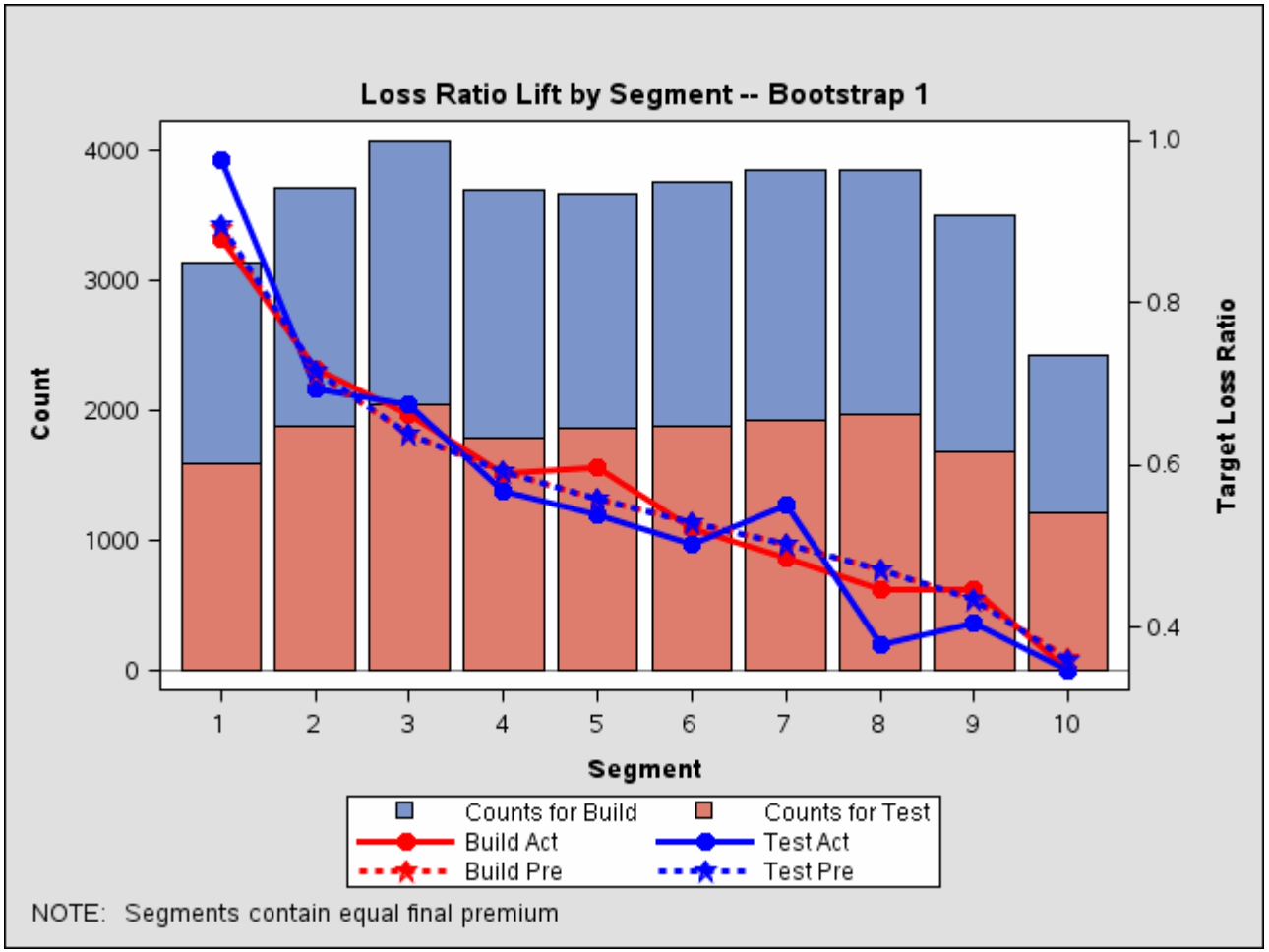
After Several Months

The underwriting department and the actuarial department get on the same page

Candidate Model Lift Curve



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