

```
In [ ]: import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

```
In [ ]: df = pd.read_csv("/content/HR-Employee-Attrition.csv")
```

```
In [ ]: # Set the maximum number of displayed columns to 40
pd.set_option('display.max_columns', 40)
```

```
In [ ]: df.head()
```

```
Out[ ]:
```

	Age	Attrition	BusinessTravel	DailyRate	Department	DistanceFromHome	Educational
0	41	Yes	Travel_Rarely	1102	Sales	1	
1	49	No	Travel_Frequently	279	Research & Development	8	
2	37	Yes	Travel_Rarely	1373	Research & Development	2	
3	33	No	Travel_Frequently	1392	Research & Development	3	
4	27	No	Travel_Rarely	591	Research & Development	2	

```
In [ ]: df.tail()
```

```
Out[ ]:
```

	Age	Attrition	BusinessTravel	DailyRate	Department	DistanceFromHome	Educational
1465	36	No	Travel_Frequently	884	Research & Development	23	
1466	39	No	Travel_Rarely	613	Research & Development	6	
1467	27	No	Travel_Rarely	155	Research & Development	4	
1468	49	No	Travel_Frequently	1023	Sales	2	
1469	34	No	Travel_Rarely	628	Research & Development	8	

```
In [ ]: df.sample()
```

```
Out[ ]:
```

	Age	Attrition	BusinessTravel	DailyRate	Department	DistanceFromHome	Edu
106	50	No	Travel_Frequently	1115	Research & Development		1



```
In [ ]: df.columns
```

```
Out[ ]: Index(['Age', 'Attrition', 'BusinessTravel', 'DailyRate', 'Department',  
              'DistanceFromHome', 'Education', 'EducationField', 'EmployeeCount',  
              'EmployeeNumber', 'EnvironmentSatisfaction', 'Gender', 'HourlyRate',  
              'JobInvolvement', 'JobLevel', 'JobRole', 'JobSatisfaction',  
              'MaritalStatus', 'MonthlyIncome', 'MonthlyRate', 'NumCompaniesWorked',  
              'Over18', 'OverTime', 'PercentSalaryHike', 'PerformanceRating',  
              'RelationshipSatisfaction', 'StandardHours', 'StockOptionLevel',  
              'TotalWorkingYears', 'TrainingTimesLastYear', 'WorkLifeBalance',  
              'YearsAtCompany', 'YearsInCurrentRole', 'YearsSinceLastPromotion',  
              'YearsWithCurrManager'],  
              dtype='object')
```

```
In [ ]: df.shape
```

```
Out[ ]: (1470, 35)
```

```
In [ ]: df.dtypes
```

```
Out[ ]: Age                int64
Attrition                 object
BusinessTravel            object
DailyRate                int64
Department               object
DistanceFromHome         int64
Education                int64
EducationField            object
EmployeeCount            int64
EmployeeNumber           int64
EnvironmentSatisfaction  int64
Gender                   object
HourlyRate               int64
JobInvolvement           int64
JobLevel                 int64
JobRole                  object
JobSatisfaction          int64
MaritalStatus            object
MonthlyIncome            int64
MonthlyRate              int64
NumCompaniesWorked       int64
Over18                   object
OverTime                 object
PercentSalaryHike        int64
PerformanceRating        int64
RelationshipSatisfaction int64
StandardHours            int64
StockOptionLevel         int64
TotalWorkingYears        int64
TrainingTimesLastYear    int64
WorkLifeBalance          int64
YearsAtCompany           int64
YearsInCurrentRole       int64
YearsSinceLastPromotion  int64
YearsWithCurrManager     int64
dtype: object
```

```
In [ ]: df['Attrition']=df['Attrition'].astype('category')
df['BusinessTravel']=df['BusinessTravel'].astype('category')
df['Department']=df['Department'].astype('category')
df['EducationField']=df['EducationField'].astype('category')
df['Gender']=df['Gender'].astype('category')
```

```
In [ ]: df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1470 entries, 0 to 1469
Data columns (total 35 columns):
#   Column                                Non-Null Count  Dtype
---  -
0   Age                                   1470 non-null   int64
1   Attrition                           1470 non-null   category
2   BusinessTravel                       1470 non-null   category
3   DailyRate                           1470 non-null   int64
4   Department                           1470 non-null   category
5   DistanceFromHome                    1470 non-null   int64
6   Education                           1470 non-null   int64
7   EducationField                       1470 non-null   category
8   EmployeeCount                       1470 non-null   int64
9   EmployeeNumber                      1470 non-null   int64
10  EnvironmentSatisfaction              1470 non-null   int64
11  Gender                               1470 non-null   category
12  HourlyRate                           1470 non-null   int64
13  JobInvolvement                      1470 non-null   int64
14  JobLevel                            1470 non-null   int64
15  JobRole                             1470 non-null   object
16  JobSatisfaction                     1470 non-null   int64
17  MaritalStatus                       1470 non-null   object
18  MonthlyIncome                      1470 non-null   int64
19  MonthlyRate                         1470 non-null   int64
20  NumCompaniesWorked                  1470 non-null   int64
21  Over18                             1470 non-null   object
22  OverTime                            1470 non-null   object
23  PercentSalaryHike                   1470 non-null   int64
24  PerformanceRating                   1470 non-null   int64
25  RelationshipSatisfaction             1470 non-null   int64
26  StandardHours                       1470 non-null   int64
27  StockOptionLevel                    1470 non-null   int64
28  TotalWorkingYears                   1470 non-null   int64
29  TrainingTimesLastYear               1470 non-null   int64
30  WorkLifeBalance                     1470 non-null   int64
31  YearsAtCompany                      1470 non-null   int64
32  YearsInCurrentRole                  1470 non-null   int64
33  YearsSinceLastPromotion              1470 non-null   int64
34  YearsWithCurrManager                 1470 non-null   int64
dtypes: category(5), int64(26), object(4)
memory usage: 352.5+ KB
```

```
In [ ]: df['BusinessTravel'].unique()
```

```
Out[ ]: array(['Travel_Rarely', 'Travel_Frequently', 'Non-Travel'], dtype=object)
```

```
In [ ]: df['Department'].unique()
```

```
Out[ ]: array(['Sales', 'Research & Development', 'Human Resources'], dtype=object)
```

```
In [ ]: df['JobRole'].unique()
```

```
Out[ ]: array(['Sales Executive', 'Research Scientist', 'Laboratory Technician',
              'Manufacturing Director', 'Healthcare Representative', 'Manager',
              'Sales Representative', 'Research Director', 'Human Resources'],
              dtype=object)
```

```
In [ ]: df.describe()
```

	Age	DailyRate	DistanceFromHome	Education	EmployeeCount	Em
count	1470.000000	1470.000000	1470.000000	1470.000000	1470.0	
mean	36.923810	802.485714	9.192517	2.912925	1.0	
std	9.135373	403.509100	8.106864	1.024165	0.0	
min	18.000000	102.000000	1.000000	1.000000	1.0	
25%	30.000000	465.000000	2.000000	2.000000	1.0	
50%	36.000000	802.000000	7.000000	3.000000	1.0	
75%	43.000000	1157.000000	14.000000	4.000000	1.0	
max	60.000000	1499.000000	29.000000	5.000000	1.0	



```
In [ ]: df.isnull().sum()
```

```
Out[ ]: Age                                0
Attrition                                0
BusinessTravel                           0
DailyRate                                0
Department                               0
DistanceFromHome                         0
Education                                0
EducationField                           0
EmployeeCount                             0
EmployeeNumber                           0
EnvironmentSatisfaction                   0
Gender                                    0
HourlyRate                               0
JobInvolvement                           0
JobLevel                                 0
JobRole                                  0
JobSatisfaction                           0
MaritalStatus                             0
MonthlyIncome                             0
MonthlyRate                               0
NumCompaniesWorked                        0
Over18                                    0
OverTime                                  0
PercentSalaryHike                         0
PerformanceRating                         0
RelationshipSatisfaction                   0
StandardHours                             0
StockOptionLevel                          0
TotalWorkingYears                         0
TrainingTimesLastYear                     0
WorkLifeBalance                           0
YearsAtCompany                             0
YearsInCurrentRole                         0
YearsSinceLastPromotion                    0
YearsWithCurrManager                       0
dtype: int64
```

```
In [ ]: df.duplicated().sum()
```

Out[]: 0

Overall attrition rate

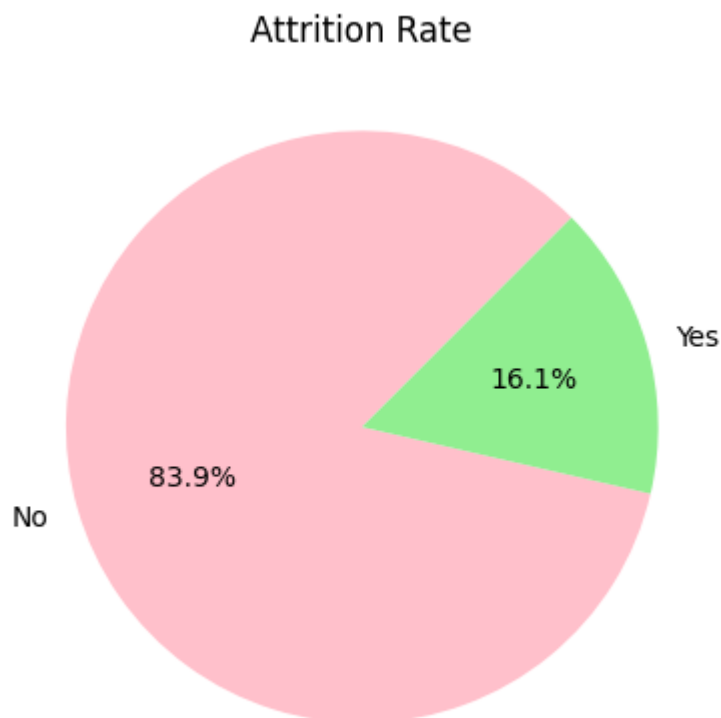
```
In [ ]: attrition_rate=((df[df['Attrition']=='Yes'].count()[0])/df.shape[0])*100
attrition_rate
```

Out[]: 16.122448979591837

