



# Employee Attrition

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By: Amanda Jo Griffin (Aj)

# Background

As the lead data engineer for a large enterprise, I am spearheading a collaborative effort with HR to analyze employee attrition trends and develop an advanced predictive application.

My primary focus is designing a robust prediction model. To ensure the dataset is analysis-ready, we will employ effective data cleaning techniques.

Through the integration of cutting-edge technology and leveraging data-driven insights, our goal is to provide the HR department with a powerful tool for proactive decision-making and effective mitigation of employee attrition.



# Purpose



For the HR department, I am tasked by the VP of Data and Product to deliver a concise overview of our new attrition prediction app's market launch readiness. This will include key findings on features that best predict attrition based on employee information.

Additionally, I'll outline the methodologies employed in the process and provide insights into the reliability rate of our predictions.

# Data Overview

## The Data

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Information about various features related to employees that work for the company.

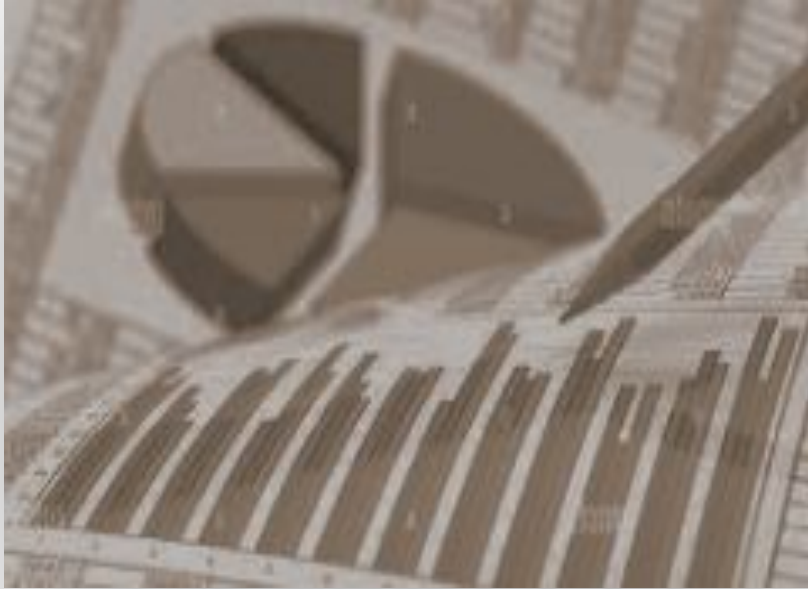
## Size

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1470 rows  
35 columns

Learn More About The Data

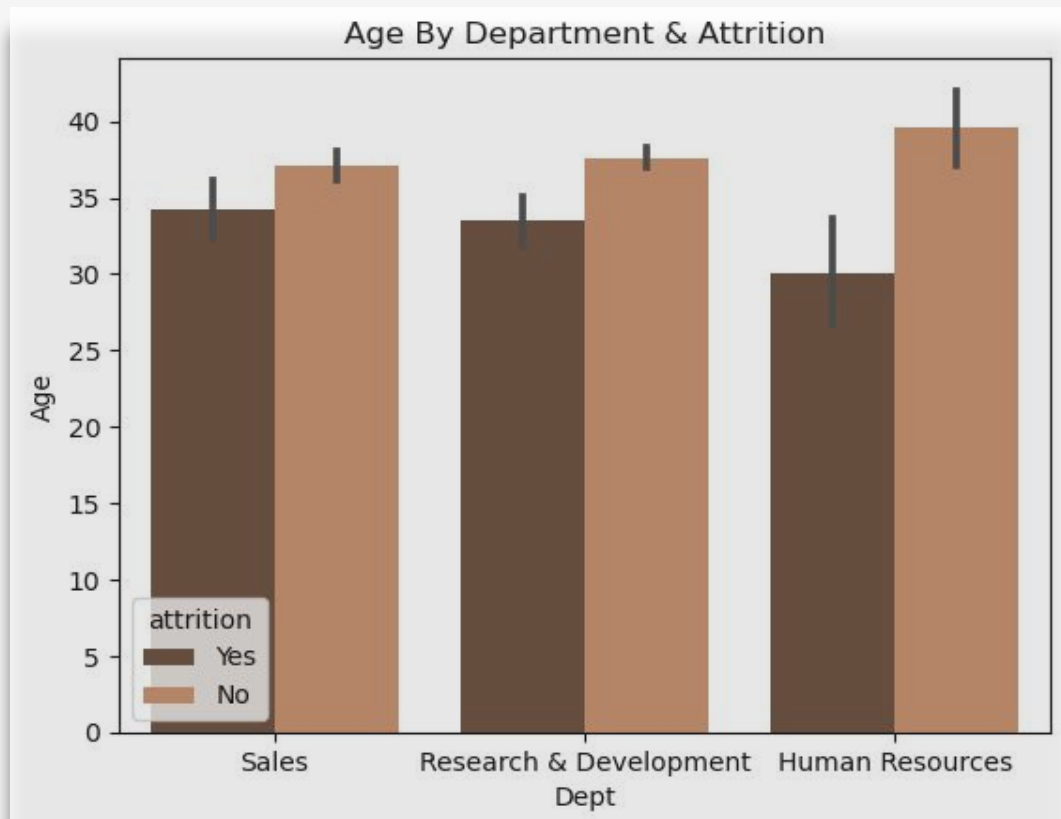
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# Current Trends

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# Age By Department & Attrition



