

Department

DEPI

HR

Data Analytics

CAI2_DAT1_G1



وزارة الاتصالات
وتقنيولوجيا المعلومات



Team Members





Eslam Gamal
21093859
Petrophysicist &
Data Analyst





Salma Ayman
21083449
RAN Engineer & Data Analyst





Reham Ehab
21089282
Data Analyst





Fatma El-Zahraa Ahmed
21060326
Chemical Analyst & Data Analyst



Naglaa Mohamed
21079509
Data Analyst



889.33



Agenda



Introduction

Agenda



Agenda

Features



Agenda

Data Preparation & Modelling



Agenda

Insights



Agenda

Conclusion & Recommendations





Introduction

- A Data analysis project using HR department data to understand employee performance, satisfaction, and career progression is essential for making informed HR decisions. This project focuses on analyzing a comprehensive dataset from the HR department, which contains detailed information about employees and their performance ratings over several years.
- The dataset includes a wide range of features such as demographic details, job roles, education, work experience, and various performance-related metrics including self and manager ratings, satisfaction scores, training participation, and more. By exploring this data, the objective of the analysis is to uncover patterns and insights that can help the HR team identify key factors influencing employee performance, predict potential attrition risks, and support strategic workforce planning.



Introduction

Objectives

- Explore a comprehensive employee dataset to uncover meaningful patterns and relationships that influence employee performance and satisfaction.
- Enable the HR team to identify key drivers of productivity, assess potential attrition risks, and inform strategic decisions for workforce development and planning.
- Make recommendations to help taking decisions that can improve employee's performance and satisfaction levels.

Features

- Our dataset contains 2 main sheets:
 - Employees data.
 - Performance data.

| | |
|----------------------------|------------------------------|
| Employee ID | Performance ID |
| First Name | Employee ID |
| Last Name | Review Date |
| Gender | Environment Satisfaction |
| Age | Job Satisfaction |
| Business Travel | Relationship Satisfaction |
| Department | Training Opportunities |
| Distance From Home (KM) | Within Year |
| State | Training Opportunities Taken |
| Ethnicity | Work Life Balance |
| Education | Self Rating |
| Education Field | Manager Rating |
| Job Role | |
| Marital Status | |
| Salary | |
| Stock Option Level | |
| Over Time | |
| Hire Date | |
| Attrition | |
| Years At Company | |
| Years In Most Recent Role | |
| Years Since Last Promotion | |
| Years With Curr Manager | |

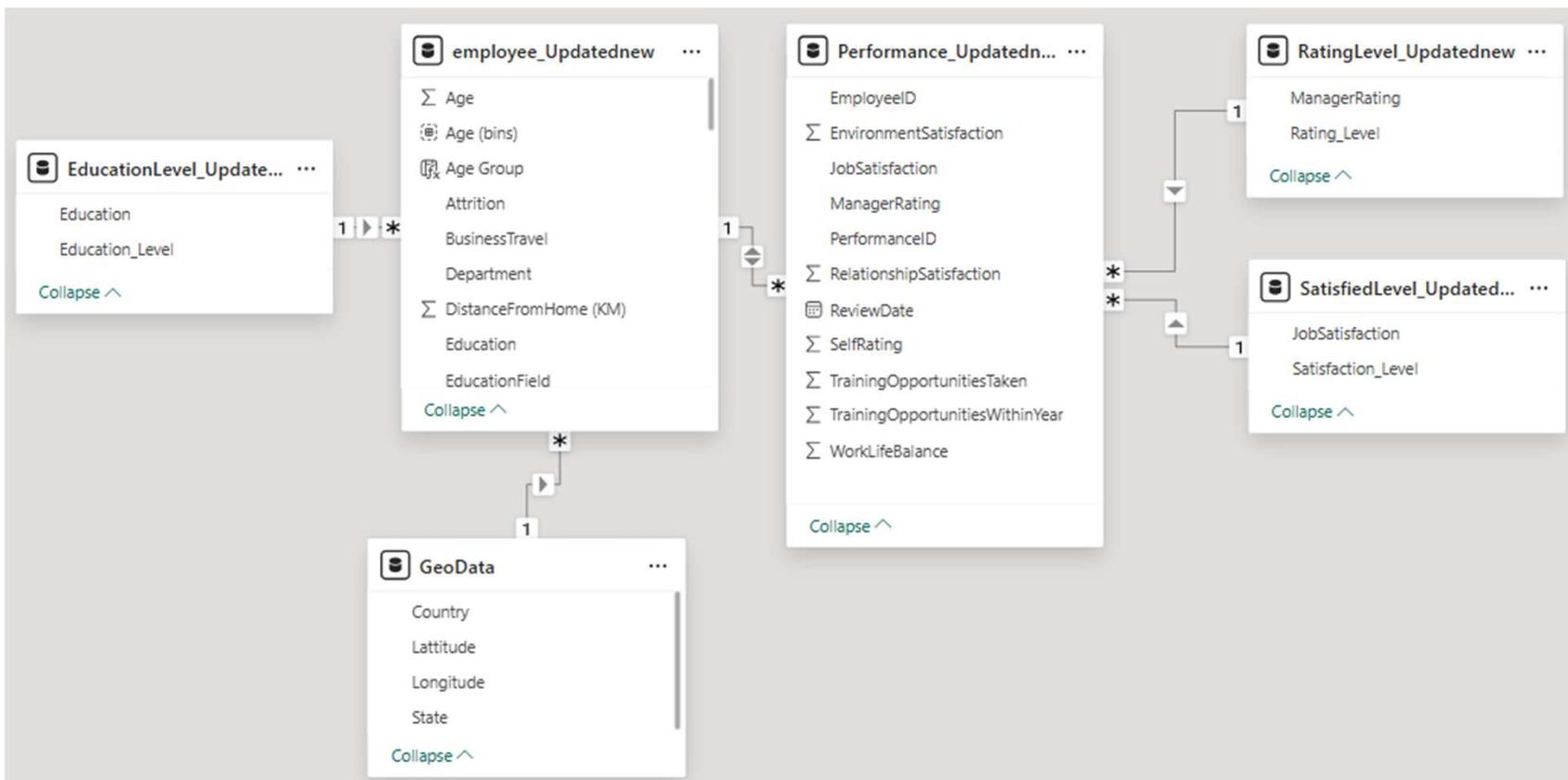
Data Preparation & Modelling

Database Schema & Table Structure

1. Table 1 (Employees)
 - Primary key: Employee ID
 - Foreign key: State, Education
2. Table 2 (Performance)
 - Primary key: Performance ID
 - Foreign key: Employee ID
3. Table 3 (Education level)
 - Primary key: Education
4. Table 4 (Geo Data)
 - Primary key: State
5. Table 5 (Rating Level)
 - Primary key: Rating Level
6. Table 6 (Satisfaction Level)
 - Primary key : Satisfaction Level

| | |
|----------------------------|------------------------------|
| Employee ID | Performance ID |
| First Name | Employee ID |
| Last Name | Review Date |
| Gender | Environment Satisfaction |
| Age | Job Satisfaction |
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| Stock Option Level | |
| Over Time | |
| Hire Date | |
| Attrition | |
| Years At Company | |
| Years In Most Recent Role | |
| Years Since Last Promotion | |
| Years With Curr Manager | |

Data Preparation & Modelling





Data Preparation & Modelling

Data Cleaning

- Check for Duplicates: No duplicates were found in employee id column

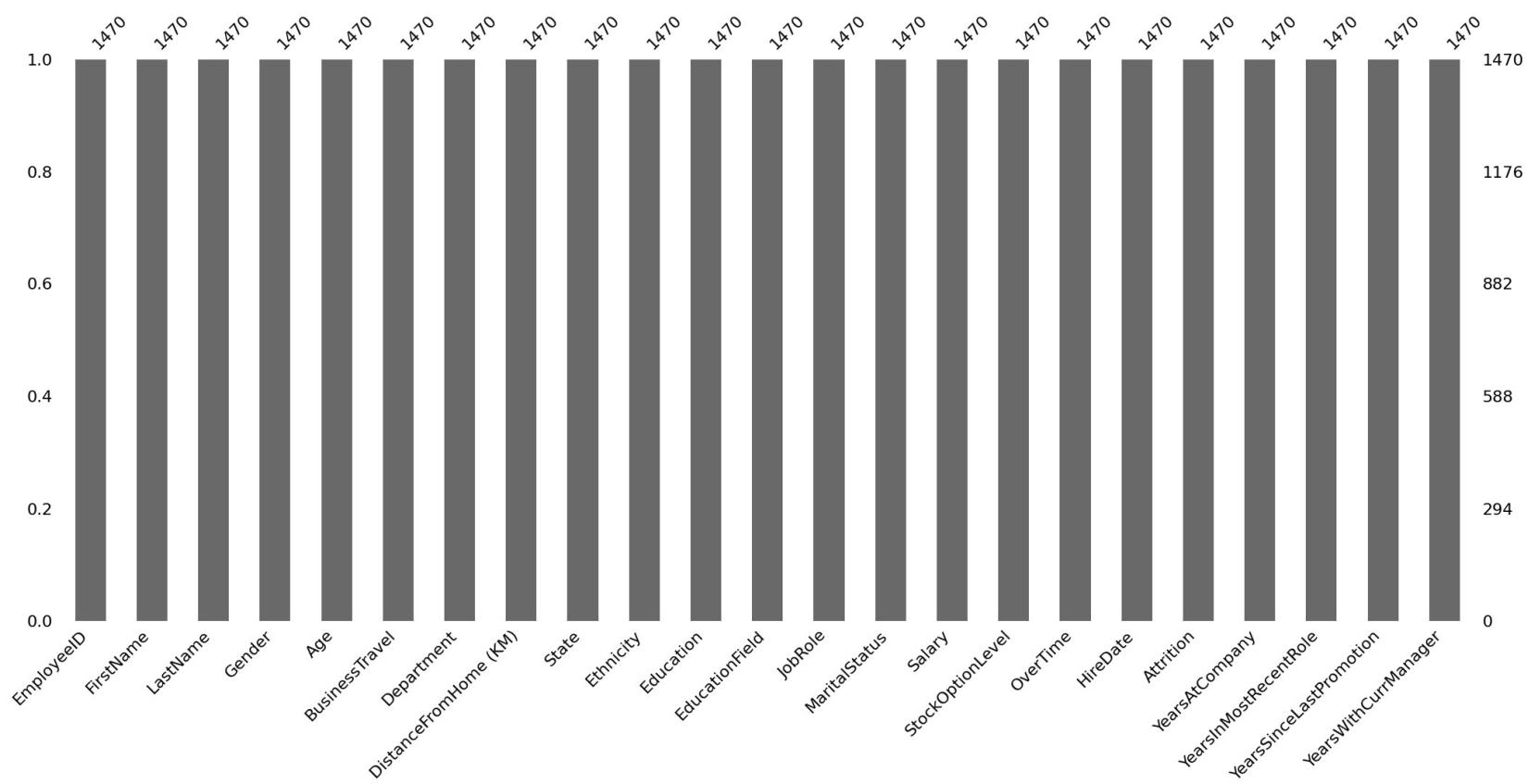
```
[27] data.duplicated()  
    ✓ 0.0s  
... 0    False  
1    False  
2    False  
3    False  
4    False  
...  
1465 False  
1466 False  
1467 False  
1468 False  
1469 False  
Length: 1470, dtype: bool
```

```
[28] data.duplicated().unique()  
    ✓ 0.0s  
... array([False])
```

Data Preparation & Modelling

Data Cleaning

- Check Missing values: No missing values were found in all columns





Data Preparation & Modelling



Data Cleaning

Check wrong spellings:

- Check wrong spellings: Found space after “No Travel “ in Business Travel column.
- Found duplicated “Marketing” education field due to extra space.

```
data['BusinessTravel'].unique()
✓ 0.0s
array(['Some Travel', 'No Travel ', 'Frequent Traveller'], dtype=object)
```

```
data['BusinessTravel'] = data['BusinessTravel'].replace('No Travel ','No Travel')
✓ 0.0s
```

```
data['BusinessTravel'].unique()
✓ 0.0s
array(['Some Travel', 'No Travel', 'Frequent Traveller'], dtype=object)
```

```
▶ ● data['EducationField'].unique()
[11] ✓ 0.0s
...
array(['Marketing', 'Marketing ', 'Computer Science', 'Technical Degree',
       'Information Systems', 'Other', 'Economics', 'Human Resources',
       'Business Studies'], dtype=object)
```

```
data['EducationField'] = data['EducationField'].replace('Marketing ','Marketing')
✓ 0.0s

data['EducationField'].unique()
✓ 0.0s
array(['Marketing', 'Computer Science', 'Technical Degree',
       'Information Systems', 'Other', 'Economics', 'Human Resources',
       'Business Studies'], dtype=object)
```

Data Preparation & Modelling

Data Cleaning

Check wrong spellings:

- Found space after “Other” and “Native Hawaiian” in Ethnicity column.

```
data['Ethnicity'].unique()
[ 0.0s

array(['White', 'Asian or Asian American',
       'Mixed or multiple ethnic groups', 'Black or African American',
       'Native Hawaiian ', 'Other ', 'American Indian or Alaska Native'],
      dtype=object)

data['Ethnicity'] = data['Ethnicity'].replace('Other ', 'Other')
data['Ethnicity'] = data['Ethnicity'].replace('Native Hawaiian ', 'Native Hawaiian')
data['Ethnicity'].unique()
[ 0.0s

array(['White', 'Asian or Asian American',
       'Mixed or multiple ethnic groups', 'Black or African American',
       'Native Hawaiian', 'Other', 'American Indian or Alaska Native'],
      dtype=object)
```



Data Preparation & Modelling

Data Cleaning

- Check wrong spellings: Some Managers in the job role were not defined for which department

| Department | DistanceFromHome (KM) | State | Ethnicity | Education | EducationField | JobRole |
|------------|-----------------------|------------|-----------------|-----------|------------------|---------|
| Sales | 38 | California | Black or Africa | 5 | Marketing | Manager |
| Sales | 36 | California | Black or Africa | 4 | Marketing | Manager |
| Sales | 44 | California | Mixed or mult | 3 | Marketing | Manager |
| Sales | 17 | Illinois | Black or Africa | 4 | Economics | Manager |
| Sales | 4 | California | Asian or Asian | 4 | Marketing | Manager |
| Sales | 19 | California | American Indi | 4 | Marketing | Manager |
| Sales | 44 | California | Black or Africa | 4 | Marketing | Manager |
| Sales | 31 | California | Mixed or mult | 5 | Marketing | Manager |
| Sales | 13 | California | Asian or Asian | 5 | Marketing | Manager |
| Sales | 3 | Illinois | Mixed or mult | 1 | Economics | Manager |
| Sales | 38 | California | Mixed or mult | 2 | Technical Degree | Manager |
| Sales | 35 | New York | Asian or Asian | 3 | Marketing | Manager |
| Sales | 6 | California | Black or Africa | 3 | Economics | Manager |
| Sales | 30 | California | Mixed or mult | 2 | Marketing | Manager |
| Sales | 43 | Illinois | White | 4 | Marketing | Manager |
| Sales | 20 | California | White | 3 | Marketing | Manager |
| Sales | 16 | California | White | 3 | Marketing | Manager |
| Sales | 30 | California | White | 2 | Marketing | Manager |
| Sales | 23 | California | White | 3 | Marketing | Manager |
| Sales | 5 | New York | White | 4 | Marketing | Manager |
| Sales | 29 | New York | White | 1 | Marketing | Manager |
| Sales | 12 | California | White | 4 | Marketing | Manager |
| Sales | 17 | California | White | 4 | Economics | Manager |
| Sales | 14 | New York | White | 4 | Marketing | Manager |
| Sales | 3 | Illinois | White | 3 | Marketing | Manager |
| Sales | 32 | New York | White | 3 | Technical Degree | Manager |
| Sales | 21 | California | White | 3 | Marketing | Manager |



Data Preparation & Modelling

Data Cleaning

- Check wrong job role department: Employee 9758-DE2F is a Sales Executive but defined in Technology department instead of Sales department.

| | | | | | | | | | | | | |
|-----------|-----------|-----------|--------|----|--------------------|------------|----|----|-------|---|-----------|-----------------|
| 04E6-6B61 | Rodd | Haddow | Male | 29 | Some Travel | Sales | 17 | CA | White | 4 | Marketing | Sales Executive |
| 0F2B-3457 | Steven | Bucktrout | Male | 19 | Frequent Traveller | Sales | 14 | NY | White | 2 | Marketing | Sales Executive |
| 9758-DE2F | Modestine | Yeowell | Female | 28 | Some Travel | Technology | 15 | CA | White | 4 | Other | Sales Executive |
| 56FC-5C6E | Donovan | Sycamore | Male | 28 | Some Travel | Sales | 42 | CA | White | 3 | Marketing | Sales Executive |
| B0C2-0E3D | Cindy | Mordanti | Female | 22 | Some Travel | Sales | 22 | CA | White | 1 | Other | Sales Executive |