```
In [ ]: attrition_counts = df['Attrition'].value_counts()
attrition_counts
```

Out[]: No 1233
Yes 237
Name: Attrition, dtype: int64

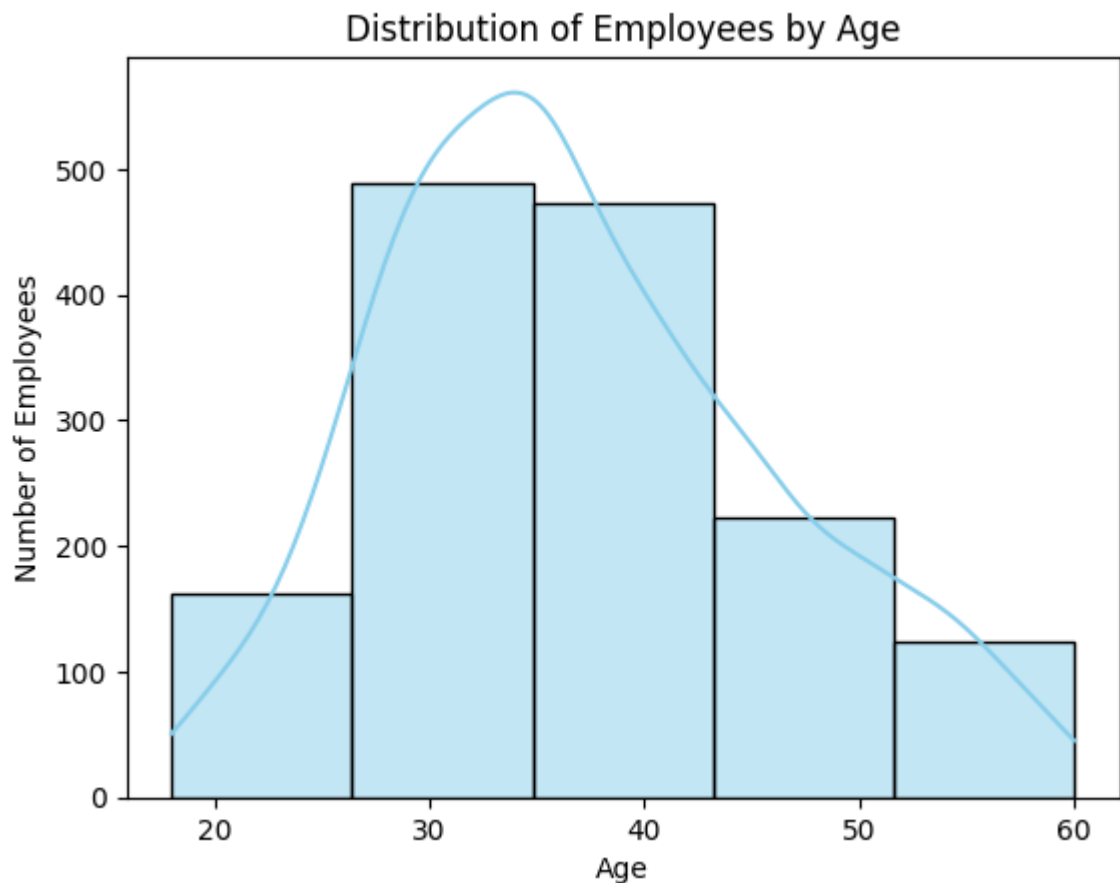
```
In [ ]: plt.pie(attrition_counts, labels=attrition_counts.index, autopct='%1.1f%%', start
plt.title('Attrition Rate')
plt.show()
```



Age Factor

Age Diversity

```
In [ ]: sns.histplot(data= df, x= 'Age', bins= 5, color= 'skyblue', kde=True)
plt.ylabel('Number of Employees')
plt.title('Distribution of Employees by Age')
plt.show()
```



Impact of age on Attrition

```
In [ ]: bins= [10,30,50,np.inf]
values= ['Young', 'Adult', 'Senile']
df['Age_category'] = pd.cut(df['Age'], bins=bins, labels=values)
```

```
In [ ]: attrition_age=df.pivot_table(index='Age_category',columns='Attrition',values='Em
attrition_age
```

```
Out[ ]:      Attrition  No  Yes
```

Age_category

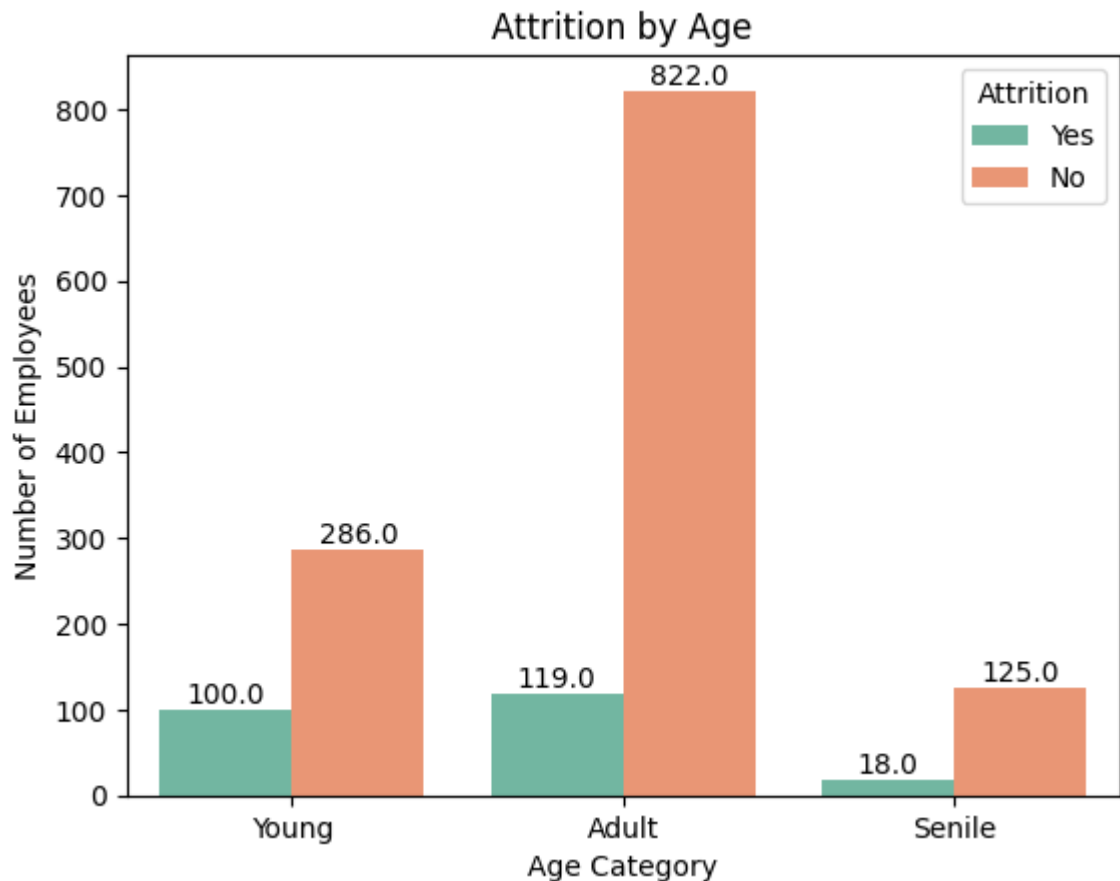
```
      Young  286  100
```

```
      Adult  822  119
```

```
      Senile  125   18
```

```
In [ ]: m=sns.countplot(data= df,x= 'Age_category', hue='Attrition',palette='Set2')
plt.xticks(rotation=0)
plt.xlabel('Age Category')
plt.ylabel('Number of Employees')
plt.title('Attrition by Age')

for p in m.patches:
    height = p.get_height()
    m.annotate(f'{height}', (p.get_x() + p.get_width() / 2, height),
               ha='center', va='bottom', fontsize=10)
plt.show()
```



Employee Distribution by department

```
In [ ]: df['Department'].value_counts()
```

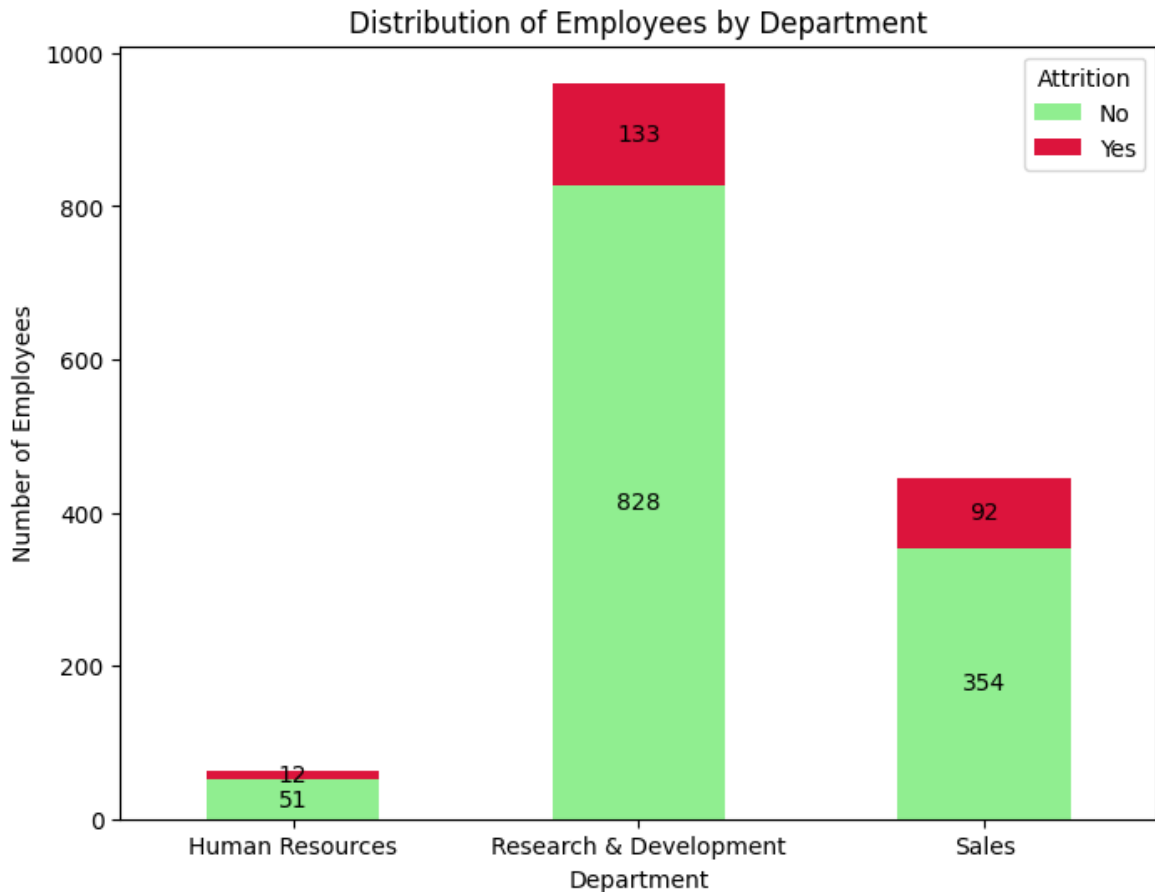
```
Out[ ]: Research & Development    961
Sales                            446
Human Resources                  63
Name: Department, dtype: int64
```

```
In [ ]: attrition_by_department = df.groupby(['Department', 'Attrition']).size().unstack

