assignent-4

September 28, 2023

[1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

[2]:
```
df=pd.read_csv("../../archive/WA_Fn-UseC_-HR-Employee-Attrition.csv")
df.head()
```

[2]:

	Age	Attrition	BusinessTravel	DailyRate	Department	DistanceFromHome	Education	EducationField	EmployeeCount	EmployeeNumber	…	RelationshipSatisfaction	StandardHours	StockOptionLevel	TotalWorkingYears	TrainingTimesLastYear	WorkLifeBalance	YearsAtCompany	YearsInCurrentRole	YearsSinceLastPromotion	YearsWithCurrManager
0	41	Yes	Travel_Rarely	1102	Sales	1	2	Life Sciences	1	1	…	1	80	0	8	0	1	6			
1	49	No	Travel_Frequently	279	Research & Development	8	1	Life Sciences	1	2	…	4	80	1	10	3	3	10			
2	37	Yes	Travel_Rarely	1373	Research & Development	2	2	Other	1	4	…	2	80	0	7	3	3	0			
3	33	No	Travel_Frequently	1392	Research & Development	3	4	Life Sciences	1	5	…	3	80	0	8	3	3	8			
4	27	No	Travel_Rarely	591	Research & Development	2	1	Medical	1	7	…	4	80	1	6	3	3	2			

```
0                   4                   0                   5
1                   7                   1                   7
2                   0                   0                   0
3                   7                   3                   0
4                   2                   2                   2

[5 rows x 35 columns]
```

[3]:
```
df.Attrition.value_counts()
```

[3]:
```
Attrition
No     1233
Yes     237
Name: count, dtype: int64
```

[4]:
```
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   object
 2   BusinessTravel            1470 non-null   object
 3   DailyRate                 1470 non-null   int64
 4   Department                1470 non-null   object
 5   DistanceFromHome          1470 non-null   int64
 6   Education                 1470 non-null   int64
 7   EducationField            1470 non-null   object
 8   EmployeeCount             1470 non-null   int64
 9   EmployeeNumber            1470 non-null   int64
 10  EnvironmentSatisfaction   1470 non-null   int64
 11  Gender                    1470 non-null   object
 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: int64(26), object(9)
memory usage: 402.1+ KB
```

[5]:
```
df.isnull().sum()
```

[5]:
```
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
```

[6]:
```
df.describe()
```

[6]:

	Age	DailyRate	DistanceFromHome	Education	EmployeeCount	\
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	

	EmployeeNumber	EnvironmentSatisfaction	HourlyRate	JobInvolvement	\
count	1470.000000	1470.000000	1470.000000	1470.000000	
mean	1024.865306	2.721769	65.891156	2.729932	
std	602.024335	1.093082	20.329428	0.711561	
min	1.000000	1.000000	30.000000	1.000000	
25%	491.250000	2.000000	48.000000	2.000000	
50%	1020.500000	3.000000	66.000000	3.000000	
75%	1555.750000	4.000000	83.750000	3.000000	
max	2068.000000	4.000000	100.000000	4.000000	

	JobLevel	…	RelationshipSatisfaction	StandardHours	\
count	1470.000000	…	1470.000000	1470.0	
mean	2.063946	…	2.712245	80.0	
std	1.106940	…	1.081209	0.0	
min	1.000000	…	1.000000	80.0	
25%	1.000000	…	2.000000	80.0	
50%	2.000000	…	3.000000	80.0	
75%	3.000000	…	4.000000	80.0	
max	5.000000	…	4.000000	80.0	

	StockOptionLevel	TotalWorkingYears	TrainingTimesLastYear	\
count	1470.000000	1470.000000	1470.000000	
mean	0.793878	11.279592	2.799320	
std	0.852077	7.780782	1.289271	
min	0.000000	0.000000	0.000000	
25%	0.000000	6.000000	2.000000	
50%	1.000000	10.000000	3.000000	
75%	1.000000	15.000000	3.000000	
max	3.000000	40.000000	6.000000	

