



**TOWERS
PERRIN**

TILLINGHAST

Implementing a New Auto Rating Structure Using Predictive Modeling

What We Did *and* What We Learned

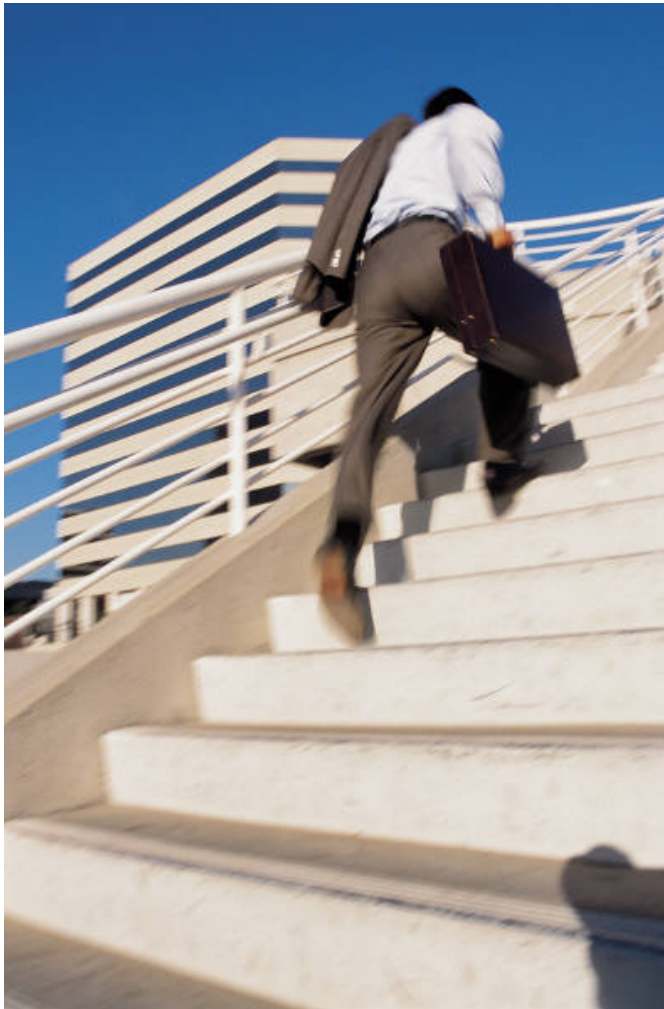
**Concurrent Session PM-4
2007 CAS Ratemaking Seminar**

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Don Closter, ACAS, MAAA — Horace Mann Insurance Companies

As actuaries, we tend to focus on the theory behind predictive models

- What are generalized linear models?
- What do they do?
- How do they do it?
- How do we build a predictive model?
- How do we translate the model output into a revised class plan or a tiering structure?

This session is designed to go to the next step



- Once the decision is made to get involved in predictive modeling, what comes next?
- What are the implementation issues?

Some implementation questions that should be answered before the modeling begins

- Who will do the modeling? Staff? Consultants?
- What lines of business? Auto? Homeowners? Other?
- What data will be used? Internal? External?
- Will the result be a revised class plan or a tiering model? Other?
- Will the results of the modeling apply to all business or new business only?
- How long will it take?
- How much will it cost?

Some additional questions that need to be answered before the modeling complete

- What systems support is needed?
- Who will be responsible for regulatory compliance?
- What policyholders will be impacted by the implementation of the results of the modeling?
- What will the impact be on those affected by the model?
- What are the reactions of field personnel?
- Is training required for marketing and underwriting personnel?

Horace Mann Insurance Companies recently went through this process

- Here to share some thoughts about his experience implementing predictive modeling is Don Closter, AVP of Pricing Research at Horace Mann

Don Closter

- Responsible for developing and implementing predictive modeling for Horace Mann
- Twenty-eight years in actuarial pricing field with Horace Mann, Nationwide and Hanover
- Associate of Casualty Actuarial Society and member of the American Academy of Actuaries
- Graduate of Kent State University

Outline

- Resources
- Data
- Algorithm Design
- Model Output
- Histograms
- Systems Issues
- Peer Review
- Testing
- The Production Environment
- Filing / FAQ's
- Communication
- Follow-up and Measurement
- The Future



What It Takes — Item #1

Commitment to a long-term project

- People: 5 people half days
- Time: About 2 years for first state
- Learning curve for the software and incorporating new ideas
- Continuous research maintenance



What It Takes — Item #2

Predictive modeling software

- A number of different software packages are available
- Software analyzes policy level parameters on a multivariate basis so covariance and interactions can be accounted for
- Important to have a source for help



