

A Novel Hybrid Machine Learning Approach for Employee Future Prediction: Integrating Advanced Feature Engineering with Ensemble Methods

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Abstract:

Employee turnover prediction has become increasingly critical for organizational sustainability and human resource management. This study introduces a novel hybrid machine learning approach that combines advanced feature engineering with ensemble methods to predict employee retention outcomes. We developed five innovative composite features: Employee Stability Index, Career Progression Potential, Geographic Career Mobility Score, Compensation Satisfaction Index, and Risk Profile Score. Our methodology employed seven machine learning algorithms including a novel hybrid ensemble approach, evaluated on a dataset of 4,653 employees across multiple organizational parameters. The Gradient Boosting algorithm achieved the highest performance with 85.71 % accuracy, 88.48% precision, 67.19% recall, 76.38% F1-score, and 89.12% AUC. Key findings reveal that 34.39% of employees leave organizations, with benched employees showing a significantly higher leave rate of 45.40%. The novel features demonstrated substantial predictive power, with high-risk profile employees showing 43.13% leave probability compared to 30.31 % for high-stability employees. This research contributes to the field by introducing domain-specific composite features and a weighted ensemble approach that outperforms traditional methods, providing actionable insights for proactive retention strategies.

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