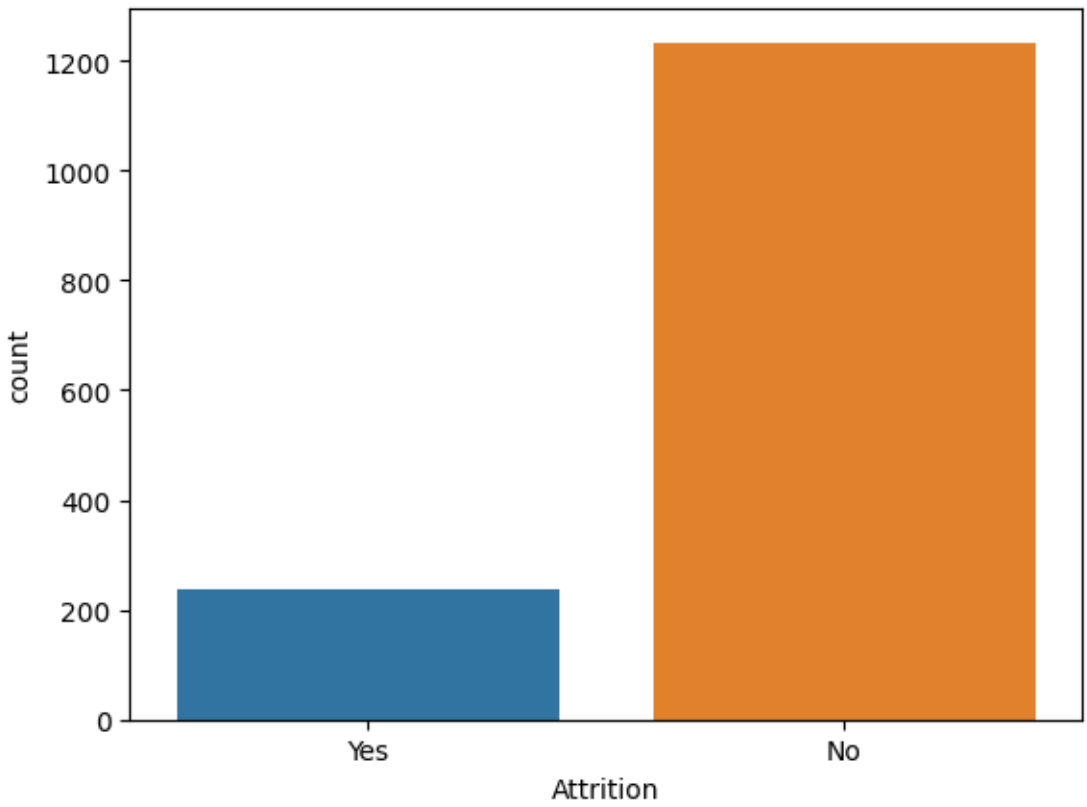
```
       WorkLifeBalance  YearsAtCompany  YearsInCurrentRole  \
count      1470.000000     1470.000000         1470.000000
mean          2.761224        7.008163            4.229252
std           0.706476        6.126525            3.623137
min           1.000000        0.000000            0.000000
25%           2.000000        3.000000            2.000000
50%           3.000000        5.000000            3.000000
75%           3.000000        9.000000            7.000000
max           4.000000       40.000000           18.000000

       YearsSinceLastPromotion  YearsWithCurrManager
count              1470.000000           1470.000000
mean                  2.187755              4.123129
std                   3.222430              3.568136
min                   0.000000              0.000000
25%                   0.000000              2.000000
50%                   1.000000              3.000000
75%                   3.000000              7.000000
max                  15.000000             17.000000

[8 rows x 26 columns]
```