# Create a stacked bar chart
ax = attrition_by_department.plot(kind='bar', stacked=True, figsize=(8, 6), color
plt.legend(title='Attrition', loc='upper right')
plt.xticks(rotation=0)
plt.xlabel('Department')
plt.ylabel('Number of Employees')
plt.title('Distribution of Employees by Department')
m.bar_label(m.containers[0], fontsize=10)

for p in ax.patches:
    width, height = p.get_width(), p.get_height()
    x, y = p.get_xy()
    ax.annotate(f'{int(height)}', (x + width/2, y + height/2), ha='center', va='

plt.show()
```

```
In [ ]: #Percentage attrition departmentwise
department_groups = df.groupby('Department')
total_employees_by_department = department_groups.size().reset_index(name='Total')
attrition_count_by_department = department_groups['Attrition'].apply(lambda x: (
attrition_percentage_by_department = pd.merge(total_employees_by_department, attrition_count_by_department, on='Department')
attrition_percentage_by_department['AttritionPercentage'] = (attrition_count_by_department['Attrition'] / total_employees_by_department['Total']) * 100
print(attrition_percentage_by_department)
```

	Department	TotalEmployees	AttritionCount	AttritionPercentage
0	Human Resources	63	12	19.047619
1	Research & Development	961	133	13.839750
2	Sales	446	92	20.627803

Conclusion: There are varying levels of attrition across departments, with Sales and Human Resources experiencing higher attrition rates compared to Research & Development. The Sales department experiences a higher attrition rate, with approximately 20.63% of employees leaving. The Research & Development department has a relatively lower attrition rate, with approximately 13.84% of employees leaving. This department seems to have better employee retention compared to Human Resources and Sales.

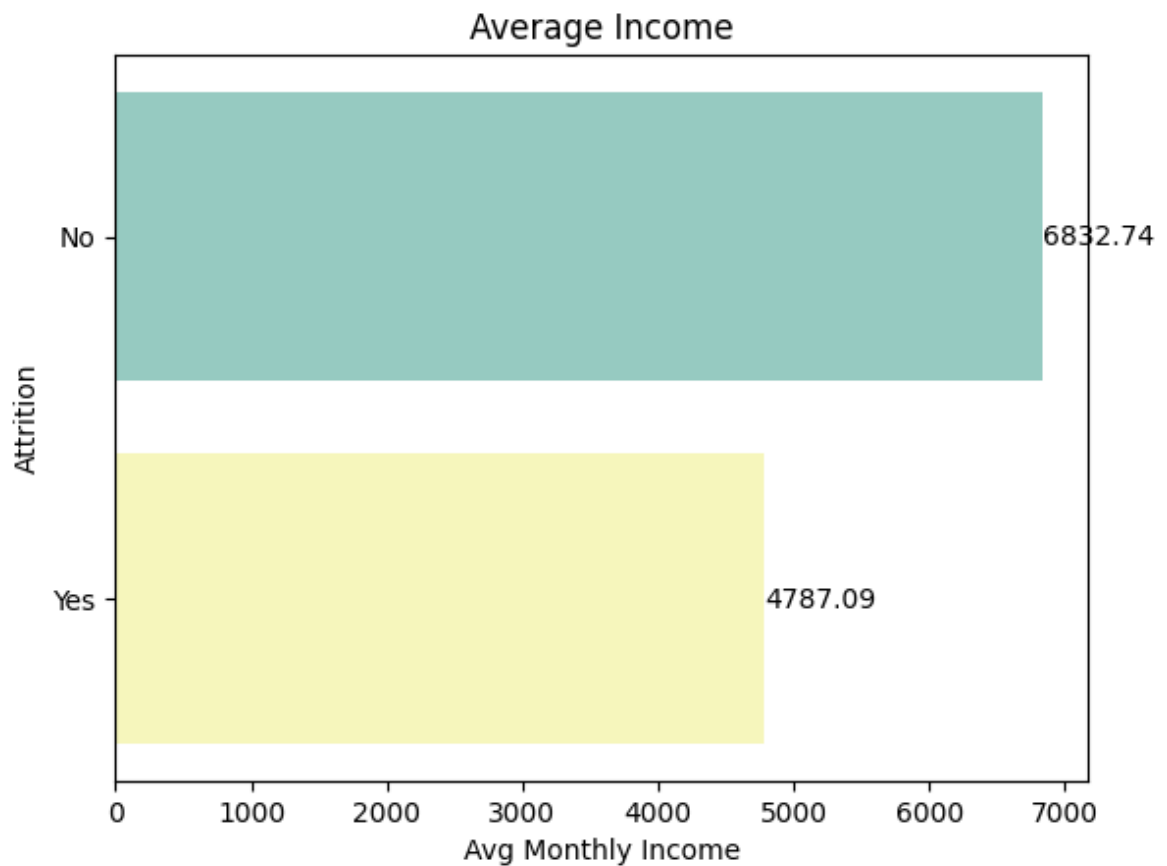
Effect of income on attrition

```
In [ ]: avg_income=df.groupby('Attrition')['MonthlyIncome'].mean()
avg_income
```

```
Out[ ]: Attrition
No      6832.739659
Yes     4787.092827
Name: MonthlyIncome, dtype: float64
```

```
In [ ]: p=sns.barplot(data=df, y= avg_income.index, x=avg_income.values,errorbar=None,palette='magma')
p.bar_label(p.containers[0], fontsize=10)
plt.title('Average Income')
```

```
plt.xlabel('Avg Monthly Income')
plt.show()
```

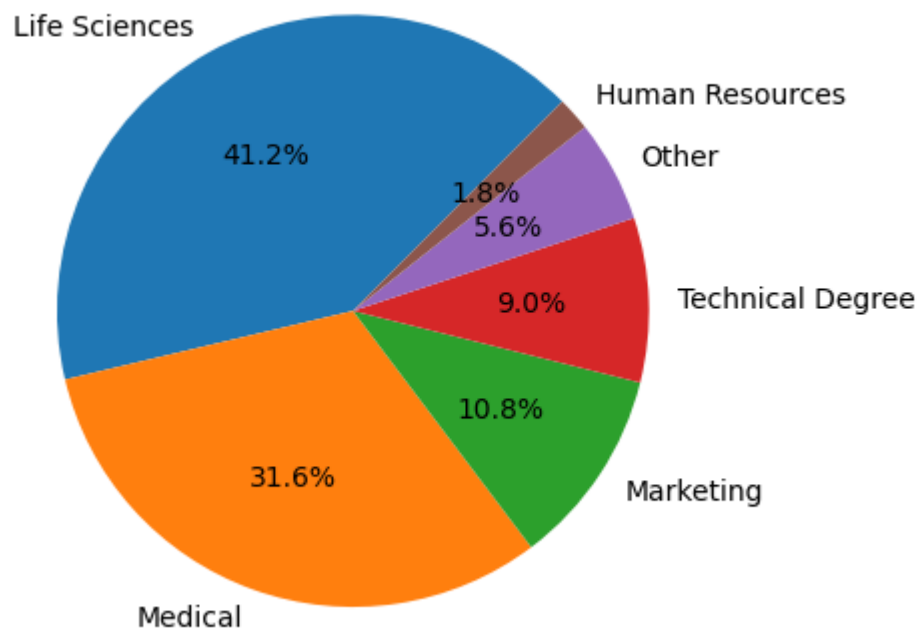


Education levels of employees

```
In [ ]: edu_dist=df['EducationField'].value_counts()
edu_dist
```

```
Out[ ]: Life Sciences      606
Medical      464
Marketing     159
Technical Degree 132
Other         82
Human Resources 27
Name: EducationField, dtype: int64
```

```
In [ ]: plt.pie(edu_dist, labels=edu_dist.index, autopct='%1.1f%%', startangle=45)
plt.show()
```

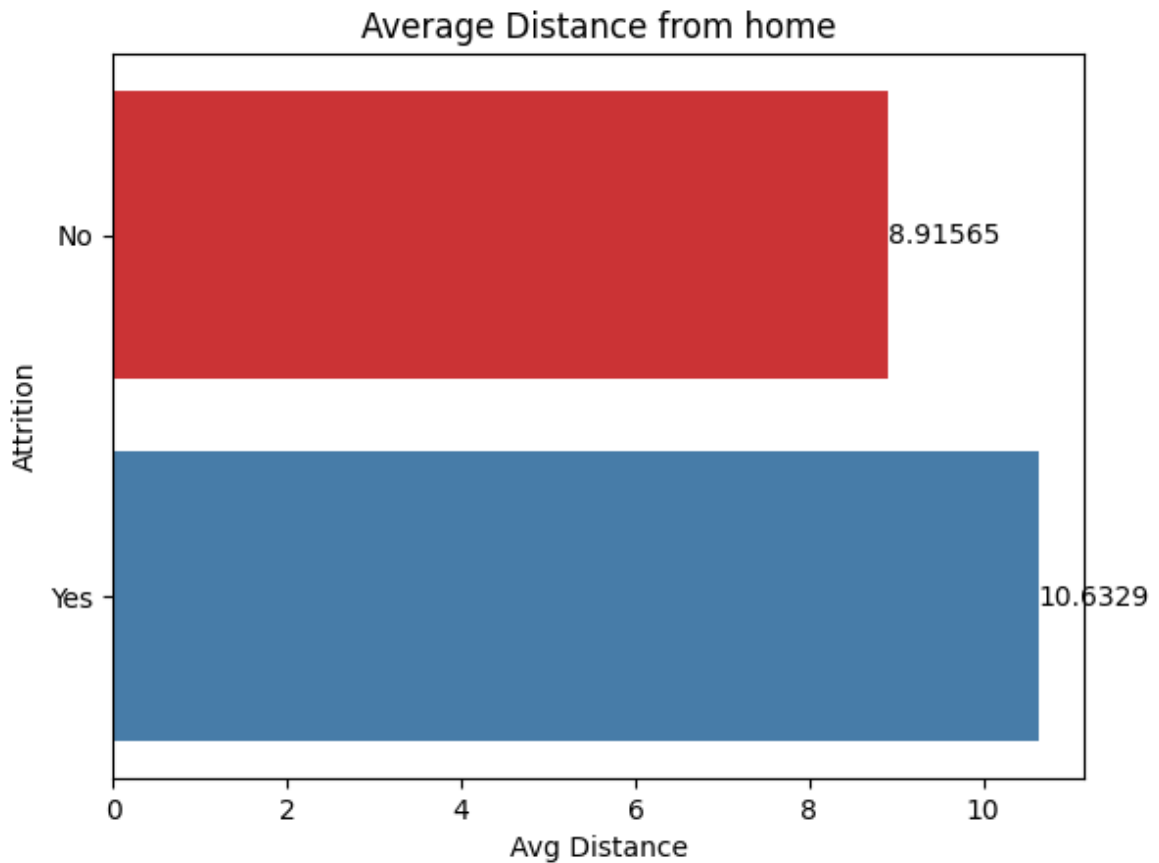


Location Proximity

```
In [ ]: avg_distance=df.groupby('Attrition')['DistanceFromHome'].mean()  
avg_distance
```