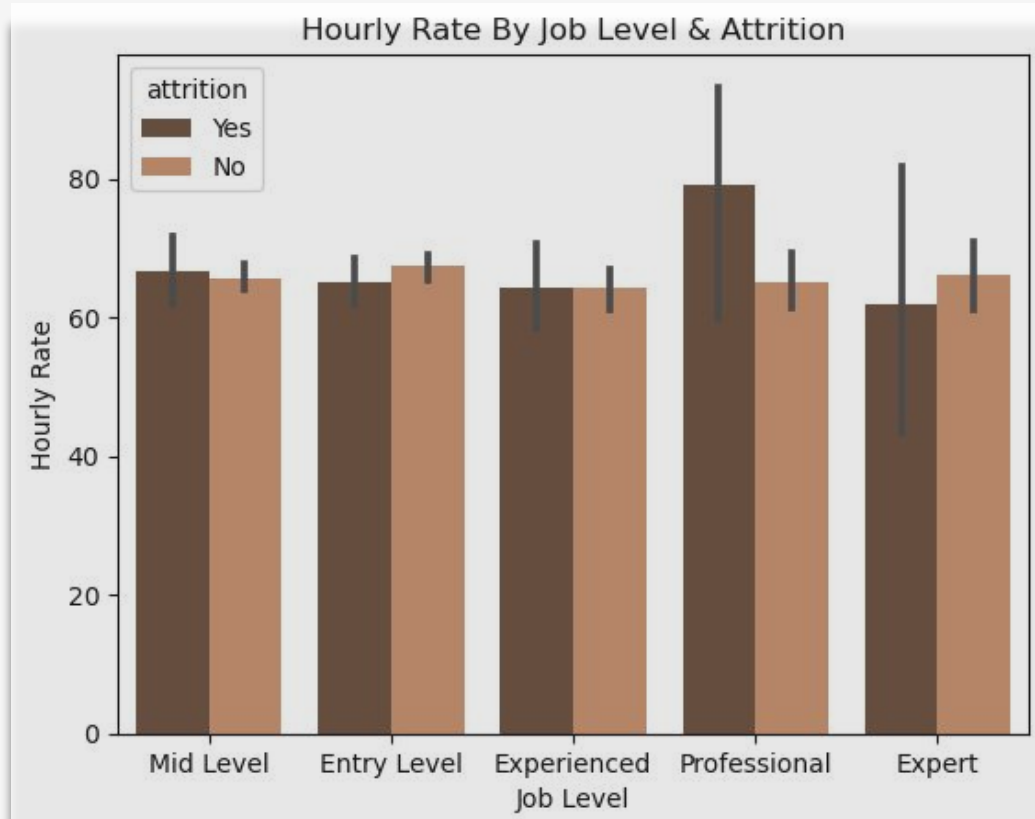
Average Age Range

30-40

Retention Patterns

Slightly older (35-40) = longer tenures, particularly in HR dept.

# Hourly Rate By Job Level & Attrition



## Average Hourly Rate

- 60-80

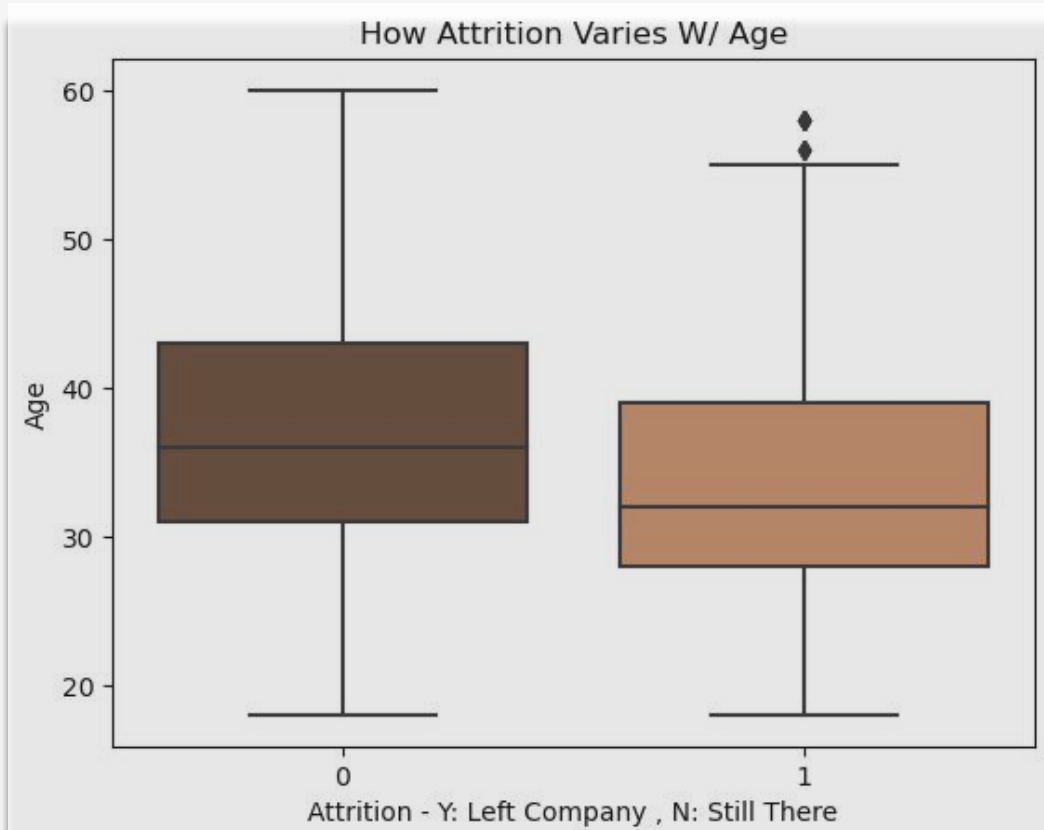
## Retention Patterns

- Entry & Expert level more inclined to stay, especially when paid more.
- Employees at Expert level tend to stay more, reflecting higher retention rate when job level increases.

## Attrition Patterns

- Higher pay at Mid and Professional levels corresponds to higher likelihood of attrition, particularly at the Professional level where they exhibit higher tendency to leave.

# How Attrition Varies W/ Age



## Attrition Age Range (50%)

- Half of employees who left were between 28 and 39.

## Retention Age Range (50%)

- 50% of employees who stayed were between 31 and 43.