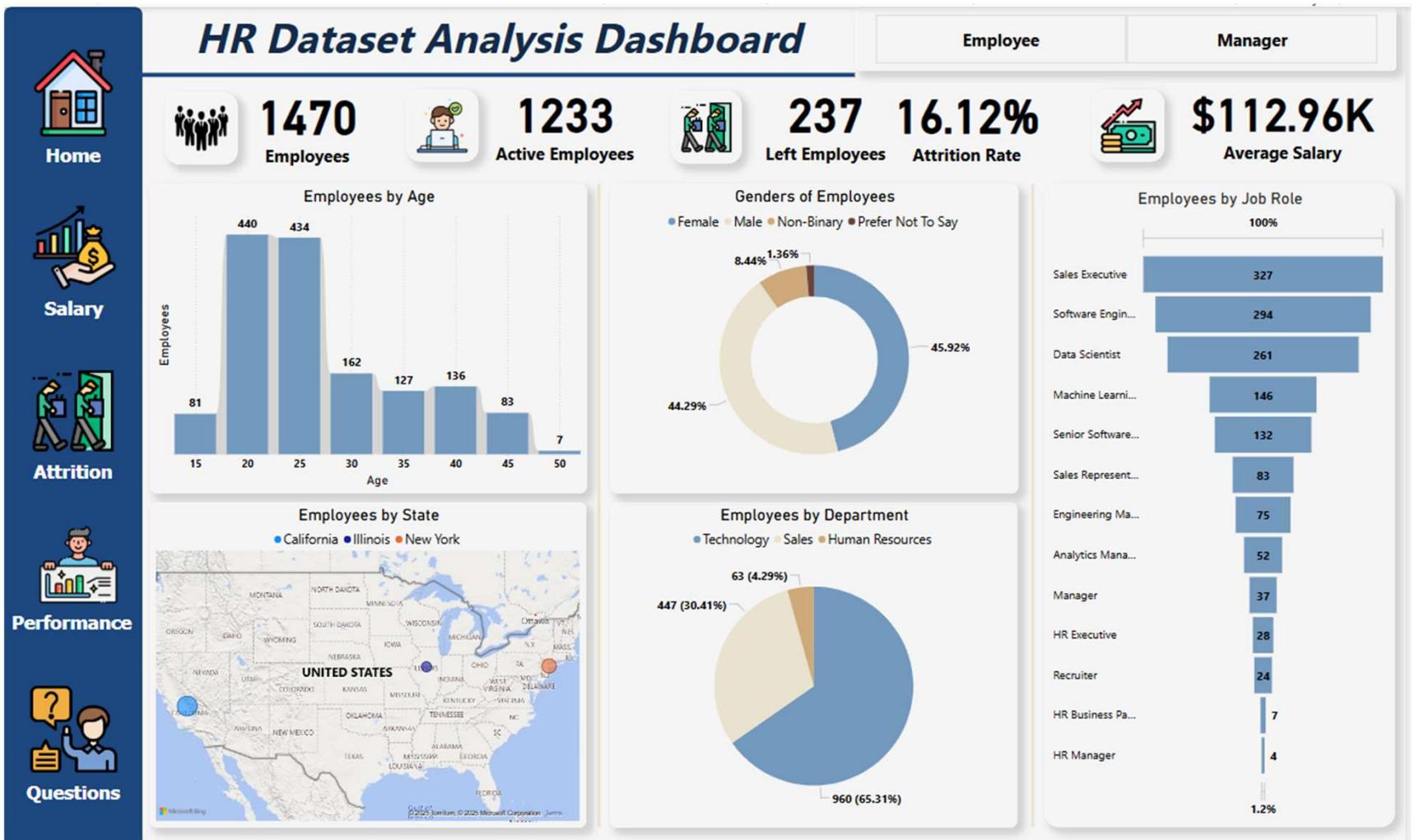
Data Preparation & Modelling

Data Cleaning

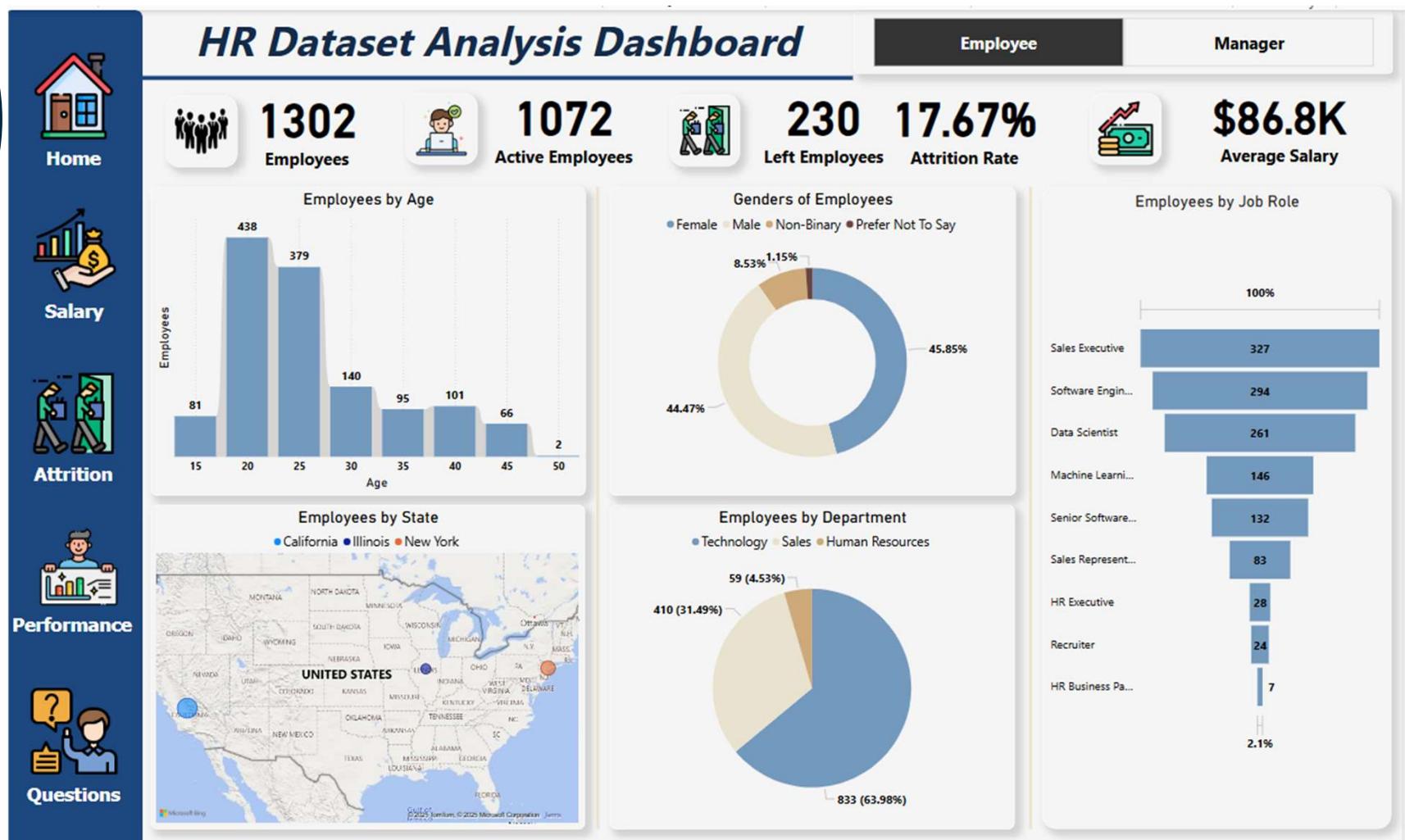
- Doubtful instances: Two employees were very young for their positions and their salaries.

| Employee | FirstNa | LastNa | Gender | Age | Department | Educat | Educat | JobRole | Salary | StockC | HireDate | Attritio | YearsAtCompany | YearsInMostRecentRole | YearsSinceLastPromotion | YearsWithCurrManager | |
|-----------|----------|----------|--------|-----|------------|--------|--------------------------------|---------|--------|------------|----------|----------|----------------|-----------------------|-------------------------|----------------------|--|
| 4938-402A | Gherardo | Stratiff | Male | 24 | Sales | 3 | Economic Manager | 135407 | 1 | 7/5/2018 | No | 4 | 2 | 4 | 2 | 2 | |
| 29AC-099C | Boy | Greenall | Male | 24 | Technology | 1 | Informatic Engineering Manager | 115110 | 2 | 11/19/2019 | No | 3 | 3 | 3 | 3 | 3 | |

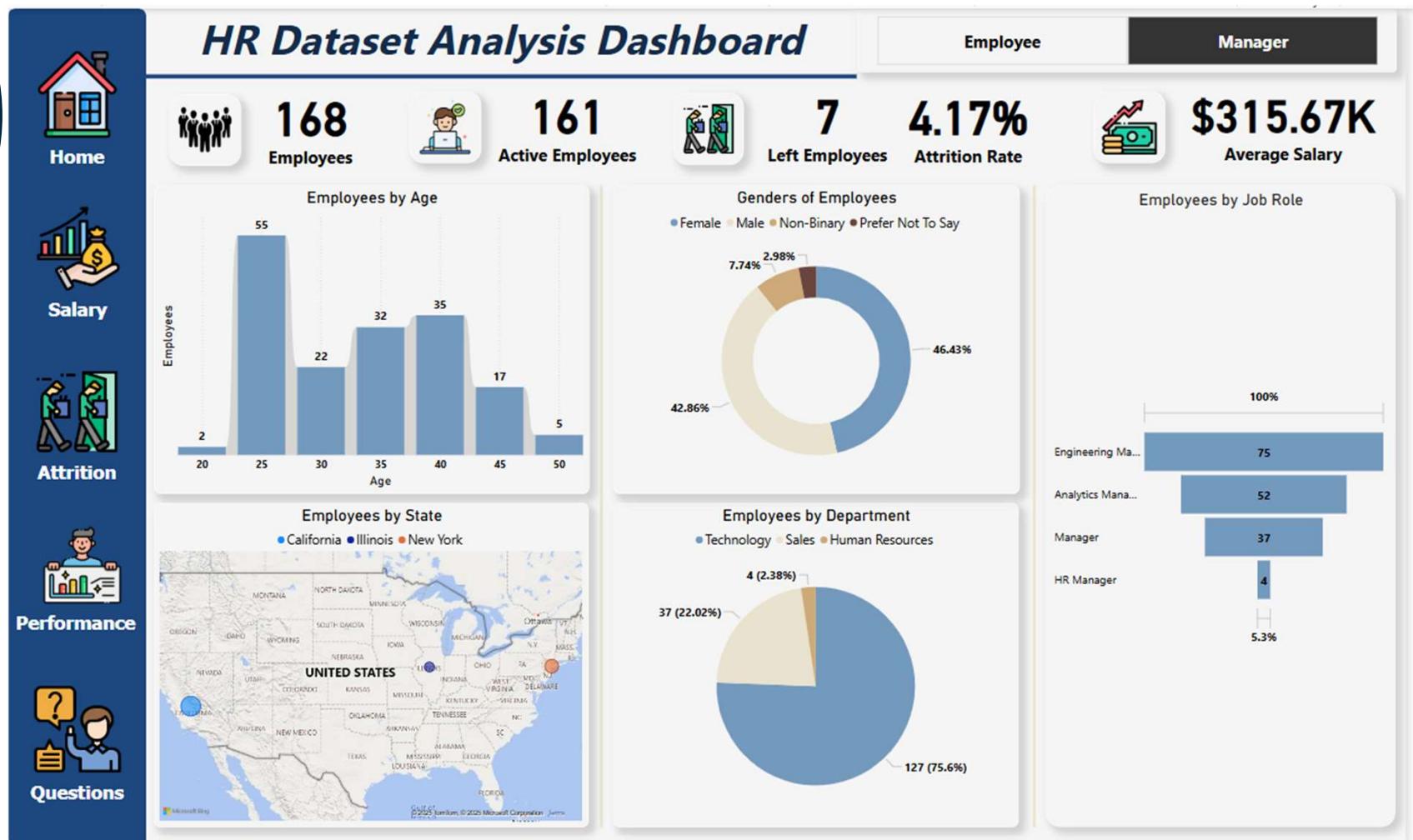
Dashboard & Insights



Dashboard & Insights



Dashboard & Insights



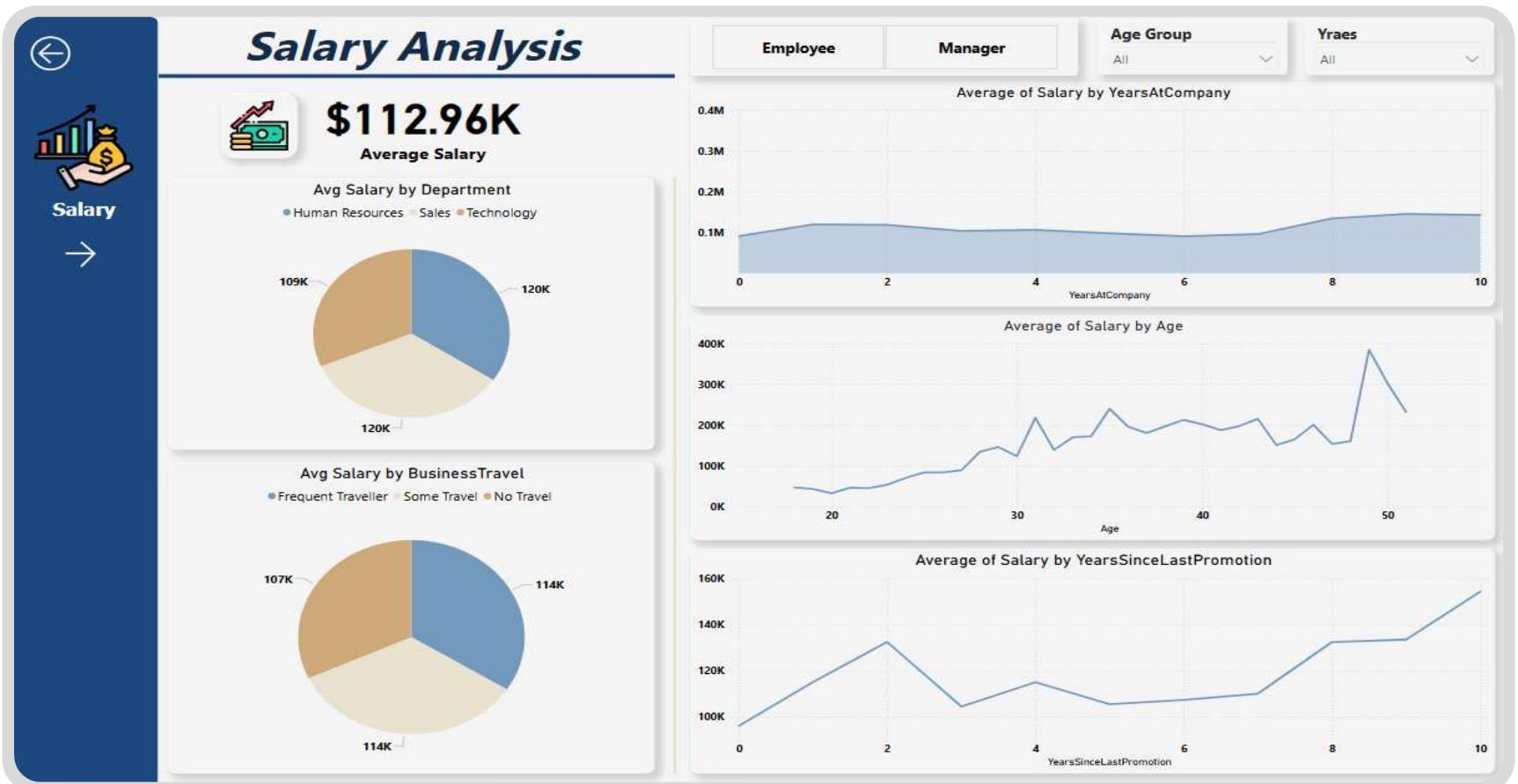
Insights



-
- A central circular icon contains a stylized human figure in a light blue gradient. Around the figure are three icons: a blue gear with an exclamation mark, a lightbulb with a gear and a checkmark, and a speech bubble with a question mark. Arrows from each of the ten numbered questions point to this central icon.
- 1- How does salary vary across different departments?
 - 2- How does the frequency of Business Travel relate to salary?
 - 3- How does salary change with years at the company?
 - 4- Is there a correlation between age and salary?
 - 5- What is the impact of years since the last promotion on salary?
 - 6- How does overtime affect salary?
 - 7- How does salary relate to education level?
 - 8- What is the relationship between salary and education field?
 - 9- How does salary differ across job roles?
 - 10- How does salary correlate with job satisfaction?

Insights

Salary Dashboard



Insights

Salary Dashboard

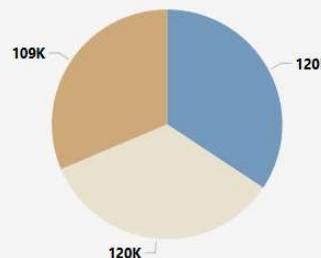


Salary Analysis Insights

1

Avg Salary by Department

• Human Resources Sales Technology



1

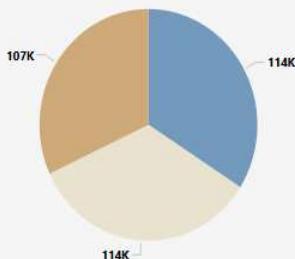
The overall average salary across all departments is (**\$112.96K**). As shown from the chart **Sales** and **Human Resources** have the highest average salaries at (**\$120K**) each, while **Technology** has a slightly lower average.

| | | |
|-----------|----------|----------|
| Job Title | Manager | → \$316K |
| | Employee | → \$87K |

2

Avg Salary by BusinessTravel

• Frequent Traveller Some Travel No Travel

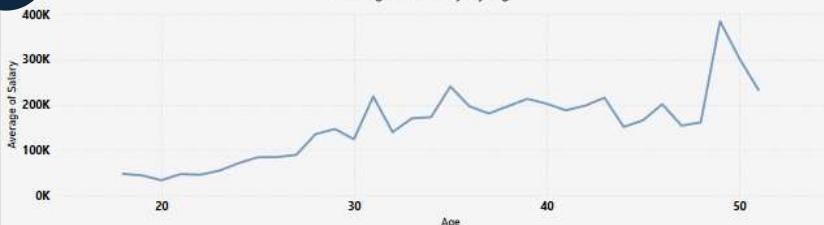


2

Traveling employees earn higher average salaries (**\$114K**) compared to those who don't travel (**\$107K**).

