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basic building blocks of the model and does not necessarily need to be included by the filer with the initial submission,

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Section	Information Element oTT9 8s6T.0738

Section	Information Element	Level of Importance to the Regulator's Review	Comments
A.2.c	Det162 0 10.02 30EMx[(I)2.3 (mp)2.7 (o6 Tm( )TjETq 52.98 34.92 235.8 13.084uype /Pauv9DC 44.46 660.48a (mp)TjETEMC B		

Section	Information Element	Level of Importance to the Regulator's Review	Comments
3. Adjustments to Data			
A.3.a	Determine if premium, exposure, loss, or expense data were adjusted (e.g.,		

B. BUILDING THE MODEL

Section	Information Element	Level of Importance to the Regulator's Review	Comments
1. High-Level Narrative for Building the Model			
B.1.a	Identify the type of model underlying the rate filing (e.g., Random Forest, GLM, decision tree, Bayesian GLM, gradient-boosting machine, neural network, etc.). Understandthe model's role in the rating system and provide thereasons why that type of model is an appropriate choice for that role.	1	It is important to understand if the model in question is a Tree-based model and, therefore, these information elements are applicable, or if it is some other model type, in which case other reasonable review approaches may be considered. There should be an explanation of why the model (using the variables included in it) is appropriatefor the line of business. If by-peril or by-coverage modeling is used, the explanation should be by- peril/by-coverage. **Note**: If the model is not a Tree-based model, the information elements in this appendix may not apply in their entirety.
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.	3	Changes in software from one model version to the next may explain if such changes, over time, contribute to changes in the modeled results. The company should provide the name of the third-party vendor and a contact in the event the regulator has questions. The contact can be an intermediary at the insurer (e.g., a filing specialist) who can place the regulator in direct contact with the appropriate SME at the vendor.
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Section	Information Element	Level of Importance to the Regulator's Review	Comments
2. 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, techniques, or hyperparameters, obtain a narrative on e		

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B.2.f	Obtain the number of component trees comprising the Tree-based model. Obtain a narrative on how this number was chosen.	1	Tree-based models should contain enough trees to reduce error to an acceptable level. They should also balance this with the concept of parsimony. A model with fewer trees that achieves relatively similar reduction in error is preferable to a model with more trees. Checking the error on a test dataset or out of bag error for different numbers of trees is helpful.

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B.2.i	Obtain parameters that determined the volume of data in each tree node and a narrative of how parameters were chosen.	1	Minimum data volume constraints can be applied to a tree-based model, such that the trees will not create a split that would result in terminal nodes with volume below a set amount. The modeler should comment on how the threshold was chosen. If there was no minimum data volume threshold applied to the trees, or if the threshold was exceedingly small, obtain an explanation of any post-modeling adjustments the modeler made to address the credibility considerations and how the adjustments were applied.
B.2.j	Obtain the learning rate aka "shrinkage" if the model is a Gradient Boosting Machine	1	Learning rate is a hyperparameter that applies to Gradient Boosting Machines but not to random forest models. The hyperparameter controls how far towards indicated each tree is allowed to move. The number is typically set to a low value, to reflect that GBM is intended to be a collection of "weak learners", whose accuracy comes after ensembling a large number of trees. As a rule of thumb, values less than or equal to 0.20 are common.
B.2.k	Obtain a narrative of the process to select all hyperparameters for the Tree-based model. Detail how this process addressed potential overfitting in the model.	2	The narrative should include a description of each hyperparameter, document the values of the hyperparameters, specify the implication of using a higher or lower value for each hyperparameter, and discuss any sensitivity testing completed on the hyperparameters and observations from the sensitivity analysis. Hyperparameter tuning can be done in a variety of ways. The rigor of the tuning process should reflect the risk of overfitting on the specific dataset.
3. Predictor Variables			
B.3.a	Obtain a complete data dictionary, including the names, types, definitions, and rationales for each variable.	1	Types of variables might be continuous, discrete, Boolean, etc. Identify any variable used as an offset or control in the Tree-based model and the offset factor that was applied for each level of the offset variable. 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.
B.3.b	Obtain a list of predictor variables considered but not used in the final model and the rationale for their removal.	4	The purpose of this requirement is to identify variables the company finds to be predictive but ultimately may reject for reasons other than loss-cost consd[(i)0.6 (s)]T43J000

