# HR Analytics – Employee Promotion Prediction

## Project Overview

The company faced challenges in identifying the right employees for promotion, often relying on recommendations and past performance alone. This project used HR data to build machine learning models to predict promotion eligibility, aiming to make promotion decisions more accurate and data-driven.

## Data Summary

- Size: 54,808 employee records, 14 features.  
- Key Features: Department, region, education, gender, recruitment channel, no. of trainings, age, previous year rating, length of service, KPI score, awards won, average training score.  
- Target: is\_promoted (1 = Yes, 0 = No).

## Data Preparation

- Missing values handled:  
 • Education → filled with most frequent value.  
 • Previous year rating → filled with 0.0.  
- Encoding:  
 • Ordinal (education), binary (gender, KPIs, awards), one-hot (department, recruitment channel), label (region).  
- Removed employee\_id.

## Exploratory Analysis

- Employees with high KPIs, awards, and training scores >70 have higher promotion chances.  
- Awards increase promotion odds by 2.5×.  
- Department and recruitment channel patterns observed, but gender and education had minor impact.

## Modeling

Models Used: Logistic Regression, Random Forest, XGBoost.  
Evaluation Metrics: Accuracy, Precision, Recall, F1-score.

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| --- | --- | --- | --- | --- |
| Model | Accuracy | Precision (Class 1) | Recall (Class 1) | F1 (Class 1) |
| Logistic Regression | 0.932 | 0.867 | 0.208 | ~0.34 |
| Random Forest | 0.937 | 0.83 | 0.31 | 0.45 |
| XGBoost | 0.839 | 0.31 | 0.72 | 0.43 |

Best Model: XGBoost – highest recall (0.72), meaning it identifies most actual promotions, important in an imbalanced dataset.

## Key Insights

1. High KPIs, strong ratings, and good training scores drive promotions.  
2. Award-winning employees are much more likely to be promoted.  
3. Referral hires perform well in promotion outcomes.  
4. Gender and education have minimal impact compared to job performance metrics.

## Conclusion

Using XGBoost for promotion prediction improves fairness and reduces bias, ensuring more high-potential employees are identified for promotion consideration.