

Regulatory Review of Predictive Models

*Presentation at the
Casualty Actuarial Society's (CAS)
Ratemaking, Product, and Modeling (RPM) Virtual Seminar*



Eric Hintikka, Sandra Darby, Gennady Stolyarov

Moderator Kris DeFrain

March 16, 2021

Regulatory Review of Predictive Models

Eric Hintikka, ACAS, MAAA



Actuary, Texas

March 16, 2021

Introduction

☞ Draft white paper: *Regulatory Review of Predictive Models*

- Charges and Scope
- Agreed Principles
- Best Practices
- Drafting Issues Addressed
- Other Content
- Status of Paper

Charges to Casualty Actuarial and Statistical (C) Task Force

Product Filing
Review Handbook

- Draft and propose changes to the *Product Filing Review Handbook* to include best practices for review of predictive models and analytics filed by insurers to justify rates.

State Guidance

- Draft and propose state guidance (e.g., information, data) for rate filings based on complex predictive models

The Regulator's "Problem"

When reviewing a rate filing that is based in whole or in part on predictive model, the "problem" regulators want to solve is probably better posed as seeking an answer to this question:

How can regulators determine that predictive models, as used in rate filings, are compliant with state laws and regulations?

Agreed Principles

State insurance regulators will...

Maintain current rate regulatory authority and autonomy

Be able to share information

Share expertise and discuss technical issues

Maintain confidentiality in accordance with state law

Best Practices for Regulatory Review

Ensure compliance with rating laws; Rates shall not be excessive, inadequate, or unfairly discriminatory

Review all aspects of the model: data, assumptions, adjustments, variables, input, and resulting output.

Evaluate how the model interacts with and improves the rating plan.

Enable competition and innovation.

Best Practices for Regulatory Review

- ☞ Ensure compliance with rating laws; Rates shall not be excessive, inadequate, or unfairly discriminatory.
 - Review the overall rate level impact of the proposed revisions to rate level indications provided by the filer.
 - Determine that individual input characteristics are related to the expected loss or expense differences in risk.
 - Review the premium disruption for individual policyholders and how the disruptions can be explained to individual consumers.
 - Review the individual input characteristics to and output factors from the predictive model (and its sub-models), as well as associated selected relativities, to ensure they are compatible with practices allowed in the state and do not reflect prohibited characteristics.

Best Practices for Regulatory Review

- ∞ Review all aspects of the model: data, assumptions, adjustments, variables, input, and resulting output.
 - Obtain a clear understanding of how the selected predictive model was built.
 - Determine that the data used as input to the predictive model is accurate, including a clear understanding how missing values, erroneous values and outliers are handled.
 - Determine that any adjustments to the raw data are handled appropriately, including but not limited to trending, development, capping, and removal of catastrophes.
 - Obtain a clear understanding of how often each risk characteristic used as input to the model is updated and whether the model is periodically refreshed, so model output reflects changes to non-static risk characteristics.

Best Practices for Regulatory Review

- ∞ Evaluate how the model interacts with and improves the rating plan.
 - Obtain a clear understanding of the characteristics that are input to a predictive model (and its sub-models).
 - Obtain a clear understanding how the insurer integrates the model into the rating plan and how it improves the rating plan.
 - Obtain a clear understanding of how model output interacts with non-modeled characteristics/variables used to calculate a risk's premium.

Best Practices for Regulatory Review

∞ Enable competition and innovation.

- Enable innovation in the pricing of insurance through acceptance of predictive models, provided models are in compliance with state laws, particularly prohibitions on unfair discrimination.
- Protect the confidentiality of filed predictive models and supporting information in accordance with state law.
- Review predictive models in a timely manner to enable reasonable speed to market.

Content of White Paper

- ✎ Proposed Changes to the Product Filing Review Handbook.
- ✎ Proposed State Guidance, including information elements for a regulator to meet Best Practices' objectives when reviewing a GLM.
- ✎ Glossary of terms.
- ✎ Sample rate-disruption template.
- ✎ Other considerations.

Information Elements

79 Information Elements appear in Appendix B organized as follows:

- Selecting Model Input
 - Available Data Sources
 - Sub-Models
 - Adjustments to Data
 - Data Organization
- Building the Model
 - High-Level Narrative for Building the Model
 - Medium-Level Narrative for Building the Model
 - Predictor Variables
 - Adjusting Data, Model Validation and Goodness-of-Fit Measures
 - “Old Model” Versus “New Model”
 - Modeler Software
- The Filed Rating Plan
 - General Impact of Model on Rating Algorithm
 - Relevance of Variables and Relationship to Risk of Loss
 - Comparison of Model Outputs to Current and Selected Rating Factors
 - Responses to Data, Credibility and Granularity Issues
 - Definitions of Rating Variables
 - Supporting Data
 - Consumer Impacts
 - Accurate Translation of Model into a Rating Plan
 - Efficient and Effective Review of Rate Filing

Information Elements – Example 1

SELECTING MODEL INPUT - Available Data Sources

Information Element A.1.a:

Review the details of sources for both insurance and non-insurance data used as input to the model (only need sources for filed input characteristics included in the filed model).

1

Request details of all data sources, whether internal to the company or from external sources. For insurance experience (policy or claim), determine whether data are aggregated by calendar, accident, fiscal or policy year and when it was last evaluated. For each data source, get a list all data elements used as input to the model that came from that source. For insurance data, get a list all companies whose data is included in the datasets.

Request details of any non-insurance data used (customer-provided or other), whether the data was collected by use of a questionnaire/checklist, whether data was voluntarily reported by the applicant, and whether any of the data is subject to the Fair Credit Reporting Act. If the data is from an outside source, find out what steps were taken to verify the data was accurate, complete and unbiased in terms of relevant and representative time frame, representative of potential exposures and lacking in obvious correlation to protected classes.