What It Takes — Item #3

Hardware to efficiently run the software

- Lots of data (millions of records) are being analyzed at once so computing capacity can become an issue
- Our initial analysis runs in some cases took 8 or more hours to run
- We ended up purchasing a server dedicated to the research area and made some technical changes to reduce the run time for the largest analyses to an hour or two
- This is also where service after the sale of the software product comes in handy



Data is King

- The first painful step is getting clean data in an acceptable format **at a policy level**
- Take 4 – 8 months to understand data and clean it up at a detailed level
- You need to understand the data coding process including policy input, coding changes over time, claims coding and how to connect policy data with claim data



Data is King — part 2

- You will most likely find:
 - Invalid codes
 - Codes with multiple meanings
 - Data not updated or maintained
 - Blank fields
 - Dummy data
- These items need to be identified and fixed going forward so the problems don't perpetuate
- You also need to consider correcting historical data based on the value that data can provide weighed against the cost of correction



Algorithm Design

- What is your market focus?
- How much detail will you require?
 - Additional field data input
 - Purchased data
- Model type (multiplicative, additive, ...)
- Model complexity (overall factors, by coverage,...)
- Interactions — where do you put them, how many do you include, how complex do you make them?
- Will systems be able to support the new design?



General Approach

- Maintained the overall indication process at the individual state level
- Also maintained territory indication process at the individual state level
- Predictive modeling is done at a Countrywide level
 - To allow sufficient data at the individual variable level to generate stable and credible indicated relativities
 - To allow the predictive modeling to be done by the research area where the modeling expertise resides



General Approach

- Some variables (like limits and deductibles) may not yield useable relativities
- These can be analyzed separately, using an LER study for instance, and then offset in the predictive model



Model Output — part 1

Interpretation

- Frequency / severity / pure premium
- Standard error and percent
- Interactions
- Identifying significant parameters and interactions
- Lots of graphs