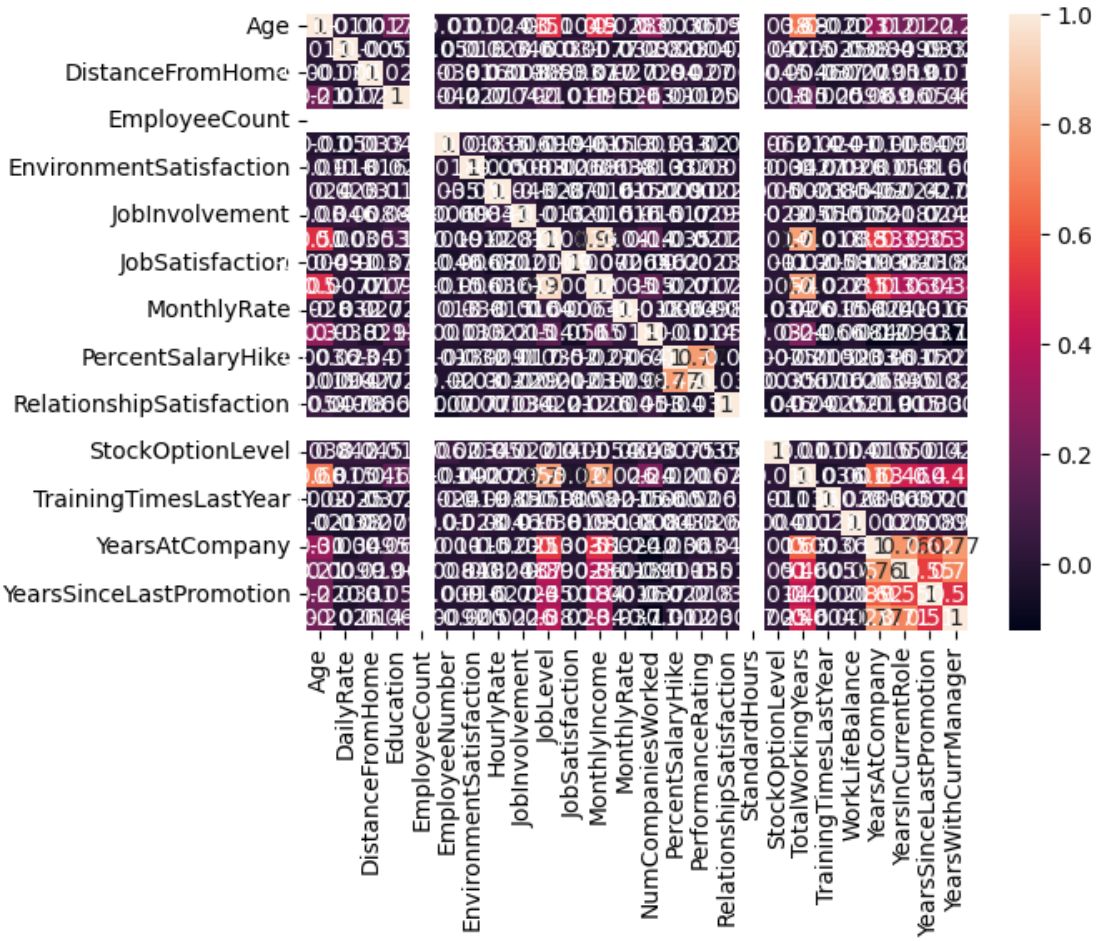
[9]:
```
sns.countplot(data=df,x="Attrition")
```