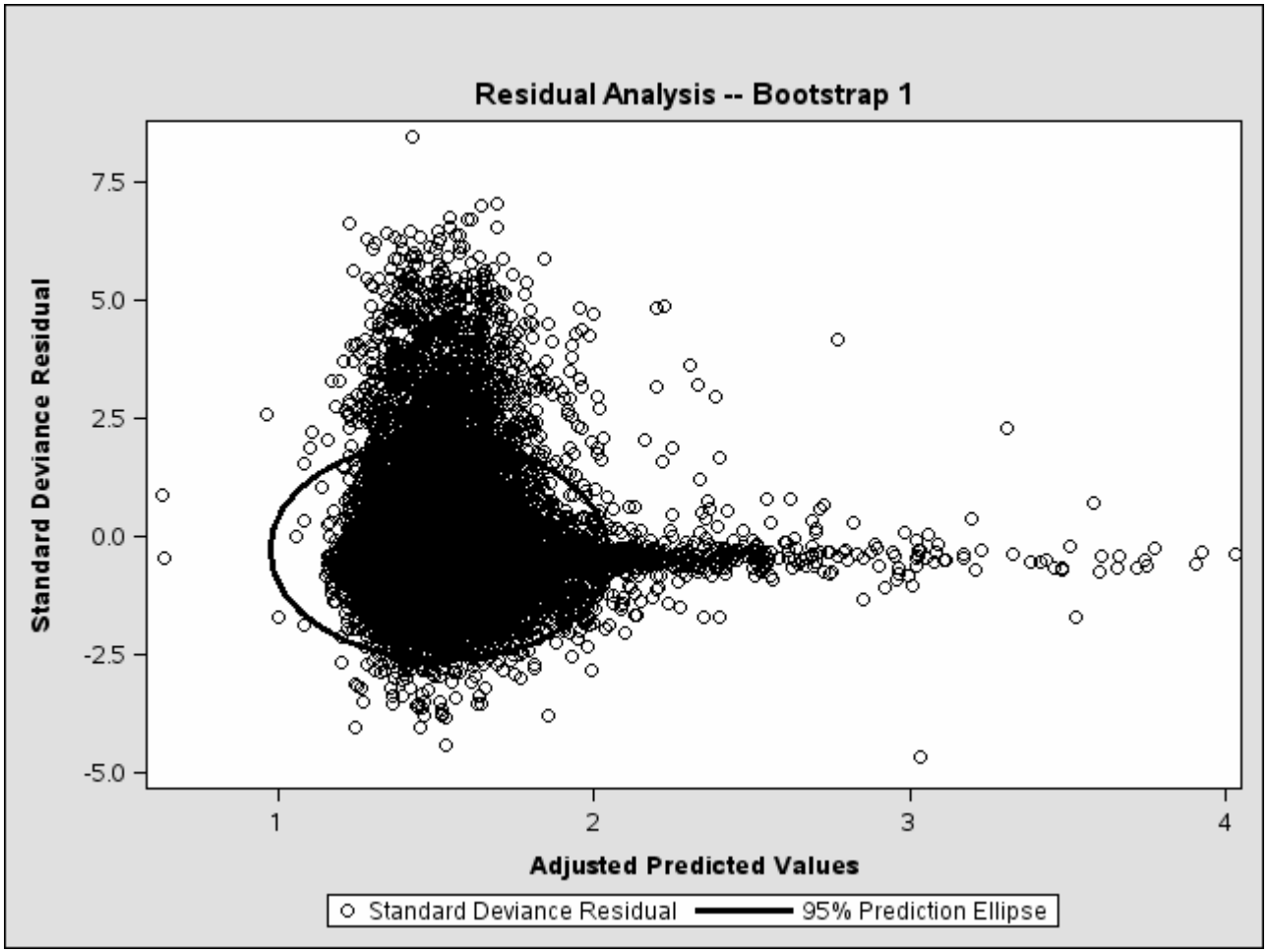
Standard Deviance by Adjusted Predicted



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A Short Vignette

The end...

Or

Is it?...