## Median Age Range

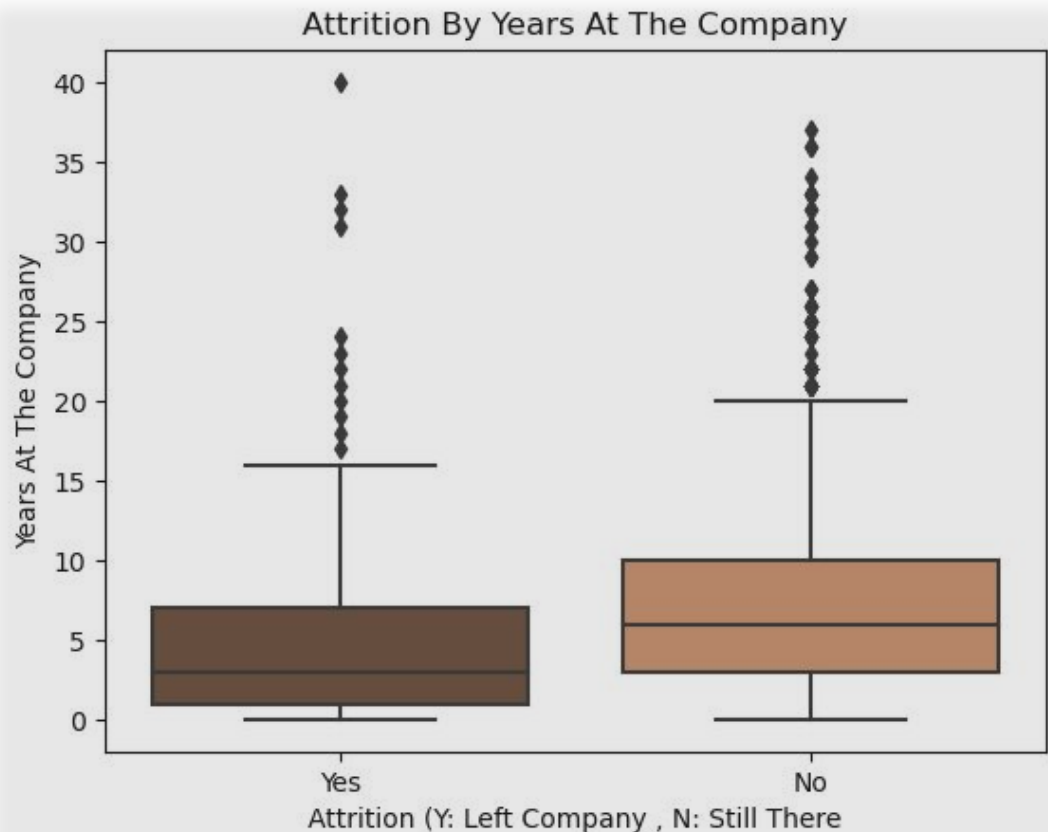
- Median age for those who left: 32
- Median age for those who stayed: 36

## General Trend

- A discernible trend that, in general, younger employees are more likely to experience attrition.
- Despite the trend, a few outliers present, representing those who left at older ages.



# Attrition By Years At The Company



## Predominant Groups

- Leaving: Tenure of 1-7 years
- Staying: 3-10 years

## Median Tenure

- 3 years

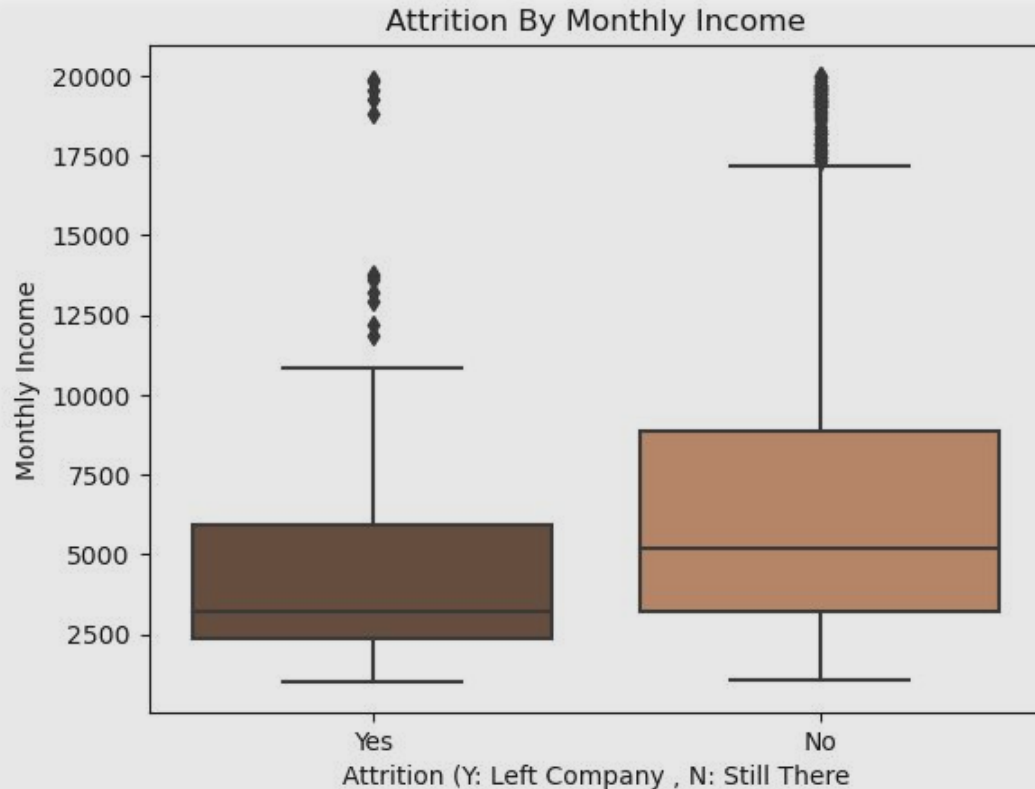
## 50%

- Half of those departing had a tenure between 1 and 7 years.
- While for those staying, tenure is around 6 years.

## General Trend

- A notable trend suggesting that the longer employees have been with the company, the more likely they are to stay.
- Despite trend, there are a few outliers who deviate from the typical tenure pattern.