3

Average of Salary by Age



3

Salary generally rises with age, with a notable peak around **age 50**, where many employees likely hold senior or leadership positions.

Salary Analysis Insights

4



4

As shown in the chart, salaries increase with more years at the company, reaching their highest averages after **8 to 10 years** of service.

5



5

Salaries increase with time since the last promotion, peaking at an average of (~\$154K) after **10 years**.

6



6

Employees who work overtime earn a bit more (\$115K) than those who don't (\$112K).

Note that employees who work overtime earn more than those who don't when filtering by department and age group.

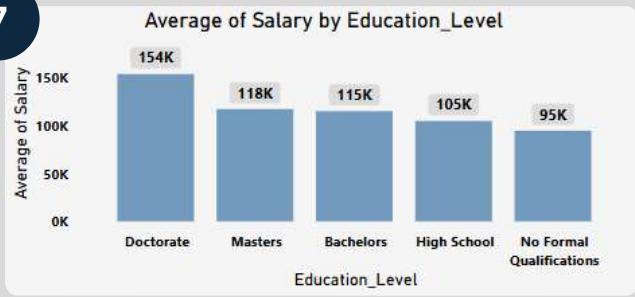
6



Filtered by HR Department & Young Age Group

Salary Analysis Insights

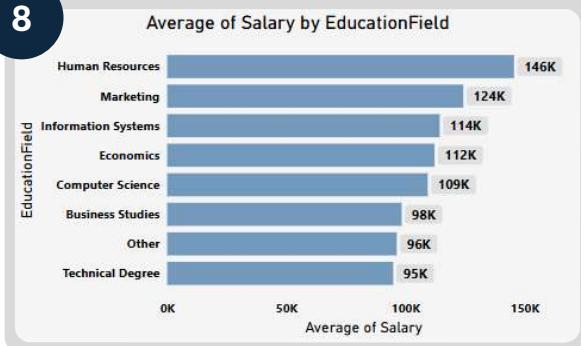
7



7

Doctorate holders earn the most (**\$154K**), followed by those with a Master's and Bachelor's (**\$118K**), with the lowest earners being those with no formal qualification (**\$95K**).

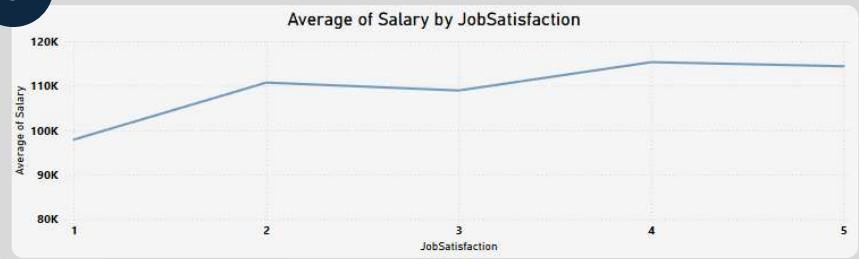
8



8

Top earners studied Human Resources (**\$146K**) Marketing (**\$124K**) and Information Systems (**\$114K**) while lower salaries are found in Business Studies, Technical Degrees, and Other fields (~\$95K–\$98K).

9



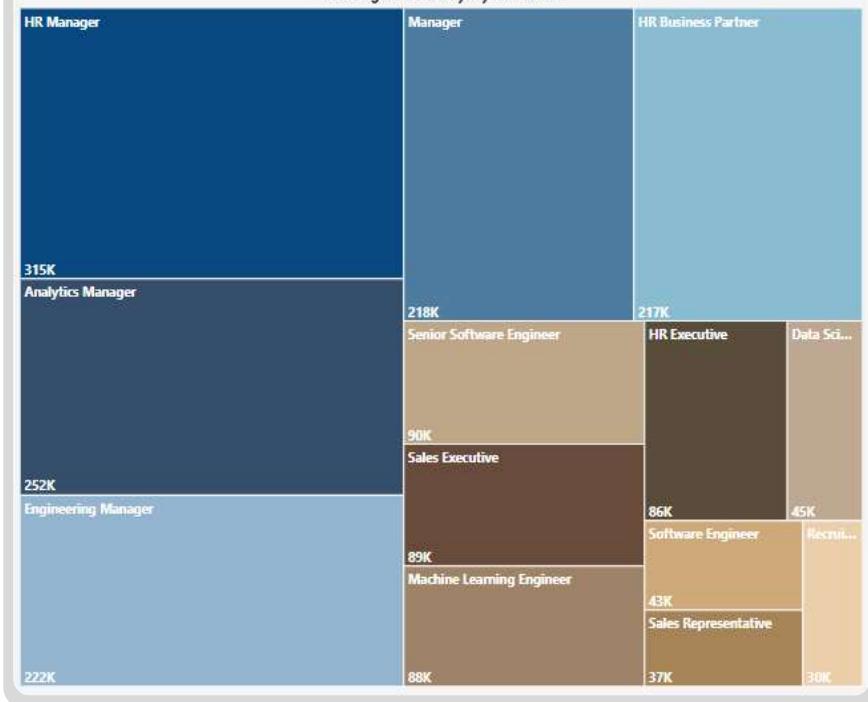
9

Employees who are more satisfied often earn higher salaries because they perform better and stay with the company longer, so they get rewarded with better pay.

Salary Analysis Insights

10

Average of Salary by JobRole



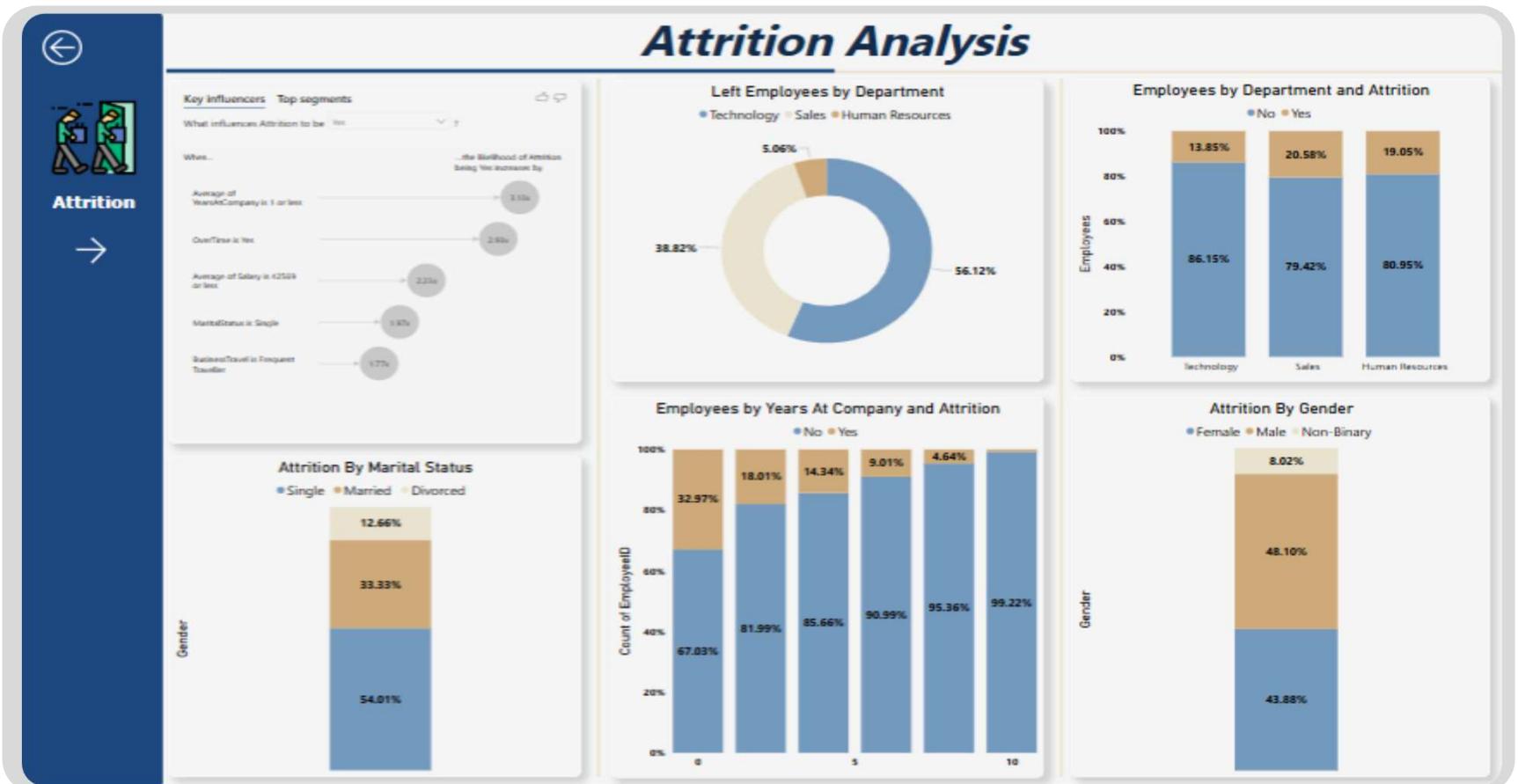
10

As shown in the chart, The HR Manager has the highest average salary at (**\$449K**), followed by the Analytics Manager at (**\$346K**) and Manager at (**\$318K**).

The lowest-paid roles are Sales Representative (**\$41K**) and Recruiter (**\$38K**), as these are usually junior positions.

