HR Data: Predicting & Understanding Employee Attrition

By

Sayan Roy

Introduction

Employee attrition remains one of the most pressing challenges for modern organizations. The loss of skilled employees impacts productivity, increases recruitment and training costs, and disrupts team dynamics. In today's competitive labor market, understanding the underlying reasons behind attrition has become essential for sustaining operational efficiency and long-term growth. This project, titled **"HR Data: Predicting & Understanding Employee Attrition,"** focuses on identifying the key drivers of employee turnover and developing data-informed strategies to reduce it.

Using a dataset sourced from Kaggle, comprising 1,480 records and 38 features, this analysis aims to uncover patterns and predictors of employee attrition through both statistical and visual methods. Techniques in **Python** were employed for data preprocessing, exploratory analysis, and correlation assessment, while **Microsoft Power BI** was used to create interactive dashboards and visual summaries. The dataset includes attributes such as age, job role, job satisfaction, monthly income, overtime status, years at company, and distance from home—providing a rich foundation for deep behavioral analysis.

Initial observations indicate that attrition is notably higher among employees with lower monthly income, shorter tenure, frequent overtime, and lower job satisfaction. Roles such as Sales Representatives and Laboratory Technicians, as well as departments like Sales and Human Resources, exhibit higher attrition rates. Additionally, young professionals (particularly in the 18–35 age range), employees with lower education levels, and those living farther from the office also show higher likelihoods of leaving.

By identifying both individual and environmental factors contributing to attrition, the project aims to support HR teams in building targeted retention strategies. Recommendations derived from the data—such as improving onboarding processes, offering skill development opportunities, recognizing early achievements, and adopting flexible work models—are designed to enhance employee engagement and reduce turnover.

Ultimately, this project provides a data-driven roadmap to help organizations retain top talent, strengthen employee satisfaction, and build a more resilient workforce in a rapidly changing professional landscape.

Business Problem

Employee attrition presents a significant challenge for the organization, impacting operational continuity, employee morale, and financial performance. The company seeks to understand why employees are leaving, identify key predictors of attrition, and design data-driven strategies to reduce turnover—particularly among specific demographics such as younger employees, lower-income groups, certain job roles (e.g., Sales Reps, Lab Technicians), and those with lower job satisfaction or shorter tenures.

Core business problem-

 "How can the organization use data to identify at-risk employees and develop targeted, proactive strategies to reduce voluntary attrition, improve employee engagement, and retain top talent across all departments and roles?"

Addressing this issue will help the company:

- Reduce the high costs of rehiring and retraining.
- Improve organizational knowledge retention and productivity.
- Enhance employee satisfaction and workplace culture.
- Strengthen talent development and leadership pipelines.

Dataset Description

- **Data Source:** Kaggle
- **Number of rows & columns:** 1480 rows & 38 columns
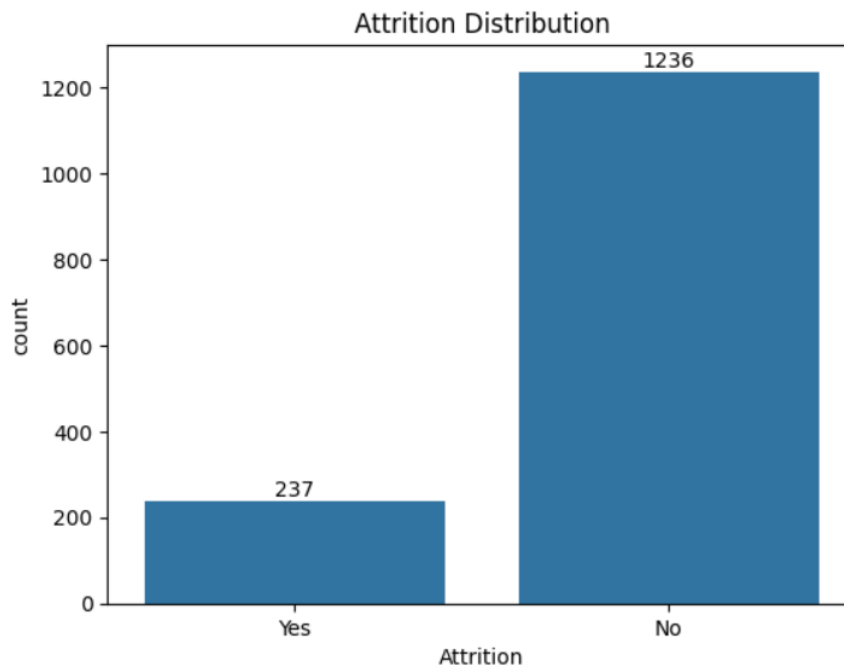- **Data Types:** Object, Int64, Float64

Data Cleaning
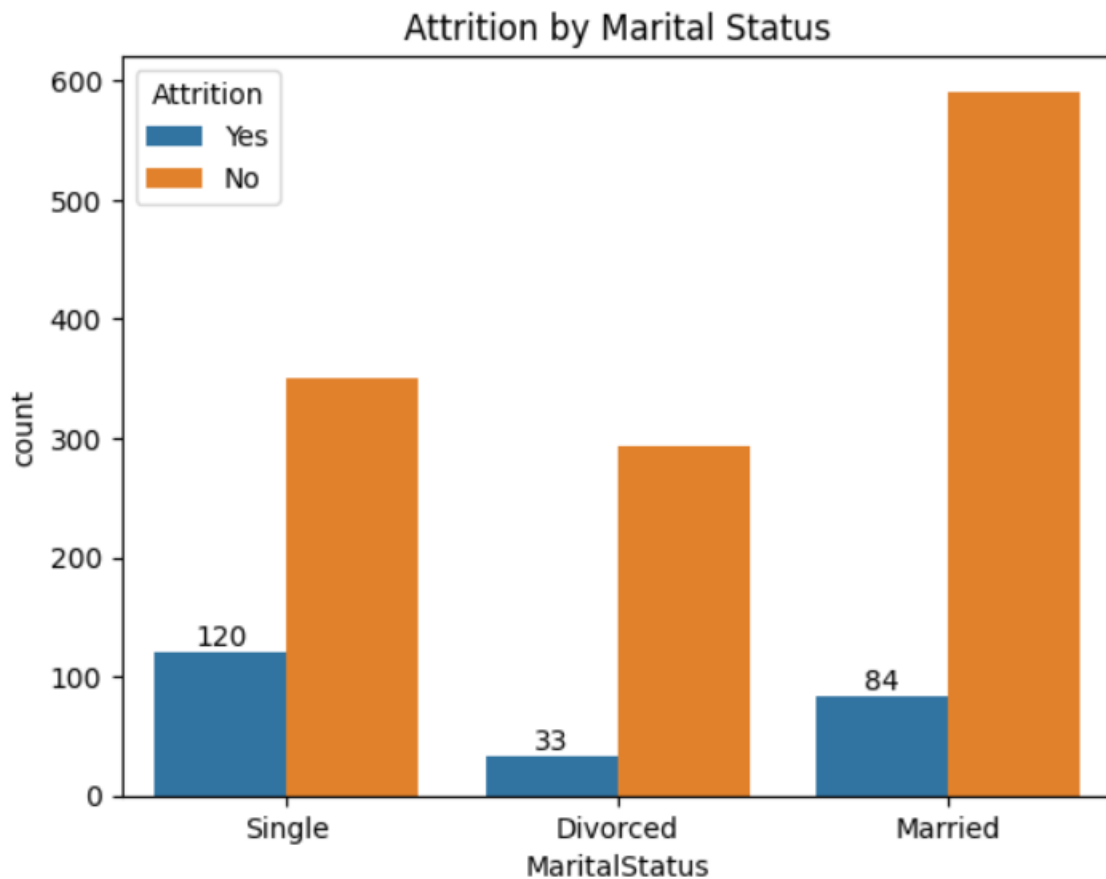
- **Missing Value:** Null
- **Duplicates:** 7