# Attrition By Monthly Income



## Predominant Groups

- Leaving: Falls within monthly income range of 1000-12000
- Staying: Monthly income between 1000 - 17000

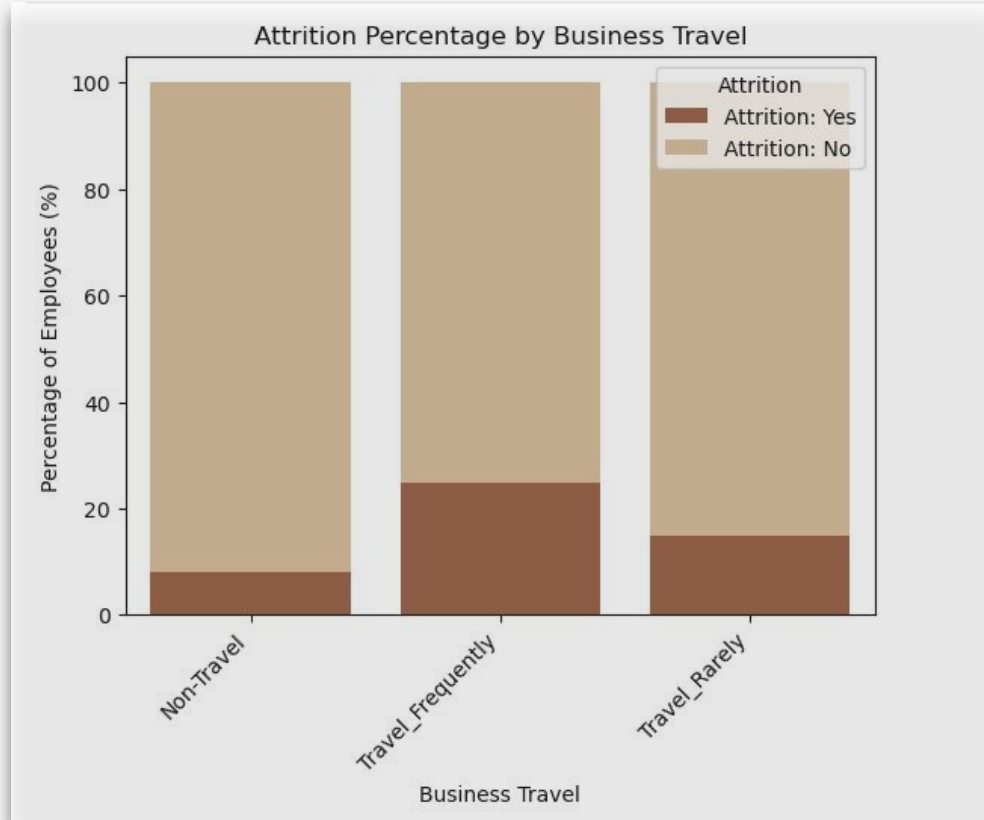
## 50%

- Half of those departing had monthly income between 2500-6000.
- While for those staying, monthly income between 3000-8500

## General Trend

- Trend indicates that employees with a higher monthly income are more likely to remain with the company.
- While the overall pattern supports this trend, there are a few outliers that deviate from the norm.

# Attrition % By Business Travel



## Rare Travelers

- Approximately 90% retention rate, with a less than 10% attrition rate

## Frequent Travelers

- Retention rate around 80%, but with a higher attrition rate of about 25%.

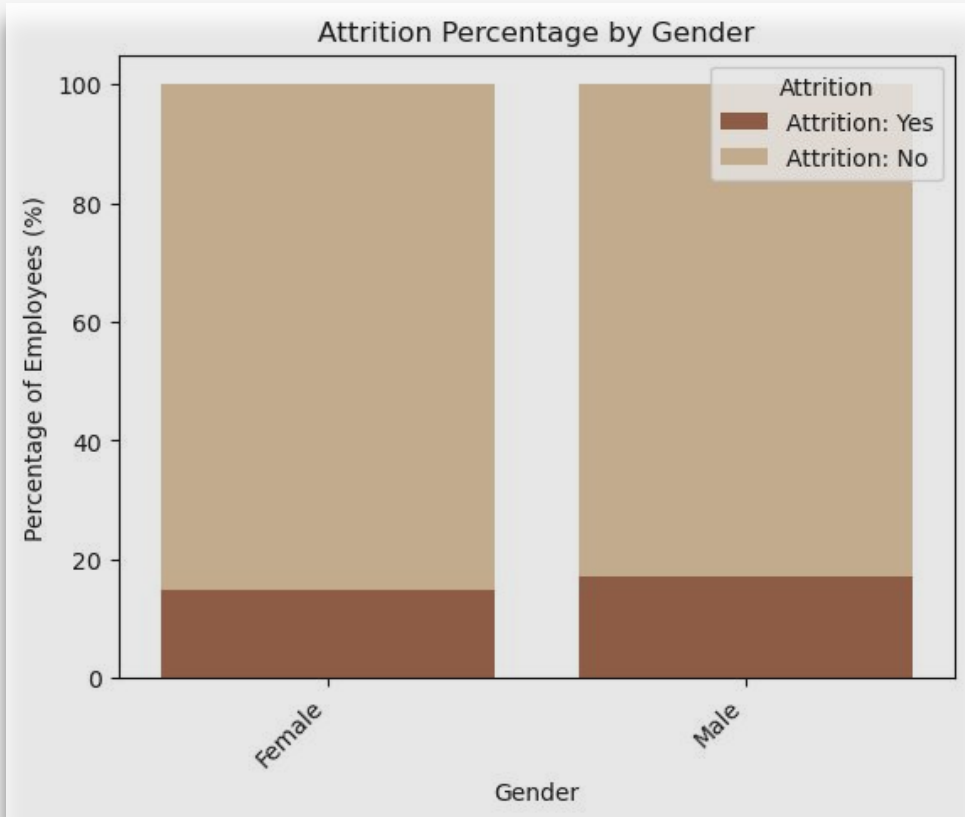
## Non Travelers

- An exceptionally high retention rate of approximately 95%, with a low attrition rate of about 5%.