[9]:
```
<Axes: xlabel='Attrition', ylabel='count'>
```



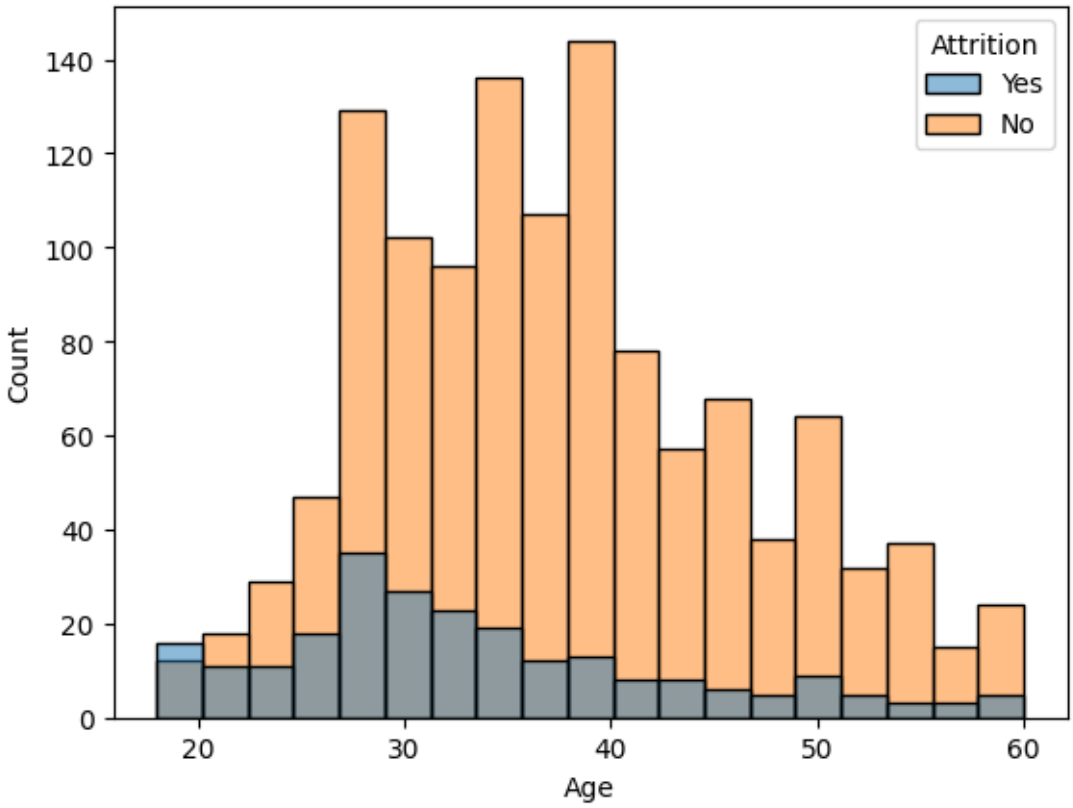
[15]:
```
corr=df.corr(numeric_only=True)
sns.heatmap(data=corr,annot=True)
```

[15]: <Axes: >



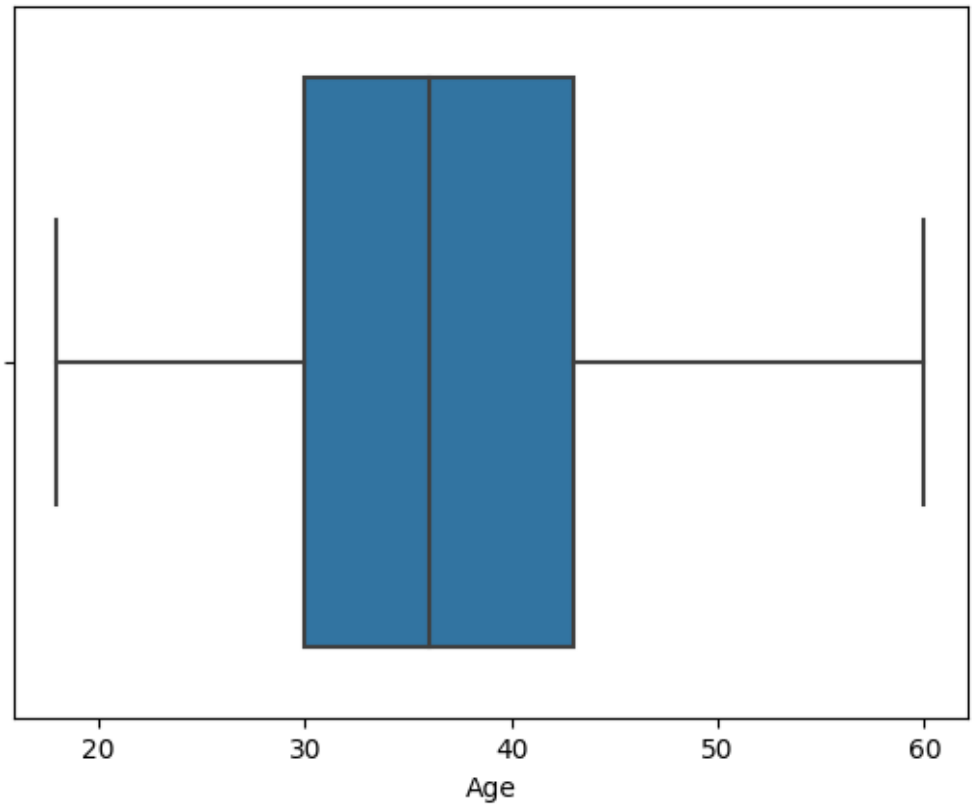
[16]:
```
sns.histplot(data=df, x='Age', hue='Attrition')
```