Note that reviewing source details should not make a difference when the model is new or refreshed; refreshed models would report the prior version list with the incremental changes due to the refresh.

Information Elements – Example 2

BUILDING THE MODEL - High-Level Narrative for Building the Model

<p>Information Element B.1.f:</p> <p>Identify the model's target variable.</p>	<p>1</p>	<p>A clear description of the target variable is key to understanding the purpose of the model. It may also prove useful to obtain a sample calculation of the target variable in Excel format, starting with the “raw” data for a policy, or a small sample of policies, depending on the complexity of the target variable calculation.</p>
---	----------	---

Information Elements – Example 3

THE FILED RATING PLAN - General Impact of Model on Rating Algorithm

Information Element C.1.c:

Obtain a complete list of characteristics/variables used in the proposed rating plan, including those used as input to the model (including sub-models and composite variables) and all other characteristics/variables (not input to the model) used to calculate a premium. For each characteristic/variable, determine if it is only input to the model, whether it is only a separate univariate rating characteristic, or whether it is both input to the model and a separate univariate rating characteristic. The list should include transparent descriptions (in plain language) of each listed characteristic/variable.

1

Examples of variables used as inputs to the model and used as separate univariate rating characteristics might be criteria used to determine a rating tier or household composite characteristic.

Drafting Issues Addressed

- ∞ Rational explanation.
- ∞ Confidentiality of model information.
- ∞ Importance of information elements needed for review (GLM).
- ∞ Lines of business.
- ∞ Non-GLM models.

White Paper Status

- ☞ Adopted by CASTF on 09/15/2020.
- ☞ Adopted by C Committee on 12/08/2020.
- ☞ Will be considered for adoption by NAIC membership at the Spring National Meeting 2021.

Regulatory Review of Predictive Models



Sandra Darby



P&C Actuary, Maine Bureau of Insurance

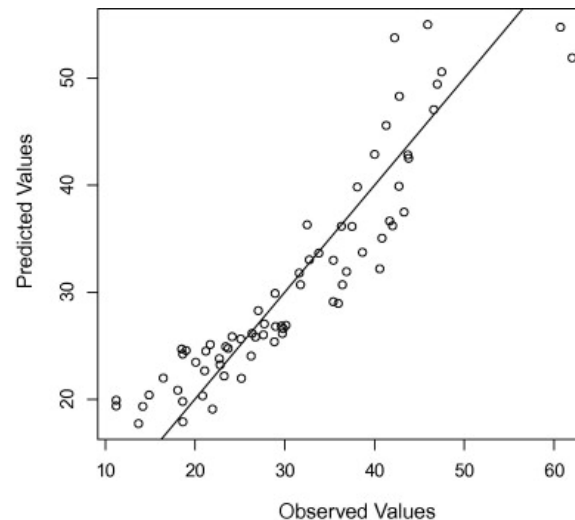
Sandra.c.darby@maine.gov



March 16, 2021

Information Elements

- 79 information elements included for a regulator to meet Best Practices' objectives when reviewing a GLM
 - Selecting Model input
 - Building the Model



Selecting Model Input

Available Data Sources

- A.1.a. Review the details of sources for both insurance and non-insurance data used as input to the model (only need sources for filed input characteristics included in the filed model).
- A.1.b. Reconcile aggregated insurance data underlying the model with available external insurance reports.
- A. 1.c. Review the geographic scope and geographic exposure distribution of the raw data for relevance to the state where the model is filed



Selecting Model Input

Sub-models

- A.2.a. Consider the relevance of (i.e., whether there is bias) of overlapping data or variables used in the model and sub-models.
- A.2.b. Determine if the sub-model was previously approved (or accepted) by the regulatory agency.
- A.2.c Determine if the sub-model output was used as input to the GLM; obtain the vendor name, as well as the name and version of the sub-model.
- A.2.d. If using catastrophe model output, identify the vendor and the model settings/assumptions used when the model was run.
- A.2.e Obtain an explanation of how catastrophe models are integrated into the model to ensure no double counting.
- A.2.f. If using output of any scoring algorithms, obtain a list of the variables used to determine the score and provide the source of the data used to calculate the score.
- **Notice: all Level 1 importance**



Selecting Model Input

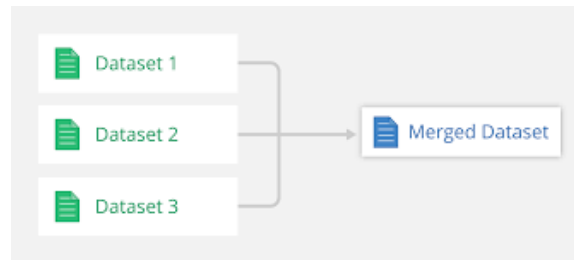
∞ Adjustments to data

- A.3.a. Determine if premium, exposure, loss, or expense data were adjusted (e.g., developed, trended, adjusted for catastrophe experience, or capped). If so, how? Do the adjustments vary for different segments of the data? If so, identify the segments and how the data was adjusted.
- A.3.b. Identify adjustments that were made to aggregated data (e.g., transformations, binning and/or categorizations). If any, identify the name of the characteristic/variable and obtain a description of the adjustment.
- A.3.c. Ask for aggregated data (one dataset of preadjusted/scrubbed data and one dataset of post-adjusted/scrubbed data) that allows the regulator to focus on the univariate distributions and compare raw data to adjusted/binning/transformed/etc. **Data. Notice: Level 4 importance**
- A.3.d. Determine how missing data was handled.
- A.3.e. If duplicate records exist, determine how they were handled.
- A.3.f. Determine if there were any material outliers identified and subsequently adjusted during the scrubbing process.