## Observations

- Non-traveling employees demonstrate the strongest job stability, followed by rare travels and then frequent travelers.

# Attrition % By Gender



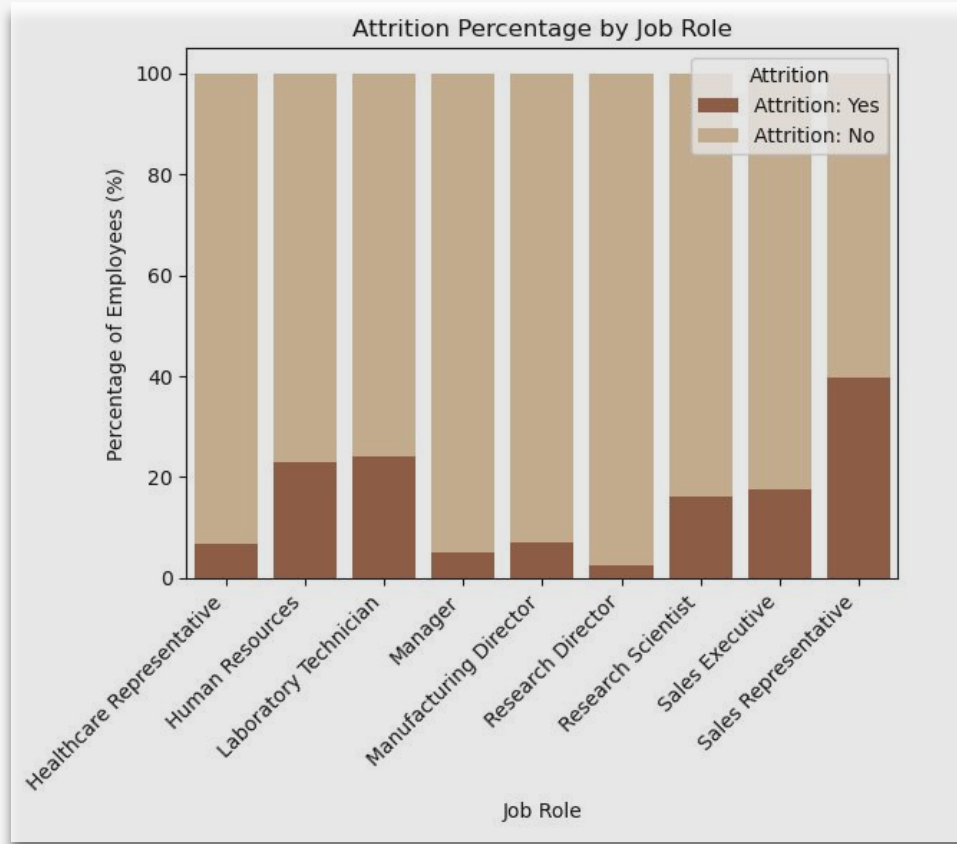
## Gender-Based Attrition Rates

- Approximately 86% of female employees choose to stay.
- Around 80% of male employees opt to stay.

## Observations

- The analysis suggests that gender does not play a substantial role in influencing the overall attrition rate.

# Attrition % By Job Role



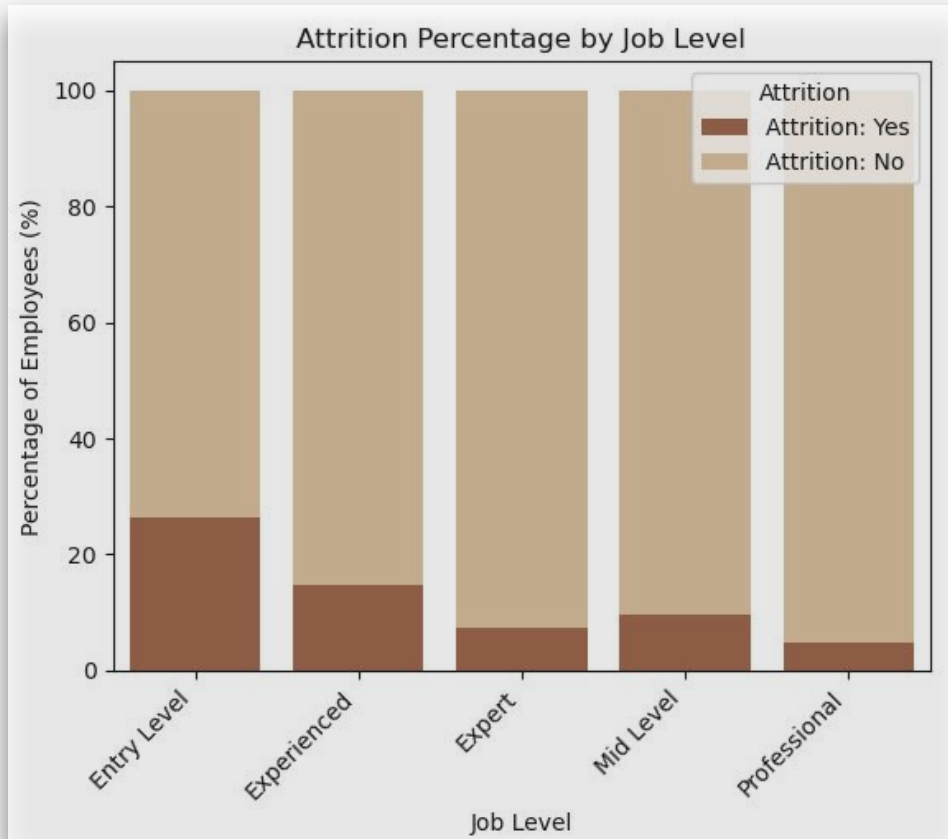
## Attrition Trends

- Sales Reps: 40% turnover - Factors contributing to high turnover need exploration.
- Research Directors: 2% turnover - Exceptionally stable workforce.
- HR Professionals: 20% turnover - Notable turnover, reasons warrant attention.
- Managers: 5% turnover - Highlights the role of effective leadership in promoting loyalty and stability.
- Lab Techs & Manufacturing Directors: Slightly higher attrition compared to Research Scientists & Health Care Reps.