```
Out[ ]: Attrition  
No      8.915653  
Yes     10.632911  
Name: DistanceFromHome, dtype: float64
```

```
In [ ]: p=sns.barplot(data=df, y= avg_distance.index, x=avg_distance.values,errorbar=None)  
p.bar_label(p.containers[0], fontsize=10)  
plt.title('Average Distance from home')  
plt.xlabel('Avg Distance')  
plt.show()
```



Effect of overtime on employee attrition

```
In [ ]: total_employees_with_overtime = df[df['OverTime'] == 'Yes']['EmployeeNumber'].count()
overtime_and_left = df[(df['OverTime'] == 'Yes') & (df['Attrition'] == 'Yes')]
percentage_left_with_overtime = (overtime_and_left / total_employees_with_overtime) * 100
print(round(percentage_left_with_overtime, 2))
```

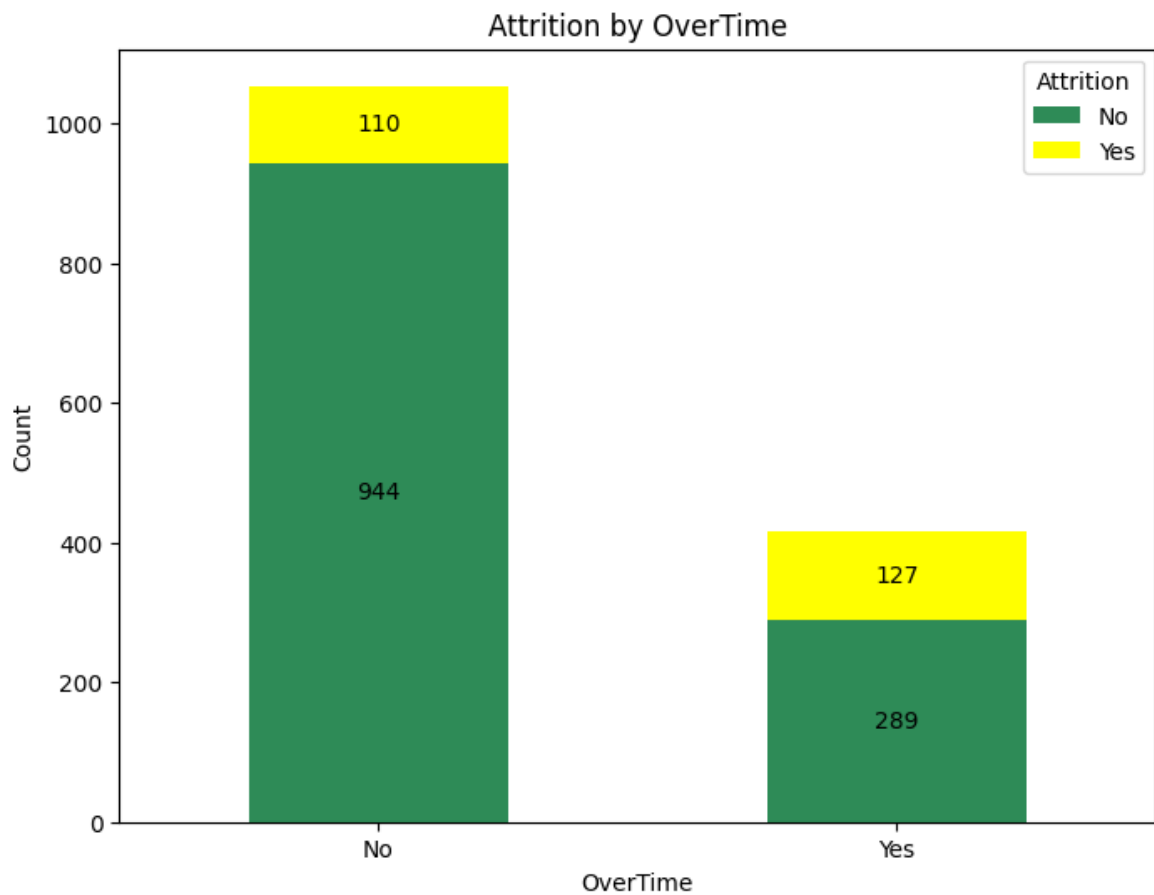
30.528846153846157

```
In [ ]: attrition_by_overtime = df.groupby(['OverTime', 'Attrition']).size().unstack()

# Create a stacked bar chart
ax = attrition_by_overtime.plot(kind='bar', stacked=True, figsize=(8, 6), color=['#f8766d', '#4c78a8'])
plt.title('Attrition by OverTime')
plt.xlabel('OverTime')
plt.ylabel('Count')
plt.xticks(rotation=0)
plt.legend(title='Attrition', loc='upper right')

for p in ax.patches:
    width, height = p.get_width(), p.get_height()
    x, y = p.get_xy()
    ax.annotate(f'{int(height)}', (x + width/2, y + height/2), ha='center', va='bottom')

plt.show()
```

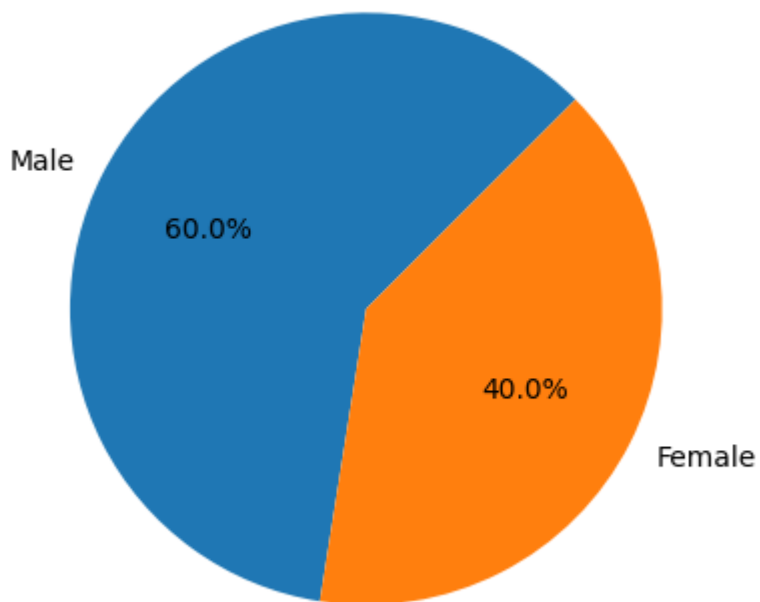


Gender Diversity and its impact on attrition

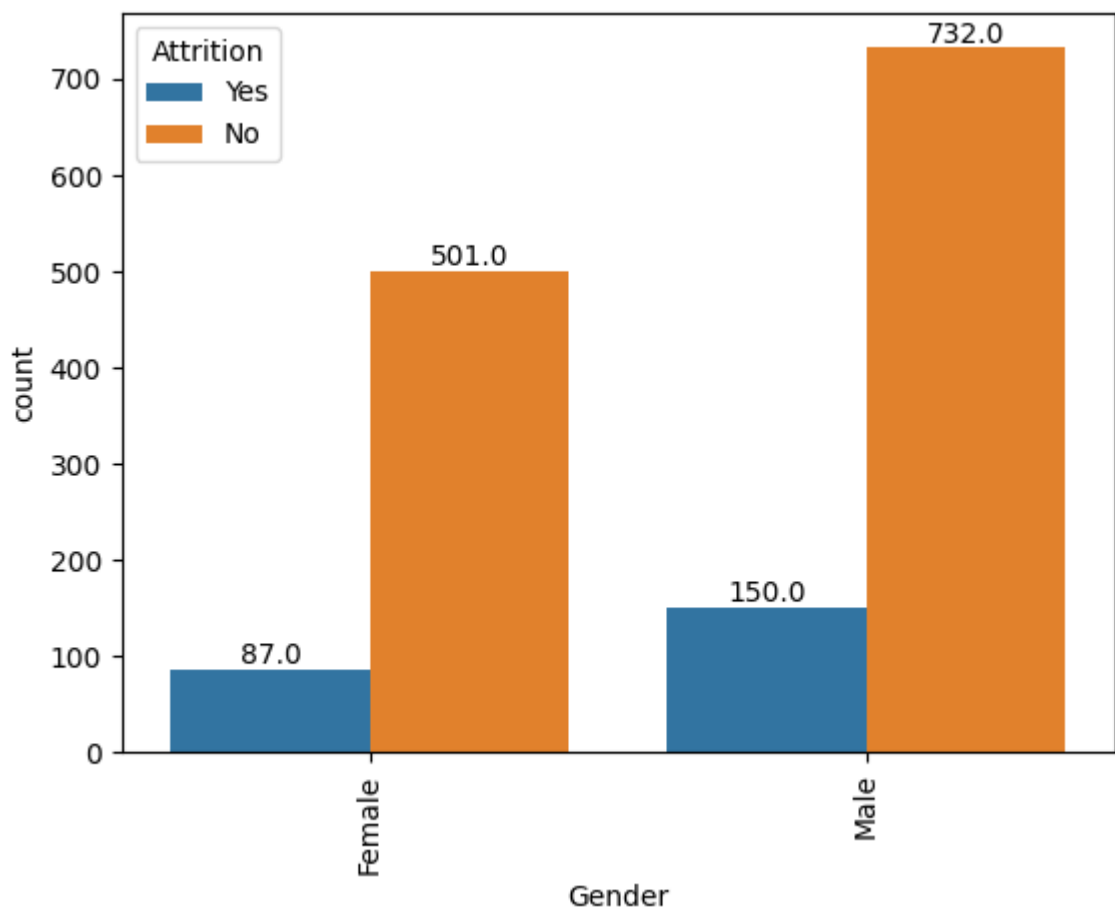
```
In [ ]: gend_dist=df['Gender'].value_counts()  
gend_dist
```

```
Out[ ]: Male      882  
        Female    588  
        Name: Gender, dtype: int64
```

```
In [ ]: plt.pie(gend_dist, labels=gend_dist.index,autopct='%1.1f%%', startangle=45)  
plt.show()
```