Selecting Model Input

Data organization

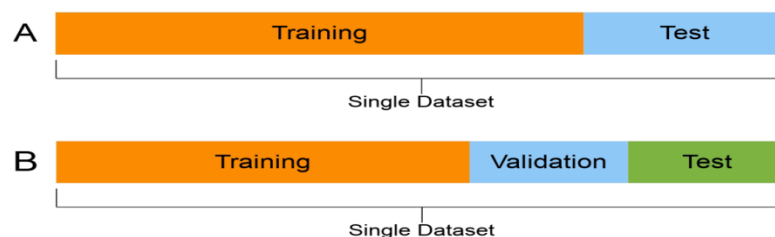
- A.4.a Obtain documentation on the methods used to compile and organize data, including procedures to merge data from different sources or filter data based on particular characteristics and a description of any preliminary analyses, data checks, and logical tests performed on the data and the results of those tests.
- A.4.b. Obtain documentation on the insurer's process for reviewing the appropriateness, reasonableness, consistency, and comprehensiveness of the data, including a discussion of the rational relationship the data has to the predicted variable.
- A.4.c. Identify material findings the company had during its data review and obtain an explanation of any potential material limitations, defects, bias, or unresolved concerns found or believed to exist in the data. If issues or limitations in the data influenced modeling analysis and/or results, obtain a description of those concerns and an explanation how modeling analysis was adjusted and/or results were impacted.



Building the Model

High-Level narrative for building the model

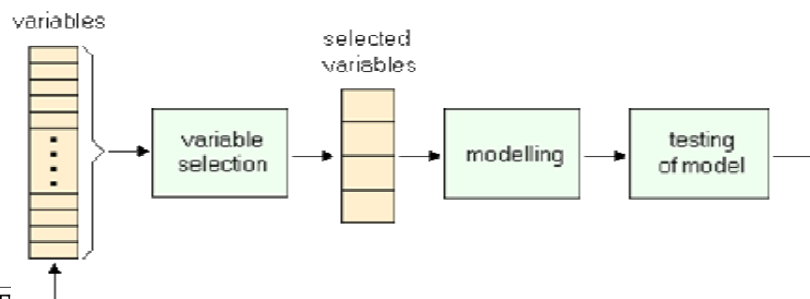
- B.1.a. Identify the type of model underlying the rate filing (e.g., GLM, decision tree, Bayesian GLM, gradient boosting machine, neural network, etc.). Understand the model's role in the rating system and provide the reasons why that type of model is an appropriate choice for that role.
- B.1.b. Identify the software used for model development. Obtain the name of the software vendor/developer, software product, and a software version reference used in model development.
- B.1.c. Obtain a description how the available data was divided between model training, test, and/or validation datasets. The description should include an explanation why the selected approach was deemed most appropriate, whether the company made any further subdivisions of available data, and reasons for the subdivisions (e.g., a portion separated from training data to support testing of components during model building). Determine if the validation data was accessed before model training was completed and, if so, obtain an explanation of why that came to occur. Obtain a discussion of whether the model was rebuilt using all the data or if it was only based on the training data.



Building the Model

High-Level narrative for building the model

- B.1.d. Obtain a brief description of the development process, from initial concept to final model and filed rating plan.
- B.1.e. Obtain a narrative on whether loss ratio, pure premium, or frequency/severity analyses were performed and, if separate frequency/severity modeling was performed, how pure premiums were determined.
- B.1.f. Identify the model's target variable.
- B.1.g. Obtain a description of the variable selection process



Building the Model

- ∞ High-Level narrative for building the model
 - B.1.h. In conjunction with variable selection, obtain a narrative on how the company determined the granularity of the rating variables during model development
 - B.1.i. Determine if model input data was segmented in any way (e.g., by-coverage, by-peril, or by-form basis). If so, obtain a description of data segmentation and the reasons for data segmentation.
 - B.1.j. If adjustments to the model were made based on credibility considerations, obtain an explanation of the credibility considerations and how the adjustments were applied.



Building the Model

Medium-Level narrative for building the model

- B.2.a At crucial points in model development, if selections were made among alternatives regarding model assumptions or techniques, obtain a narrative on the judgment used to make those selections.
- B.2.b If post-model adjustments were made to the data and the model was rerun, obtain an explanation on the details and the rationale for those adjustments.
- B.2.c Obtain a description of the testing that was performed during the model-building process, including an explanation of the decision-making process to determine which interactions were included and which were not.



Building the Model

Medium-Level narrative for building the model

- B.2.d For the GLM, identify the link function used. Identify which distribution was used for the model (e.g., Poisson, Gaussian, log-normal, Tweedie). Obtain an explanation of why the link function and distribution were chosen. Obtain the formulas for the distribution and link functions, including specific numerical parameters of the distribution. If changed from the default, obtain a discussion of applicable convergence criterion.
- B.2.e. Obtain a narrative on the formula relationship between the data and the model outputs, with a definition of each model input and output. The narrative should include all coefficients necessary to evaluate the predicted pure premium, relativity, or other value, for any real or hypothetical set of inputs
- B.2.f. If there were data situations in which GLM weights were used, obtain an explanation of how and why they were used.

Building the Model



∞ Predictor variables

- B.3.a. Obtain a complete data dictionary, including the names, types, definitions, and uses of each predictor variable, offset variable, control variable, proxy variable, geographic variable, geodemographic variable, and all other variables in the model used on their own or as an interaction with other variables (including sub-models and external models).
- B.3.b. Obtain a list of predictor variables considered but not used in the final model, and the rationale for their removal. **Notice: Level 4 importance**
- B.3.c. Obtain a correlation matrix for all predictor variables included in the model and sub-model(s).

Building the Model

Predictor variables

- B.3.d. Obtain a rational explanation for why an increase in each predictor variable should increase or decrease frequency, severity, loss costs, expenses, or any element or characteristic being predicted.
- B.3.e. If the modeler made use of one or more dimensionality reduction techniques, such as a principal component analysis (PCA), obtain a narrative about that process, an explanation why that technique was chosen, and a description of the step by-step process used to transform observations (usually correlated) into a set of linearly uncorrelated variables. In each instance, obtain a list of the pre-transformation and post-transformation variable names, as well as an explanation of how the results of the dimensionality reduction technique was used within the model.