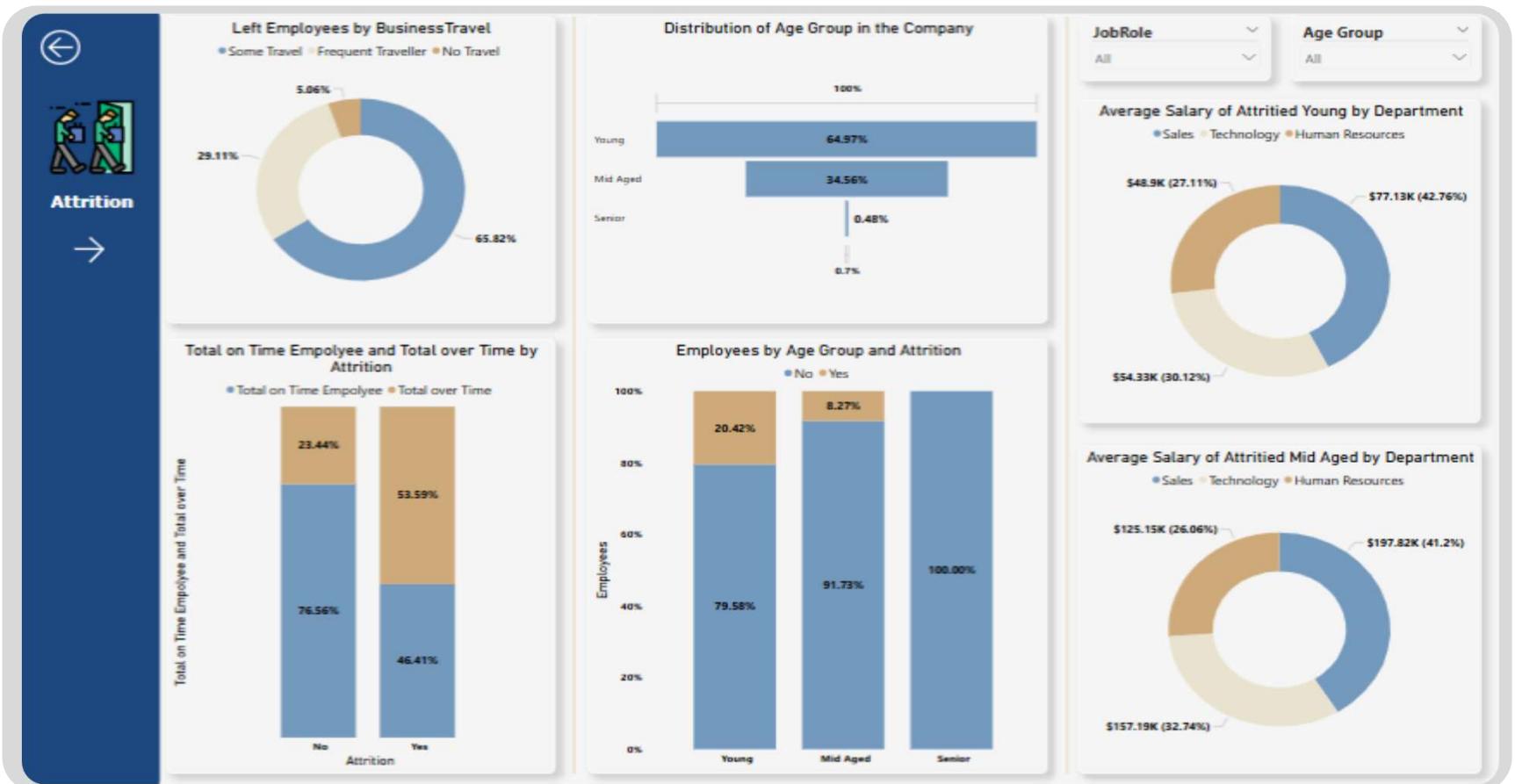
Insights

Attrition Dashboard



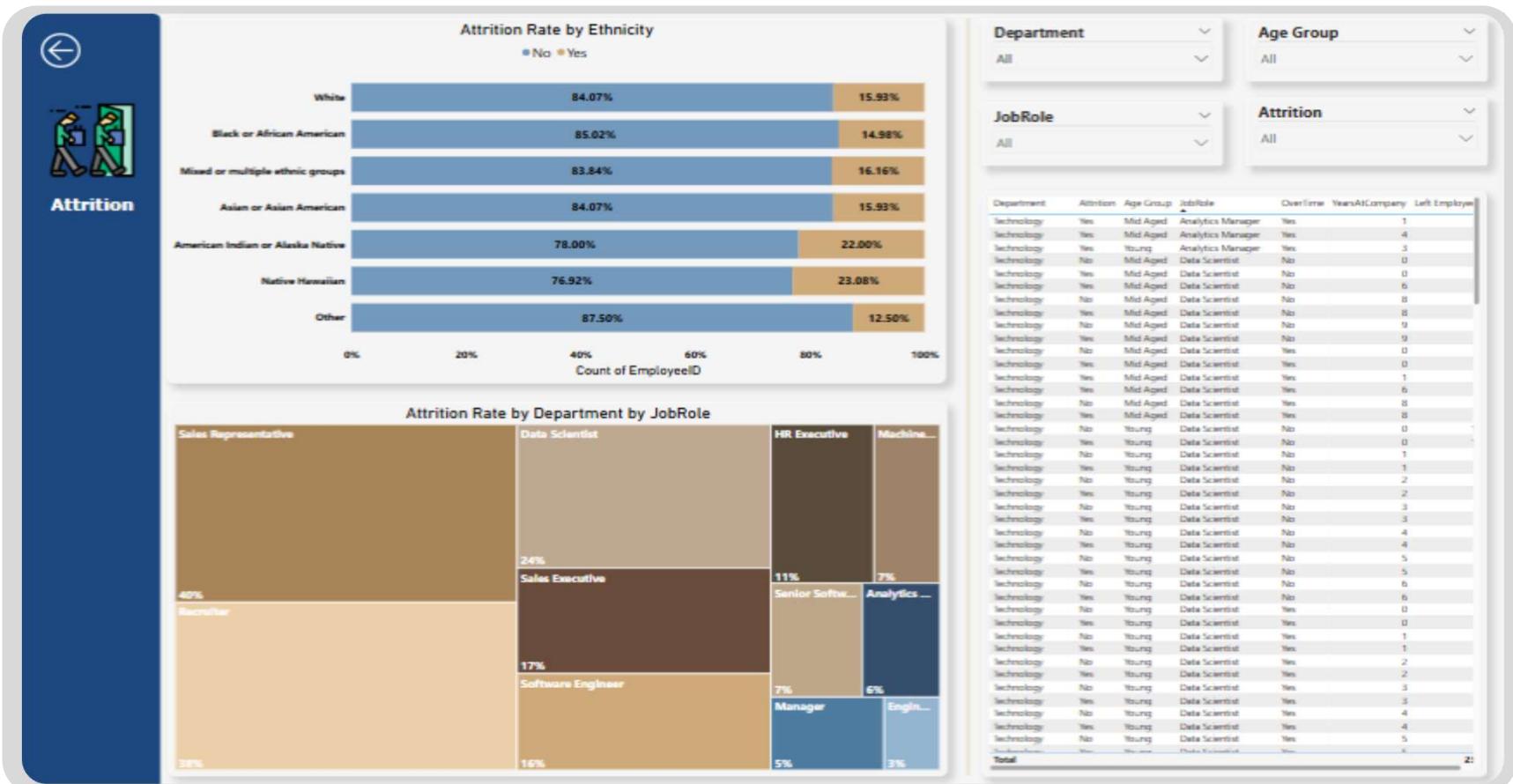
Insights

Attrition Dashboard



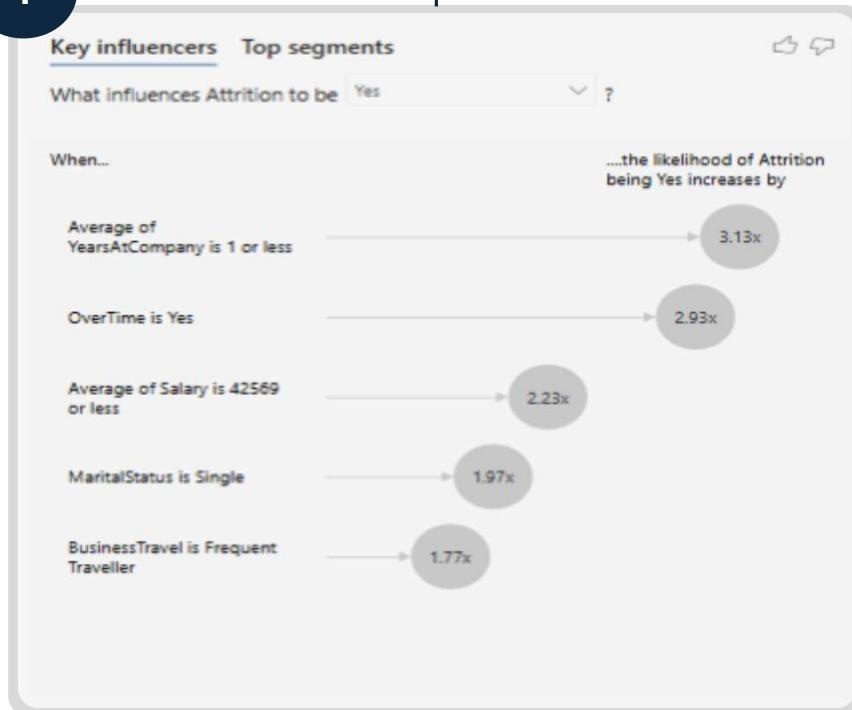
Insights

Attrition Dashboard



Attrition Analysis Insights

1



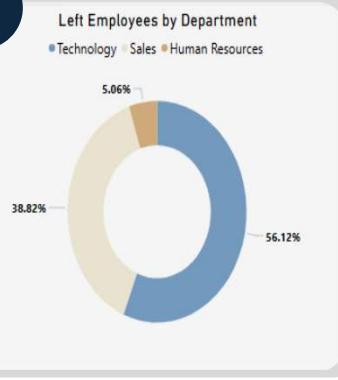
1

As shown in the chart :

- **Young** employees with ≤ 1 year of experience are **3.11x** more likely to leave.
- Working OverTime increases attrition likelihood by **2.5x**.
- Lower salaries, being **Single**, and **Frequent Business Travel** also contribute significantly to attrition.

Attrition Analysis Insights

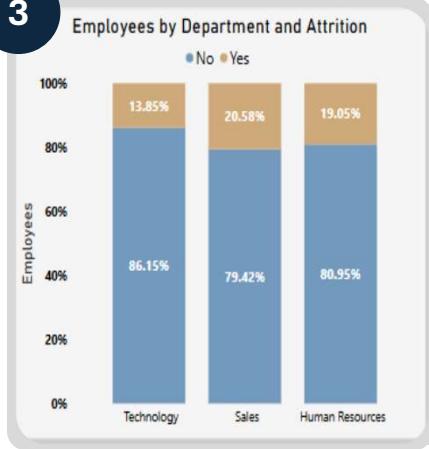
2



2

- The **Technology** Department has the highest attrition rate (**56.12%**) of total leavers.
- **Sales** comes next with (**38.82%**), and **Human Resources** the least (**5.06%**).

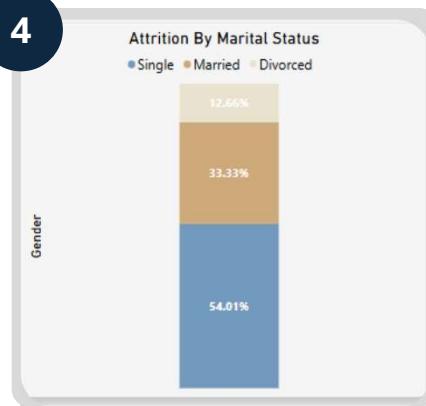
3



3

This chart exhibited that the internal Department attrition rates are: **Sales (20.58%)**, **HR (19.05%)**, **Technology (13.85%)**.

4



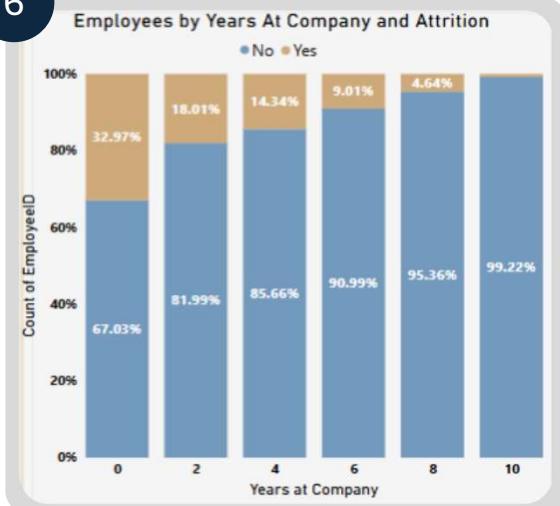
4

- (**54.01%**) of those who left were **Single**.
- **Married** employees are less likely to leave (**33.33%**).
- **Divorced** employees represent (**12.66%**) of attrition cases.

Attrition Analysis Insights



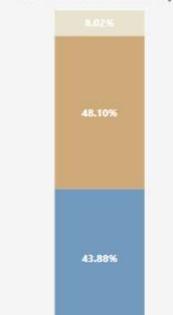
6



5

Attrition By Gender

Female Male Non-Binary



5

- Females represent the highest proportion of leavers (48.10%), following by Males with (43.88%), and Non-Binary with (8.02%).

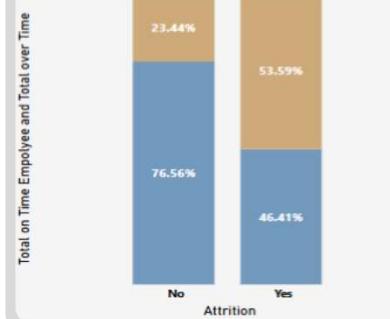
6

- Highest attrition occurs during the first year (32.97%).
- Attrition sharply decreases with time and is nearly (0%) after 8 years.

7

Total on Time Employee and Total over Time by Attrition

Total on Time Employee Total over Time

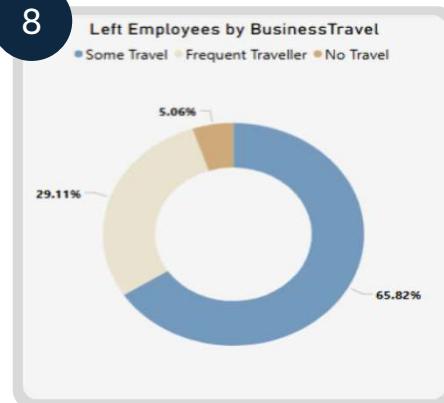


7

- (53.5%) of total Left Employees work over time.
- Those who worked on time had lower attrition rates.

Attrition Analysis Insights

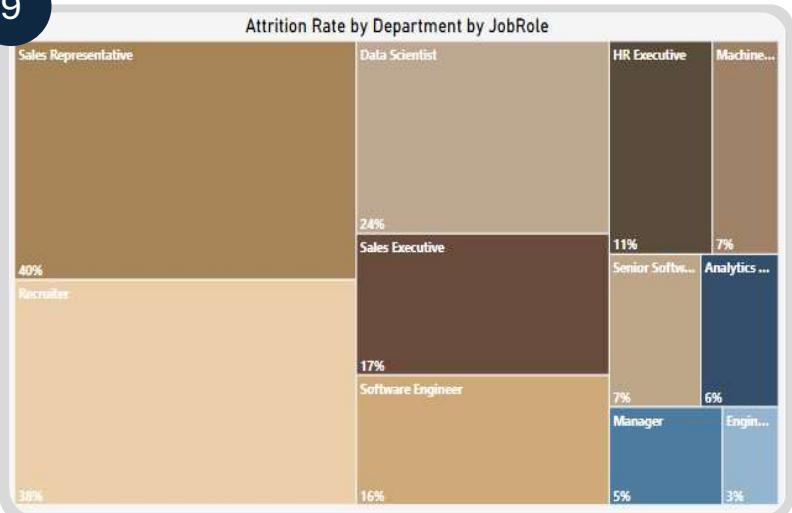
8



8

Most Left Employees do **some** or **Frequent travel** with **(68.82%)** and **(29.11%)**, respectively compared to **No Travel** ones.

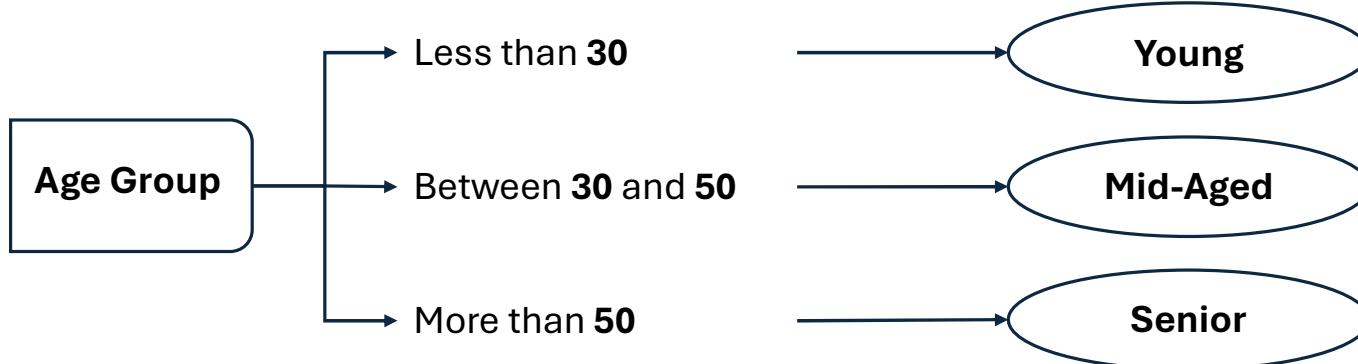
9



9

- Small differences across different job roles.
- Higher attrition seen among:
Sales Representatives (40%)
Recruiters (38%)
Data Scientist (18.18%).

Attrition Analysis Insights



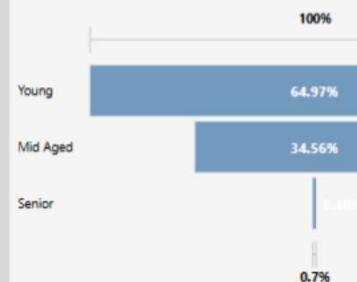
Note

- **Young** employees (**64.57%**) dominate the workforce, Therefore they represent the highest attrition rates.
- **Mid-Aged (34.56%)**.
- **Senior Only (0.87%)**, with (**0%**) attrition.

Attrition Analysis Insights

8

Distribution of Age Group in the Company

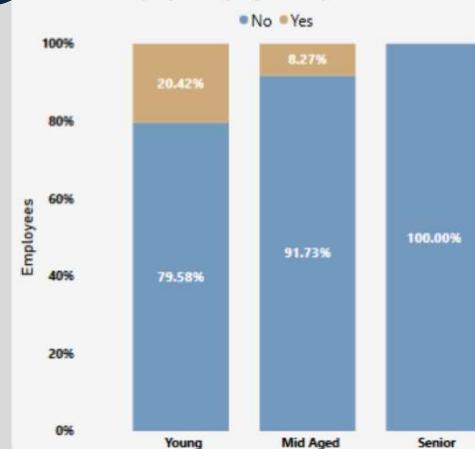


Age Group



9

Employees by Age Group and Attrition



Attrition Rate by Age group

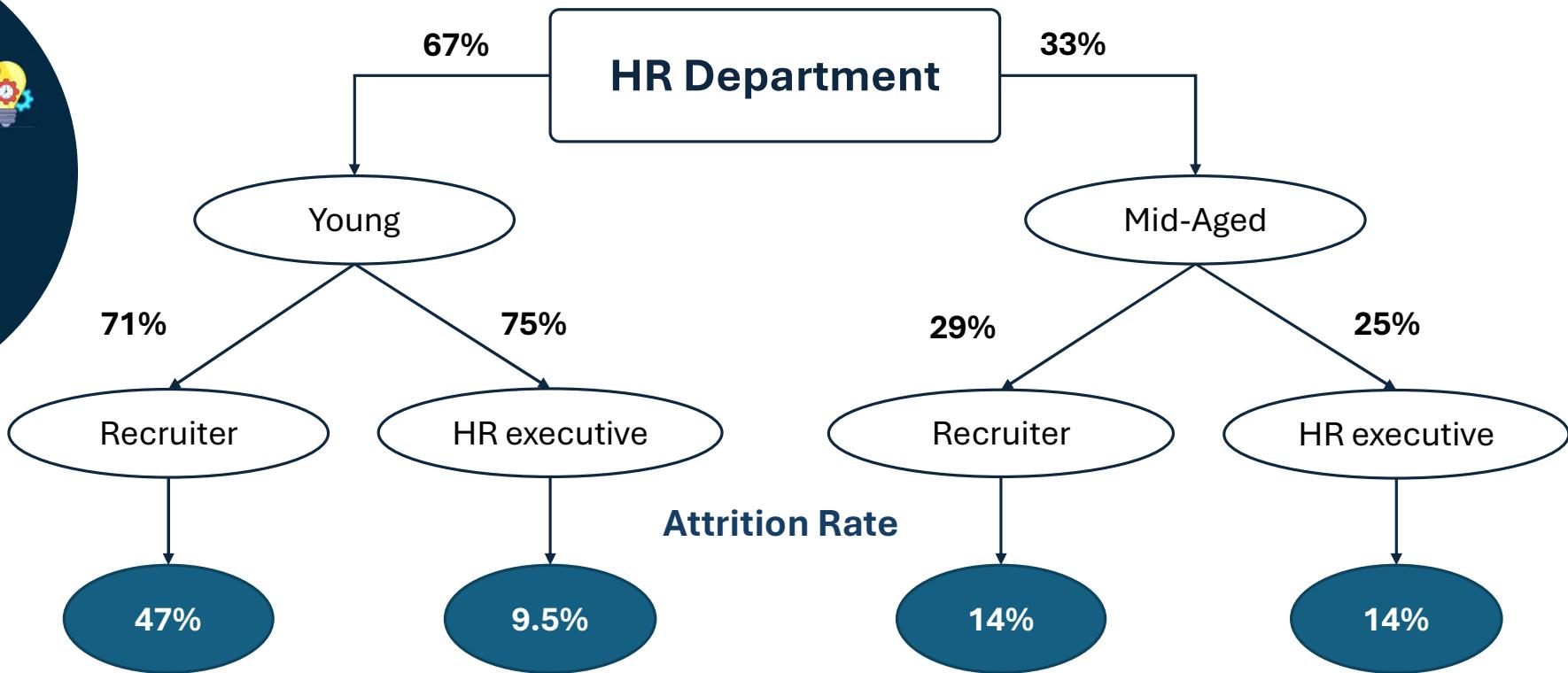
Highest



Young



Attrition Analysis Insights



Why..??

Highest Attrition Rate in HR department is Young Recruiter..?

Attrition Analysis Insights

9



9

The **(47.06%)** of the leaved **Young HR** was **Recruiter** and **(9.52%)** for **HR executives**.

