Enhancing Credit Risk Prediction using TabNet: A Comparative Study with Interpretable Deep Learning on Imbalanced Financial Data

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Abstract

Credit risk assessment is a fundamental task for financial institutions to ensure economic stability and minimize potential losses from loan defaults. While traditional statistical methods and tree-based machine learning models like XGBoost and LightGBM have been widely adopted, they often face challenges regarding the trade-off between predictive accuracy and model interpretability, especially when dealing with highly imbalanced datasets. This research proposes an advanced credit risk classification framework utilizing TabNet—a deep learning architecture specifically designed for tabular data that incorporates sequential attention mechanisms.

The study utilizes a comprehensive credit dataset, encompassing key financial features such as debt ratio, monthly income, and delinquency history. To address the inherent class imbalance problem where default cases are significantly fewer than non-default ones, resampling techniques and cost-sensitive learning were applied. The performance of TabNet was rigorously evaluated against state-of-the-art benchmarks, including LightGBM, XGBoost, and CatBoost, using metrics such as Area Under the ROC Curve (AUC) and F1-score.

Experimental results demonstrate that TabNet achieves competitive predictive performance, reaching an AUC comparable to top-tier boosting models while offering superior interpretability through its built-in masking mechanism. This feature allows for the visualization of feature importance and selection process, providing "explainable AI" (XAI) insights that are crucial for regulatory compliance in the banking sector. The findings suggest that TabNet is a robust alternative for credit scoring, offering a sophisticated balance of high-dimensional pattern recognition and decision transparency.

Keyword: Credit Risk Prediction, TabNet, Deep Learning, Interpretable AI, Class Imbalance, Financial Technology.