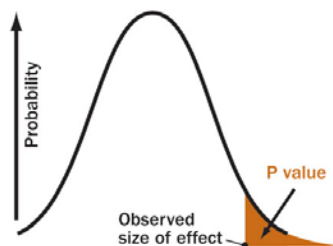
Building the Model

- ∞ Adjusting Data, Model Validation, Goodness of Fit measures
 - B.4.a. Obtain a description of the methods used to assess the statistical significance/goodness-of-fit of the model to validation data, such as lift charts and statistical tests. Compare the model's projected results to historical actual results and verify that modeled results are reasonably similar to actual results from validation data.
 - B.4.b. For all variables (discrete or continuous), review the appropriate parameter values and relevant tests of significance, such as confidence intervals, chi-square tests, p-values, or F tests. Determine if model development data, validation data, test data, or other data was used for these tests.

Building the Model

∞ Adjusting Data, Model Validation, Goodness of Fit measures

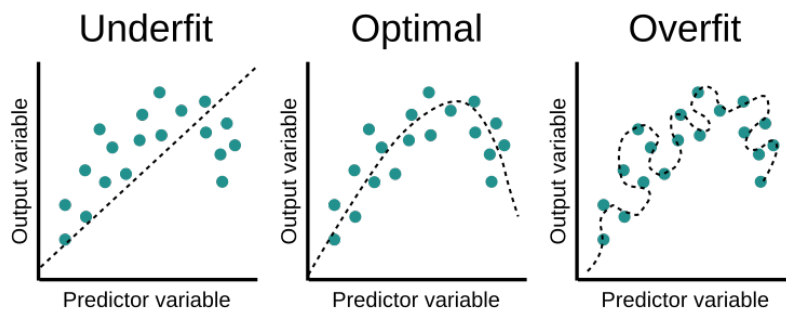
- B.4.c. Identify the threshold for statistical significance and explain why it was selected. Obtain a reasonable and appropriately supported explanation for keeping the variable for each discrete variable level where the p-values were not less than the chosen threshold.
- B.4.d. For overall discrete variables, review type 3 chi-square tests, p-values, F tests and any other relevant and material test. Determine if model development data, validation data, test data, or other data was used for these tests.
- B.4.e. Obtain evidence that the model fits the training data well, for individual variables, for any relevant combinations of variables, and for the overall model.



Building the Model

Adjusting Data, Model Validation, Goodness of Fit measures

- B.4.f. For continuous variables, provide confidence intervals, chi-square tests, p-values, and any other relevant and material test. Determine if model development data, validation data, test data, or other data was used for these tests.
- B.4.g. Obtain a description how the model was tested for stability over time.
- B.4.h. Obtain a narrative on how potential concerns with overfitting were addressed.
- B.4.i. Obtain support demonstrating that the GLM assumptions are appropriate.
- B.4.j. Obtain 5-10 sample records with corresponding output from the model for those records. **Notice: Level 4 importance**



Building the Model

∞ "Old Model" vs. "New Model"

- B.5.a. Obtain an explanation of why this model is an improvement to the current rating plan. If it replaces a previous model, find out why it is better than the one it is replacing; determine how the company reached that conclusion and identify metrics relied on in reaching that conclusion. Look for an explanation of any changes in calculations, assumptions, parameters, and data used to build this model from the previous model.
- B.5.b. Determine if two Gini coefficients were compared and obtain a narrative on the conclusion drawn from this comparison.
- B.5.c. Determine if double-lift charts were analyzed and obtain a narrative on the conclusion drawn from this analysis.
- B.5.d. If replacing an existing model, obtain a list of any predictor variables used in the old model that are not used in the new model. Obtain an explanation of why these variables were dropped from the new model. Obtain a list of all new predictor variables in the new model that were not in the prior old model.

Building the Model

Modeler Software

- Request access to SMEs (e.g., modelers) who led the project, compiled the data, and/or built the model. **Notice: Level 4 importance**





Maine GLM Questionnaire



ADDITIONAL INFORMATION REQUIRED FOR REVIEW OF GLMs

1. Data used in the creation and testing of the model
 1. Document the sources of data, both internal and external.
 2. Document the scope of the data (years, companies, geographies, etc.).
 3. If “countrywide” data was used, provide the percentage distribution of states in the dataset.
 4. Document the process for reviewing the appropriateness and accuracy of the data.
 5. Identify and material limitations or defects found or believed to exist in the data.
 6. What, if any, data was excluded and how does that impact the results?
 7. Describe any limitations of the analysis resulting from the issues or concerns with the data.
 8. Describe any adjustments made to the raw data (trend, development, exclusion of cats, etc.).
 9. What percent of the data was used for training versus testing (hold-out)?
 10. If this is an update of a model previously approved, describe material changes in data.
2. Variables used and Adjustments Made
 1. List all variables used in the model with a common language description of each.
 2. Document whether the variables are continuous, discrete, or categorical.
 3. Explain any transformations that were made to the variables (natural log, binning, etc.).
 4. Describe any offsets, weights, or other variables used in the model.
 5. Does the model target pure premium or frequency and severity separately? Why?
 6. If this is an update of a model previously approved, describe material changes in above.
3. Assumptions and Model Validation
 1. Document the distributions, parameters, and link functions chosen in the model.
 2. Describe tests for and adjustments made for correlation, multicollinearity, or aliasing.
 3. Provide the model coefficients, p-values, and confidence intervals.
 4. Document any credibility procedures used in connection with the model.
 5. Describe the methods used to validate the assumptions and assess the goodness of fit.
 6. Describe actions taken to assess model stability such as bootstrapping or cross-validation.
 7. Provide lift charts, Gini-index scores, loss ratio charts, and other statistics analyzed by the company during the modeling process.
 8. If this is an update of a model previously approved, provide a double-lift chart.
4. Model Output
 1. Document the relativities indicated by the model
 2. Document any deviation of the rating plan from the indicated relativities and justify the deviation.
5. Regulatory Compliance
 1. Is this model being implemented countrywide? If so, in what states has it been filed and/or approved? Separate the lists into “prior approval” states versus “all other”.
 2. What variables have been included in the model that are not explicitly part of the rating system on file with the Department.