9

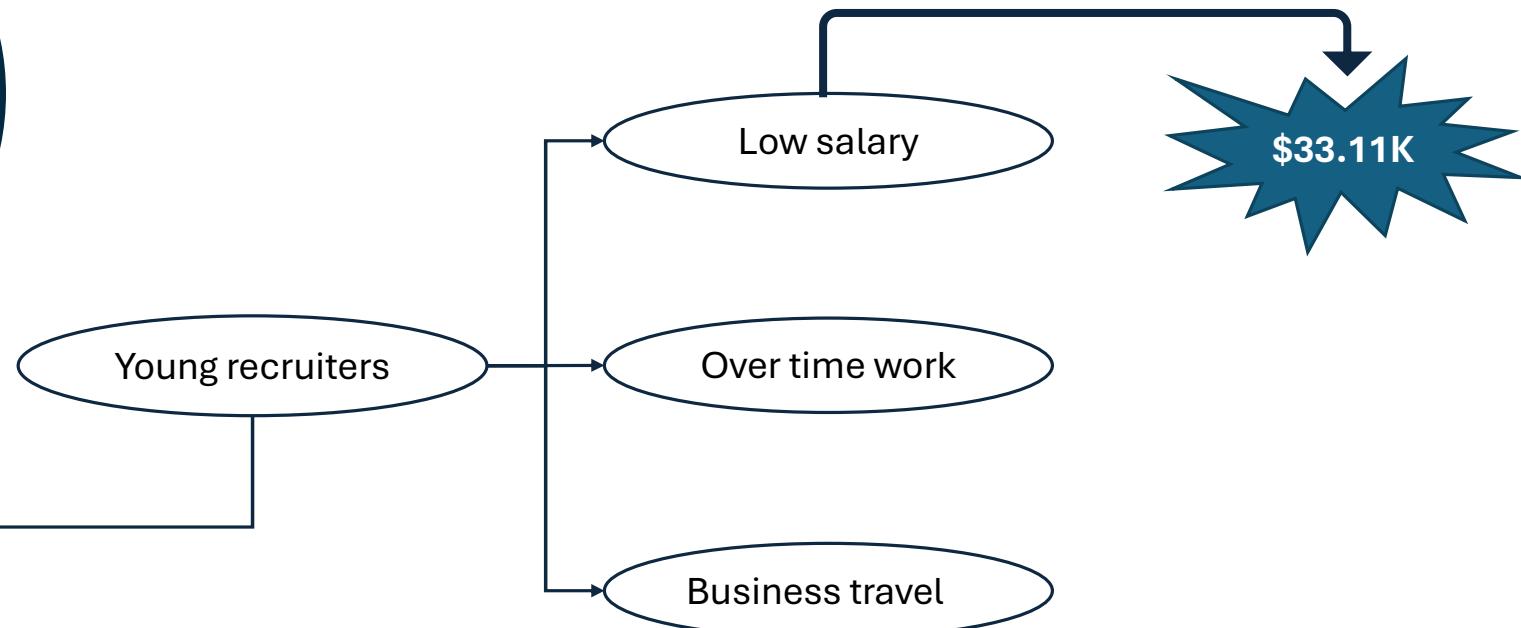


9

The attrition rate of **HR** at **Mid-aged** for both **Recruiters** and **Executives** were **(14.29%)**.

Attrition Analysis Insights

- Factors affect on the attrition rate of HR employees:

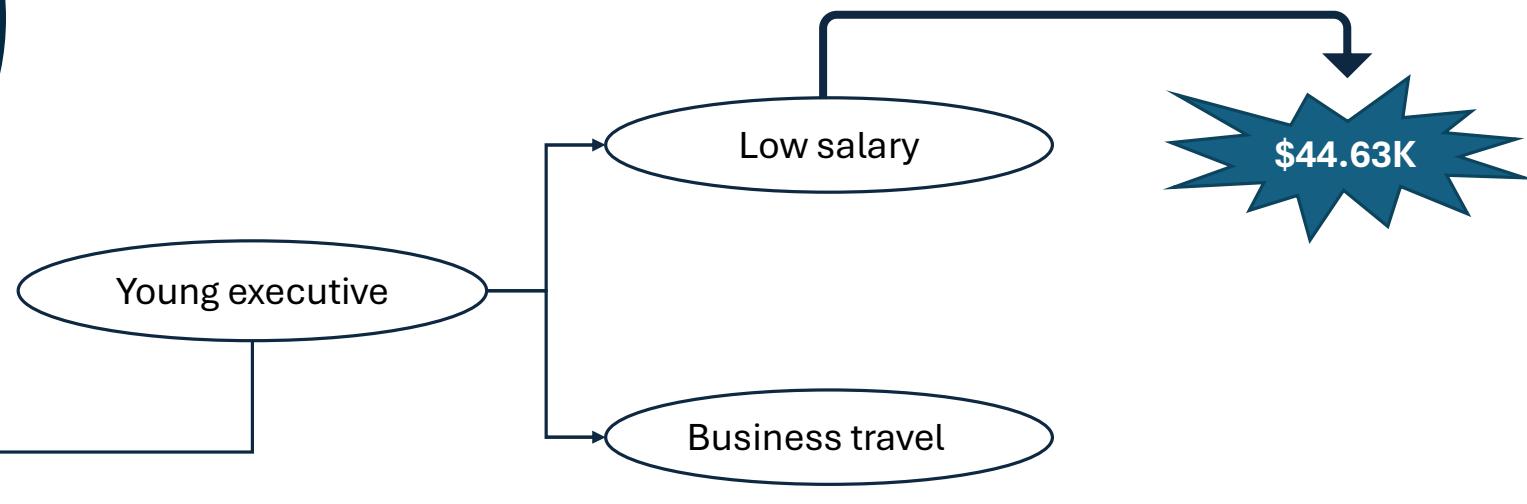


Note

Reasons for the attrition in the Mid-Aged recruiters are the same reasons of the young ones.

Attrition Analysis Insights

- Factors affect on the attrition rate of HR employees:



Note

Reasons for the attrition in the Mid-Aged executive are business travel and over time working.

Attrition Analysis Insights

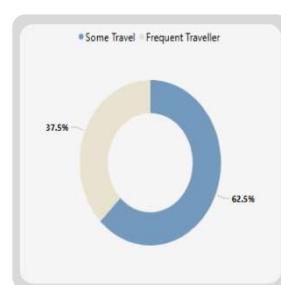
Young HR employees



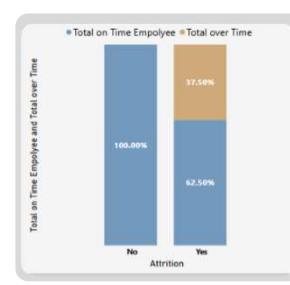
Recruiters



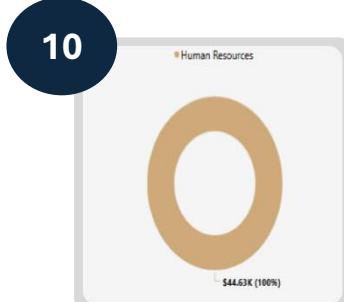
33.11K \$



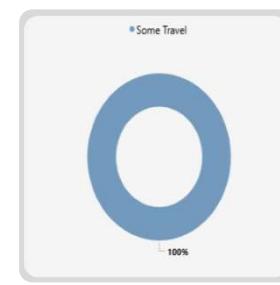
All have business travel 37.5% of the left ones worked overtime



HR executives



\$44.63K



All have some business travel

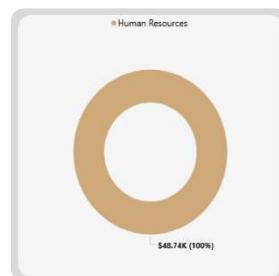


Attrition Analysis Insights

Mid-Aged HR employees



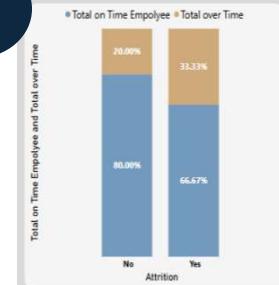
Recruiters



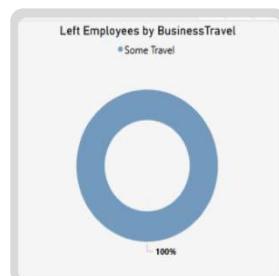
\$48.74K

11

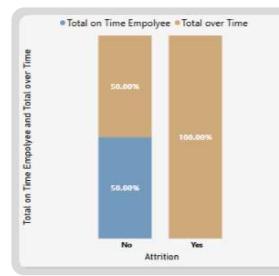
HR executives



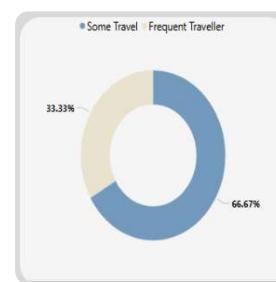
33.33% worked overtime



All have some business travel

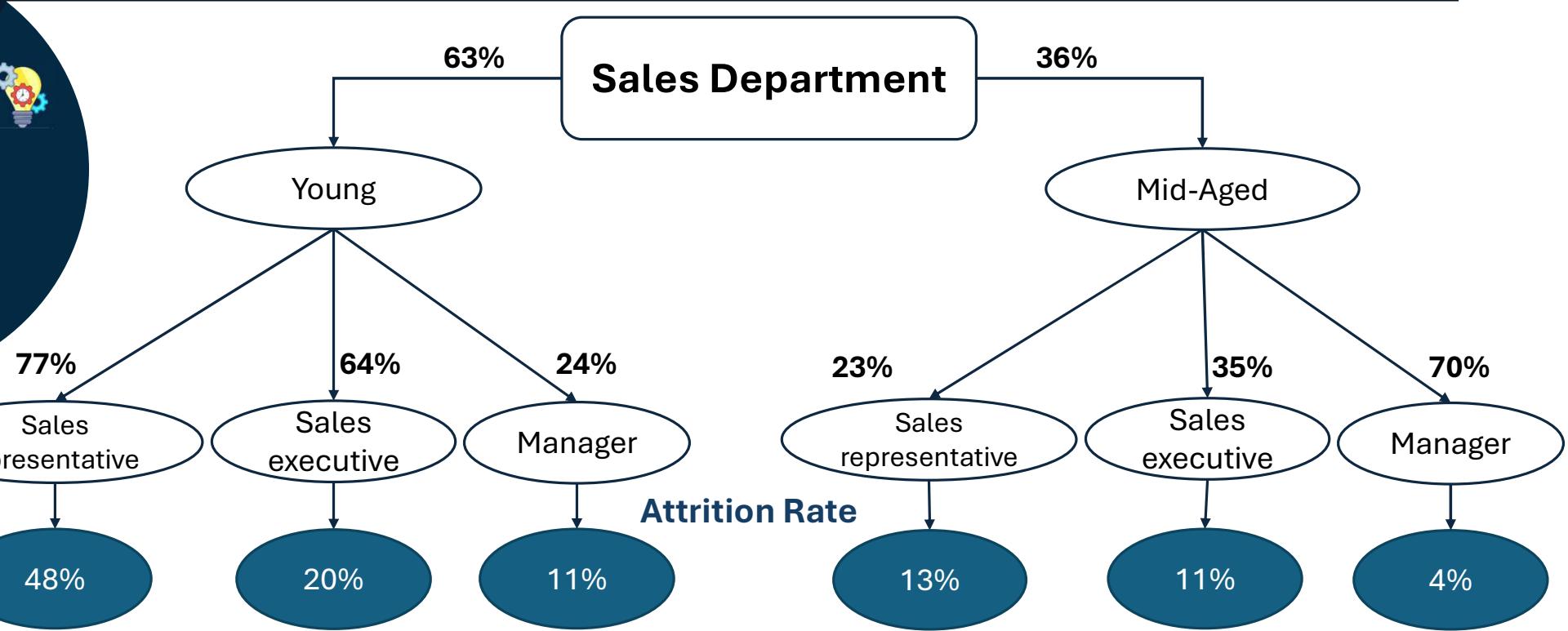


All of them worked overtime



All have business travels

Attrition Analysis Insights



Highest attrition rate in sales department among young are sales representative, Same among Mid-Aged..?

Attrition Analysis Insights



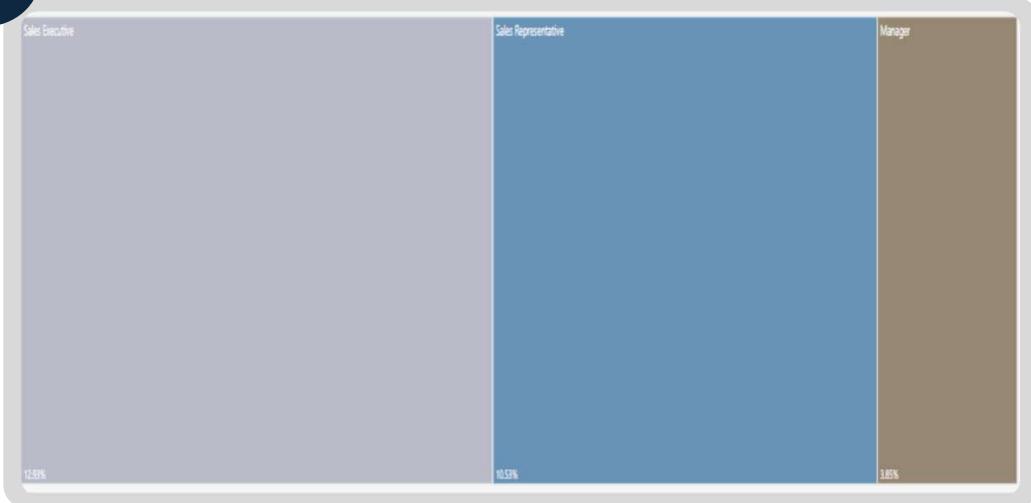
12



12

The **(48.44%)** of the leaved **young sales** was **sales representative**, following by **(20%)** for **sales executive** and **(11.11%)** for manager.

12

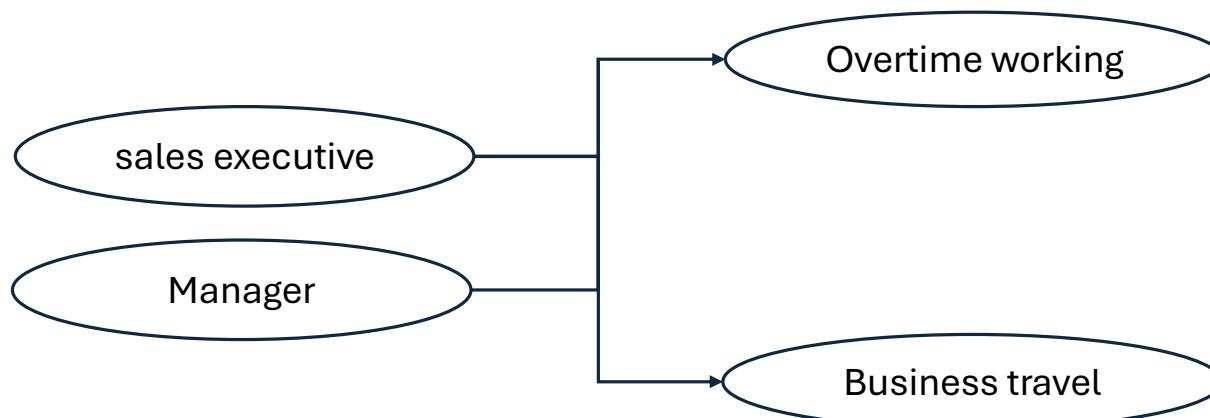
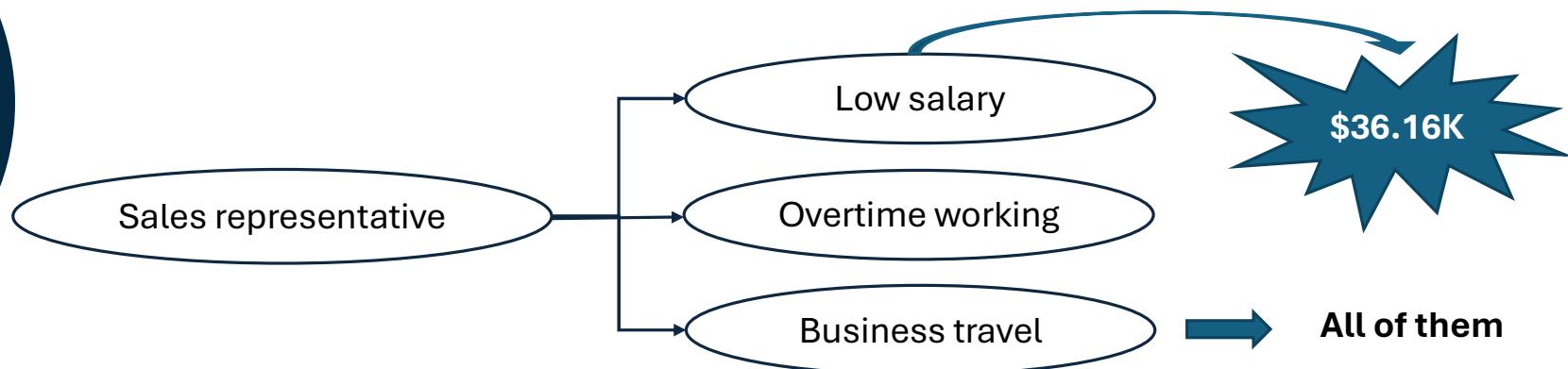


12

The attrition rate of **mid-aged sales** were **(12.98%)** for **sales executive**, **(10.53%)** for **sales representative**, then **(3.85%)** for manager.