Analysis

Python

1.How many employees have left vs stayed?

Out of 1473 employees, 237 has left the company.

2.Attrition by marital Status.

Attrition by Marital Status

Single employees have the highest number of attritions (120), even though they are not the largest group overall.

Remedy:-

- Offer career path clarity, growth opportunities, and flexible work arrangements**.**
- Consider mentorship or social integration programs to build stronger workplace bonds.

3.Attrition by Job Satisfaction:
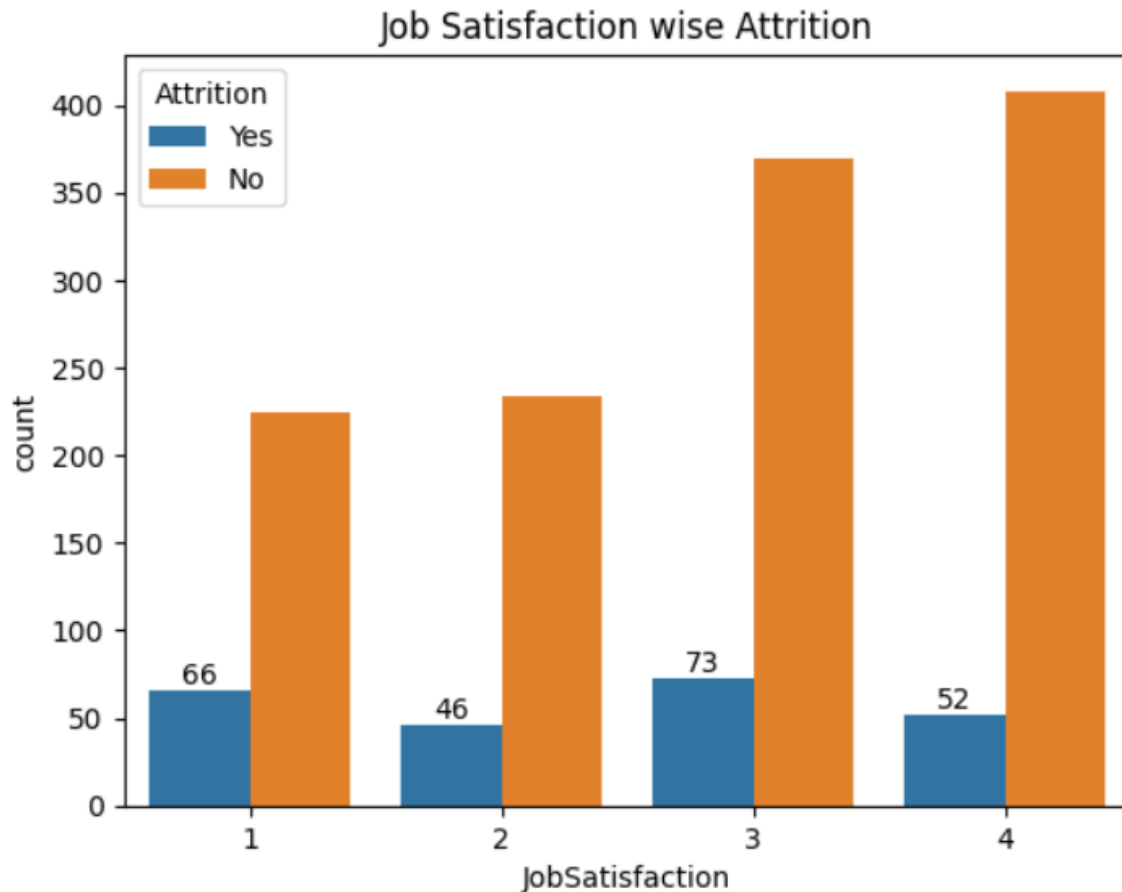
Graph indicates that low job satisfaction is still a strong predictor of attrition. Highest attrition count (73) is at satisfaction level 3. 66 employees left, which is second highest in attrition count.

Remedy:-

- **Level 3**-These employees are at risk. Consider career development conversations with role enrichment and recognition.

- **Level 1**-Improve management practices, workload balance, and internal mobility.

4.Attrition according to years of company.