## Observations

- Analysis reveals high attrition rate among sales reps and exceptional stability of research directors.
- Emphasizes importance of addressing specific challenges and implementing retention strategies tailored to each role.

# Attrition % By Job Level



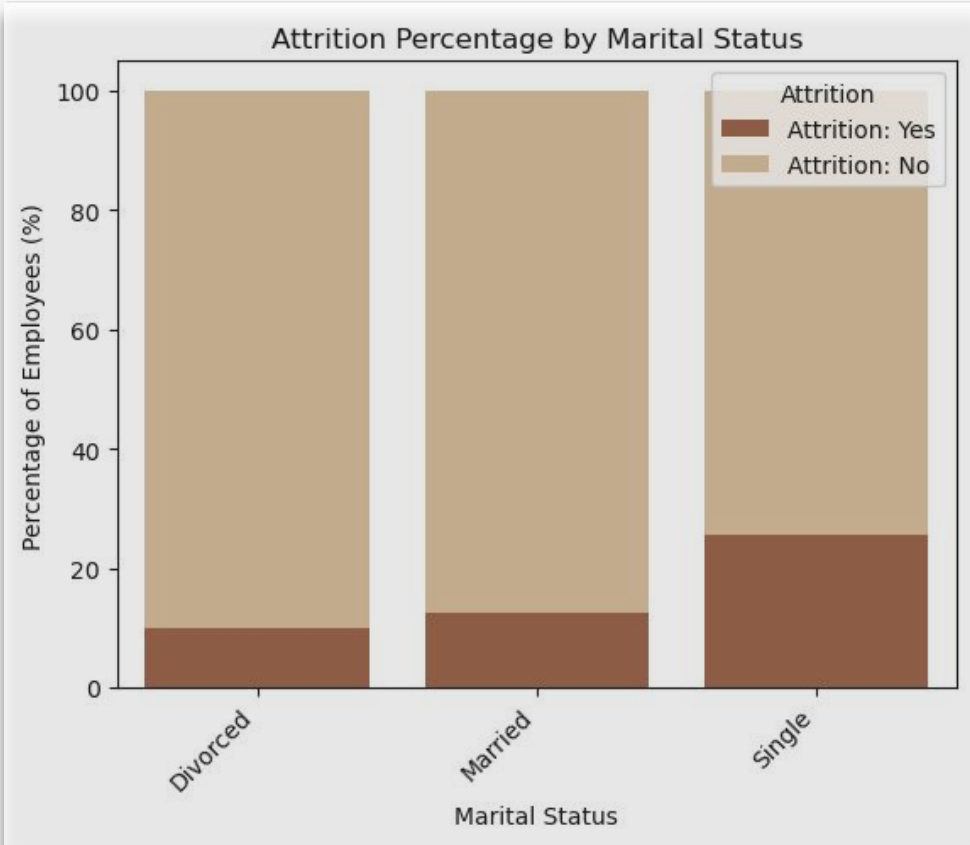
## Attrition Trends

- Entry-Level: 25% turnover
- Experienced: 15% turnover
- Mid-Level: 10% turnover
- Professionals: Low attrition rate, emphasizing the value of retaining skilled workforce.
- Experts: Exceptionally low attrition rate, highlighting challenges in replacing individuals with specialized skills.

## Observations

- Attrition rates decrease with progression, showcasing a correlation between tenure and job stability.
- Majority choose to stay in each category, underscoring a general trend of robust employee retention across all levels.

# Attrition % Marital Status



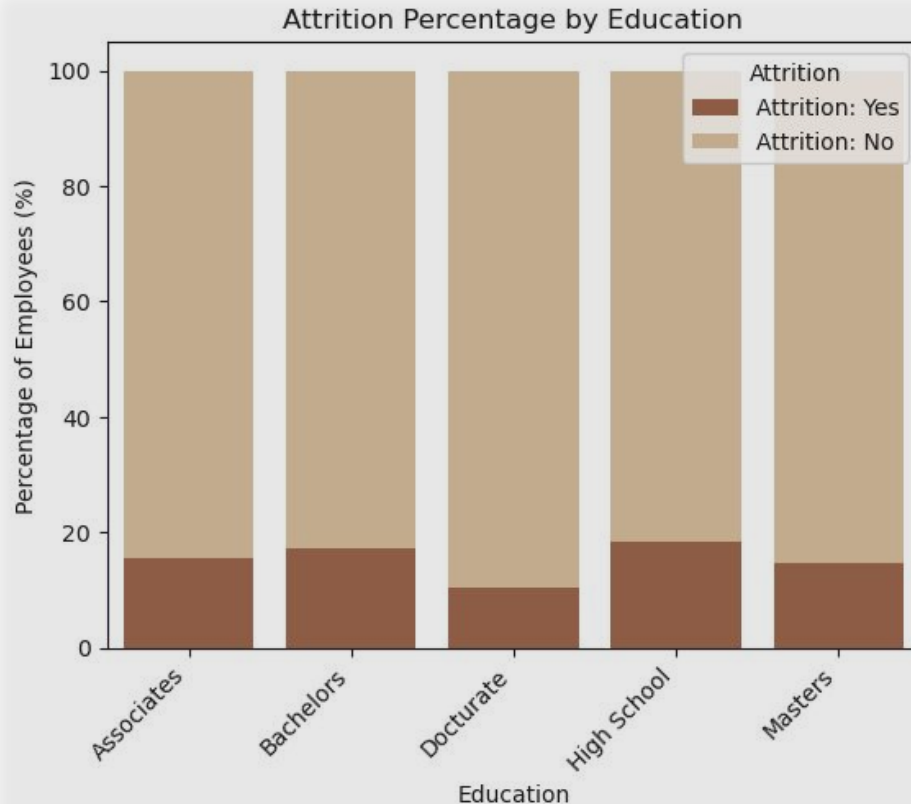
## Attrition Trends

- Single: 30% turnover - Possible factors: career mobility or desire for change.
- Married: 15% turnover - Suggests stability from marital relationships positively impacting job commitment.
- Divorced: 10% turnover - Indicates potential challenges such as personal life adjustments or the need for increased flexibility.