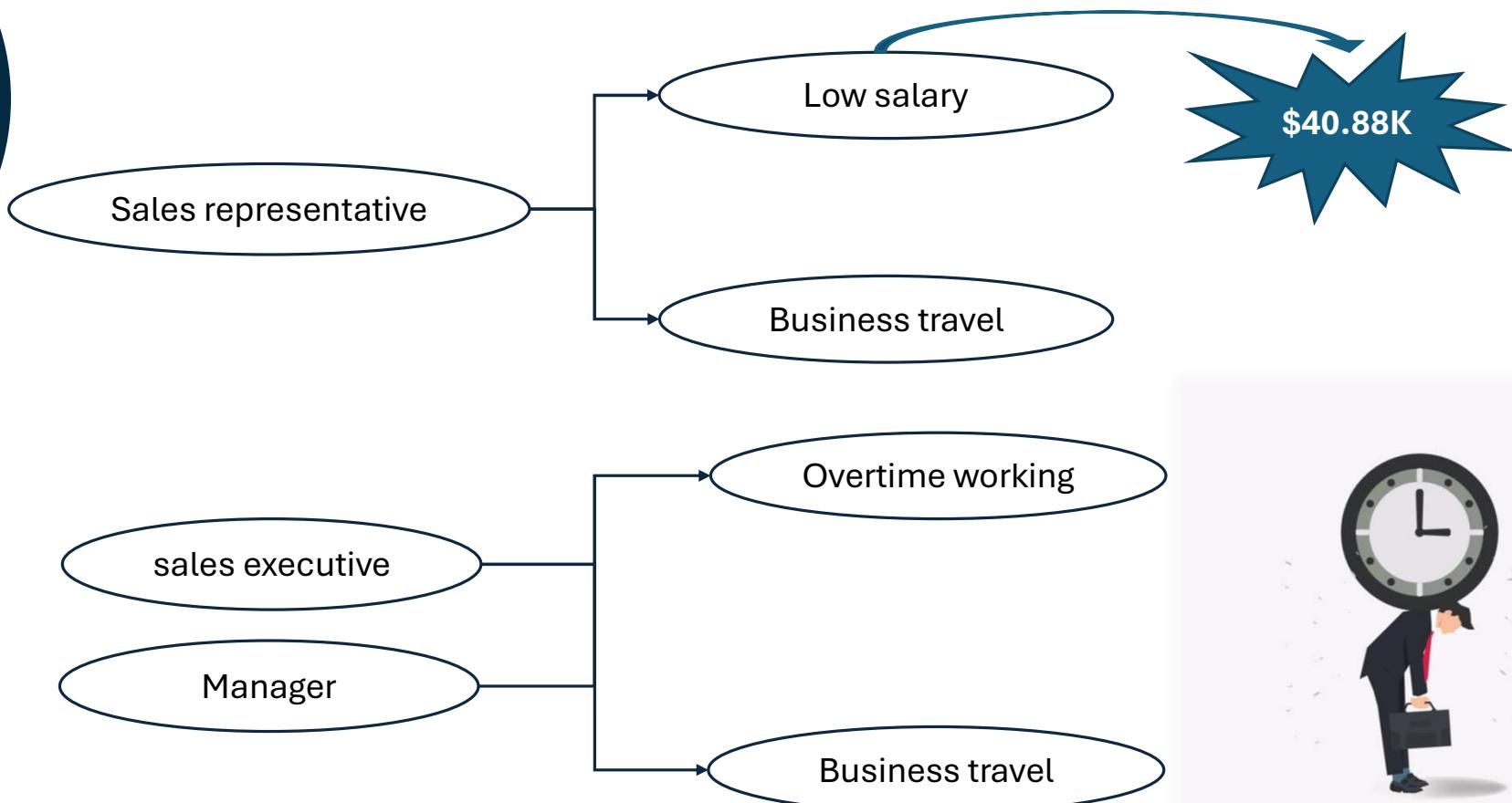
Attrition Analysis Insights

- Factors affect on the young sales employees attrition rate:



Attrition Analysis Insights

- Factors affect on the Mid-ages sales employees attrition rate:

