Conclusion

This study demonstrates that machine learning can effectively distinguish genuine Swiss banknotes from counterfeits using only six simple physical measurements. Through rigorous evaluation—100 repeated 80/20 train–test splits—Random Forest emerged as the clear leader, achieving a negligible 0.19% misclassification rate. Naive Bayes also performed well (0.58% error), while full Logistic Regression (2.22%) and a simplified Logistic model (41%) fell short, underscoring the risks of over-restricting model complexity.

Synthetic data experiments further revealed each method's strengths and weaknesses under controlled conditions. When class clusters were tightly separated, all classifiers neared perfect accuracy. As overlap increased, however, only Random Forest and Naive Bayes retained robust performance (≈9% and ≈8% error), whereas Logistic Regression degraded to chance levels. These results confirm Random Forest's resilience to non-linear relationships, feature correlations, and noisy or ambiguous inputs.

Going forward, deploying the Random Forest model in a real-time fraud-detection pipeline could substantially strengthen currency authentication systems. Future work might explore deep-learning architectures, anomaly-detection frameworks, and adaptive ensemble methods. Also, we could also enhance our Logistic Regression models by applying various transformations (Box-Tidwell) to the covariates to better capture non-linear relationships.