## Observations

- Important to note that number of employees who choose to stay outweighs those who leave, indicating overall commitment and job satisfaction within the workforce, regardless of marital status.

# Attrition % Education



## Attrition Trends

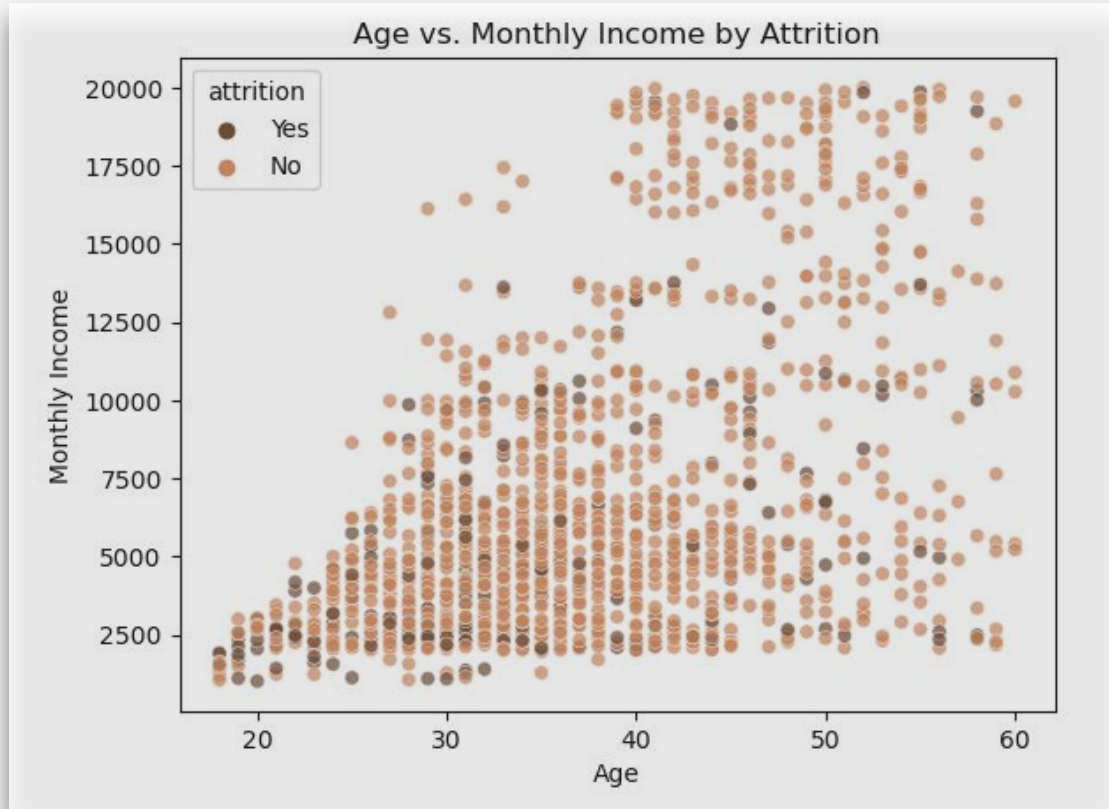
- Associate's Degree: 20% turnover
- Bachelor's Degree: 20% turnover (similar to high school diploma holders)
- Master's Degree: Just under 20% turnover
- Doctoral Degree: 15% turnover

## Observations

- Emphasizes the value of advanced education and expertise gained through doctoral studies in promoting lower attrition rates.
- Majority choose to stay across all categories, emphasizing overall commitment and job satisfaction within our workforce.



# Age Vs. Monthly Income By Attrition



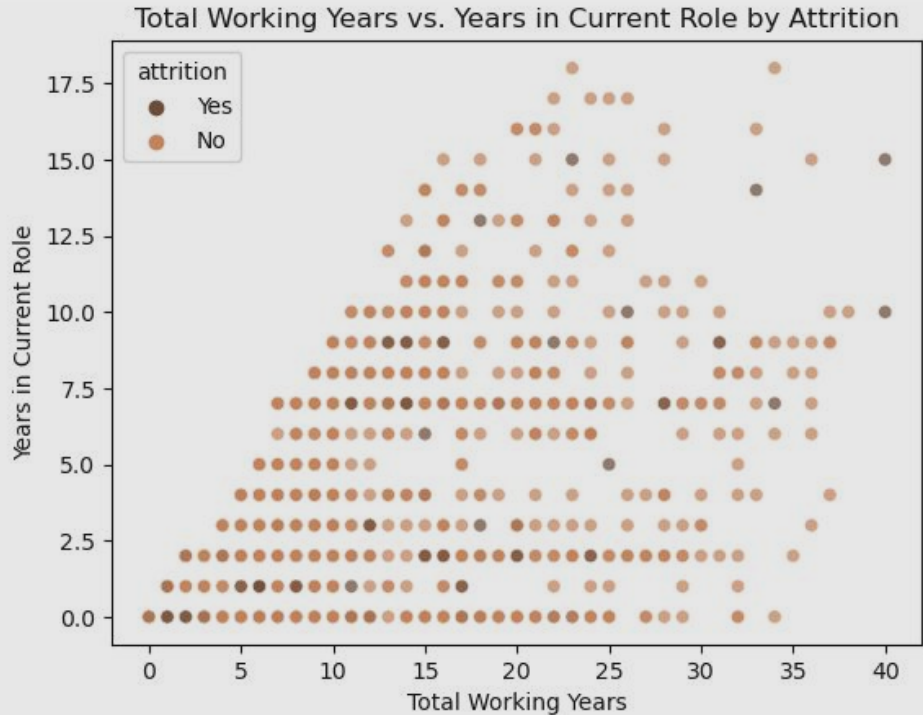
## Dot Scatter Analysis:

- Concentration of brown dots (attrition) in lower half of age and income.
- Majority of dots, regardless of attrition, in lower half of age and income.