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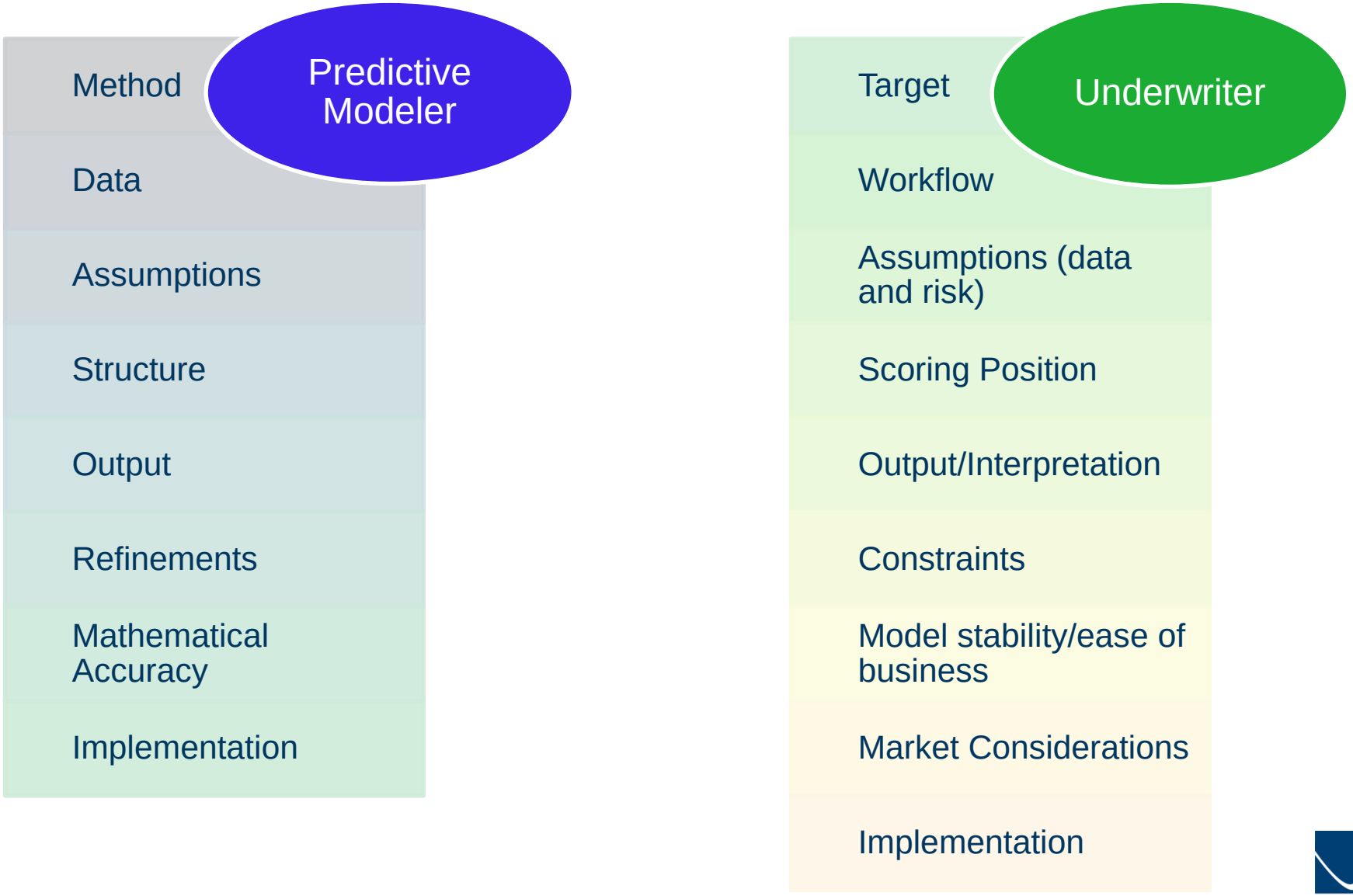
The Stage

- Intuition versus Empiricism
- Art versus Math
- Underwriting versus Predictive Modeling/Actuarial
- Collaborative Effort

