Assignment A1:
Credit Card Fraud Detection Analysis Report

Course: AI in Finance: Data-Driven Investment Strategies with Python
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The key findings of this analysis have revealed the challenges and implications associated with detecting fraudulent transactions in very imbalanced financial datasets. At a fraud rate of 0.1727%, traditional evaluation metrics like accuracy begin to produce misleading effects. As a result, fraud detection and monitoring must rely on precision, recall and AUC-based metrics to provide useful fraud detection and monitoring

Through visual analysis, it was observed that fraudulent transactions were often smaller in monetary value and tended to cluster in specific time windows. These behavioral trends suggest that some fraud schemes test the system by executing many low-value transactions rapidly. This insight reinforces the need for monitoring systems that can flag temporal anomalies or apply dynamic thresholds based on transaction value patterns.

The Random Forest classifier provided a strong baseline model (precision = 0.9720; recall = 0.7027) and identified much fewer false positives while maintaining good success in capturing fraud. Other evaluation metrics, like ROC-AUC (0.9275) and PR-AUC (0.8152), offered a reliable view of model performance, even with an extremely imbalanced target class and without any feature scaling or resampling approaches.

From a business operations standpoint, this balance is important. High precision means there is little disruption to legitimate users, which reduces friction and operational burden, while high recall mitigates financial exposure by catching fraud cases as early as possible. Moreover, the analysis shows that PCA components can be used rather than raw transaction fields, and by employing PCA, we can still produce impactful results with privacy-preserved data.

This analysis highlights the value of precision-based frameworks and scalable, interpretable models for financial services. The model suggests important risk metrics even without further tuning, and those metrics could be included in an operational, real-time system. Financial institutions could advance on this work by including real-time transaction data, adapting the model to changing fraud patterns, or layering additional models to provide better detection through a networked based approach. In summary, this project provided evidence that impactful fraud detection can be achieved with a thoughtful analysis plan, model selection, and performance metrics that are aligned with business risk.