ABSTRACT

This research aims to evaluate the impact of various resampling techniques on the performance of stacking ensemble models in detecting credit card transaction fraud. The class imbalance between normal and fraudulent transactions poses a major challenge in building an accurate detection system. To address this issue, four resampling methods are applied: SMOTE-Tomek, SMOTE-ENN, Random Oversampling (ROS), and Random Undersampling (RUS), which are then combined with an ensemble stacking approach using Decision Tree, Random Forest, and Support Vector Machine as base learners, and Logistic Regression as a meta learner. The results of the study show that Random Oversampling (ROS) provides the best overall performance with an accuracy of 99.68%, precision of 95.16%, recall of 83.29%, f1-score of 88.83%, and ROC AUC of 0.9994, along with the fastest resampling time of 0.08 seconds. This technique is capable of maintaining a balance between fraud detection and minimizing. This technique is able to maintain a balance between fraud detection and minimizing false positives. Meanwhile, SMOTE-ENN has the highest recall at 96.11%, indicating very sensitive detection, but its precision is lower (73.23%) and it has the longest processing time. SMOTE-Tomek provides balanced results with a recall of 94.39% and precision of 80.57%, while RUS, although excelling in recall (99.20%), has the lowest precision (59.79%) due to the loss of information from majority data removal. This research concludes that the combination of Random Oversampling and ensemble stacking is the most effective and efficient solution for detecting credit card fraud. This approach not only excels in evaluation metrics but is also suitable for the implementation of a fast and accurate detection system in digital transaction environments.

Keywords: *Credit Card Fraud, Resampling, Random Oversampling, Ensemble Stacking, Decision Tree, Random Forest, SVM, Logistic Regression.*

ABSTRAK

Penelitian ini bertujuan untuk mengevaluasi pengaruh berbagai teknik resampling terhadap kinerja model ensemble stacking dalam mendeteksi penipuan transaksi kartu kredit. Ketidakseimbangan kelas antara transaksi normal dan penipuan menjadi tantangan utama dalam membangun sistem deteksi yang akurat. Untuk mengatasi hal tersebut, digunakan empat metode resampling, yaitu SMOTE-Tomek, SMOTE-ENN, Random Oversampling (ROS), dan Random Undersampling (RUS), yang kemudian dikombinasikan dengan pendekatan ensemble stacking menggunakan algoritma Decision Tree, Random Forest, dan Support Vector Machine sebagai base learners, serta Logistic Regression sebagai meta learner.Hasil penelitian menunjukkan bahwa Random Oversampling (ROS) memberikan performa terbaik secara keseluruhan dengan accuracy sebesar 99.68%**,** precision 95.16%**,** recall 83.29%**,** f1-score 88.83%**,** dan ROC AUC 0.9994**,** serta waktu resampling tercepat yaitu 0.08 detik. Teknik ini mampu menjaga keseimbangan antara deteksi fraud dan meminimalkan false positive. Sementara itu**,** SMOTE-ENN memiliki recall tertinggi yaitu 96.11%, menunjukkan deteksi yang sangat sensitif, namun precision-nya lebih rendah (73.23%) dan waktu pemrosesan paling lama. SMOTE-Tomek memberikan hasil yang seimbang dengan recall 94.39% dan precision 80.57%, sedangkan RUS meskipun unggul dalam recall (99.20%), memiliki precision paling rendah (59.79%) karena hilangnya informasi akibat penghapusan data mayoritas.Penelitian ini menyimpulkan bahwa kombinasi Random Oversampling dan ensemble stacking merupakan solusi yang paling efektif dan efisien dalam mendeteksi penipuan kartu kredit. Pendekatan ini tidak hanya unggul dalam metrik evaluasi, tetapi juga cocok untuk implementasi sistem deteksi yang cepat dan akurat di lingkungan transaksi digital.

Kata Kunci: *Penipuan Kartu Kredit, Resampling, Random Oversampling, Ensemble Stacking, Decision Tree, Random Forest, SVM, Logistic Regression.*