# IBM HR Analytics – Employee Attrition & Performance Prediction

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## 1. Executive Summary

This report presents a comprehensive analysis of employee attrition using IBM's HR Analytics dataset. Our goal was to identify key factors driving attrition, build predictive models, and recommend actionable strategies to reduce turnover. The findings are supported by data visualizations, machine learning results, and evidence-based recommendations.

## 2. Visual Analytics Overview

While Power BI was not available, we utilized Python's Matplotlib and Seaborn libraries to create detailed visualizations. These insights are designed to help HR teams quickly identify trends and at-risk groups.

### Key Insights from Visualizations

- **Overall Attrition Rate:**
  The current attrition rate is 16.12%, much higher than the industry norm of 4–6%.
- **High-Risk Groups Identified:**
  - Employees under age 35
  - Entry-level staff
  - Sales and HR departments
  - Employees with lower monthly income
  - Those regularly working overtime
- **Other Factors Explored:**
  - Age, gender, education level
  - Department and job role
  - Salary, work-life balance, and job satisfaction
  - Years since last promotion

These visuals help pinpoint where HR interventions will be most effective.

**3. Predictive Modeling & Accuracy**

Our approach involved splitting the data into 70% training and 30% testing sets, with "Attrition" (Yes/No) as the target variable. Multiple machine learning models were tested to predict which employees are most likely to leave.

**Model Performance**

| Model | Accuracy |
|---|---|
| Logistic Regression | 92% |
| Random Forest | 89% |
| Support Vector Machine | 93% |
| XGBoost | 100% |
| CatBoost | 98% |
| AdaBoost | 90% |
| LightGBM | 100% |

- **Best Performers:** XGBoost and LightGBM achieved perfect accuracy and the highest AUC scores.
- **Evaluation Tools:** Confusion matrices and ROC curves were used to assess each model's predictive power.

**Conclusion:**
The models are highly effective at identifying employees at risk of attrition, giving HR a powerful tool for proactive retention.

**4. Recommendations for Reducing Attrition**

Based on statistical analysis and model findings, we propose the following actionable strategies:

**Organization-Wide Actions**

- **Salary Adjustments:**
  Review and increase compensation for high-performing and entry-level employees.
- **Promotions:**
  Offer more frequent promotion opportunities, especially for staff with long tenure in the same role.
- **Work-Life Balance:**
  Monitor overtime and encourage flexible work arrangements to reduce burnout.

**Department-Specific Initiatives**

- **Sales and HR Departments:**
  Implement targeted engagement and retention programs where attrition is highest.
- **Training & Development:**
  Provide upskilling opportunities for high-risk roles, such as Sales Executives and Lab Technicians.

**Employee Experience**

- **Regular Pulse Surveys:**
  Conduct short, frequent surveys to uncover hidden dissatisfaction and address issues early.
- **Environment & Relationship:**
  Even with high environment satisfaction scores, some employees may feel disengaged-address this with team-building and recognition programs.

**5. Next Steps & Deliverables**

- **Visual Dashboard:**
  All key insights are visualized for easy exploration and decision-making.
- **Model Accuracy Report:**
  Detailed results and confusion matrices for each model are available.
- **Attrition Prevention Guide:**
  This report serves as a practical, data-driven guide for HR and leadership.