Years at Company vs Attrition
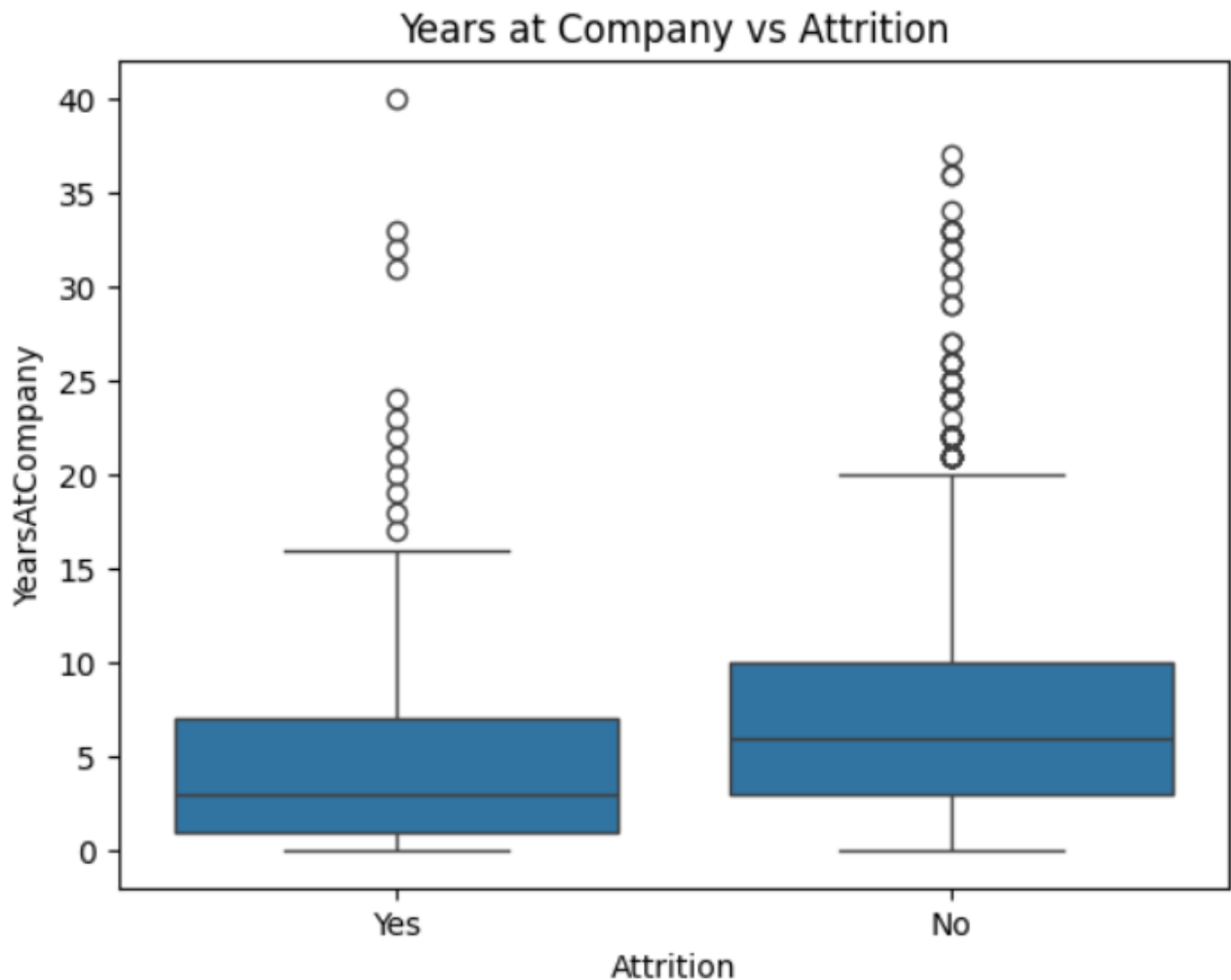
Employees who left ("Yes") had a lower median number of years at the company. Employees who stayed ("No") had a higher median tenure.

Remedy:-

- Onboarding, mentorship, and engagement in the first 1–5 years are crucial.
- Employees might leave early due to lack of progression or unclear growth paths. Structured development plans may help.
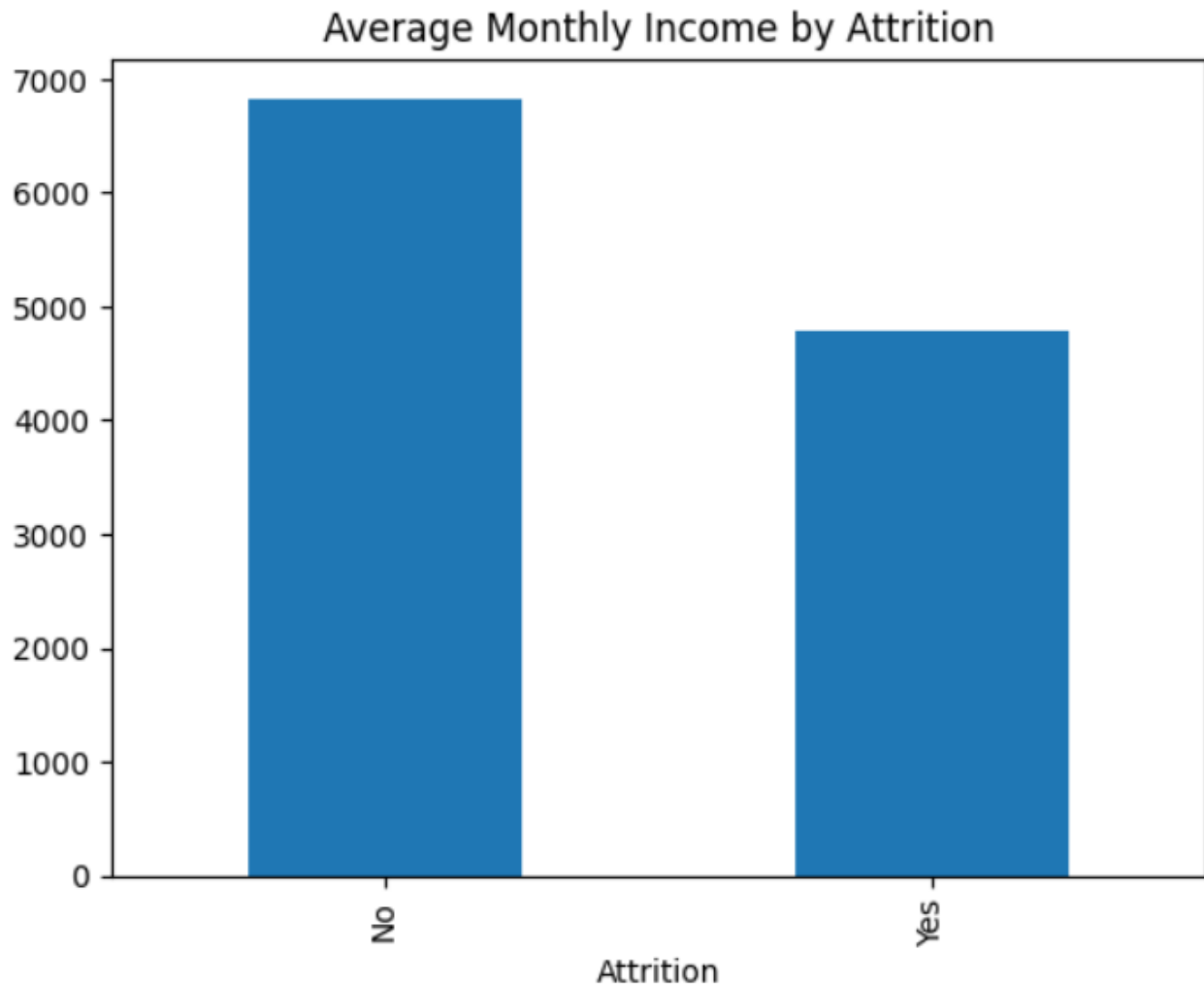
5.Impact of overtime on attrition.
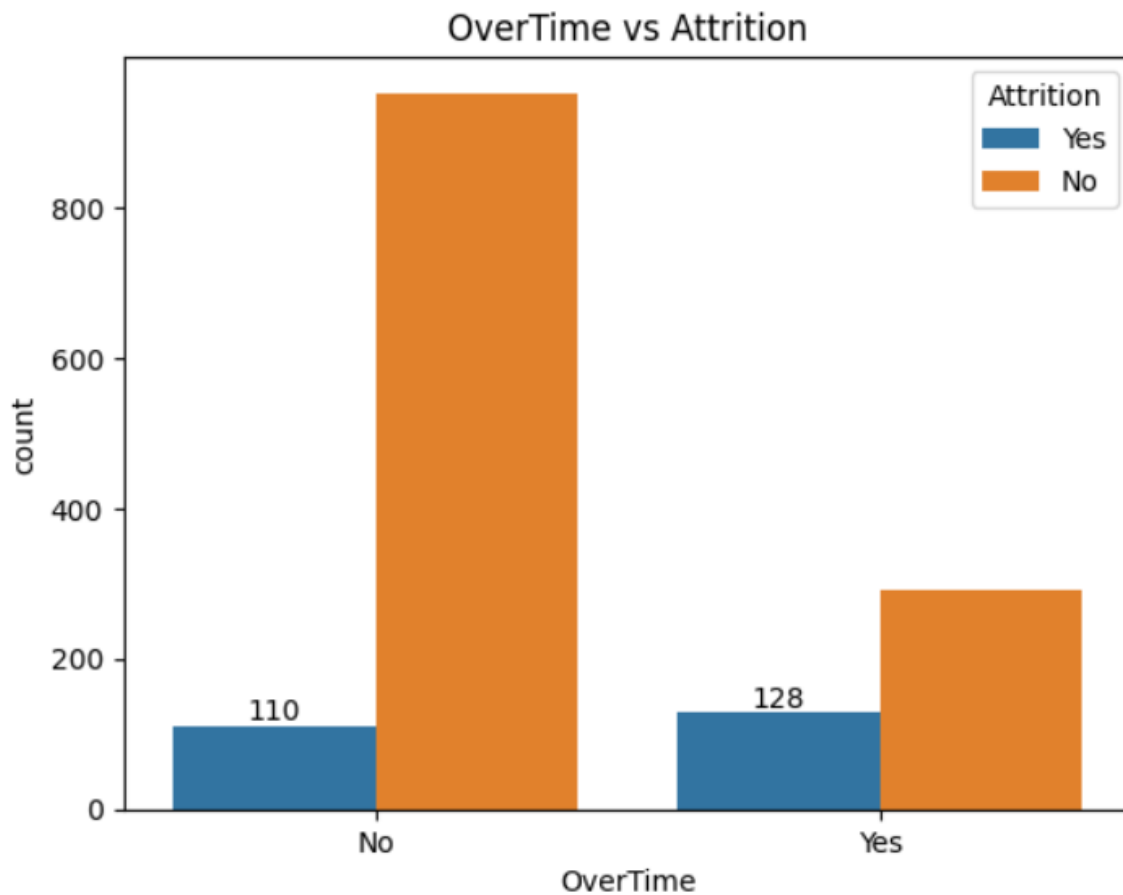
Overtime strongly correlates with higher attrition.