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B.3.f	Obtain variable importance plots. Obtain a description of how variable importance was calculated.	1	Variable Importance Plots for tree-based methods highlight which variables contributed most to the model. There are multiple ways to calculate variable importance. Variables with the lowest importance measures should be prioritized when identifying variables that may not be contributing significantly to the model. Variables may have a low importance measure due to high correlation with other variables but may still prove useful if they interact with other variables to identify unique subsets of risks. Variables with the highest importance measures should be prioritized when determining which variables have the largest impact on predictions.
4. Adjusting Data, Model Validation, and 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.	1	For models that are built using multistate data, validation data for some segments of risk is likely to have low credibility in individual states. Nevertheless, some regulators require model validation on state-only data, especially when analysis using state-only data contradicts the countrywide results. State-only data might be more applicable, but it could also be impacted by low credibility for some segments of risk. **Note**: It may be useful to consider geographic stability measures for territories within the state.
B.4.b	Obtain evidence that the model fits the training data well by variable and for the overall model.	2	The regulator should ask for the company to provide exhibits or plots that show the fitted average makes

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			Evaluate the build/test/validation datasets for potential time-sensitive model distortions (e.g., a winter storm in year 3 of 5 can distort the model in both the testing and validation datasets). Obsolescence over time is a model risk (e.g., old data for a variable or a variable itself may no longer be relevant). If a model being introduced now is based on
B.4.c	Obtain a description how the model was tested for stability over time.	2	

Section	Information Element	Level of Importance to the Regulator's Review	Comments

Section	Information Element	Level of Importance to the Regulator's Review	Comments
B.5.c	Determine if double-[illegible]	[illegible]	[illegible]

Section	Information Element	Level of Importance to the Regulator's Review	Comments
3. Comparison of Model Outputs to Current and Selected Rating Factors			
C.3.a	Obtain documentation and support for all calculations, judgments, or adjustments that connect the model's indicated values to		

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5. Definitions of Rating Variables			
C.5.a	Obtain a narrative regarding 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.	2	If rating tiers or other intermediate rating categories are created from model output, the rate and/or rule pages should present these rating tiers or categories. The company should provide an explanation of how model output was translated into these rating tiers or intermediate rating categories.
6. Supporting Data			
C.6.a	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 of whether it is raw or adjusted and, if the latter, obtain a detailed explanation for the adjustments.	4	For example, were losses developed/undeveloped, trended/untrended, capped/uncapped, etc.? Univariate indications should not necessarily be used to override more sophisticated multivariate indications. However, they do provide additional context and may serve as a useful reference.
7. Consumer Impacts			
C.7.a	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		

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C.7.d	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.	2	The analysis should include the largest dollar and percentage impacts arising from the filing, including the impacts arising specifically from the adoption of the model or changes to the model as they translate into the proposed rating plan. While the default request would typically be for the distribution/dislocation of impacts at the overall filing level, the regulator may need to delve into the more granular variable-specific effects of rate changes if there is concern about particular variables having extreme or disproportionate impacts, or significant impacts that have otherwise yet to be substantiated. See Appendix D for an example of a disruption analysis.
C.7.e	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.	3	See Appendix D for an example of an exposure distribution.
C.7.f	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.	3	Some examples of "static" policy characteristics are prior carrier tenure, prior carrier type, prior liability limits, claim history over past X years, or lapse of coverage. These are specific policy characteristics usually set at the time new business is written, used to create an insurance score or to place the business in a rating/underwriting tier, and often fixed for the life of the policy. The reviewer should be aware of, and possibly concerned about, how the company treats an insured over time when the insured's risk profile based on "static" variables changes over time, but the rate charged, based on a new business insurance score or tier assignment, no longer reflect the insured's true and current risk profile. A few examples of "non-static" policy characteristics are age of driver, driving record, and credit information (FCRA-related). These are updated automatically by the company on a periodic basis, usually at renewal, with or without the policyholder explicitly informing the company.

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			The filed rating plan should contain enough information for a regulator to be able to validate policy premium. However, for a complex model or rating plan, a score or premium can be [illegible]
C.7.g	Obtain a means to calculate the rate charged a consumer.	3	

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C.9.b	Be knowledgeable of state laws and regulations in order to determine if the proposed rating plan (and models) are compliant with state laws and/or regulations.	nTw	

TREE-BASED MODELS GLOSSARY OF TERMS

Accumulated Local Effects Plots: A type of interpretability plot. Accumulated local effects (ALE) plots calculate smaller, incremental changes in the feature effects. ALE shows the expected and centered effects of a variable.

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Root Node: The first (top) node in a decision tree. This node contains the entire set of data used by the tree as no splits have occurred yet.

Shapley Additive Explanation Plots: A type of interpretability plot. Shapley plots investigate the effect of including a variable in the model by the order in which it is added. The Shapley value represents the amount the variable of interest contributes to the prediction.

Splitting: The process of dividing a node into two or more sub-nodes, starting from the root node. Splitting occurs at every node up until the terminal (leaf) nodes when the stopping criterion is met.

Stopping Criterion: A criterion applied to the splitting process that informs the node when it is ineligible to split any further. Volume of data is often used as a stopping criterion, such that each leaf node is based on at least a pre-determined amount of