Perspectives



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Method

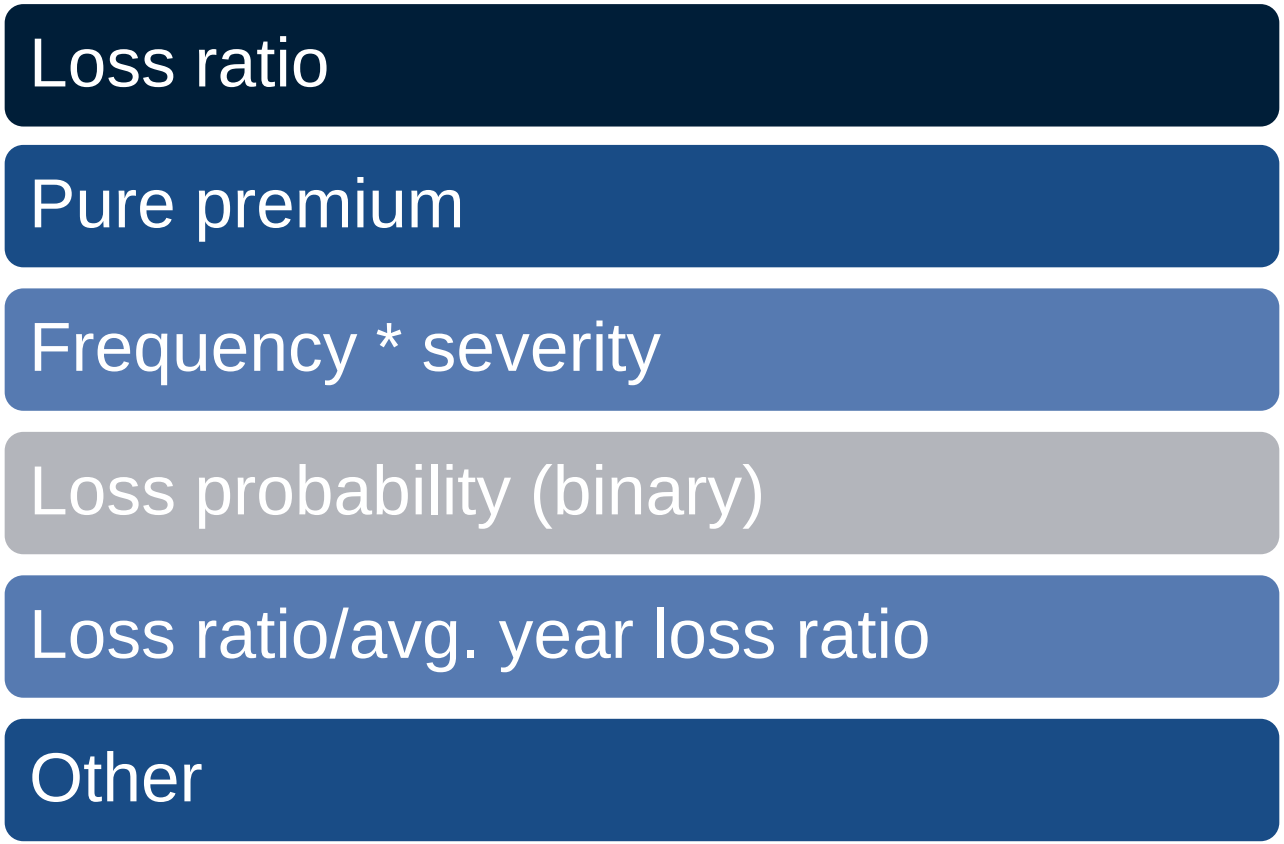
- If you can't explain it, don't expect others to understand it
- For example: generalized linear model (GLM) is …
  - Layman's explanation…
  - Statistician's explanation

$$E[Y_i] = \mu_i = g^{-1}\left(\sum X_{ij}\,\beta_j + \xi_i\right)$$

$$Var[Y_i] = \phi V(\mu_i)/\omega_i$$

…Huh?

Target



- What is the intent of the model?
- What other business rules are applied in the underwriting process
- How can the model build synergy with current best practices without being “constrained to fail”

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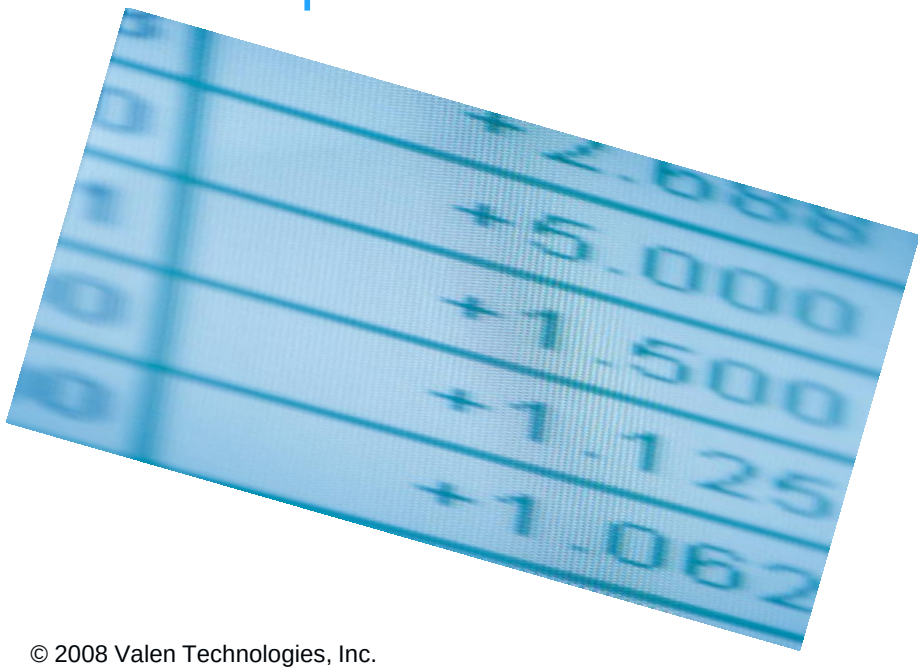
Workflow