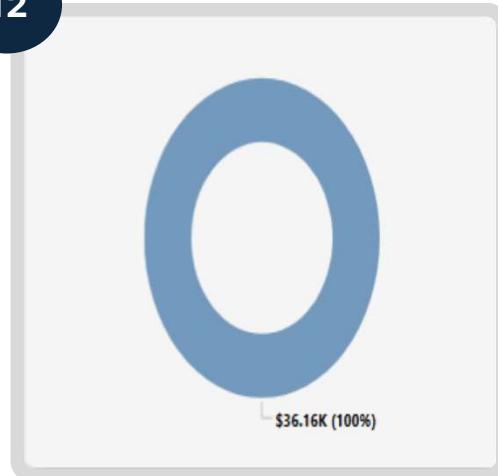


Attrition Analysis Insights

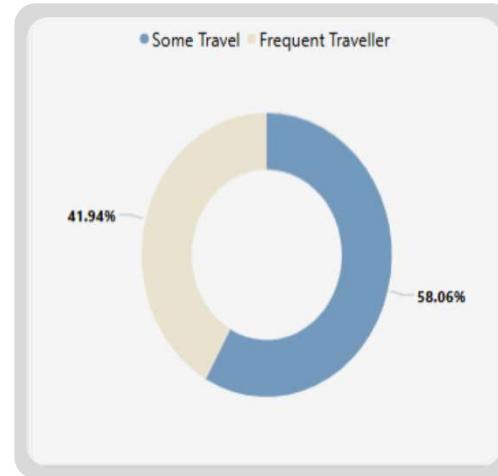
Young Sales employees

Sales representative

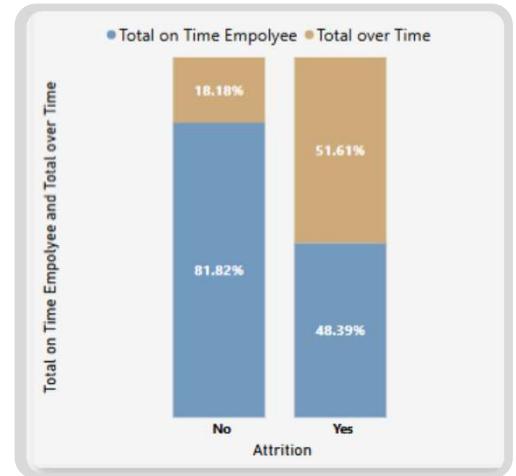
12



\$36.16K



All have business travel

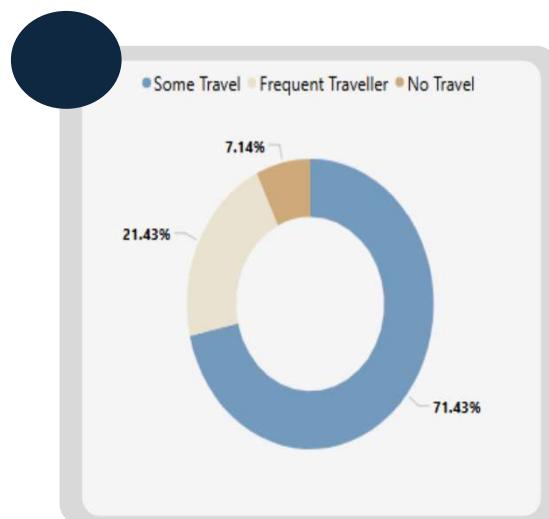


51.61% working overtime

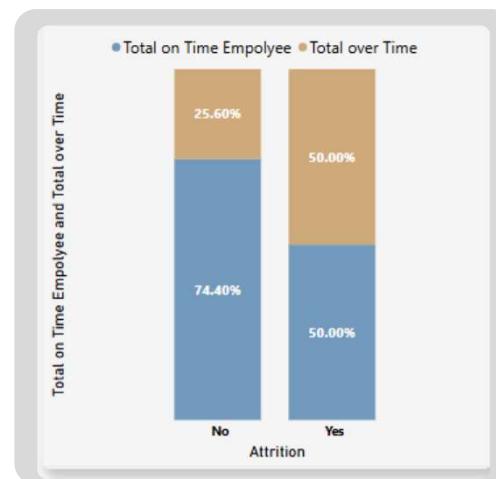
Attrition Analysis Insights

Young Sales employees

sales executive



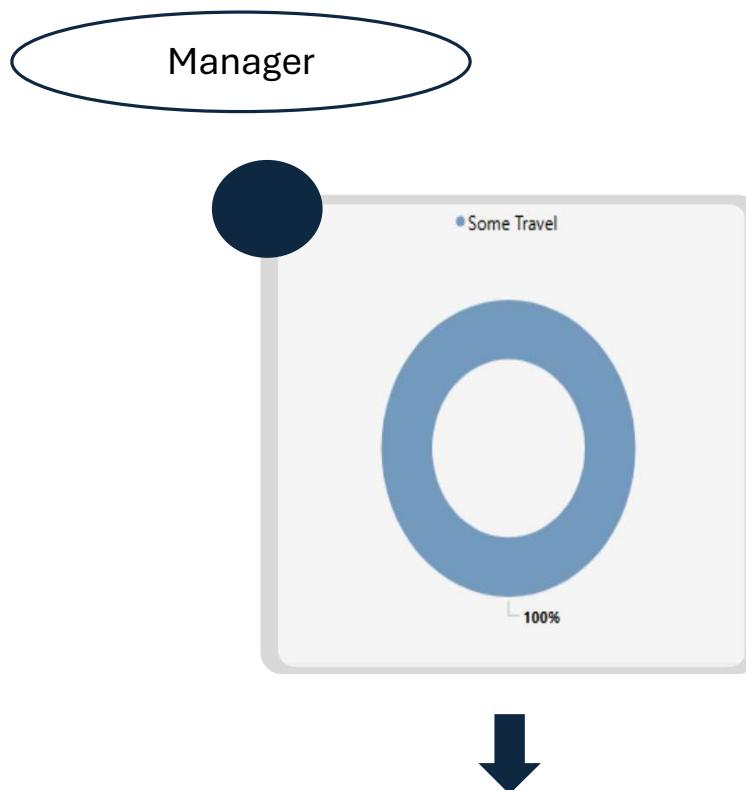
92.86% have business travel



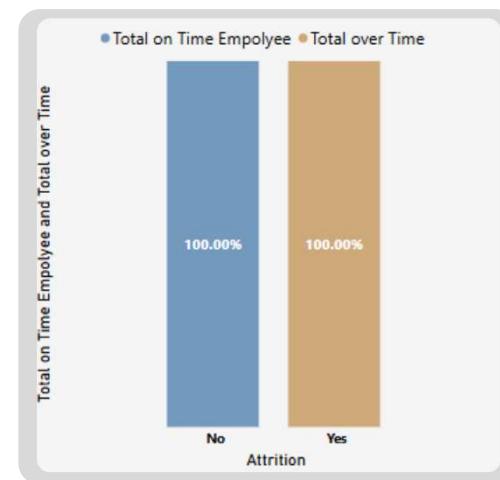
50% working overtime

Attrition Analysis Insights

Young Sales employees



All have some business travel

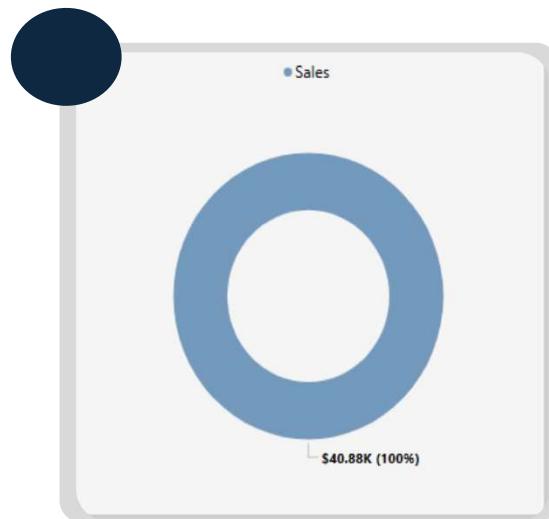


All working overtime

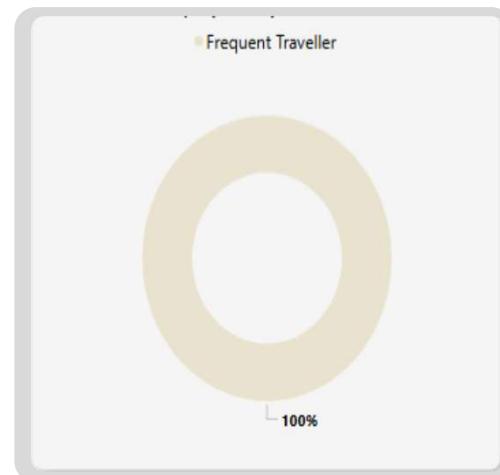
Attrition Analysis Insights

Mid-aged Sales employees

Sales representative



\$40.88K

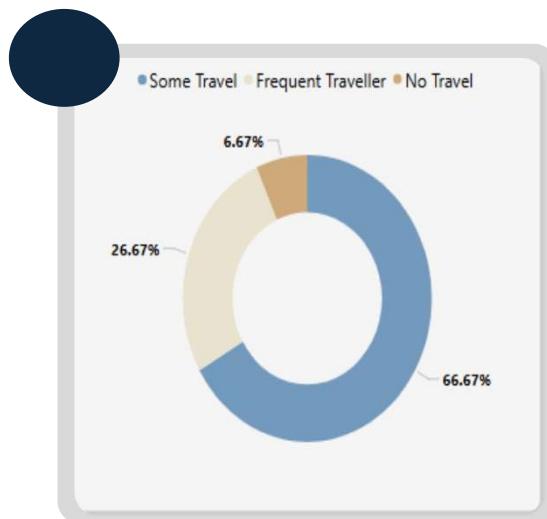


All have frequent business travel

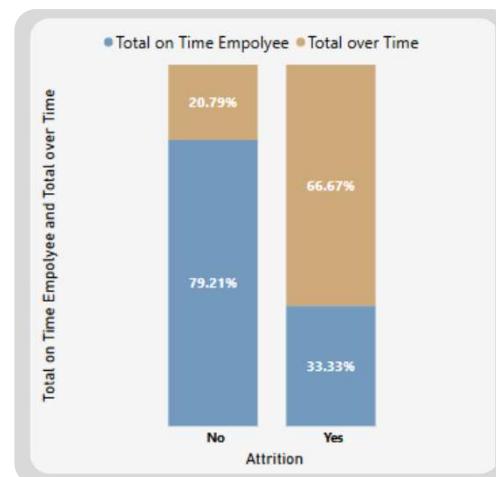
Attrition Analysis Insights

Mid-aged Sales employees

sales executive



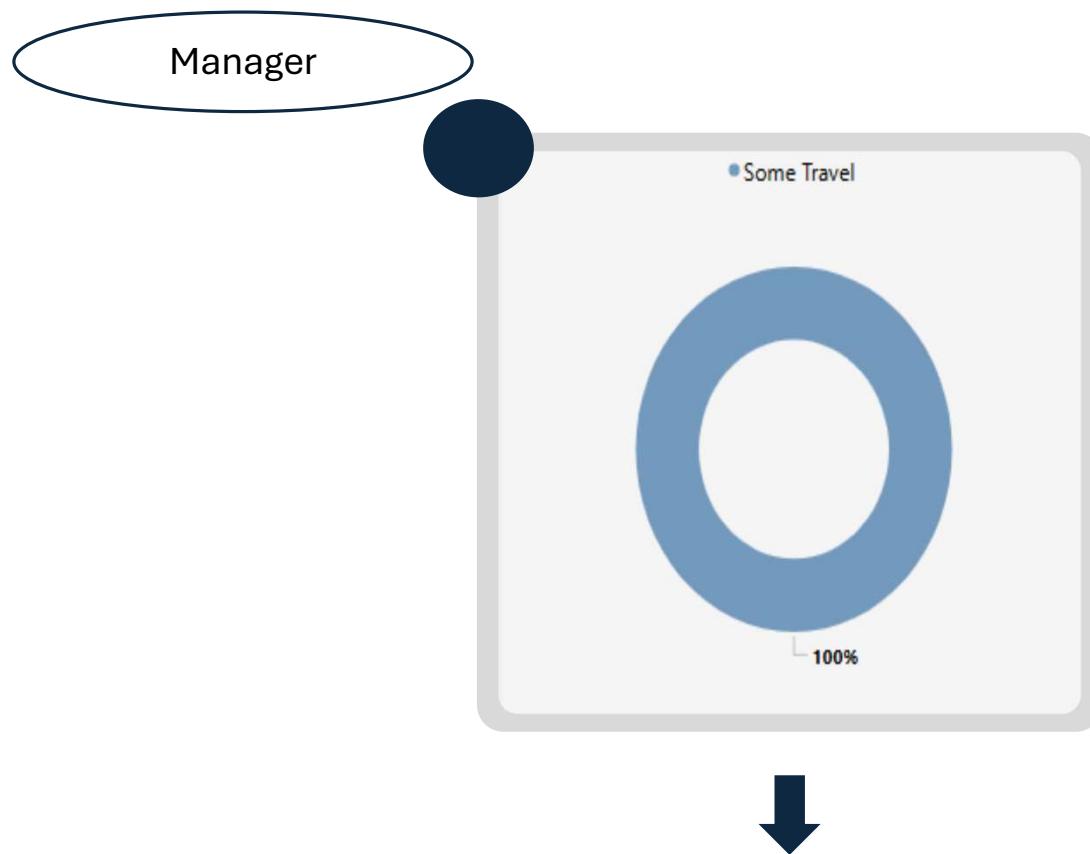
93.34% have business travel



66.67% working overtime

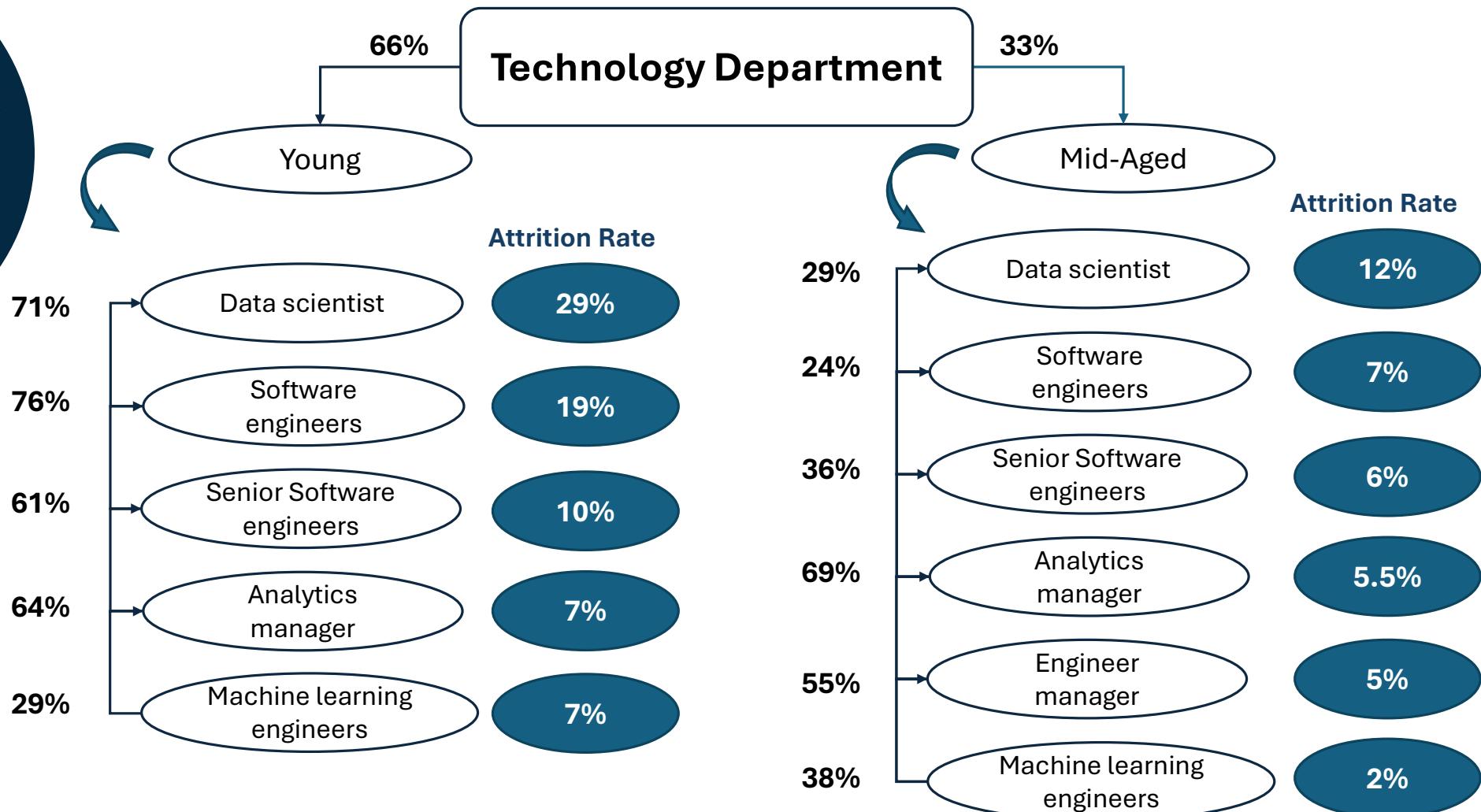
Attrition Analysis Insights

Mid-aged Sales employees



All have some business travel

Attrition Analysis Insights



Attrition Analysis Insights



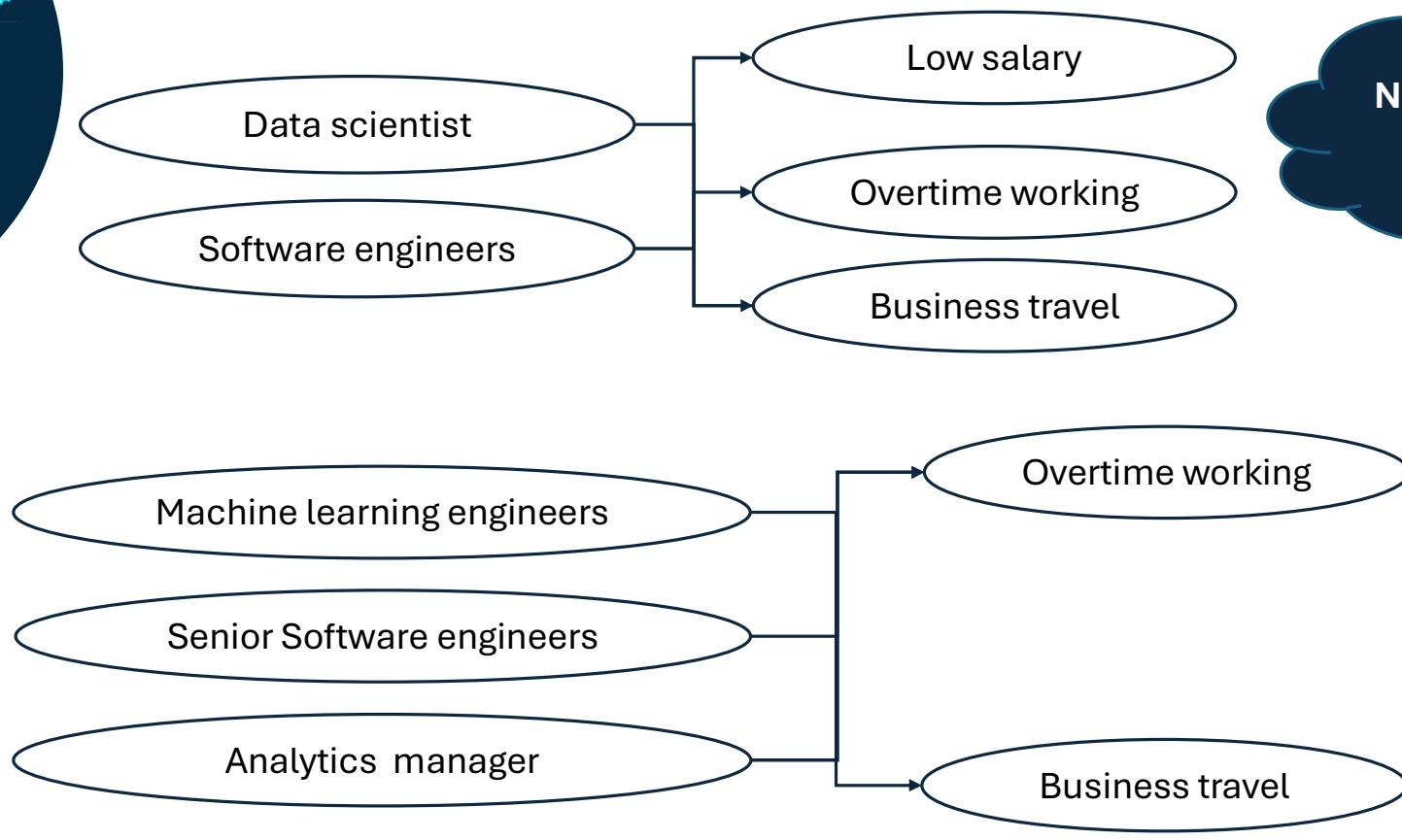
The chart showed that the highest attrition rate in **young technology** department was in **data science** branch with **(28.65%)**, followed by **software engineers** at **(18.75%)**, **machine learning engineers** at **(10.11%)**, **senior software engineers** at **(7.06%)**, and **analytics manager** at **(6.67%)**.



The chart showed that the highest attrition rate among **mid-aged** people in the **technology** department was in the **data science** branch, with **(11.84%)**, followed by **software engineers** at **(7.14%)**, **senior software engineers** at **(6.38%)**, **analytics managers** at **(5.56%)**, **engineer managers** at **(4.88%)**, and **machine learning engineers** at **(1.79%)**.

Attrition Analysis Insights

- Factors affect on the Young Technology employees attrition rate:



Not enough, I need more details..?



