Machine Learning-Based Predictive Modelling for the Enhancement of Wine Quality

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Abstract: *The certification of wine quality is crucial for the wine industry to ensure product standardization, consumer safety, and market competitiveness. This research proposes the application of multiple machine learning (ML) models to predict wine quality using the Red Wine Dataset (RWD), which contains 11 physicochemical attributes. Models including Random Forest (RF), Decision Trees (DT), AdaBoost, Gradient Boosting, and Extreme Gradient Boosting (XGBoost) are evaluated for their predictive performance. Notably, XGBoost and RF demonstrated the highest accuracy. Feature selection and cluster analysis were performed to identify key attributes and manage collinearity. The study supports ML-driven quality certification and provides insights into essential physicochemical parameters of wine quality.*

Keywords: Wine quality prediction, Machine Learning, Feature selection, Random Forest, XGBoost, Data preprocessing, Cluster analysis