```
In [ ]: m=sns.countplot(data=df, x='Gender', hue='Attrition')
plt.xticks(rotation=90)
for p in m.patches:
    height = p.get_height()
    m.annotate(f'{height}', (p.get_x() + p.get_width() / 2, height),
               ha='center', va='bottom', fontsize=10)
plt.show()
```



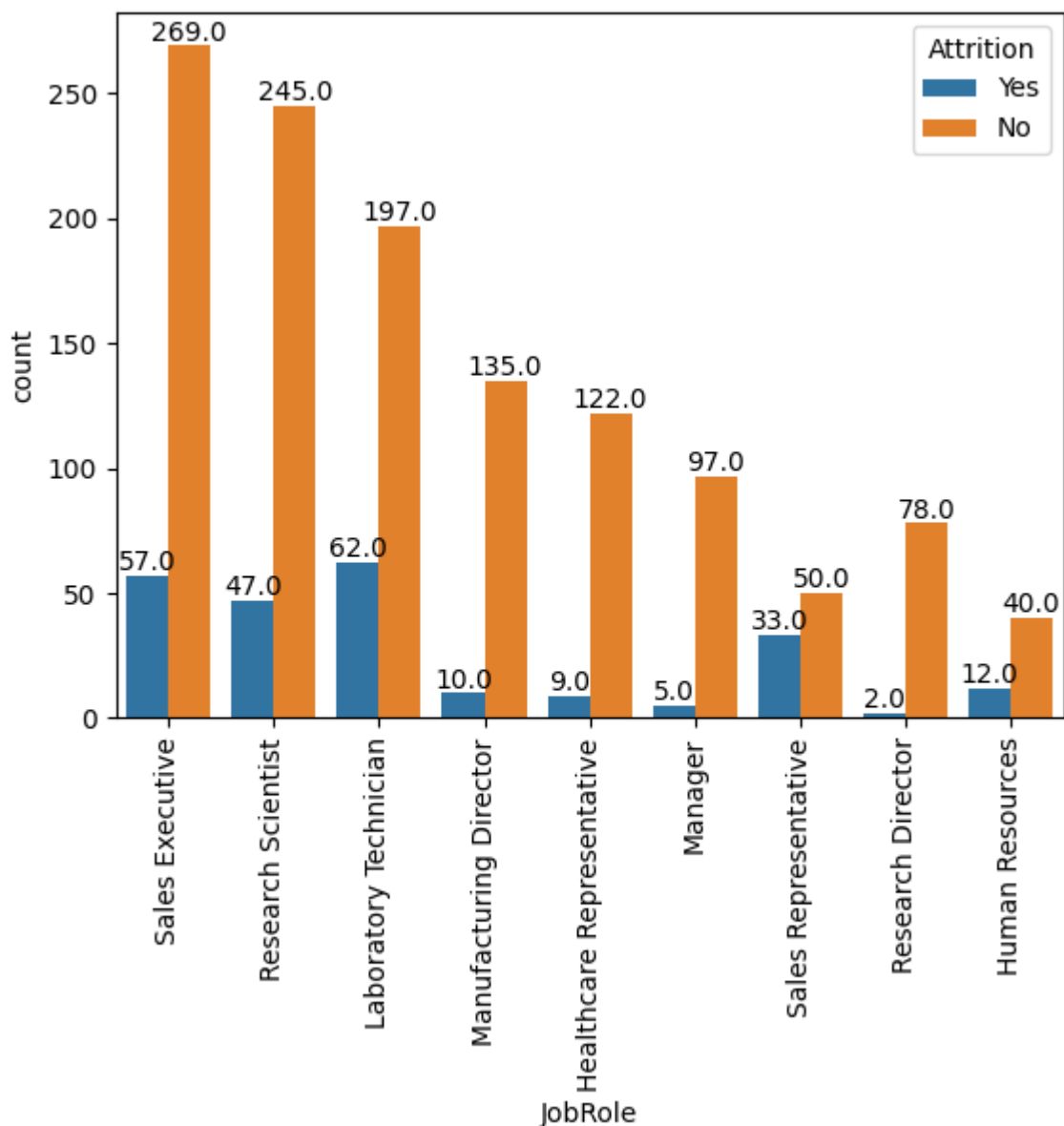
```
In [ ]: #Percentage attrition by gender
```

```
gender_groups = df.groupby('Gender')
total_employees_by_gender = gender_groups.size().reset_index(name='TotalEmployee')
attrition_count_by_gender = gender_groups['Attrition'].apply(lambda x: (x == 'Yes').sum())
attrition_percentage_by_gender = pd.merge(total_employees_by_gender, attrition_count_by_gender, on='Gender')
attrition_percentage_by_gender['AttritionPercentage'] = (attrition_count_by_gender / total_employees_by_gender['TotalEmployee']) * 100
print(attrition_percentage_by_gender)
```

	Gender	TotalEmployee	AttritionCount	AttritionPercentage
0	Female	588	87	14.795918
1	Male	882	150	17.006803

Job Profile and its impact

```
In [ ]: jp=sns.countplot(data=df, x='JobRole', hue='Attrition')
plt.xticks(rotation=90)
for p in jp.patches:
    height = p.get_height()
    jp.annotate(f'{height}', (p.get_x() + p.get_width() / 2, height),
               ha='center', va='bottom', fontsize=10)
plt.show()
```



```
In [ ]: job_profile_groups = df.groupby('JobRole')
total_employees_by_jobrole = job_profile_groups.size().reset_index(name='TotalEm
attrition_count_by_jobrole = job_profile_groups['Attrition'].apply(lambda x: (x
attrition_percentage_by_jobrole = pd.merge(total_employees_by_jobrole, attrition
attrition_percentage_by_jobrole['AttritionPercentage'] = (attrition_percentage_b
print(attrition_percentage_by_jobrole)
```

	JobRole	TotalEmployees	AttritionCount	\
0	Healthcare Representative	131	9	
1	Human Resources	52	12	
2	Laboratory Technician	259	62	
3	Manager	102	5	
4	Manufacturing Director	145	10	
5	Research Director	80	2	
6	Research Scientist	292	47	
7	Sales Executive	326	57	
8	Sales Representative	83	33	

	AttritionPercentage
0	6.870229
1	23.076923
2	23.938224
3	4.901961
4	6.896552
5	2.500000
6	16.095890
7	17.484663
8	39.759036

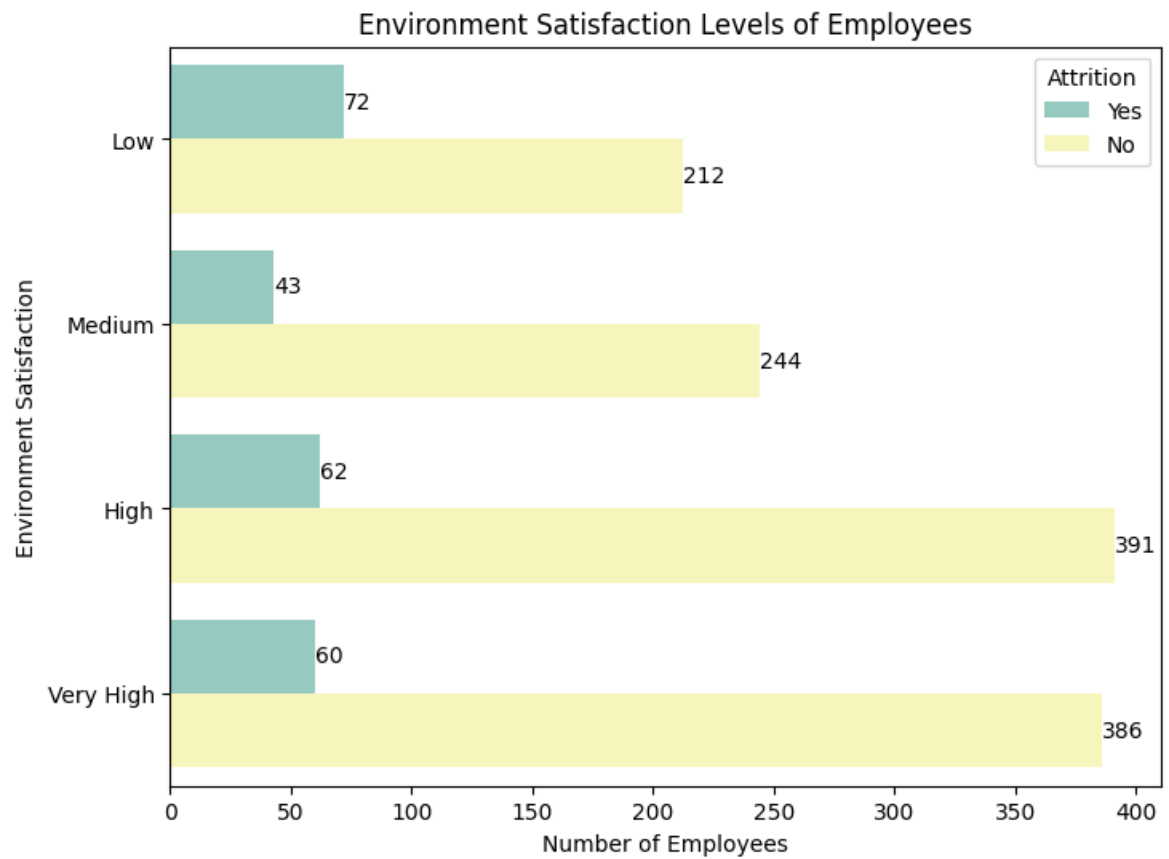
Environment Satisfaction Rating

```
In [ ]: plt.figure(figsize=(8, 6))
env_sat = sns.countplot(data=df, y='EnvironmentSatisfaction', hue='Attrition', pa
plt.title('Environment Satisfaction Levels of Employees')
plt.xlabel('Number of Employees')
plt.ylabel('Environment Satisfaction')

for p in env_sat.patches:
    width = p.get_width()
    height = p.get_height()
    x, y = p.get_x() + width, p.get_y() + height/2
    plt.annotate(f'{int(width)}', (x, y), ha='left', va='center', fontsize=10)

env_sat.set_yticklabels(['Low', 'Medium', 'High', 'Very High'])