## Observations

- Suggests potential correlation between younger age, lower income, and attrition.

# Total Working Yrs Vs. Yrs In Current Role By Attrition



## Dot Scatter Analysis:

- Higher concentration of brown dots (attrition) in lower half of years in current role and total working years.

## Observations

- Suggests employees with fewer years in current role and overall work experience are more likely to experience attrition.
- Indicates a potential correlation between attrition and employees who are relatively new to their roles or have less overall work experience.

# Years At Company By Attrition



## Violin Analysis

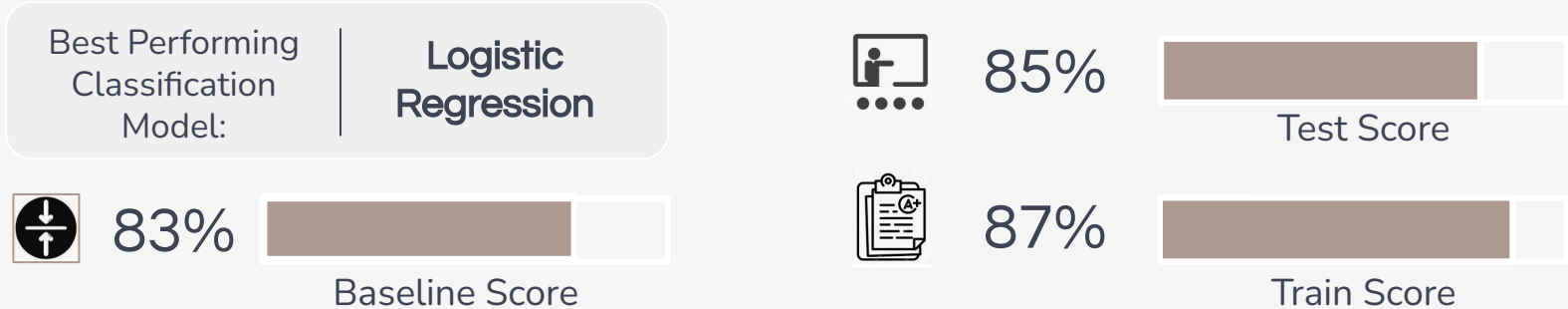
- Concentration around median years at the company.
- Median tenure: Stay (7 years), Leave (3 years).
- Attrition more frequent among shorter tenures.
- Some stay for extended durations, even with attrition.
- Relatively low number with very short tenures, slightly shorter for those who leave.
- Majority of data (mid-bubble part) for those who stay ends at about 15 years, indicating a significant portion staying for an extended period.
- Difference in shape implies different distributions, with a higher concentration of longer tenures among those who stay.



# Modeling

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# Performance



- Although the Random Forest Classifier achieved a perfect accuracy score of 100% on the training data, it did not generalize well to the testing data, achieving an accuracy score of only 86%. K-Nearest Neighbors (KNN) model showed a relatively consistent performance with an accuracy score of 86% on the training data and slightly improved to 88% on the testing data. Logistic Regression model performed consistently with an accuracy score of 85% on the training data and improved to 88% on the testing data.
- We can conclude that while the Random Forest Classifier may have overfit the training data by achieving a perfect score, it struggled to generalize to new, unseen data. Both the KNN and Logistic Regression models demonstrated better generalization performance, with the KNN model having a slightly higher accuracy score on the testing data.
- When using predictive modeling, working with KNN or Logistic Regression will yield the best results.



# Application For Predicting

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Streamlit



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# Synopsis

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# Conclusions

Attrition Patterns	Departmental Insights	Education & Job Levels	Demographic Trends	Modeling Performance	Application For Predicting
<p>Employees with shorter tenures, younger ages, and lower incomes are more prone to attrition.</p> <p>Notable exceptions exist, emphasizing the importance of individualized retention strategies.</p>	<p>Sales Reps: High attrition - Investigate contributing factors.</p> <p>Research Directors: Exceptional stability - Highlight effective departmental practices.</p> <p>HR Professionals: Notable turnover - Address specific challenges.</p> <p>Managers: Low attrition - Emphasize effective leadership impact.</p>	<p>Higher education, especially a doctoral degree, correlates with lower attrition rates.</p> <p>Professionals and Experts exhibit lower attrition, emphasizing the value of retaining skilled workforce.</p>	<p>Age, monthly income, and business travel influence attrition rates.</p> <p>Non-traveling employees show strong job stability, while frequent travelers experience higher attrition.</p>	<p>Logistic Regression is the best-performing model for attrition prediction, achieving an 85% to 88% accuracy score and beating the baseline of 83%.</p>	<p>A Streamlit app has been developed to facilitate further exploratory data analysis (EDA) and predict outcomes based on employee features.</p>

# Recommendations:

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## Focus On:

- **Retention Strategies:** Tailor strategies for Sales Reps to address high turnover factors. Implement effective practices observed in Research Directors' departments.
- **Leadership Development:** Invest in leadership development programs for lower attrition. Prioritize skill development for managers to enhance effective leadership.
- **Targeted Support for HR Professionals:** Investigate and address specific challenges for HR Professionals to reduce turnover.
- **Education and Skill Development:** Continue supporting higher education, correlating with lower attrition. Prioritize retaining Professionals and Experts for their significant contributions.



## Prioritize:

- **Demographic Considerations:** Explore flexible arrangements for frequent travelers to mitigate higher attrition. Consider additional support for younger employees with lower incomes.
- **Continuous Monitoring:** Regularly monitor attrition trends and adjust strategies accordingly.
- **Communication and Feedback:** Establish open channels for employee feedback on workplace experiences. Utilize insights from the predictive model for proactive decision-making.
- **Utilize Streamlit App:** Incorporate the developed Streamlit app for ongoing analysis and prediction.

# Thank You!

Q&A