Remedy:-

- Use time-tracking tools to flag employees who regularly work late or extra hours.
- Ensure that employees who do overtime are either compensated fairly or recognized meaningfully.

6.Average income of leavers vs stayers.

Employees who left the company had a lower average monthly income (~4800). Employees who stayed earned a higher average monthly income (~6800).

Remedy:-

- Offer bonuses, training grants, or skill-based raises for entry- or mid-level employees.
- Help employees see how they can grow into better-paying roles.

# 7.Years in current role vs attrition.
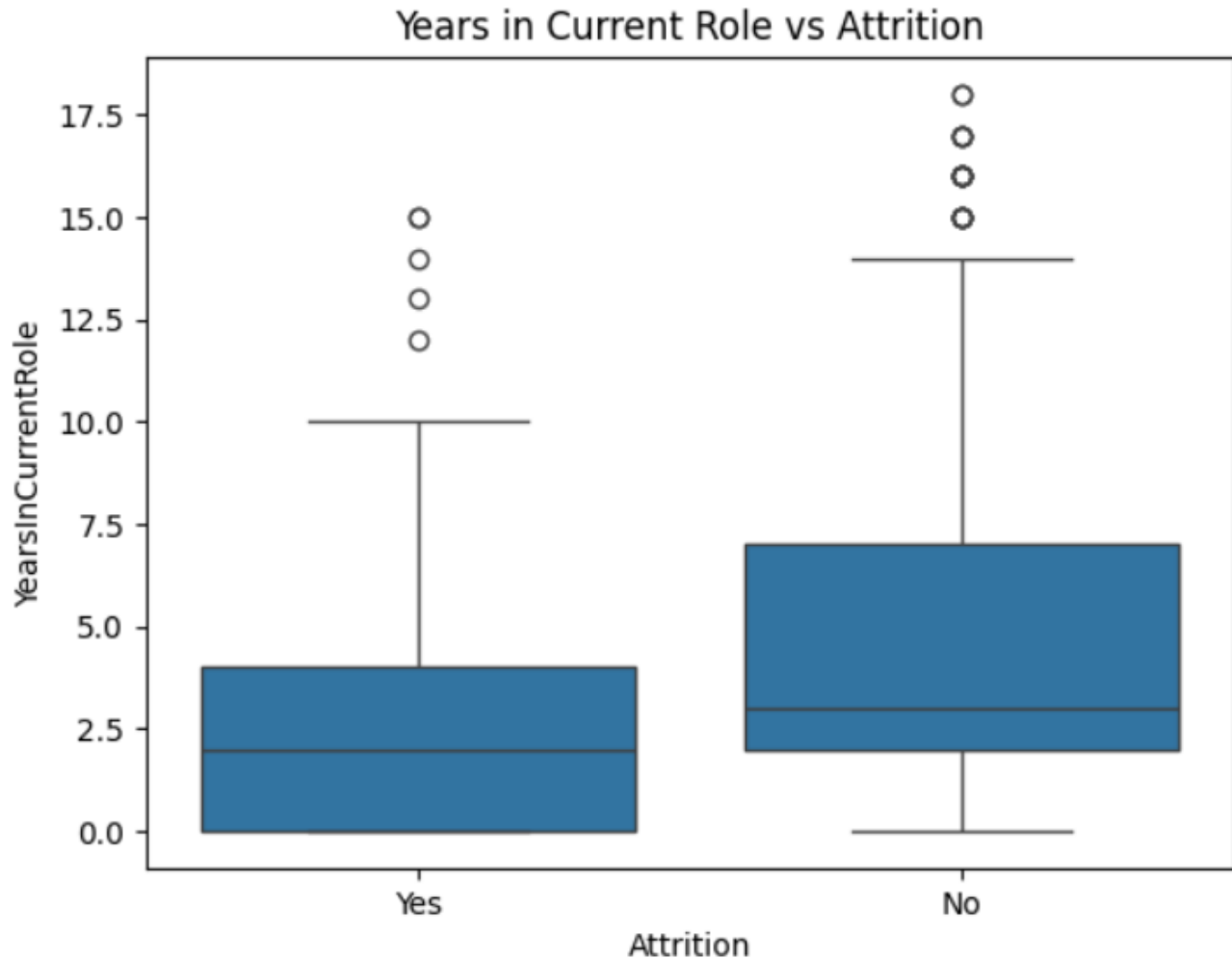
Short Tenure in Role is Linked to Higher Attrition. Employees tend to leave early in their role, often within the first 2–3 years.