Division of Insurance

NAIC White Paper on Regulatory Review of Predictive Models: *Rational Explanation and Consumer Impacts of Predictive Models*

***Gennady Stolyarov II, FSA, ACAS, MAAA, CPCU, ARe, ARC, API, AIS, AIE, AIAF
Lead Actuary, Property and Casualty Insurance***

Nevada Division of Insurance

Contact: gstolyarov@doi.nv.gov

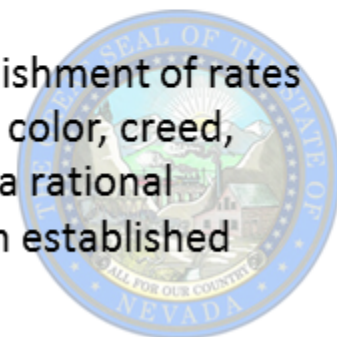
*Presentation for the
Casualty Actuarial Society (CAS)
Ratemaking, Product, and Modeling (RPM) Virtual Seminar
March 16, 2021*



Division of Insurance

“Rational Explanation” Defined

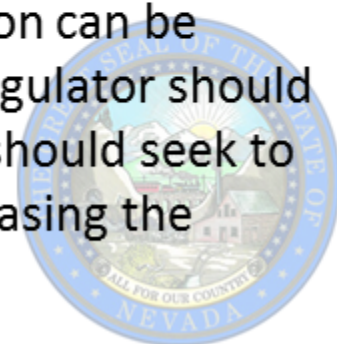
- **Rational Explanation** – A *“rational explanation”* refers to a plausible narrative connecting the variable and/or treatment in question with real-world circumstances or behaviors that contribute to the risk of insurance loss in a manner that is readily understandable to a consumer or other educated layperson. A *“rational explanation”* does not require strict proof of causality but should establish a sufficient degree of confidence that the variable and/or treatment selected are not obscure, irrelevant, or arbitrary.
- A *“rational explanation”* can assist the regulator in explaining an approved rating treatment if challenged by a consumer, legislator, or the media. Furthermore, a *“rational explanation”* can increase the regulator’s confidence that a statistical correlation identified by the insurer is not spurious, temporary, or limited to the specific data sets analyzed by the insurer.
 - NAIC White Paper on Regulatory Review of Predictive Models, Draft of August 27, 2020, p. 47
- **In Nevada, we have requested rational explanations for various rating treatments for many decades. We will not approve a new rating variable without a rational understanding of why it works!**
- **NRS 686B.060(2):** “Risks may be classified in any reasonable way for the establishment of rates and minimum premiums, except that classifications may not be based on race, color, creed, national origin, sexual orientation or gender identity or expression.” If we lack a rational explanation, we cannot determine whether a classification treatment has been established based on reasonable considerations.



Division of Insurance

The Importance of a Rational Explanation

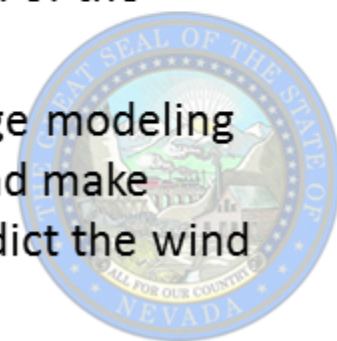
- The NAIC White Paper on Regulatory Review of Predictive Models *did not* originate the emphasis on rational explanation. **Regulators have been seeking rational explanations for newly introduced rating variables for decades. They will continue to seek rational explanations no matter what happens to the NAIC White Paper.**
- **Information Element B.3.d** (p. 24 – Importance Level 3): “Obtain a rational explanation for why an increase in each predictor variable should increase or decrease frequency, severity, loss costs, expenses, or any element or characteristic being predicted.”
- **Comment in White Paper:** “The explanation should go beyond demonstrating correlation. Considering possible causation may be relevant, but proving causation is neither practical nor expected. If no rational explanation can be provided, greater scrutiny may be appropriate. For example, the regulator should look for unfamiliar predictor variables and, if found, the regulator should seek to understand the connection that variable has to increasing or decreasing the target variable.”



Division of Insurance

Rational Explanation for Data Organization

- **Information Element A.4.a** (p. 19 – Importance Level 2): “Obtain documentation on the methods used to compile and organize data, including procedures to merge data from different sources or filter data based on particular characteristics and a description of any preliminary analyses, data checks, and logical tests performed on the data and the results of those tests.”
- **Comment in White Paper:** “This should explain how data from separate sources was merged or how subsets of policies, based on selected characteristics, are filtered to be included in the data underlying the model and the rationale for that filtering.”
- **Information Element A.4.b** (p. 19 – Importance Level 2): “Obtain documentation on the insurer’s process for reviewing the appropriateness, reasonableness, consistency and comprehensiveness of the data, including a discussion of the rational relationship the data has to the predicted variable.”
- **Comment in White Paper:** “An example is when by-peril or by-coverage modeling is performed; the documentation should be for each peril/coverage and make rational sense. For example, if ‘murder’ or ‘theft’ data are used to predict the wind peril, provide support and a rational explanation for their use.”



