The dual quest for interpretability and performance in credit scoring via spline-rule ensembles

Abstract

Accurately estimating customers' creditworthiness is crucial for financial institutions to minimize losses from defaults and maximize profitable opportunities. Traditional credit scoring models, such as logistic regression, offer high interpretability but may lack predictive performance. As computational power increased, more complex black box models such as tree ensembles (e.g., random forest and XGBoost) became more popular due to their higher predictive performance (Lessman et al., 2015). This creates a trade-off for financial institutions, as enhancing model performance often comes at the expense of interpretability. In the case of credit scoring, interpretability is essential because financial regulators require creditors to provide a statement of specific reasons to denied applicants in the interest of consumer protection (Equal Credit Opportunity Act; Report on big data and advanced analytics, EBA).

Due to the popularity of tree ensembles, the focus of research in credit scoring has transitioned from developing inherently interpretable models to employing post-hoc explainable artificial intelligence (XAI) techniques to gain insights in these black-box models (Bücker et al., 2022; Rudin, 2019). However, these techniques are criticized because they are not directly linked with the black-box model's predictions and are not perfectly faithful to the original model (Rudin, 2019). In situations with potentially severe consequences for consumers, interpretable models might thus be favored over black-box models.

To balance predictive performance with interpretability, we propose spline-rule ensembles as a novel model category to the credit scoring domain, after having demonstrated their value in other business domains (De Bock, 2017; De Bock & De Caigny, 2021). Spline-rule ensembles integrate rules generated from tree ensembles with spline and linear terms in an additive manner, enhancing the model's ability to capture nonlinear relationships while maintaining interpretability. Different variants of spline-rule ensembles are implemented through different tree generation algorithms and benchmarked against their conventional rule ensemble counterparts and other classifiers. Results indicate that spline-rule ensembles outperform alternative interpretable classifiers including conventional rule ensembles and compete favorably with state-of-the-art models, particularly in datasets with a high proportion of numeric features.

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