Remedy:-

- Improve onboarding and first-year experience**.**
- Celebrate achievements in the first 1–2 years to boost morale and retention.

8.Performance ratings wise attrition.

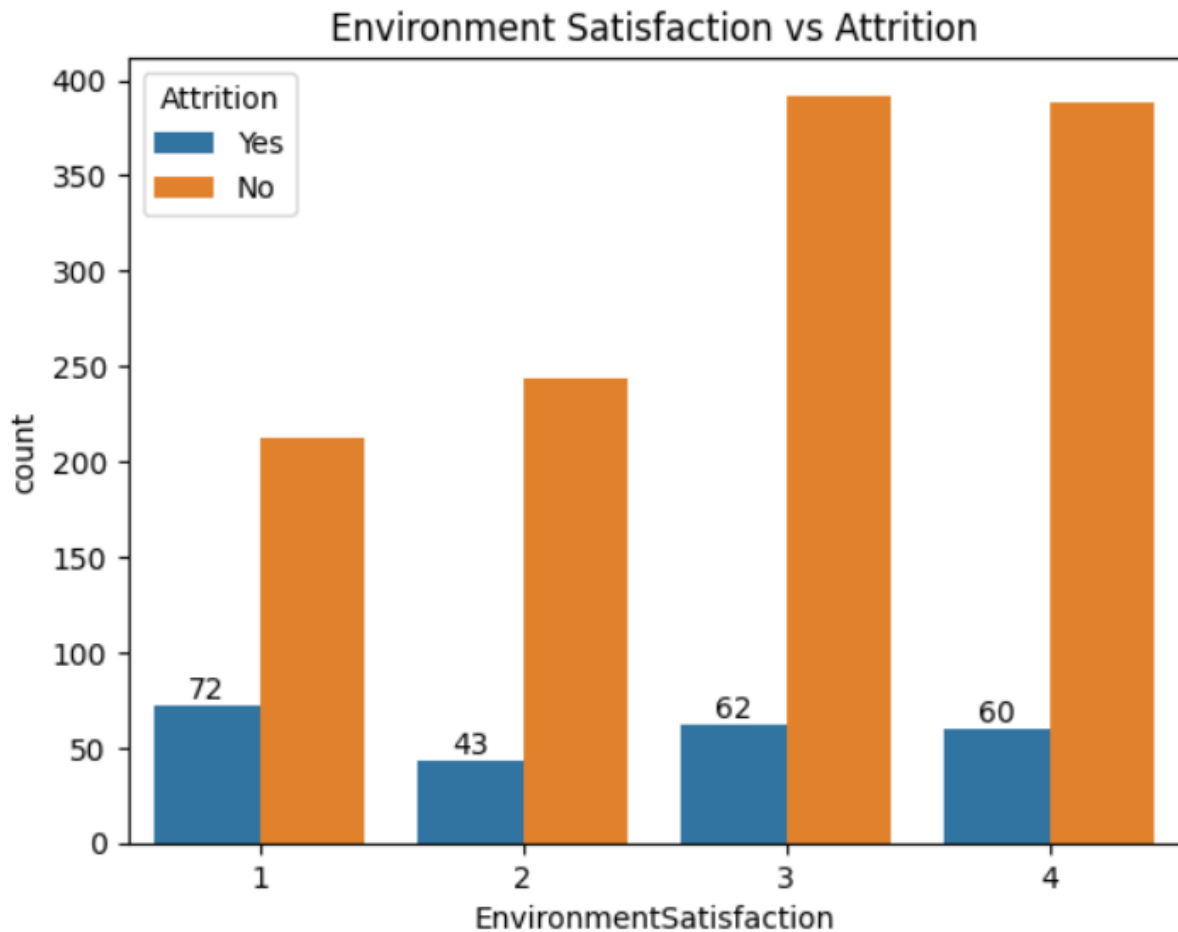Attrition across Different Performance Ratings
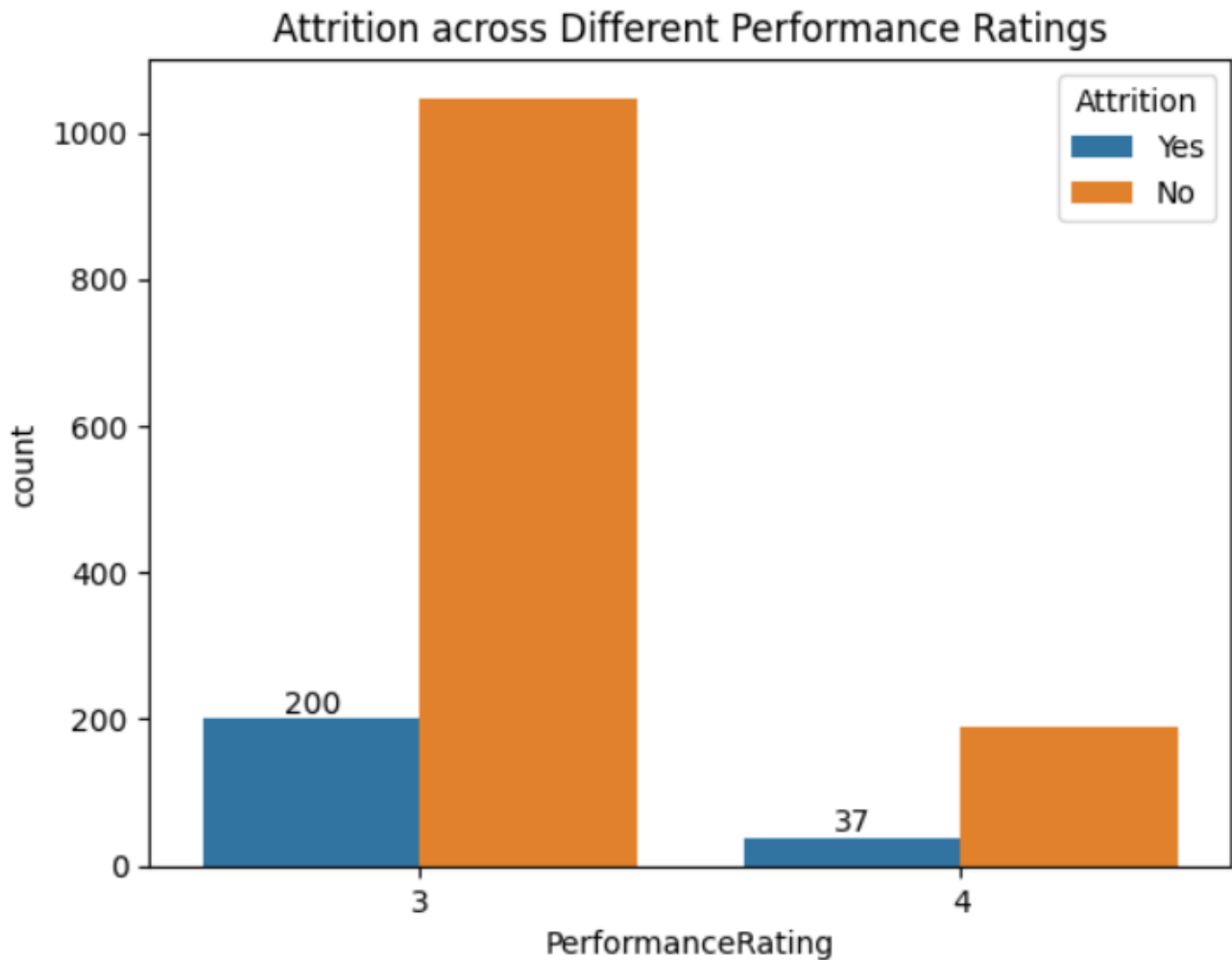
Most attrition is coming from average performers.