plt.show()
```

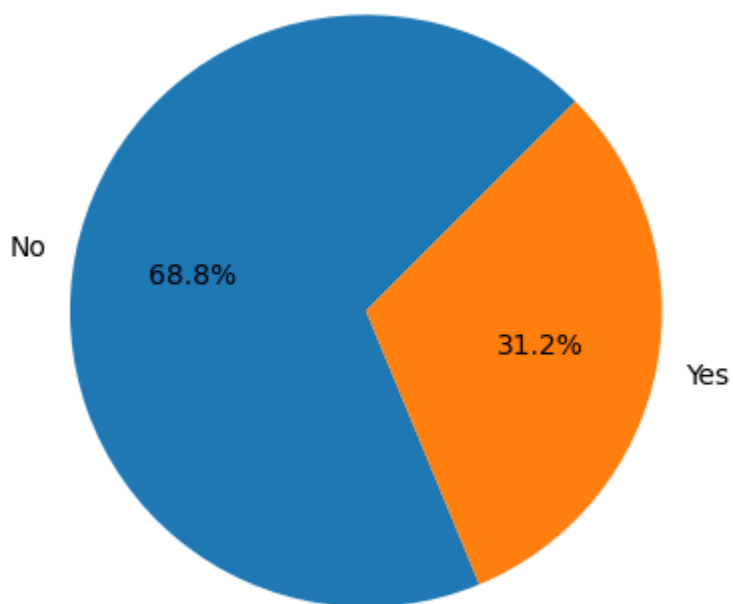
Work-Life Balance

```
In [ ]: df1= df[df['WorkLifeBalance']==1]
```

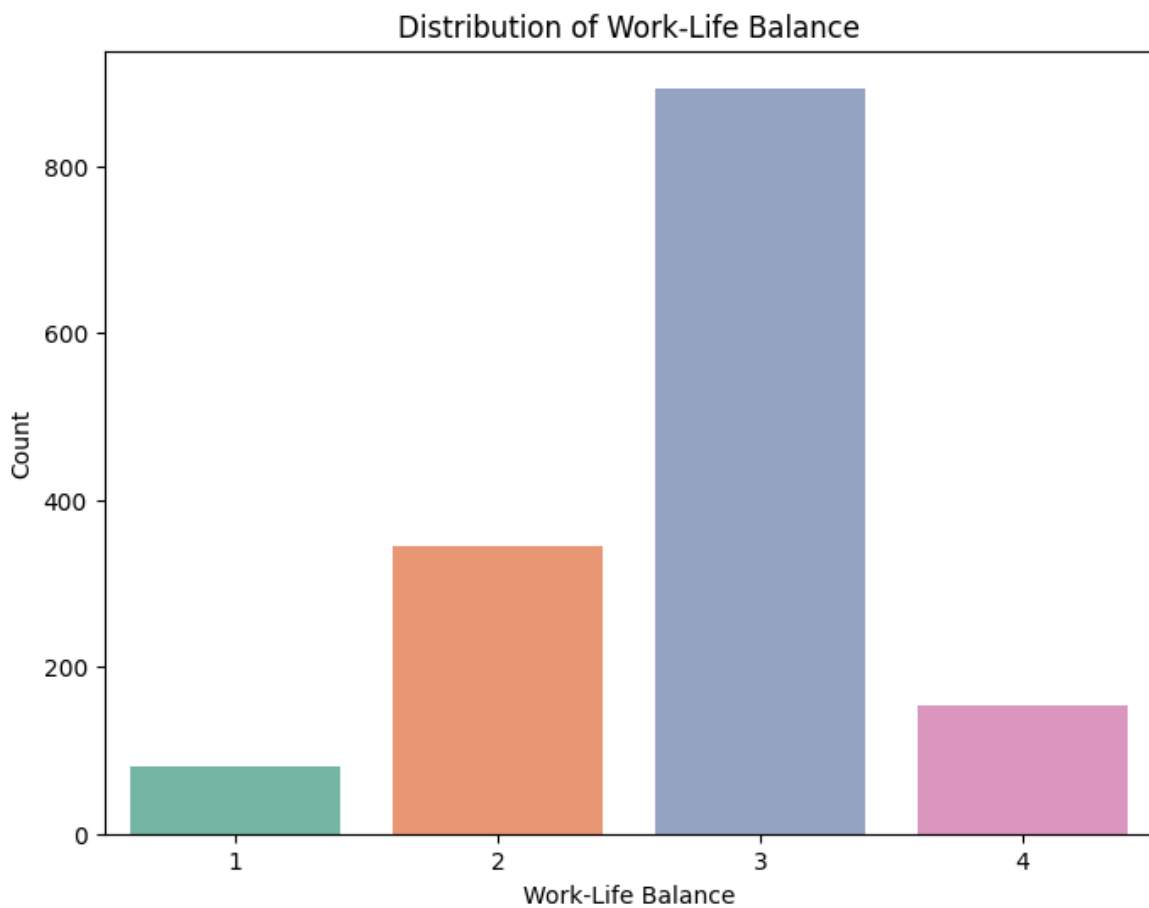
```
In [ ]: att_cnt=df1['Attrition'].value_counts()  
att_cnt
```

```
Out[ ]: No      55  
        Yes      25  
        Name: Attrition, dtype: int64
```

```
In [ ]: plt.pie(att_cnt, labels=att_cnt.index, autopct='%1.1f%%', startangle=45)  
plt.show()
```



```
In [ ]: plt.figure(figsize=(8, 6))
sns.countplot(data=df, x='WorkLifeBalance', palette='Set2')
plt.title('Distribution of Work-Life Balance')
plt.xlabel('Work-Life Balance')
plt.ylabel('Count')
plt.show()
```



Business Travel

```
In [ ]: pivot_table = pd.pivot_table(df, values='Attrition', index='BusinessTravel', agg
pivot_table.columns = ['TotalEmployees', 'AttritionCount']
pivot_table['AttritionPercentage'] = (pivot_table['AttritionCount'] / pivot_table['TotalEmployees'])
pivot_table.reset_index(inplace=True)

print(pivot_table)
```

	BusinessTravel	TotalEmployees	AttritionCount	AttritionPercentage
0	Non-Travel	150	12	8.000000
1	Travel_Frequently	277	69	24.909747
2	Travel_Rarely	1043	156	14.956855

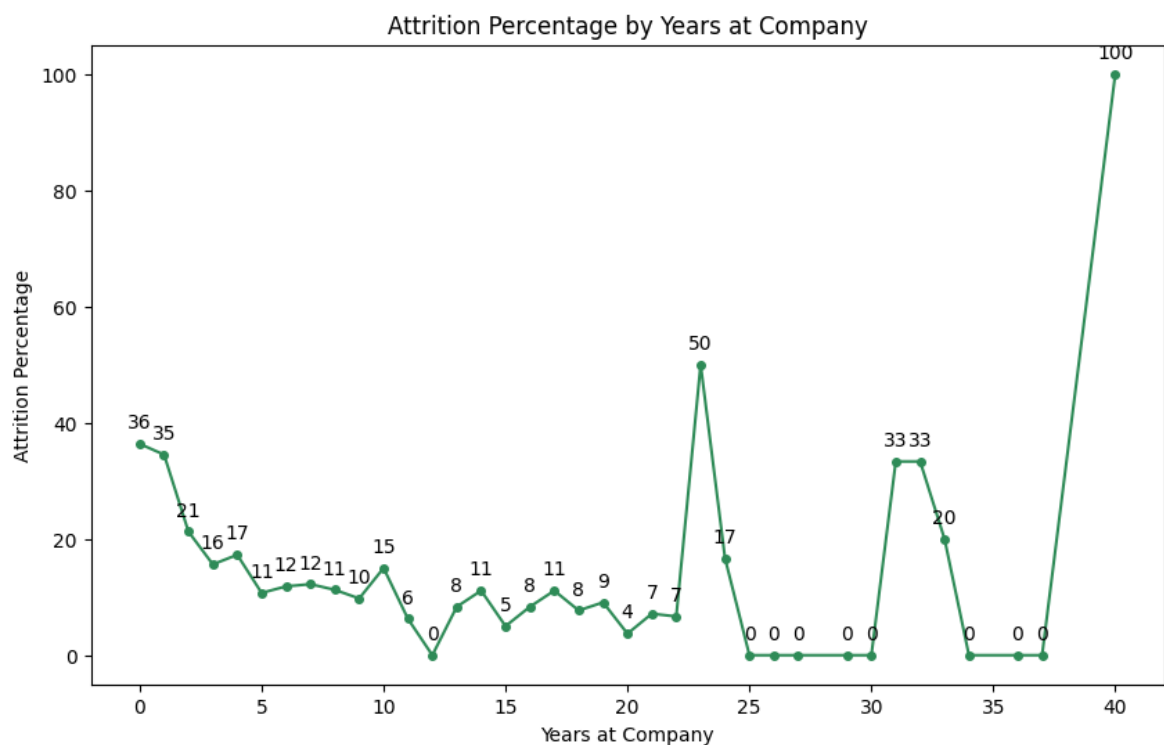
Number of years spent in the company

```
In [ ]: attrition_by_years = df.groupby('YearsAtCompany')['Attrition'].apply(lambda x: (

# Create a Line chart
plt.figure(figsize=(10, 6))
plt.plot(attrition_by_years.index, attrition_by_years.values, marker='o', linestyle='solid')
plt.title('Attrition Percentage by Years at Company')
plt.xlabel('Years at Company')
plt.ylabel('Attrition Percentage')

label_offset = 2 # Adjust this value to control label height
for x, y in zip(attrition_by_years.index, attrition_by_years.values):
    label = f'{int(round(y))}' # Round the percentage and convert it to an integer
    plt.text(x, y + label_offset, label, ha='center', va='bottom', fontsize=10)

plt.show()
```



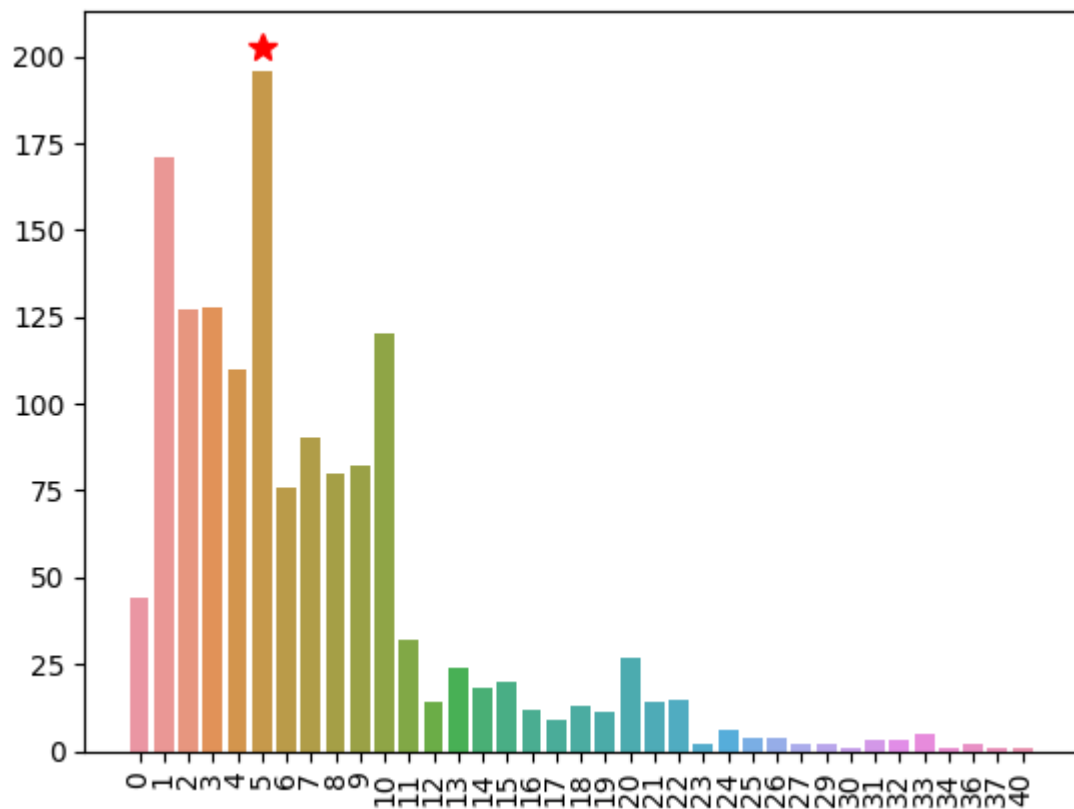
```
In [ ]: x = df['YearsAtCompany'].value_counts()
```

x

