Dissertation Title	An Analytical Framework for Employee Promotion Modeling
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ABSTRACT

Employee promotion represents a strategic function within human resource management, bearing significant implications for workforce motivation, organizational advancement, and career development. However, conventional promotional decisions often rely on subjective judgment, which can lead to inconsistencies and potential bias. Therefore, to address these challenges, this research introduces a comprehensive machine learning framework that incorporates both supervised and unsupervised learning techniques to enhance the identification of promotable employees. The proposed framework consists of three essential components. The first component is feature augmentation, which is performed through the construction of a novel engineered variable termed the Generated Promotion Feature (GPF), derived from performance-driven indicators such as key performance index (KPI) scores, award history, and average training performance. The second component is feature extraction, performed through Principal Component Analysis (PCA) and t-distributed Stochastic Neighbor Embedding (t-SNE) to reduce data dimensionality, identify critical structures, and improve computational efficiency while preserving informative patterns. The last component is the Synthetic Minority Oversampling Technique (SMOTE), employed to address class imbalance and enhance the model’s ability to recognize underrepresented cases of promotion. In addition, two publicly available human resource datasets were utilized to validate the proposed methodology across six classification algorithms: Random Forest, Decision Tree, Support Vector Machine, K-Nearest Neighbor, Logistic Regression, and Neural Network, as well as two clustering techniques, known as K-means and Fuzzy C-means. Experimental results demonstrate that, in classification tasks, the application of SMOTE significantly improves model performance across all algorithms, particularly in handling class imbalance and enhancing recall and F1-score.

In clustering tasks, the combination of GPF, PCA, and SMOTE yields the best results, producing more apparent cluster separations and greater consistency across different configurations. Among the dimensionality reduction methods, PCA outperforms t-SNE in both clustering quality and model stability. Additionally, the introduction of GPF, a domain-informed feature derived from high-correlation performance indicators, enhances model interpretability and discriminatory power. These findings suggest that the proposed framework offers a robust and generalizable approach for employee promotion modeling, adaptable to both supervised and unsupervised learning scenarios within diverse organizational contexts.

Keywords: Employee Promotion, Feature Engineering, SMOTE, Clustering, Classification