Remedy:-

- Provide growth paths, stretch assignments, or mentorship to help them progress.
- Ensure "solid" employees (rating 3) feel seen and appreciated, not just the top performers.

# 9.Attrition according to environmental satisfaction.

Low Environment Satisfaction is a red flag for attrition.

Remedy:-

- Understand what specifically causes dissatisfaction (e.g., noise, safety, leadership, inclusiveness).
- Enhance physical workspace, promote positive culture, improve leadership accessibility, etc.

10.Heatmap of employee attrition & different numeric values.

Correlation Heatmap with Attrition (Numeric)
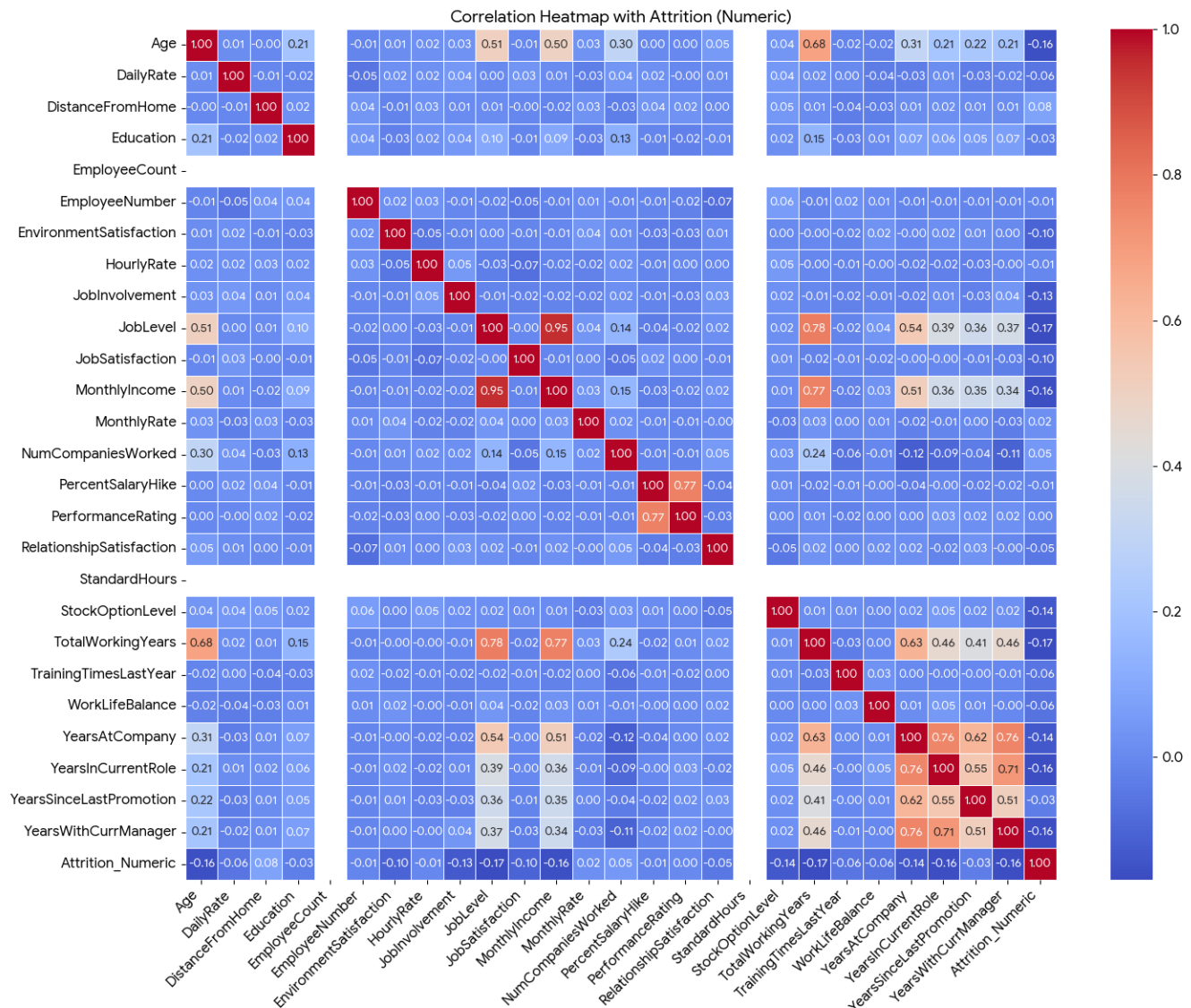
Based on the heatmap we generated, we can analyze the relationships between **Attrition_Numeric** and other numerical columns by looking at the Attrition_Numeric row or column in the matrix. The values in this row/column indicate the Pearson correlation coefficient, which ranges from -1 to +1.

- **Positive Correlation (closer to +1)**: Means that as the value of the other numerical column increases, the likelihood of attrition (being 'Yes', or 1) also tends to increase.
- **Negative Correlation (closer to -1)**: Means that as the value of the other numerical column increases, the likelihood of attrition tends to decrease.
- **Near Zero Correlation (closer to 0)**: Suggests a weak or no linear relationship between the two variables.

Key Observations from the Heatmap:

- **Top Negative Correlations with Attrition (i.e., Retention Factors)**:

Feature	Correlation	Interpretation
TotalWorkingYears	-0.17	More experienced employees are less likely to leave.
YearsAtCompany	-0.14	Longer tenure is linked to lower attrition.
MonthlyIncome	-0.17	Higher-paid employees tend to stay longer.
YearsWithCurrManager	-0.16	Stable management relationships reduce attrition.
Age	-0.16	Older employees are less likely to leave.
JobLevel	-0.17	Higher job levels correlate with better retention.