```
Out[ ]: 5      196
        1      171
        3      128
        2      127
       10      120
        4      110
        7       90
        9       82
        8       80
        6       76
        0       44
       11       32
       20       27
       13       24
       15       20
       14       18
       22       15
       12       14
       21       14
       18       13
       16       12
       19       11
       17        9
       24        6
       33        5
       25        4
       26        4
       31        3
       32        3
       27        2
       36        2
       29        2
       23        2
       37        1
       40        1
       34        1
       30        1
Name: YearsAtCompany, dtype: int64
```

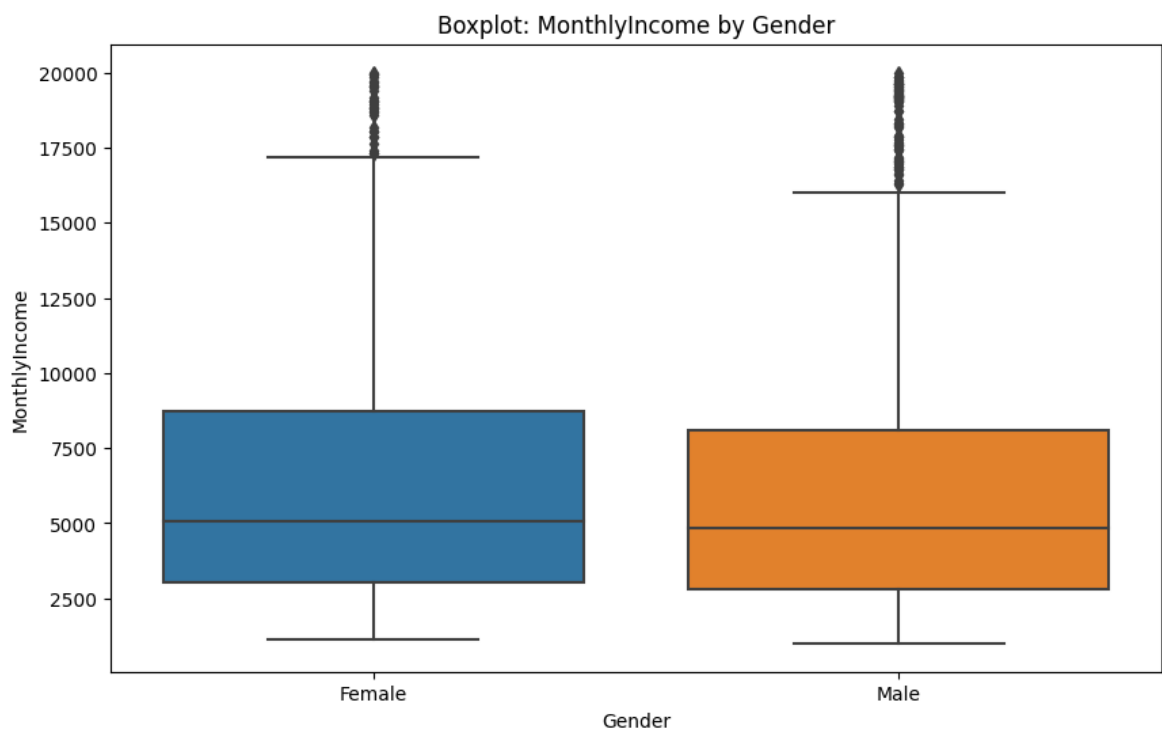
```
In [ ]: ax = sns.barplot(
        x=x.index, y=x.values,
        errorbar=None,
    )
    plt.xticks(rotation=90)

    ax.plot(5, 203, "*", markersize=10, color="r")
    plt.show()
```



Gender vs Monthly Income

```
In [ ]: plt.figure(figsize=(10, 6))
sns.boxplot(x='Gender', y='MonthlyIncome', data=df)
plt.title('Boxplot: MonthlyIncome by Gender')
plt.show()
```



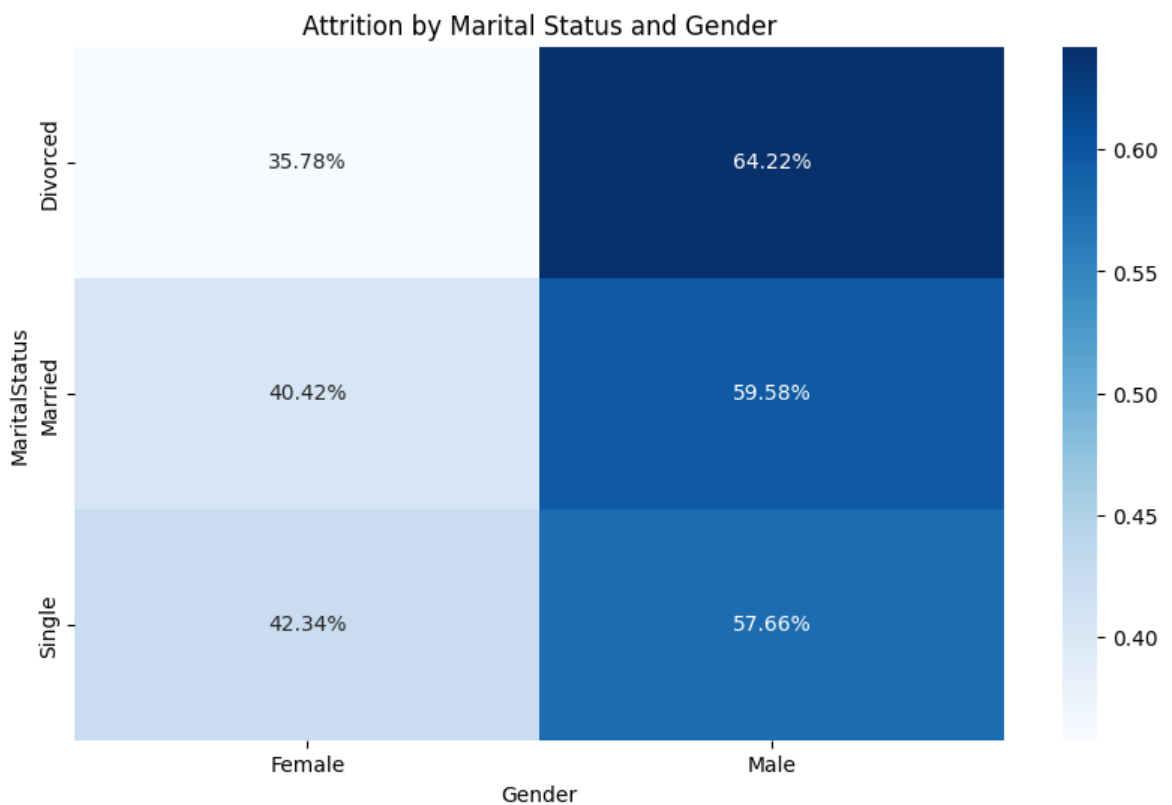
```
In [ ]: df.pivot_table(index='MaritalStatus', columns='JobInvolvement', values='EmployeeNu
```

```
Out[ ]: JobInvolvement    1    2    3    4
```

MaritalStatus				
Divorced	22	71	200	34
Married	33	175	391	74
Single	28	129	277	36

Attrition by Marital Status and Gender

```
In [ ]: cross_tab = pd.crosstab(df['MaritalStatus'], df['Gender'], values=df['Attrition']
plt.figure(figsize=(10, 6))
sns.heatmap(cross_tab, annot=True, cmap='Blues', fmt=".2%", cbar=True)
plt.title('Attrition by Marital Status and Gender')
plt.show()
```



Relationship satisfaction vs. Job satisfaction

```
In [ ]: df.pivot_table(index='RelationshipSatisfaction', columns='JobSatisfaction', valu
```

Out[]: **JobSatisfaction** **1** **2** **3** **4**

RelationshipSatisfaction

	1	54	53	85	84
	2	57	57	94	95
	3	91	81	133	154
	4	87	89	130	126

Is there a correlation between performance rating and percent salary hike?

```
In [ ]: df['PerformanceRating'].corr(df['PercentSalaryHike'])
```

Out[]: 0.773549996401268

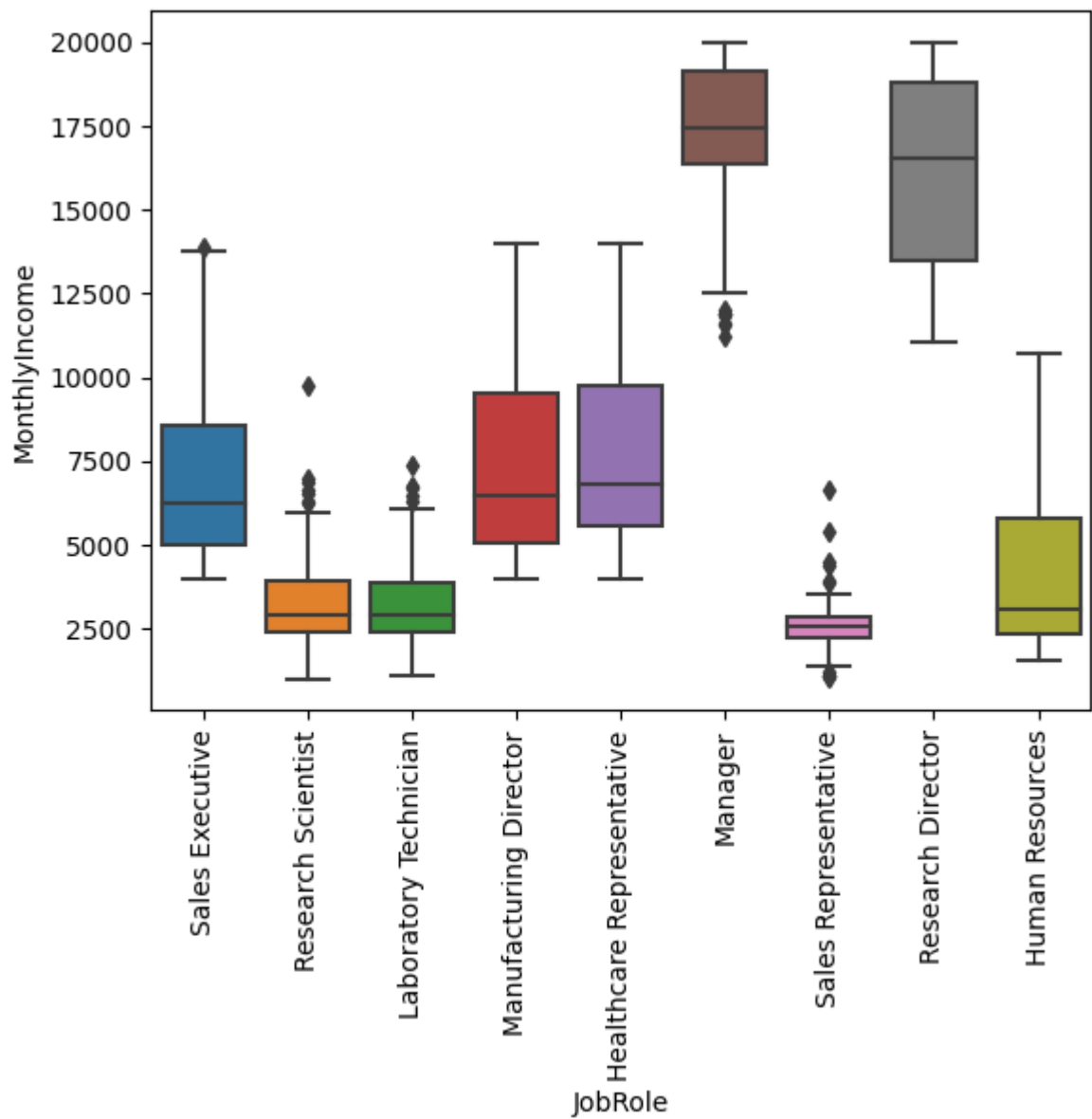
How many employees have never received a promotion?