Model Output — part 1

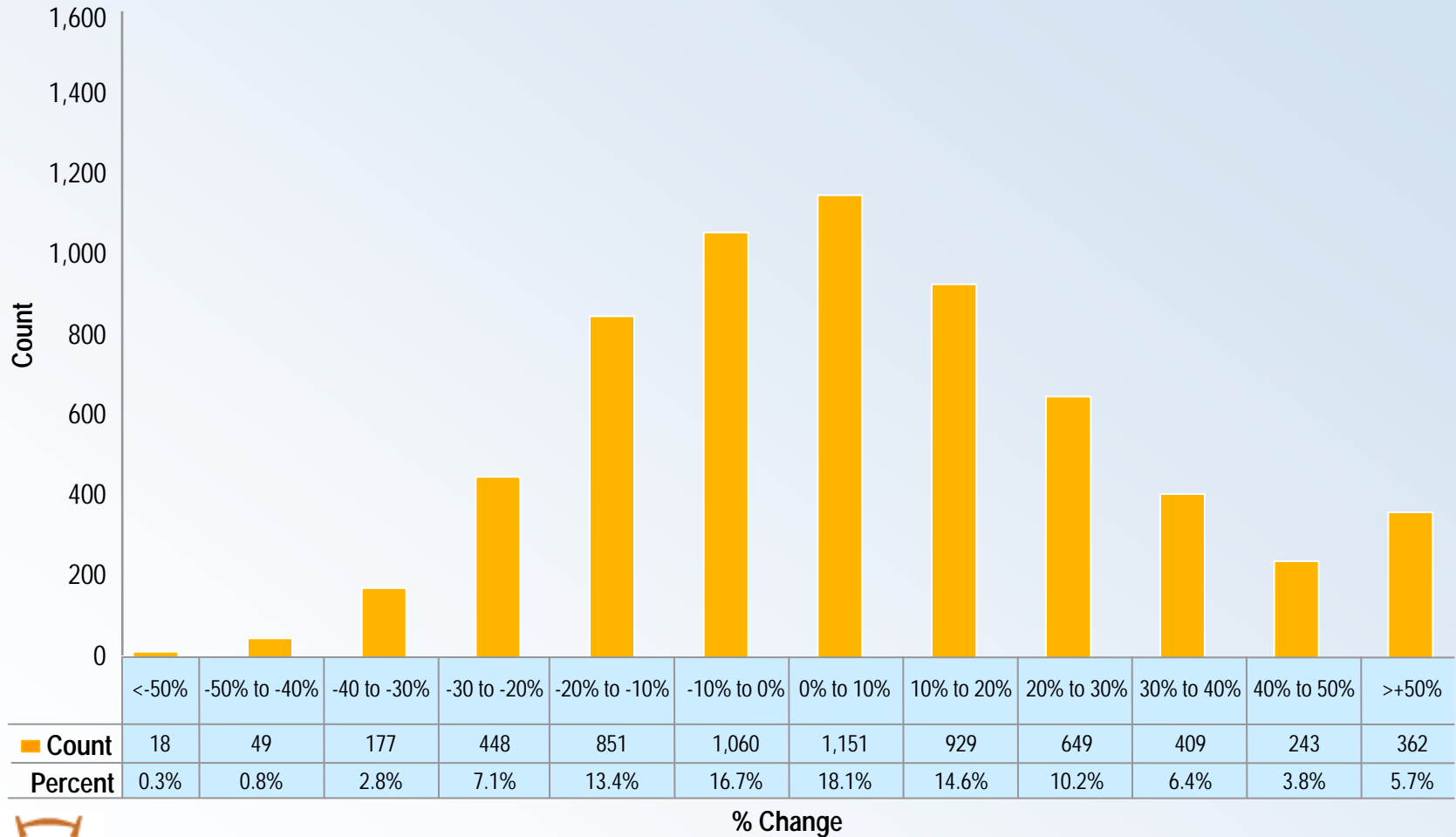
Analysis and Adjustments

- Histograms
- Policy lists
- Competitive position
- Smoothing / fitting / offsetting / controlling extremes
- Lots of iterations because the models are multivariate