These suggest that **tenure, income, job level, and experience are major retention factors**

- **Top Positive Correlations with Attrition (i.e., Attrition Risk Indicators)**:

Feature	Correlation	Interpretation
NumCompaniesWorked	+0.13	Employees who have changed jobs more often are more likely to leave.
DistanceFromHome	+0.03	Slightly higher attrition when employees live farther from work.

These may suggest **instability or dissatisfaction**, especially when employees have a history of frequent job changes.

Microsoft Power Bi

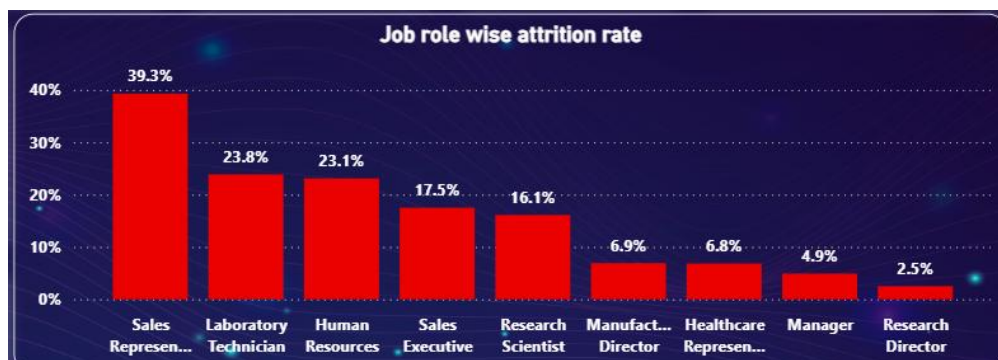## 1.Department wise attrition rate.
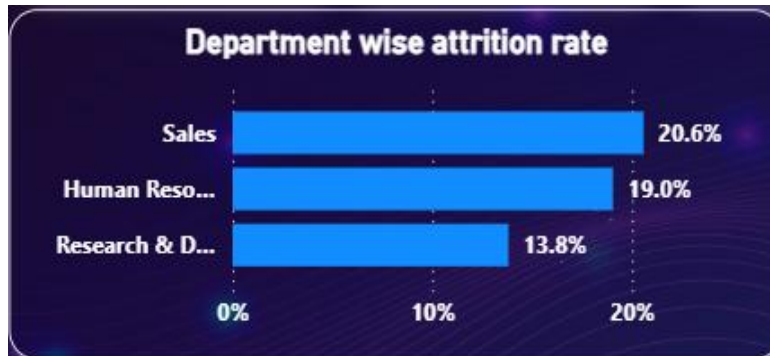
Sales Department & Human Resources Department has the highest(20.6%) and second-highest(19%) attrition rate.

Remedy:-

- Conduct exit interviews to understand why employees are leaving.
- Analyze workloads, compensation, and employee engagement initiatives in high attrition departments.

2.Jobrole wise attrition rate.

Sales Representative (39.3%),Laboratory Technician (23.8%) and Human Resources (23.1%), these roles show high attrition rates, suggesting issues that may need addressing, such as job satisfaction, workload, or career advancement opportunities.

Remedy:-

- Implement targeted initiatives such as improved training, mentoring, performance incentives, and better work-life balance to enhance job satisfaction in high attrition areas.

3.Age group wise attrition.

Age group of 18-25 & 26-35 shows significant attrition rates.

Remedy:-
- HR should investigate the reasons behind the high attrition in the 26-35 age group. Surveys and feedback sessions could help identify specific concerns or desires.
- Implement targeted initiatives that cater to the career aspirations of younger employees, such as mentorship programs, training, and clear pathways for advancement.

4.Education wise attrition rate.
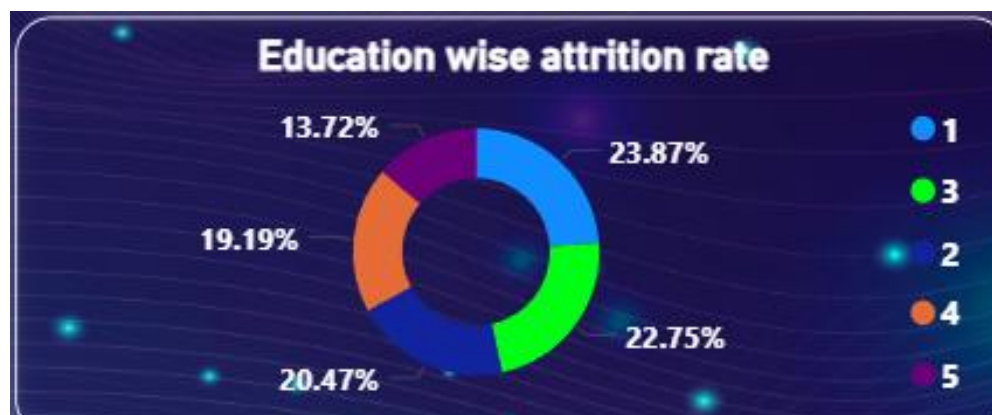
Education level 1,2,3 has highest attrition rate.

Remedy:-

- Offer opportunities for advancement and further education to employees to ensure alignment with employer expectations.

5.Attrition rate due to distance from office.
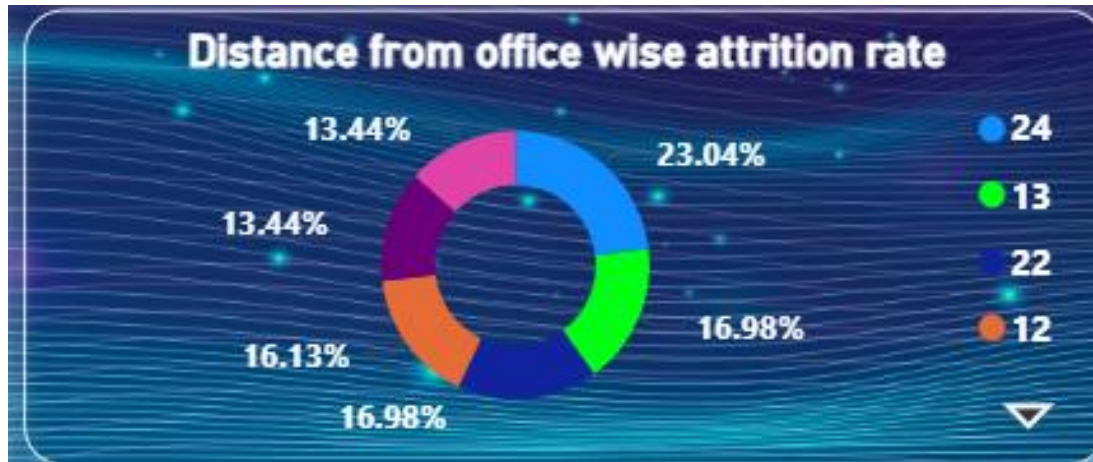
Employees, who live away from the office are tends to attrite more.