- Where will the scoring engine live?
- At what point during the logical process will the model be used?
  - When will the output values be rendered to make a risk judgment?
- What data is available at time of scoring?
- What are the underwriters going to do before and after they render the outputs?
  - What judgments have they already made?
  - What judgments will they make post scoring?
- How does the workflow constrain the data or the scoring parameters?

Data

- How much (e.g. exposure, claim counts)
- States, years, class codes
- Explanatory variables
  - Huge opportunity to build rapport
- Data adjustments/transformations
- Data splits (e.g. hold-out samples for model validation)



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Assumptions

- Model assumptions
  - Link function
    - log ==> multiplicative
    - Identity ==> additive
    - Logit ==> probability
  - Distribution assumptions
    - Frequency (Poisson)
    - Severity (gamma)
    - Combine Frequency/Severity model results
    - Loss Costs (Tweedie)
    - Probability of loss (Binomial)
- Model assumptions
  - Loss ratio goal
  - Market penetration goal
  - Tier cuts based on production and market assumptions
  - Sync market forces with model tier cuts and constraints
  - Model uses production available data
  - Independent variables must pass test of reasonableness

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Model structure

Clearly define the variables in your models and the model structure.

- Equation:

$$E[\text{Loss Ratio}] = g^{-1}(\alpha + \beta.\text{freq 2 term avg} + \gamma.\text{emod amount} + \ldots)$$

- Table:

Variable	Intuitive	Production Available	Data Support
Freq 2T	Yes	Yes	Yes
Emod Amt	Yes or No	Maybe	Yes
Class bin	Yes	Yes	Maybe
…			