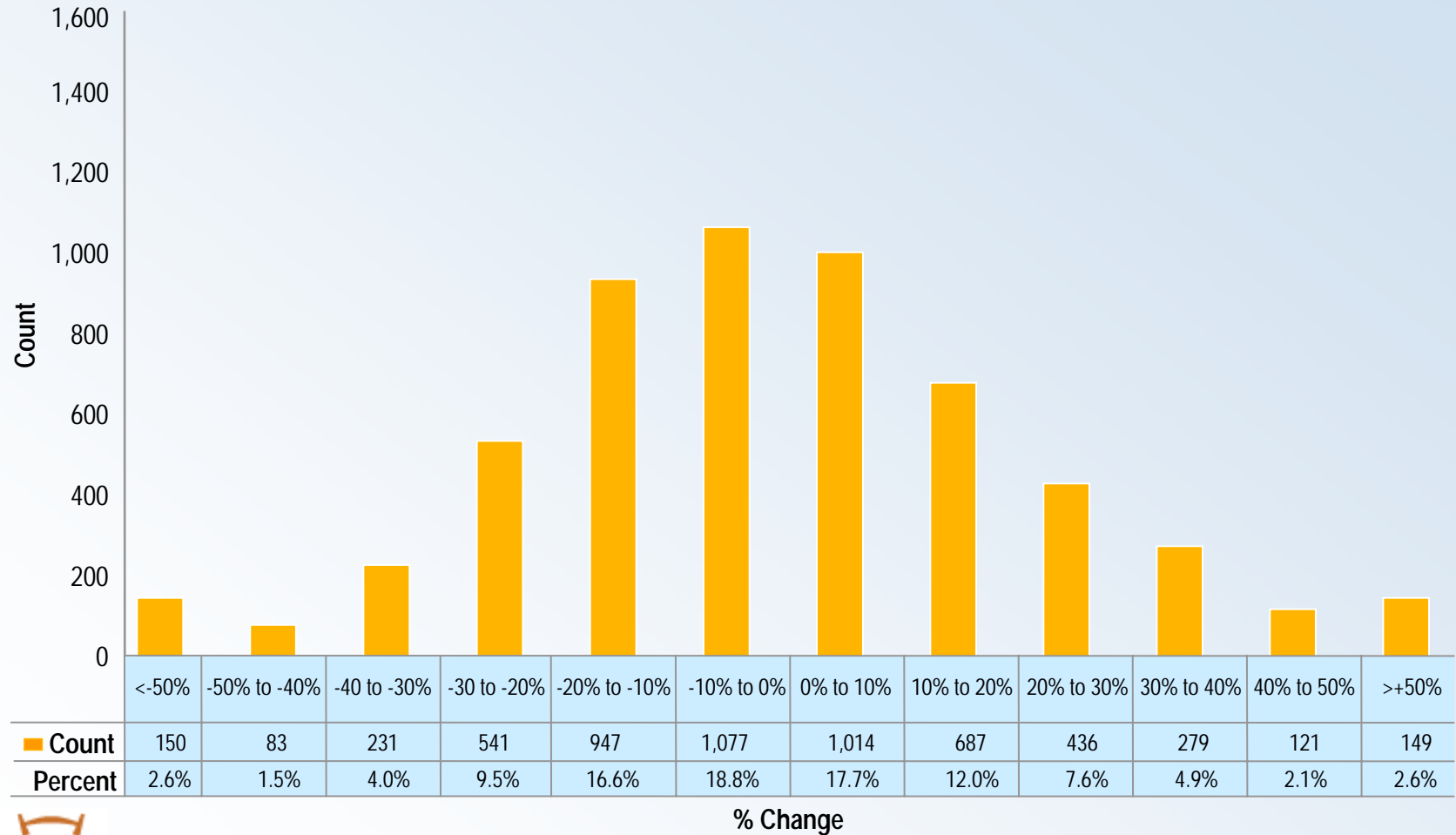
Model Output — part 1

Sample Histogram — State A round #1



Model Output — part 1

Sample Histogram — State A round #10b



Model Output — part 2

Decisions

- New business only
 - May need a clean charter to do this
 - Maintain multiple algorithms
 - Slower impact of new model advantages
 - Need some kind of transition plan



Model Output — part 2

Decisions

- In-force impacts
 - Can generate significant premium swings on implementation
 - Need to temper impacts to generate desired effects



Model Output — part 2

Tailoring

- State specific issues
- Marketing, underwriting, regulatory and systems issues



Systems Issues

- Get systems involved early so you can tailor the algorithm, data acquisition, and data manipulation to accommodate system constraints
- Opportunity to discuss system needs for the future



Peer Review of first state

- Unique new method so want to make sure we are doing the right thing and are comfortable with the results
- Gain insights into:
 - How to review the output
 - Approaches used by others
 - Additional parameters or ways of looking at things in the future



Testing

- Too many combinations to test everything so focus on educated sampling
- We built several test sets:
 - Imaginary policies focusing on changes occurring in the interaction tables
 - In-force policy rating from histogram compared to mainframe rating



The Production Environment

- Once a state or two is in production, management will be screaming for lots of implementations in a short timeframe
- Take some time to clean up the process so it can be turned over to the pricing actuaries
 - If you don't, the research area will end up doing production pricing and be a bottleneck in the implementation process



Filing

- Generally describe multivariate approach
- Preliminary conversation with DOI so they know what is coming
- Simplify descriptions of what is happening in general terms rather than swamping with lots of numbers and pages
- Build FAQ's



FAQ Examples

- What software was used?
- What is the experience period?
- What volume of data was used?
- Was all the data company specific?
- Was **f** and **s** modeled separately? Why?
- How did we determine which rating variables to put in the model?
- What is the difference between ‘simple’ rating factors and ‘interaction’ factors? Are they both used in the algorithm?



Communication

- **Everyone** needs to know this is a very big change — especially the agency force, marketing, and customer service
- Agents need to:
 - Be comfortable with the screens and data required for quoting a risk
 - Understand that there are complexities in this model that make traditional terms like ‘discount’ and ‘surcharge’ meaningless
 - There are only rating factors associated with the characteristics of the risk
 - Understand that there will be significant changes to policies as they renew



Follow-up and Measurement

- Be sure to get a key variable snapshot of your book of business prior to implementing a new rating structure
 - Provides a benchmark or starting point for measuring the impact of the new model
 - Comparisons should include:
 - Growth measures
 - Retention measures
 - Profitability measures
 - Distribution shift measurements



Results so far

- Based on combined 11 states where the new rating structure has been in place long enough to obtain experience, compared to states with the old rating structure over the same time period:

Change Over Prior Year		
New business growth:		
Old algorithm	+15%	1000 to 1150
New algorithm	+45%	1000 to 1450
Retention:		
Old algorithm	improved by +1.6%	90.0% to 91.4%
New algorithm	improved by +1.2%	90.0% to 91.1%
Loss ratio:		
Old algorithm	deteriorated by 9.6%	55.0% to 60.3%
New algorithm	deteriorated by 9.9%	55.0% to 60.4%
Distribution shifts:		
Difficult to measure rating structure impact because of other activities		
Seeing shift toward target educator market & better insurance scores		

The Future

- Set up regular (annual) review of CW rating factors
- Measure and understand changes from prior model
- Look for additional rating variables
 - Appending external data
 - Collecting additional information
 - Designing scoring mechanisms
- Develop approaches with underwriting and marketing to take advantage of non-pricing information