Remedy:-
- Offering transportation benefits, carpooling programs, or subsidies.
- Implementing remote work, hybrid models, or flexible hours for roles that allow it.
- For critical roles, considering assistance for employees willing to move closer.

Key findings & insights

1. Overall Attrition Rate

- Out of 1,473 employees analyzed, **237 employees (16.1%)** left the company.
- This level of attrition represents a significant operational and financial impact for the organization.

2. Demographic Factors

- **Marital Status**: Single employees account for the highest number of attritions (120), despite not being the largest group.
  - **Insight**: Younger, single employees may lack deeper workplace engagement or long-term incentives.
- **Age Group**: Employees aged **18–25** and **26–35** experience the **highest attrition rates**.
  - **Insight**: These age groups may be seeking faster career progression or better work-life balance.
- **Education Level**: Employees with **lower education levels (1, 2, and 3)** have higher attrition rates.
  - **Insight**: These employees may lack access to growth paths or feel undervalued.

3. Job & Role-Related Insights

- **Job Role**: Highest attrition seen in:
  - **Sales Representatives (39.3%)**
  - **Laboratory Technicians (23.8%)**
  - **Human Resources (23.1%)**
  - **Insight**: These roles may experience burnout, dissatisfaction, or unclear career trajectories.
- **Department**:
  - **Sales** and **HR** departments show the highest attrition rates: **20.6%** and **19%**, respectively.
  - **Insight**: These departments require targeted retention and engagement strategies.

4. Satisfaction & Performance

- **Job Satisfaction**: Employees at **Satisfaction Level 3** showed the **highest attrition count (73)**.
  - **Insight**: Moderate satisfaction might lead to indifference and disengagement—these employees are at high risk of leaving.

- **Environmental Satisfaction**: Low satisfaction correlates with higher attrition.
    - **Insight**: Workplace conditions (safety, inclusiveness, comfort) are critical to retention.
- **Performance Rating**: Majority of attrition is from **average performers (rating 3)**.
    - **Insight**: "Solid" employees may feel overlooked and unsupported.

5. Tenure & Career Progression

- Employees with **shorter tenure at the company and in current roles** are more likely to leave.
    - **Insight**: The first 1–3 years are critical for retention; early engagement and growth opportunities are vital.
- **Years with Current Manager**: Lower duration with the same manager correlates with higher attrition.
    - **Insight**: Stable leadership relationships reduce turnover risk.

6. Financial & Workload Factors

- **Monthly Income**:
    - Leavers had an average income of **~$4,800**, while stayers averaged **~$6,800**.
    - **Insight**: Compensation is a strong retention factor—especially for early- or mid-career professionals.
- **Overtime**:
    - Strongly linked to attrition.
    - **Insight**: Frequent overtime may lead to burnout and dissatisfaction.

7. Correlation Insights (From Heatmap)

- **Top Negative Correlations with Attrition** (indicate stronger retention):
    - TotalWorkingYears (-0.17)
    - YearsAtCompany (-0.14)
    - MonthlyIncome (-0.17)
    - JobLevel (-0.17)
    - Age (-0.16)
    - YearsWithCurrManager (-0.16)
- **Top Positive Correlation with Attrition**:
    - NumCompaniesWorked (+0.13) → Job-hoppers are more likely to leave.

Strategic business recommendations for attrition reduction

Employee attrition, particularly at the rate of 16.1% (237 out of 1473 employees), represents a significant cost to the business in terms of recruitment, training, lost productivity, and institutional knowledge. Addressing the root causes identified in the analysis is crucial for long-term organizational health and profitability.

- For roles with lower average incomes, explore non-monetary benefits, professional development opportunities, and clear career progression paths that demonstrate long-term value and growth potential within the company.
- Strengthen the onboarding process and first-year experience to ensure new hires feel supported, engaged, and see a clear future with the company. Implement mentorship programs and celebrate early achievements to foster stronger workplace bonds and reduce early attrition (within the first 2-3 years in a role).
- For employees at education levels 1, 2, and 3, offer robust training grants, further education opportunities, and skill-development programs to align their capabilities with employer expectations and open doors to higher-level, better-paying roles.
- Develop strategies to reduce unnecessary overtime, such as reviewing staffing levels, optimizing processes, and ensuring fair compensation or meaningful recognition for unavoidable extra hours.
- Given that low job satisfaction and short tenure with current managers correlate with attrition, invest in leadership development programs. Train managers on effective communication, employee recognition, workload balancing, and career development conversations to build stronger, more stable relationships with their teams.
- Re-evaluate hiring strategies in relation to employee proximity to the office, especially if "Distance from Office" continues to be a factor. Explore establishing satellite offices or expanding remote hiring pools to attract and retain talent who prefer shorter commutes.
- Implement a robust system for continuous monitoring of attrition metrics across all identified factors (department, job role, age, education, marital status, job satisfaction, tenure, income, etc.). Regularly conduct exit interviews, stay interviews, and employee engagement surveys to gather real-time feedback and adapt retention strategies proactively.

Technologies Used

- **Python**: For data cleaning, statistical analysis, and correlation insights. (Specific libraries like Pandas, NumPy, Matplotlib, Seaborn would be listed here if used).
- **Microsoft Power BI**: For interactive data visualization and dashboard creation.

Conclusion

Employee attrition poses a significant threat to organizational stability, talent development, and financial performance. Through comprehensive analysis of employee data using Python and Power BI, this project has uncovered critical patterns and risk factors that contribute to voluntary turnover within the company.

The findings reveal that attrition is most prevalent among employees with lower income, shorter tenure, frequent overtime, and limited job satisfaction. Specific demographics—including younger employees (ages 18–35), singles, and individuals in roles such as Sales Representatives and Laboratory Technicians—are particularly vulnerable to leaving. Additionally, departments like Sales and Human Resources demonstrate disproportionately high attrition rates, warranting targeted interventions. Key organizational factors such as overtime workloads, lack of career progression, low engagement in the first few years, and weak managerial relationships further amplify attrition risks. On the other hand, higher income, longer tenure, stronger ties with managers, and a clear path for career advancement are associated with better retention.

By identifying these drivers, the analysis empowers the organization to take proactive steps to mitigate turnover. Recommended strategies include enhancing onboarding programs, offering skill development and educational support, improving work-life balance, strengthening leadership effectiveness, and implementing targeted retention initiatives for high-risk roles and departments.

Ultimately, this project emphasizes the importance of a data-driven approach to human resource management. By continuously monitoring attrition trends and responding to employee needs, the company can foster a more engaged, satisfied, and loyal workforce—ensuring long-term organizational success and employee well-being.