[16]: <Axes: xlabel='Age', ylabel='Count'>



[17]:
```
sns.boxplot(x='Age', data=df)
```

[17]:
```
<Axes: xlabel='Age'>
```



[18]:
```
y = df['Attrition']
X = df.drop('Attrition', axis=1)
```

[19]:
```
X_encoded = pd.get_dummies(X, drop_first=True)
```

[20]:
```
X_encoded
```

[20]:

	Age	DailyRate	DistanceFromHome	Education	EmployeeCount	\
0	41	1102	1	2	1	
1	49	279	8	1	1	
2	37	1373	2	2	1	
3	33	1392	3	4	1	
4	27	591	2	1	1	
…	…	…	…	…	…	
1465	36	884	23	2	1	
1466	39	613	6	1	1	
1467	27	155	4	3	1	
1468	49	1023	2	3	1	
1469	34	628	8	3	1	

EmployeeNumber	EnvironmentSatisfaction	HourlyRate	JobInvolvement	\

```
0                1                        2          94              3
1                2                        3          61              2
2                4                        4          92              2
3                5                        4          56              3
4                7                        1          40              3
…              …                        …        …             …
1465          2061                        3          41              4
1466          2062                        4          42              2
1467          2064                        2          87              4
1468          2065                        4          63              2
1469          2068                        2          82              4

      JobLevel  …  JobRole_Laboratory Technician  JobRole_Manager  \
0            2  …                          False           False
1            2  …                          False           False
2            1  …                           True           False
3            1  …                          False           False
4            1  …                           True           False
…          …  …                          …              …
1465         2  …                           True           False
1466         3  …                          False           False
1467         2  …                          False           False
1468         2  …                          False           False
1469         2  …                           True           False

      JobRole_Manufacturing Director  JobRole_Research Director  \
0                              False                      False
1                              False                      False
2                              False                      False
3                              False                      False
4                              False                      False
…                              …                        …
1465                           False                      False
1466                           False                      False
1467                            True                      False
1468                           False                      False
1469                           False                      False

      JobRole_Research Scientist  JobRole_Sales Executive  \
0                          False                     True
1                           True                    False
2                          False                    False
3                           True                    False
4                          False                    False
…                          …                      …
1465                       False                    False
1466                       False                    False
```

```
1467                        False                      False
1468                        False                       True
1469                        False                      False

      JobRole_Sales Representative  MaritalStatus_Married  \
0                            False                  False
1                            False                   True
2                            False                  False
3                            False                   True
4                            False                   True
…                              …                      …
1465                         False                   True
1466                         False                   True
1467                         False                   True
1468                         False                   True
1469                         False                   True

      MaritalStatus_Single  OverTime_Yes
0                     True          True
1                    False         False
2                     True          True
3                    False          True
4                    False         False
…                        …             …
1465                 False         False
1466                 False         False
1467                 False          True
1468                 False         False
1469                 False         False

[1470 rows x 47 columns]
```

[21]:
```
from sklearn.preprocessing import MinMaxScaler

# Initialize the scaler
scaler = MinMaxScaler()

# Fit and transform the scaled features
X_scaled = scaler.fit_transform(X_encoded)

# Convert the scaled features back to a DataFrame (optional)
X_scaled_df = pd.DataFrame(X_scaled, columns=X_encoded.columns)
```