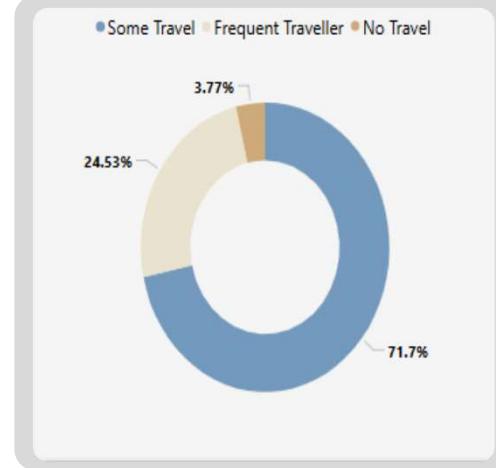
Attrition Analysis Insights

Young Technology employees

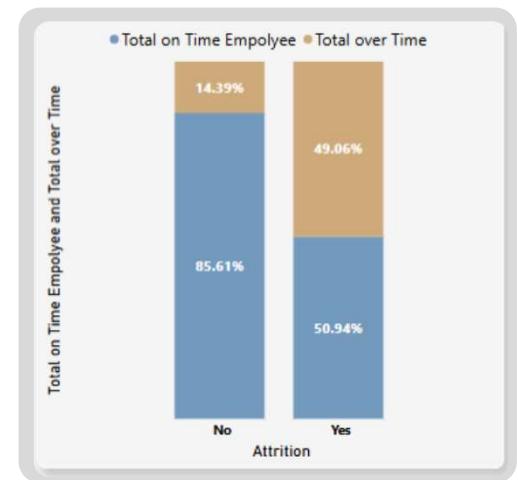
Data scientist



\$48.58K



96.23% have business travel

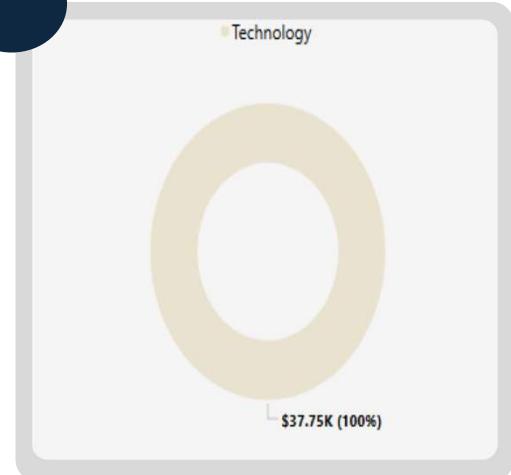


49.05% of the left ones
worked overtime

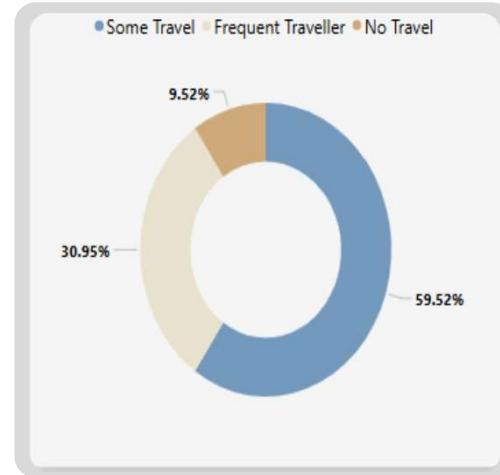
Attrition Analysis Insights

Young Technology employees

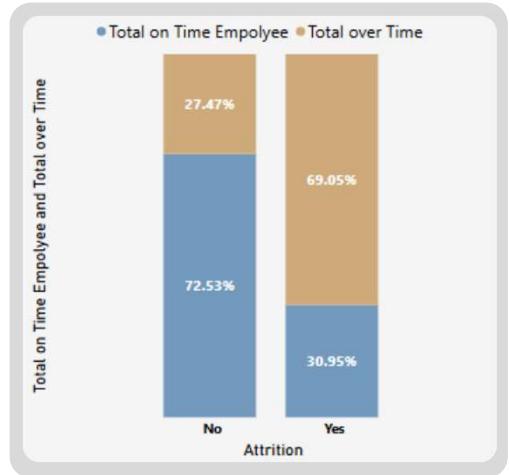
Software engineers



\$37.75K



90.47% have business travel

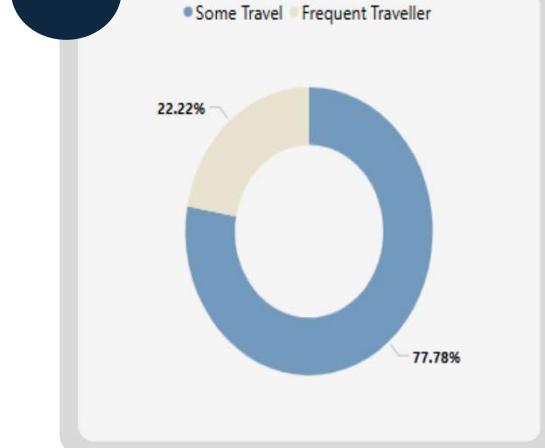


69.05% of the left ones
worked overtime

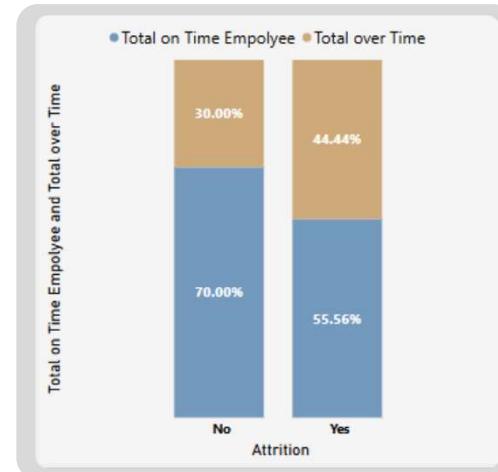
Attrition Analysis Insights

Young Technology employees

Machine learning engineers



All have business travel

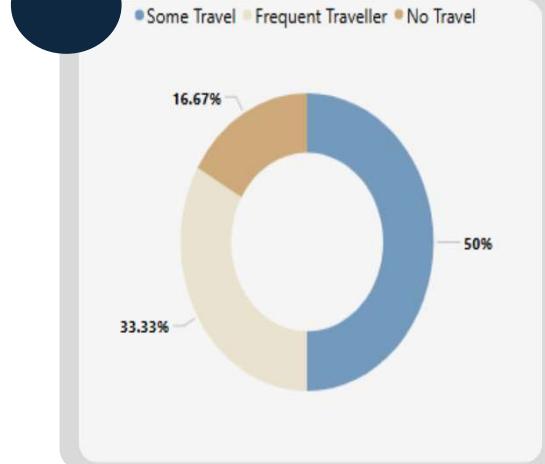


44.44% working overtime

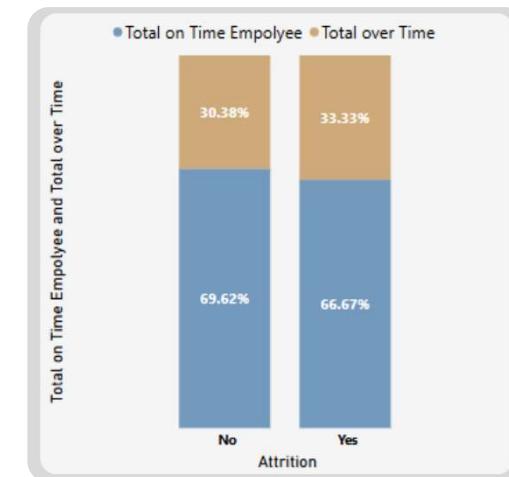
Attrition Analysis Insights

Young Technology employees

Senior Software engineers



83.33% have business travel

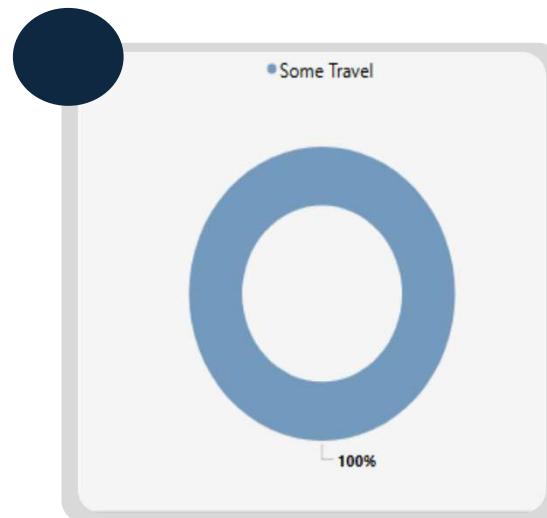


33.33% working overtime

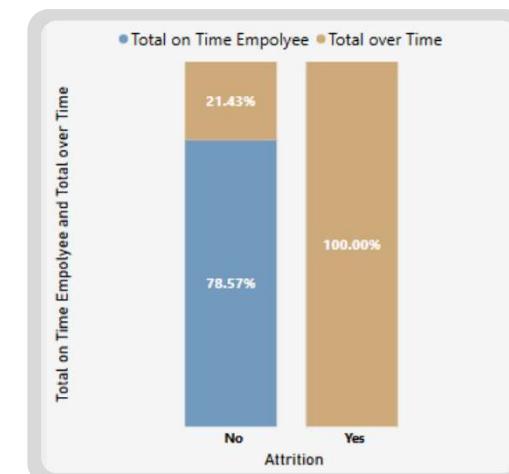
Attrition Analysis Insights

Young Technology employees

Analytics manager



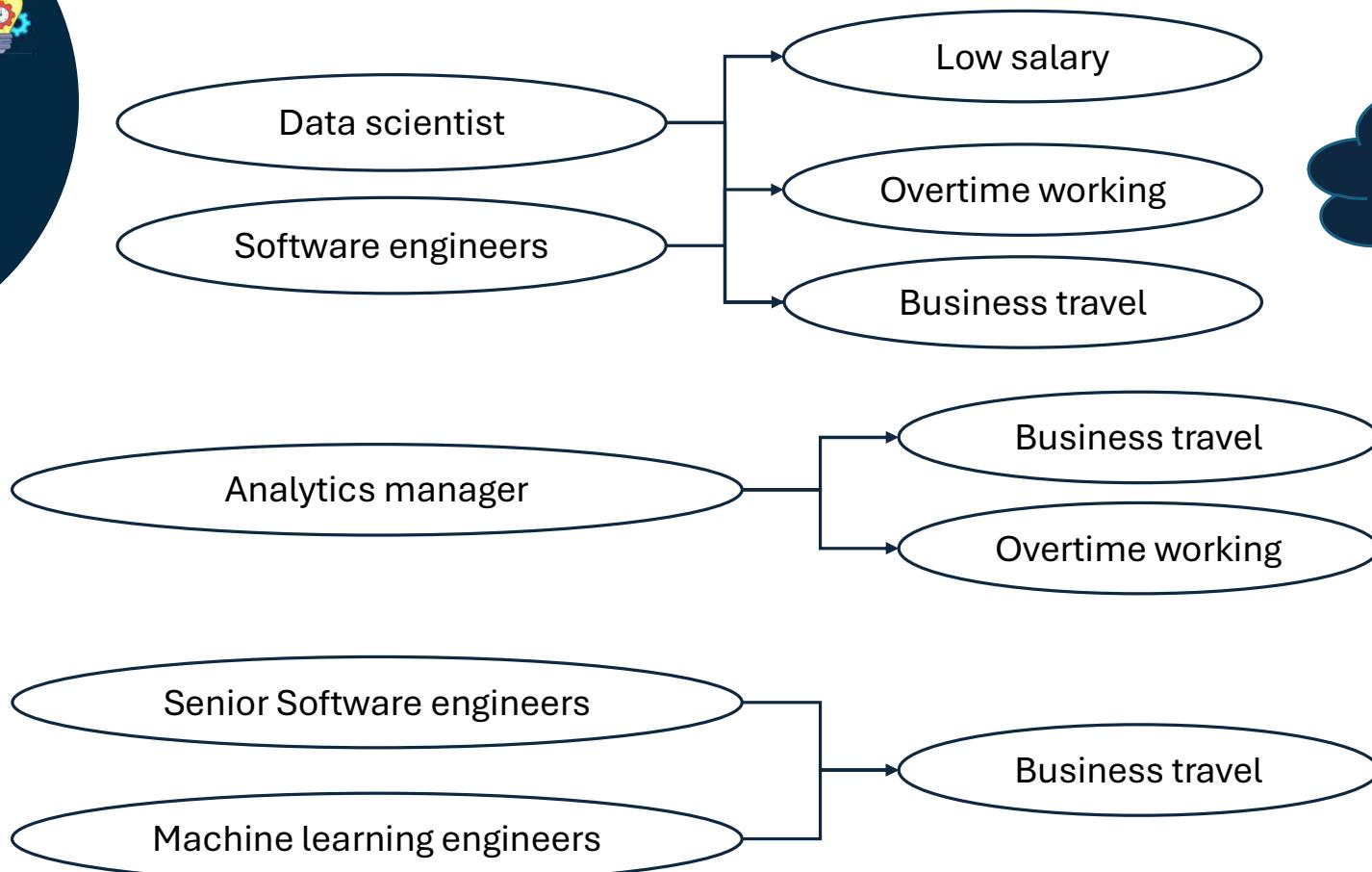
All have some business travel



All working overtime

Attrition Analysis Insights

- Factors affect on the Mid-aged Technology employees attrition rate:



I see that before..?

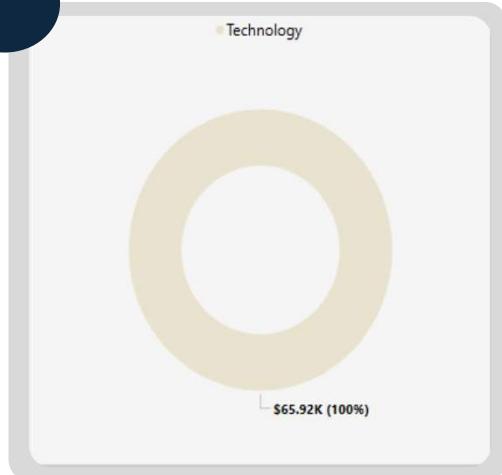


Attrition Analysis Insights

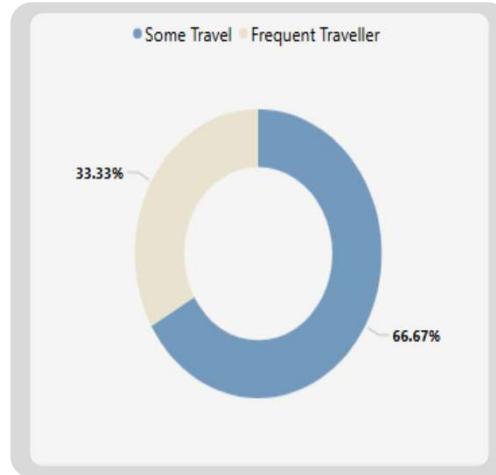
Mid-Aged Technology employees



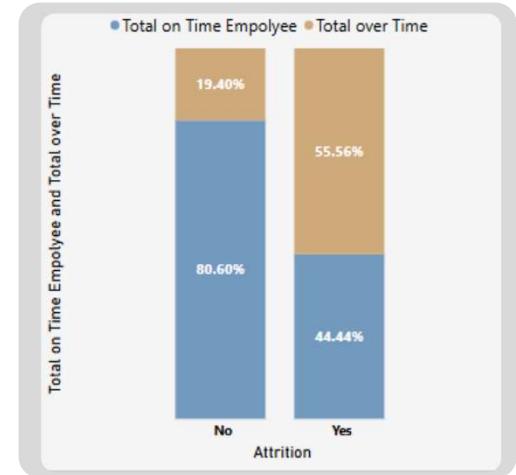
Data scientist



\$65.92K



All have business travel



55.56 % of the left ones worked overtime

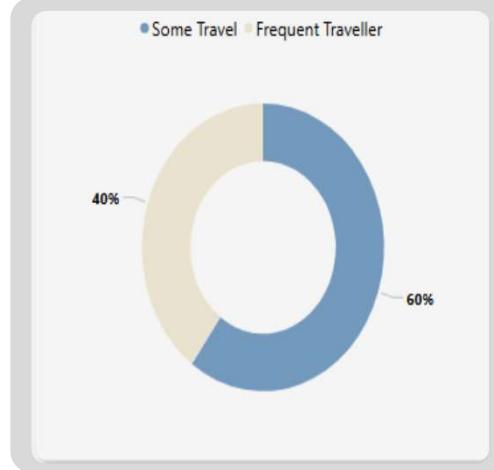
Attrition Analysis Insights

Mid-Aged Technology employees

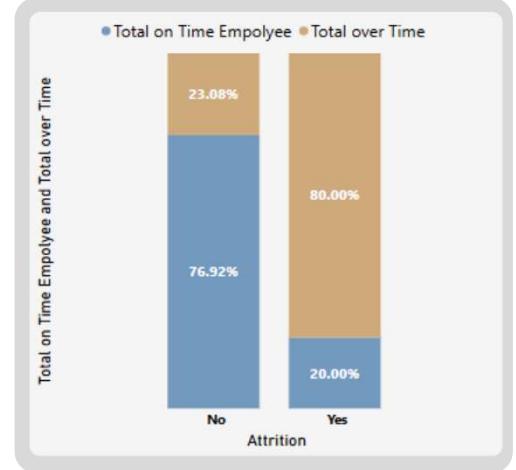
Software engineers



\$56.59K



All have business travel

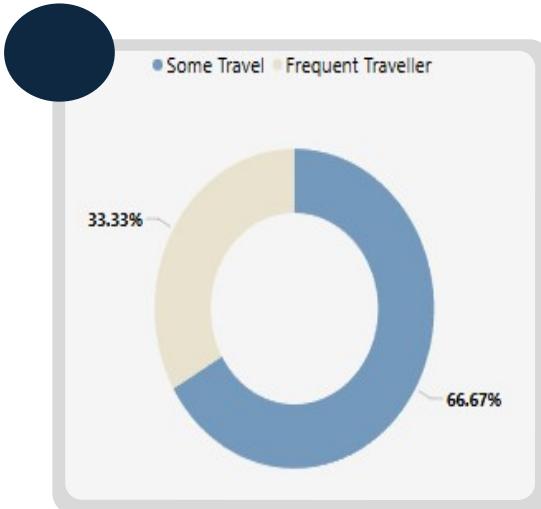


80% of the left ones
worked overtime

Attrition Analysis Insights

Mid-Aged Technology employees

Senior Software engineers

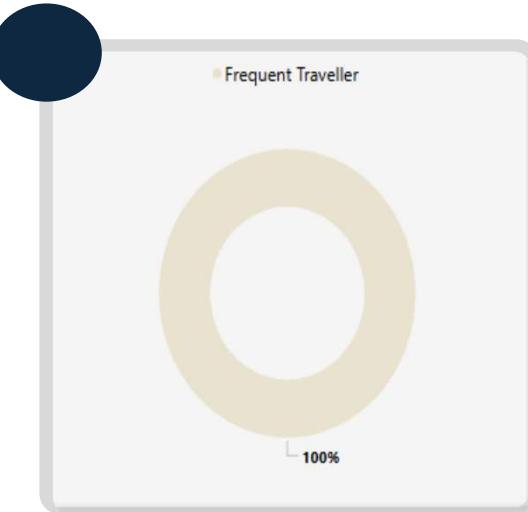


All have business travel

Attrition Analysis Insights

Mid-Aged Technology employees

Machine learning engineers



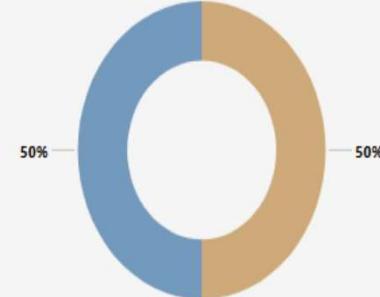
All have frequent business travel

Attrition Analysis Insights

Mid-Aged Technology employees

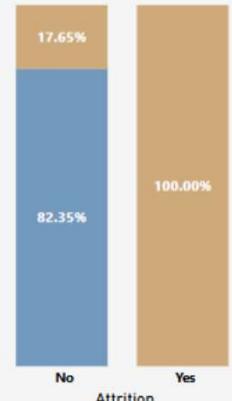
Analytics Manager

● No Travel ● Some Travel



50% have business travel

● Total on Time Employee ● Total over Time

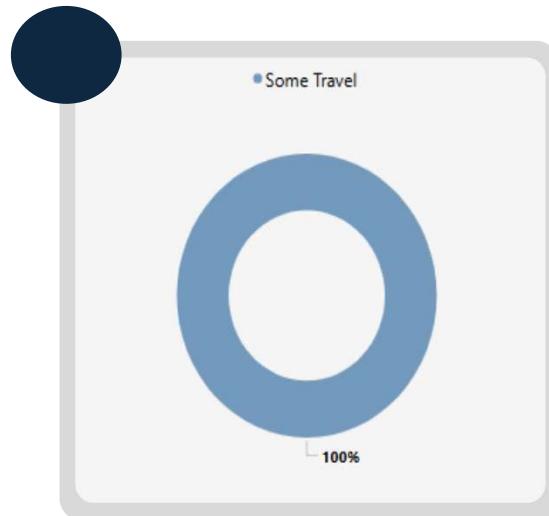


All working overtime

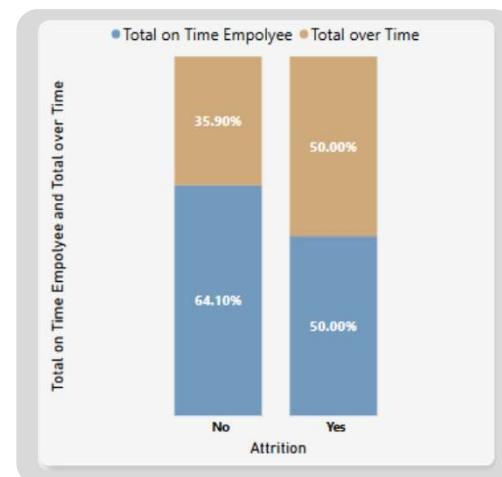
Attrition Analysis Insights

Mid-Aged Technology employees

Engineer Managers

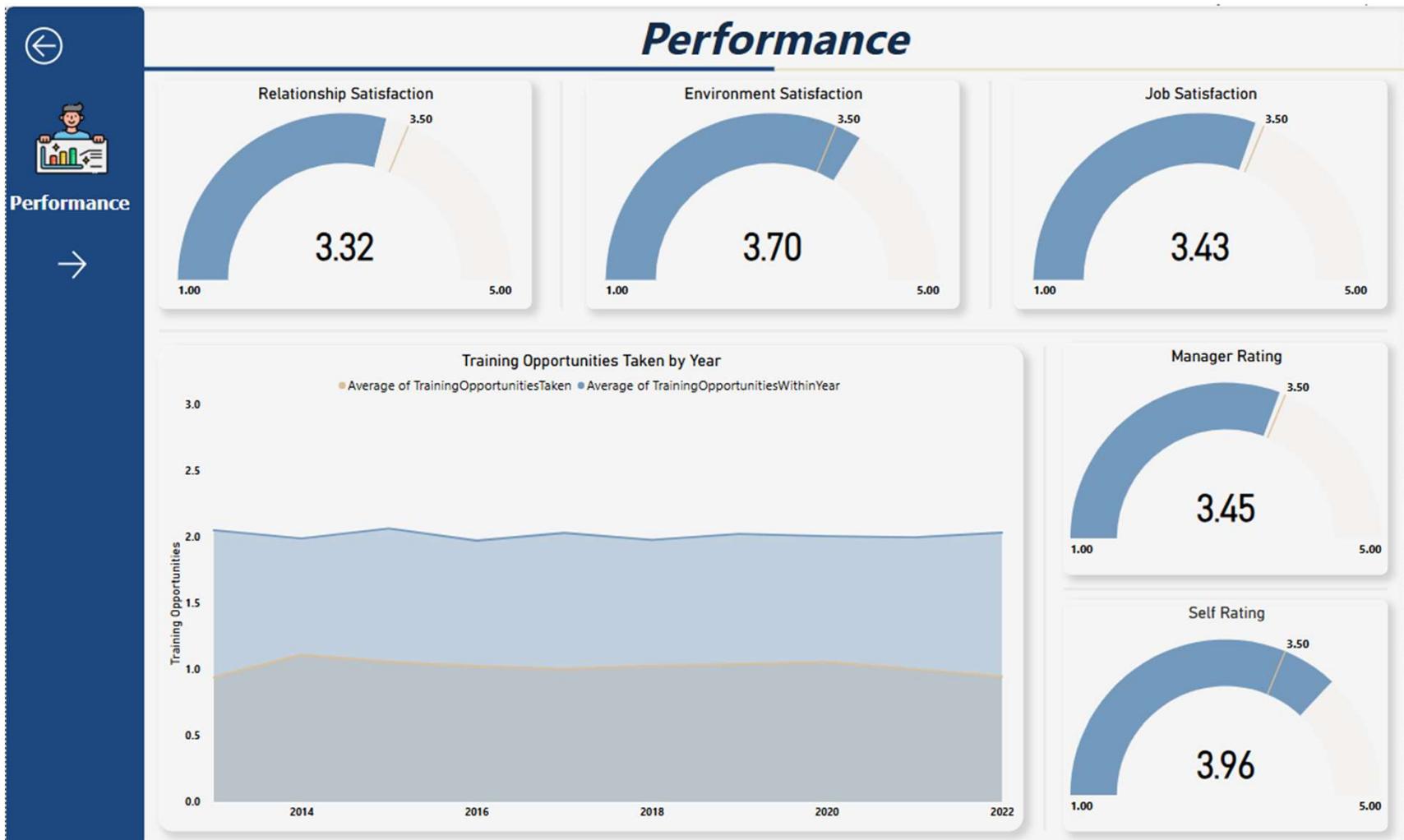


All have some business travel



50% working overtime

Performance



Q & A

The image shows a software application window titled "Questions". On the left, there is a sidebar with a back arrow icon, a user icon holding a question mark, and the word "Questions". The main area has a search bar at the top containing the text "attrition rate". Below the search bar, the number "16.12%" is displayed in large font, with "Attrition Rate" written underneath it in smaller text.

attrition rate

16.12%

Attrition Rate



Conclusion & Recommendations

- Most of Technology department employees are young aged, so they give low average salary for this department.
- The young aged employees showed the highest attrition rate due to their average low salaries.
- High attrition rate was found for the employees with 0-2 years since last promotion due to low salaries.
- Engineering managers of our company are young aged from 25 to 30 years old, so they affect the average age of employees in the company.
- HR department attrition represented in HR recruiters as they have the lowest salary average with the highest attrition rate due to their young ages and high turnovers in the market.
- High attrition in Technology department is represented in Data scientists and Software engineers.



Conclusion & Recommendations

- High attrition in Sales department is due to their high turn over in the market.
- Promotions are needed more for salary to retain the employees specially the young aged.
- Competitions and contexts are very important solutions to get more relationship satisfaction among the employees.
- More motivation for training opportunities is required for better performance.
- Discussions between employees and their managers before the annual survey is important to reduce the gap between manager and self ratings.



Q & A