Division of Insurance

Rational Explanation for Post-Model Adjustments

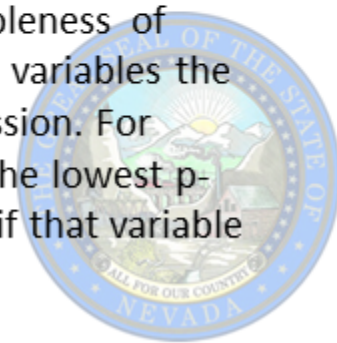
- **Information Element B.2.b** (p. 23 – Importance Level 2): “If post-model adjustments were made to the data and the model was rerun, obtain an explanation on the details and the rationale for those adjustments.”
- **Comment in White Paper:** “Evaluate the addition or removal of variables and the model fitting. It is not necessary for the company to discuss each iteration of adding and subtracting variables, but the regulator should gain a general understanding how these adjustments were done, including any statistical improvement measures relied upon.”



Division of Insurance

Rational Explanation for Predictor Variables

- **Information Element B.3.a** (p. 24 – Importance Level 1): “Obtain a complete data dictionary, including the names, types, definitions and uses of each predictor variable, offset variable, control variable, proxy variable, geographic variable, geodemographic variable and all other variables in the model used on their own or as an interaction with other variables (including sub-models and external models).”
- **Comment in White Paper:** “Types of variables might be continuous, discrete, Boolean, etc. Definitions should not use programming language or code. For any variable(s) intended to function as a control or offset, obtain an explanation of its purpose and impact. Also, for any use of interaction between variables, obtain an explanation of its rationale and impact.”
- **Information Element B.3.b** (p. 24 – Importance Level 4): “Obtain a list of predictor variables considered but not used in the final model, and the rationale for their removal.”
- **Comment in White Paper:** “The purpose of this requirement is to identify variables that the company finds to be predictive but ultimately may reject for reasons other than loss-cost considerations (e.g., price optimization). Also, look for variables the company tested and then rejected. This item could help address concerns about data dredging. The reasonableness of including a variable with given significance level could depend greatly on the other variables the company evaluated for inclusion in the model and the criteria for inclusion or omission. For instance, if the company tested 1,000 similar variables and selected the one with the lowest p-value of 0.001, this would be a far, far weaker case for statistical significance than if that variable was the only one the company evaluated. Note, context matters.”



Division of Insurance

The Filed Rating Plan

- **1. General Impact of Model on Rating Algorithm**
- **2. Relevance of Variables and Relationship to Risk of Loss**
- **3. Comparison of Model Outputs to Current and Selected Rating Factors**
- **4. Responses to Data, Credibility and Granularity Issues**
- **5. Definitions of Rating Variables**
- **6. Supporting Data**
- **7. Consumer Impacts**
- **8. Accurate Translation of Model into a Rating Plan**
- **9. Efficient and Effective Review of Rate Filing**

- **☆ Being able to rationally explain the filing impacts to the regulator in a comprehensible manner is key to enabling an effective and efficient review.**



Division of Insurance

Relevance of Variables and Relationship to Risk of Loss

- **Information Element C.2.a** (p. 31 – Importance Level 2): “Obtain a narrative regarding how the characteristics/rating variables included in the filed rating plan relate to the risk of insurance loss (or expense) for the type of insurance product being priced.”
- **Comment in White Paper:** “The narrative should include a discussion of the relevance each characteristic/rating variable has on consumer behavior that would lead to a difference in risk of loss (or expense). The narrative should include a rational relationship to cost, and model results should be consistent with the expected direction of the relationship. This explanation would not be needed if the connection between variables and risk of loss (or expense) has already been illustrated.”



Division of Insurance

General Impact of Model on Rating Algorithm

- **Information Element C.1.a** (p. 30 – Importance Level 1): “In the actuarial memorandum or explanatory memorandum, for each model and sub-model (including external models), look for a narrative that explains each model and its role (how it was used) in the rating system.”
- **Information Element C.1.b** (p. 30 – Importance Level 1): “Obtain an explanation of how the model was used to adjust the filed rating algorithm.”
- **Information Element C.1.c** (p. 30 – Importance Level 1): “Obtain a complete list of characteristics/variables used in the proposed rating plan, including those used as input to the model (including sub-models and composite variables) and all other characteristics/variables (not input to the model) used to calculate a premium. For each characteristic/variable, determine if it is only input to the model, whether it is only a separate univariate rating characteristic, or whether it is both input to the model and a separate univariate rating characteristic. The list should include transparent descriptions (in plain language) of each listed characteristic/variable.”



Division of Insurance

Comparison of Model Outputs to Current and Selected Rating Factors

- **Information Element C.3.a** (p. 31 – Importance Level 1): “Compare relativities indicated by the model to both current relativities and the insurer's selected relativities for each risk characteristic/variable in the rating plan.”
- **Information Element C.3.b** (p. 31 – Importance Level 1): “Obtain documentation and support for all calculations, judgments, or adjustments that connect the model's indicated values to the selected relativities filed in the rating plan.”
- **Information Element C.3.c** (p. 31 – Importance Level 2): “For each characteristic/variable used as both input to the model (including sub-models and composite variables) and as a separate univariate rating characteristic, obtain a narrative how each characteristic/variable was tempered or adjusted to account for possible overlap or redundancy in what the characteristic/variable measures.”



Division of Insurance

Responses to Data, Credibility and Granularity Issues

- **Information Element C.4.a** (p. 32 – Importance Level 2): “Determine what, if any, consideration was given to the credibility of the output data.”
- **Information Element C.4.b** (p. 32 – Importance Level 2): “If the rating plan is less granular than the model, obtain an explanation why.”
- **Information Element C.4.c** (p. 32 – Importance Level 2): “If the rating plan is more granular than the model, obtain an explanation why.”

Definitions of Rating Variables

- **Information Element C.5.a** (p. 32 – Importance Level 2): “Obtain a narrative on adjustments made to model output, e.g., transformations, binning and/or categorizations. If adjustments were made, obtain the name of the characteristic/variable and a description of the adjustment.”