```
In [ ]: df[df['YearsSinceLastPromotion']==0]['EmployeeNumber'].count()
```

Out[]: 581

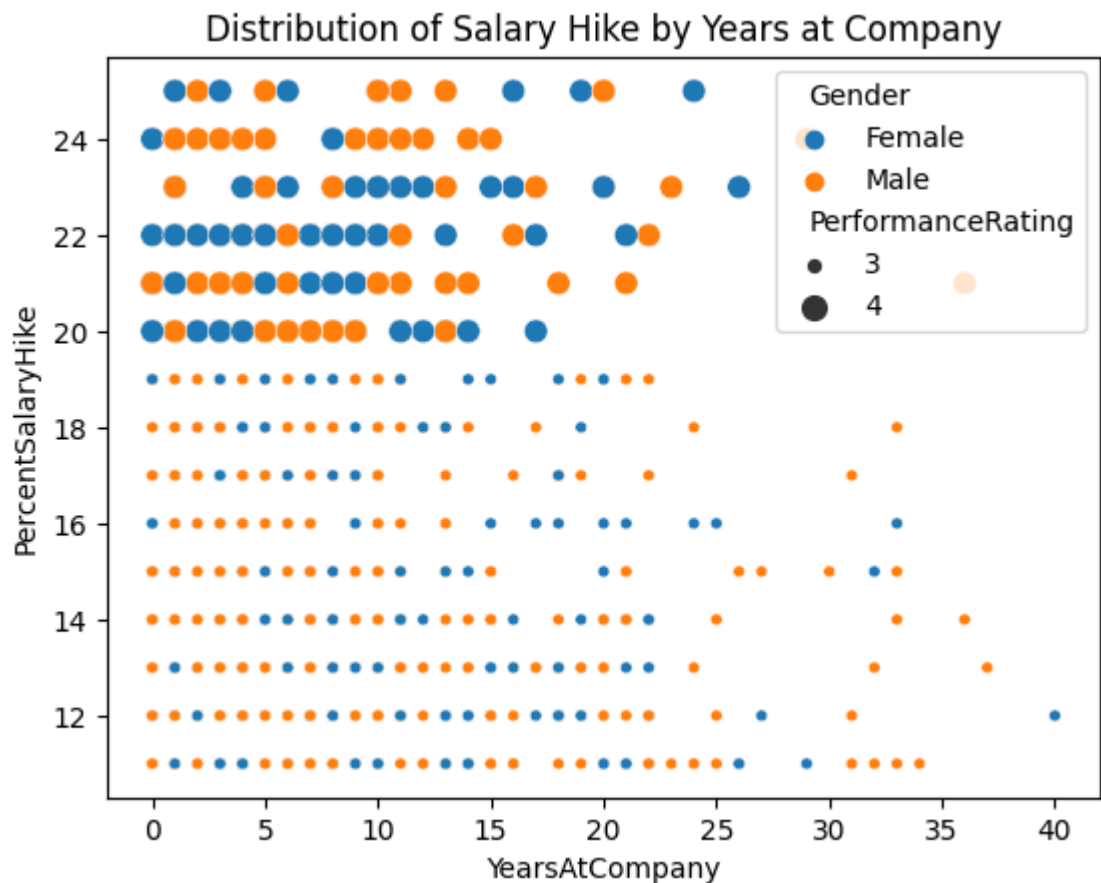
Distribution of Monthly income amongst various job roles

```
In [ ]: sns.boxplot(data=df, x='JobRole', y='MonthlyIncome')
plt.xticks(rotation=90)
plt.show()
```



Salary hike by Performance Rating and Years spent at company

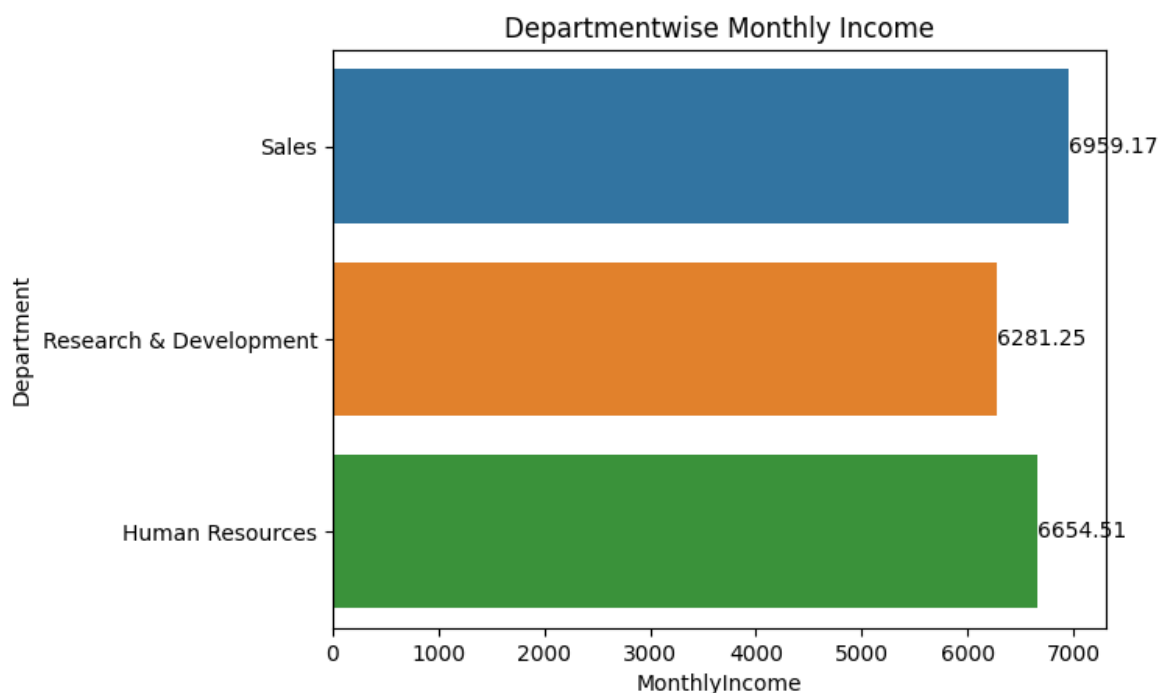
```
In [ ]: sns.scatterplot(data=df, x='YearsAtCompany', y='PercentSalaryHike', hue='Gender')
plt.title('Distribution of Salary Hike by Years at Company')
plt.show()
```

Departmentwise Monthly Income

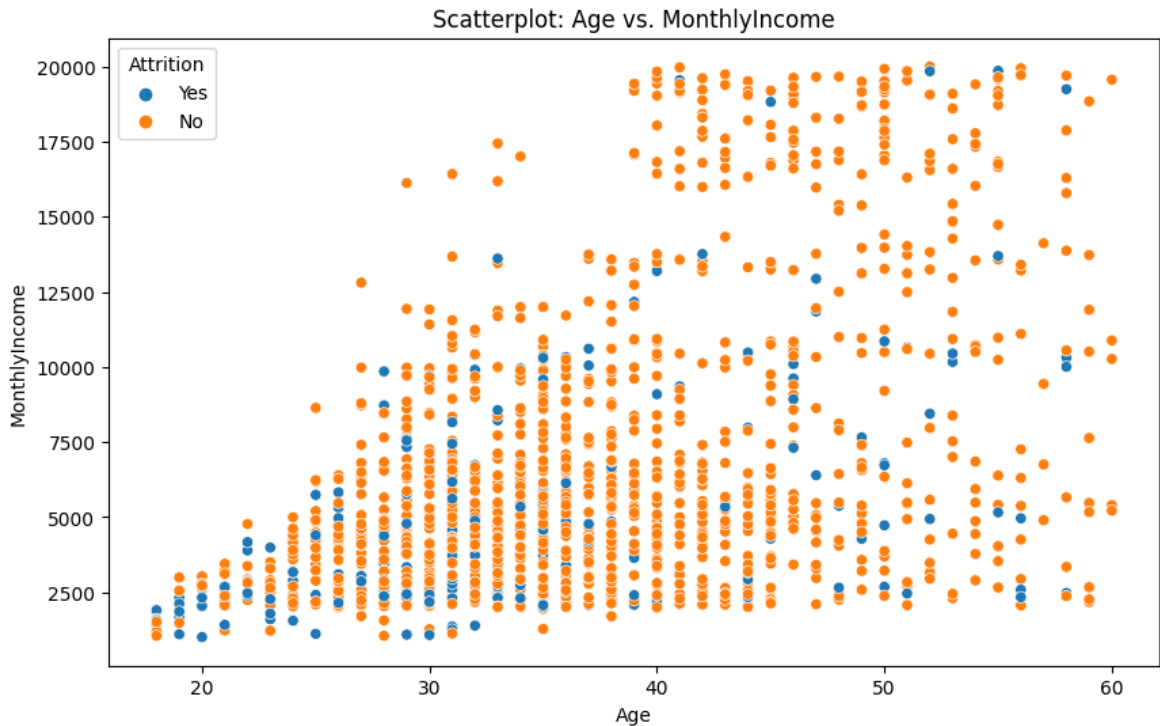
```
In [ ]: p=sns.barplot(data=df, y='Department', x='MonthlyIncome',errorbar=None)
p.bar_label(p.containers[0], fontsize=10)
plt.title('Departmentwise Monthly Income')
```

```
Out[ ]: Text(0.5, 1.0, 'Departmentwise Monthly Income')
```



Age vs. Monthly Income

```
In [ ]: plt.figure(figsize=(10, 6))
sns.scatterplot(x='Age', y='MonthlyIncome', data=df, hue='Attrition')
plt.title('Scatterplot: Age vs. MonthlyIncome')
plt.show()
```



Correlation Matrix

```
In [ ]: correlation_matrix = df.corr(numeric_only=True)
plt.figure(figsize=(20, 8))
sns.heatmap(correlation_matrix, annot=True, cmap='coolwarm')
plt.title('Correlation Matrix')
plt.show()
```