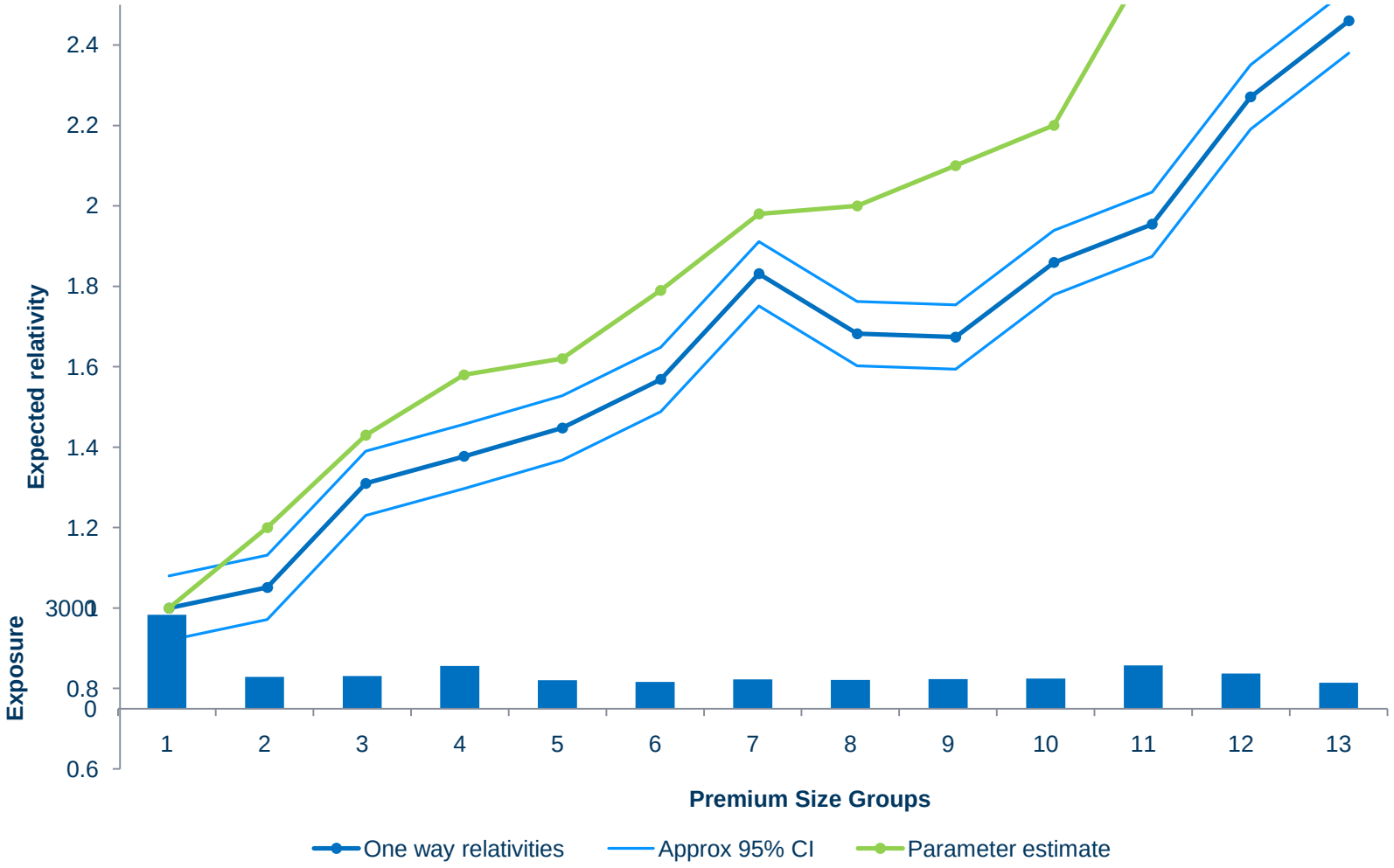
Data/Variable structure

Explain how specific variables are defined/structured.

- Continuous
- Categorical
- Interactions
- Restrictions
- Constructed
- Transformations

Reviewing univariate analysis with underwriting is key!