Division of Insurance

Supporting Data

- **Information Element C.6.a** (p. 32 – Importance Level 4): “Obtain aggregated state-specific, book-of-business-specific univariate historical experience data, separately for each year included in the model, consisting of loss ratio or pure premium relativities and the data underlying those calculations for each category of model output(s) proposed to be used within the rating plan. For each data element, obtain an explanation whether it is raw or adjusted and, if the latter, obtain a detailed explanation for the adjustments.”
- **Information Element C.6.b** (p. 33 – Importance Level 4): “Obtain an explanation of any material (especially directional) differences between model indications and state-specific univariate indications.”
- **NOTE:** Although the White Paper assigns an Importance Level of 4 to these Information Elements, some states, including Nevada, place much stronger emphasis on these elements of supporting data.



Division of Insurance

Consumer Impacts

- **Information Element C.7.a** (p. 33 – Importance Level 4): “Obtain a listing of the top five rating variables that contribute the most to large swings in renewal premium, both as increases and decreases, as well as the top five rating variables with the largest spread of impact for both new and renewal business.”
- **Information Element C.7.b** (p. 33 – Importance Level 3): “Determine if the insurer performed sensitivity testing to identify significant changes in premium due to small or incremental changes in a single risk characteristic. If such testing was performed, obtain a narrative that discusses the testing and provides the results of that testing.”
- **Information Element C.7.c** (p. 33 – Importance Level 2): “For the proposed filing, obtain the impacts on renewal business and describe the process used by management, if any, to mitigate those impacts.”

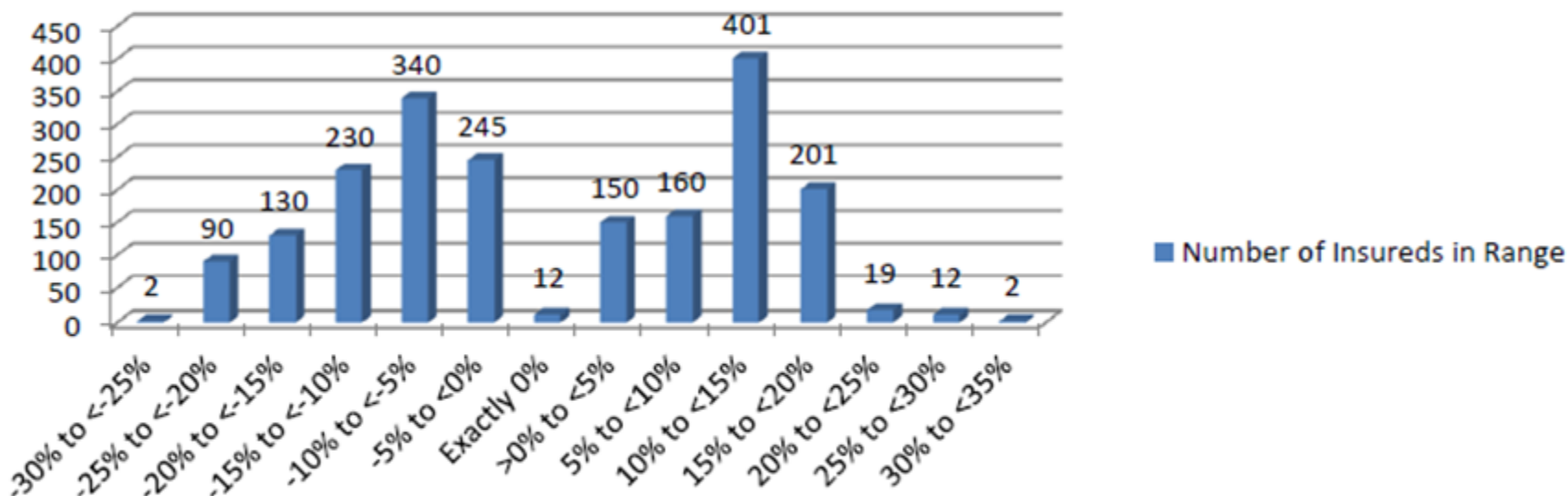


Division of Insurance

Consumer Impacts: Rate Disruption / Dislocation Analysis

- Information Element C.7.d** (p. 34 – Importance Level 2): “Obtain a rate disruption/dislocation analysis, demonstrating the distribution of percentage and/or dollar impacts on renewal business (created by rerating the current book of business), and sufficient information to explain the disruptions to individual consumers.”