Model output



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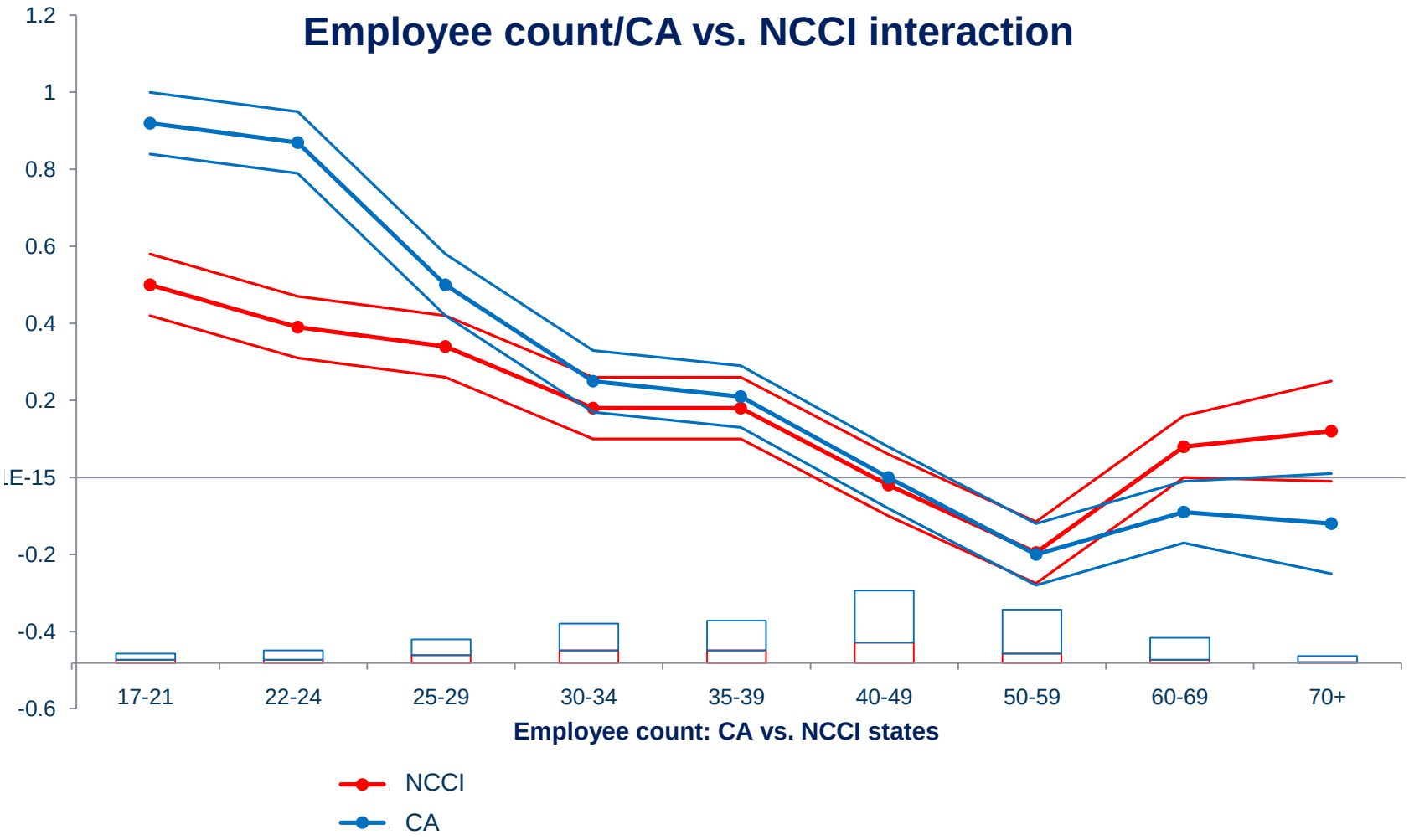
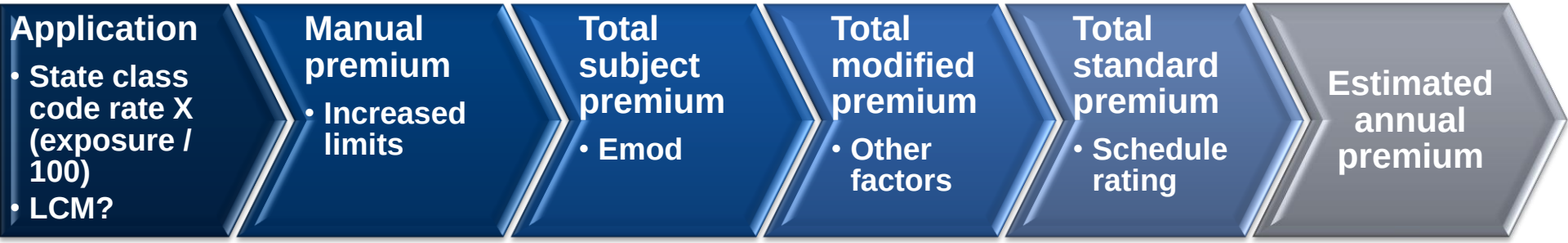
GLM output



Scoring Position



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Production Outputs and Interpretation

- Loss ratio
- Pure premium
- Expected Loss
- Avg. bin loss ratio
- Score?
- Risk grade

How will underwriters interpret results. What pitfalls can be avoided upfront?

Refinements

- Based on discussions with underwriting and business partners
- Likely changes arising from:
  - Regulatory
  - Acceptability
  - Explainability
  - Business knowledge
  - Business rules/philosophy
  - Availability

Constraints

- Rating plan limitations
  - Minimum premiums
  - Pool business
  - Per capita rated policies
  - Schedule rating caps
  - Discontinued classes/risk types
  - Business rules
    - Are they available in the data?

Model Stability vs. Ease of Business

- 3 year historical loss and pure premium variables
- Frequency variables
- Severity variables
- Exposure
- Historical premium
- Employee count

How much information is too much? This question must be asked at the outset.

Statistical Accuracy

- Parameter point estimate
- Standard errors
- Policy level prediction
- Credibility of policy level results?
- Bin Framework
- New paradigm shift for underwriting
  - Policy predictions by virtue of its inclusion to a bin with policies of like charateristics

A (Very) Short Vignette (Revisited)

Collaboration is critical...

the Predictive Modeler and
the Underwriter

Learn from each other...

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Questions???

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