EXAMPLE Uncapped Rate Disruption

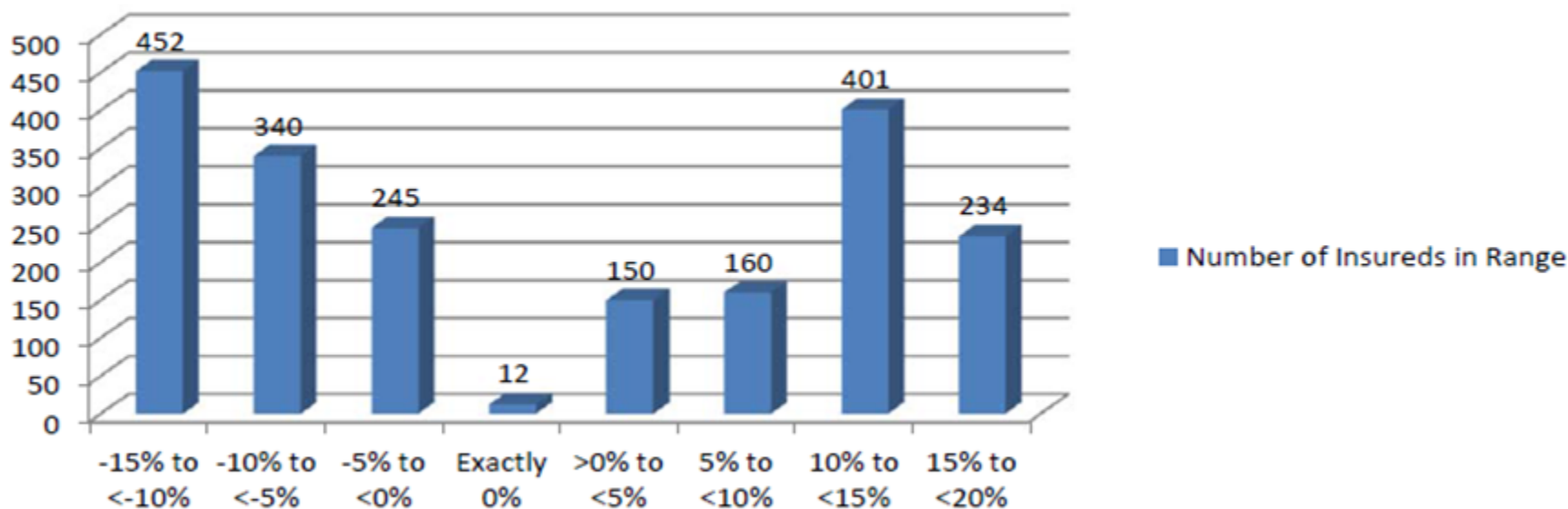


Division of Insurance

Consumer Impacts: Rate Disruption / Dislocation Analysis

- Information Element C.7.d** (p. 34 – Importance Level 2): “Obtain a rate disruption/dislocation analysis, demonstrating the distribution of percentage and/or dollar impacts on renewal business (created by rerating the current book of business), and sufficient information to explain the disruptions to individual consumers.”

EXAMPLE Capped Rate Disruption



• Fill in fields highlighted in light green. Fields highlighted in red are imported from the Template for Rate Disruption.

<u>Largest Percentage Increase</u>		<u>Corresponding Dollar Increase (for Insured Receiving Largest Percentage Increase)</u>			
Uncapped Change	30.00%	Uncapped Dollar Change	\$165.00	Current Premium	\$550.00
Capped Change (If Applicable)	15.00%	Capped \$ Change (If Applicable)	\$82.50	Proposed Premium	\$632.50

Characteristics of Policy (Fill in Below)

• **For Auto Insurance:** At minimum, identify the age and gender of each named insured, limits by coverage, territory, make / model of vehicle(s), prior accident / violation history, and any other key attributes whose treatments are affected by this filing.

• **For Home Insurance:** At minimum, identify age and gender of each named insured, amount of insurance, territory, construction type, protection class, any prior loss history, and any other key attributes whose treatments are affected by this filing.

Automobile policy: Three insureds - Male (Age 54), Female (Age 49), and Male (Age 25). Territory: Las Vegas, ZIP Code 89105.						
Vehicle:	BI Limits:	PD Limits:	UM/UIIM Limits:	MED Limits:	COMP Deductible:	COLL Deductible:
2009 Ford Focus	\$50,000 / \$100,000	\$25,000	\$50,000 / \$100,000	\$5,000	\$500	\$1,000
2003 Honda Accord	\$25,000 / \$50,000	\$10,000	\$25,000 / \$50,000	\$1,000	\$500	\$1,000

No prior accidents, 1 prior speeding conviction for 25-year-old male. Policy receives EFT discount and loyalty discount.

Primary impacts are the increases to the relativities for the age of insured, ZIP Code 89105, COLL Deductible of \$1,000, and symbol for 2003 Honda Accord.

Most Significant Impacts to This Policy (Identify attributes - e.g., base-rate change or changes to individual rating variables)

NOTE: If capping is proposed to apply for this policy, include the impact of capping at the end, after displaying uncapped impacts by attribute. Add rows as needed. Total percent and dollar impacts should reconcile to the values presented above in this exhibit.

Attribute	% Impact (Uncapped)	Dollar Impact (Uncapped)	What lengths of policy terms does the insurer offer in this book of business?			
Insured Age (M/25)	12.00%	\$66.00	Check all options that apply below.			
COLL Deductible (\$1,000)	10.00%	\$61.60	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Territory (89105)	4.00%	\$27.10	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vehicle Symbol (2003 Honda Accord)	1.46%	\$10.29	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Effect of Capping	-11.54%	-\$82.50	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
TOTAL	15.00%	\$82.50				

Division of Insurance

Consumer Impacts (Continued)

- **Information Element C.7.e** (p. 34 – Importance Level 3): “Obtain exposure distributions for the model's output variables and show the effects of rate changes at granular and summary levels, including the overall impact on the book of business.”
- **Information Element C.7.f** (p. 34 – Importance Level 3): “Identify policy characteristics, used as input to a model or sub-model, that remain ‘static’ over a policy's lifetime versus those that will be updated periodically. Obtain a narrative on how the company handles policy characteristics that are listed as ‘static,’ yet change over time.”
- **Information Element C.7.g** (p. 35 – Importance Level 3): “Obtain a means to calculate the rate charged a consumer.”
- **Information Element C.7.h** (p. 35 – Importance Level 1): “In the filed rating plan, be aware of any noninsurance data used as input to the model (customer-provided or other). In order to respond to consumer inquiries, it may be necessary to inquire as to how consumers can verify their data and correct errors.”



Division of Insurance

Accurate Translation of Model into a Rating Plan

- **Information Element C.8.a** (p. 35 – Importance Level 1): “Obtain sufficient information to understand how the model outputs are used within the rating system and to verify that the rating plan’s manual, in fact, reflects the model output and any adjustments made to the model output..”

Efficient and Effective Review of Rate Filing

- **Information Element C.9.a** (p. 35 – Importance Level 1): “Establish procedures to efficiently review rate filings and models contained therein.”
- **Information Element C.9.b** (p. 35 – Importance Level 1): “Be knowledgeable of state laws and regulations in order to determine if the proposed rating plan (and models) are compliant with state law.”
- **Information Element C.9.c** (p. 35 – Importance Level 1): “Be knowledgeable of state laws and regulations in order to determine if any information contained in the rate filing (and models) should be treated as confidential.”