[22]:
```
X_scaled_df
```

[22]:
```
           Age  DailyRate  DistanceFromHome  Education  EmployeeCount  \
0     0.547619   0.715820          0.000000       0.25            0.0
```

```
1     0.738095   0.126700          0.250000       0.00            0.0
2     0.452381   0.909807          0.035714       0.25            0.0
3     0.357143   0.923407          0.071429       0.75            0.0
4     0.214286   0.350036          0.035714       0.00            0.0
…        …         …                 …              …             …
1465  0.428571   0.559771          0.785714       0.25            0.0
1466  0.500000   0.365784          0.178571       0.00            0.0
1467  0.214286   0.037938          0.107143       0.50            0.0
1468  0.738095   0.659270          0.035714       0.50            0.0
1469  0.380952   0.376521          0.250000       0.50            0.0

      EmployeeNumber  EnvironmentSatisfaction  HourlyRate  JobInvolvement  \
0           0.000000                 0.333333    0.914286        0.666667
1           0.000484                 0.666667    0.442857        0.333333
2           0.001451                 1.000000    0.885714        0.333333
3           0.001935                 1.000000    0.371429        0.666667
4           0.002903                 0.000000    0.142857        0.666667
…              …                       …          …              …
1465        0.996613                 0.666667    0.157143        1.000000
1466        0.997097                 1.000000    0.171429        0.333333
1467        0.998065                 0.333333    0.814286        1.000000
1468        0.998549                 1.000000    0.471429        0.333333
1469        1.000000                 0.333333    0.742857        1.000000

      JobLevel  …  JobRole_Laboratory Technician  JobRole_Manager  \
0         0.25  …                            0.0              0.0
1         0.25  …                            0.0              0.0
2         0.00  …                            1.0              0.0
3         0.00  …                            0.0              0.0
4         0.00  …                            1.0              0.0
…         …  …                              …              …
1465      0.25  …                            1.0              0.0
1466      0.50  …                            0.0              0.0
1467      0.25  …                            0.0              0.0
1468      0.25  …                            0.0              0.0
1469      0.25  …                            1.0              0.0

      JobRole_Manufacturing Director  JobRole_Research Director  \
0                                0.0                        0.0
1                                0.0                        0.0
2                                0.0                        0.0
3                                0.0                        0.0
4                                0.0                        0.0
…                                …                          …
1465                             0.0                        0.0
1466                             0.0                        0.0
1467                             1.0                        0.0
```

```
1468                            0.0                          0.0
1469                            0.0                          0.0

      JobRole_Research Scientist  JobRole_Sales Executive  \
0                            0.0                      1.0
1                            1.0                      0.0
2                            0.0                      0.0
3                            1.0                      0.0
4                            0.0                      0.0
…                            …                        …
1465                         0.0                      0.0
1466                         0.0                      0.0
1467                         0.0                      0.0
1468                         0.0                      1.0
1469                         0.0                      0.0

      JobRole_Sales Representative  MaritalStatus_Married  \
0                              0.0                    0.0
1                              0.0                    1.0
2                              0.0                    0.0
3                              0.0                    1.0
4                              0.0                    1.0
…                              …                      …
1465                           0.0                    1.0
1466                           0.0                    1.0
1467                           0.0                    1.0
1468                           0.0                    1.0
1469                           0.0                    1.0

      MaritalStatus_Single  OverTime_Yes
0                      1.0           1.0
1                      0.0           0.0
2                      1.0           1.0
3                      0.0           1.0
4                      0.0           0.0
…                      …             …
1465                   0.0           0.0
1466                   0.0           0.0
1467                   0.0           1.0
1468                   0.0           0.0
1469                   0.0           0.0

[1470 rows x 47 columns]
```

[23]:
```
from sklearn.model_selection import train_test_split

# Split the data into training and testing sets (e.g., 80% train, 20% test)
```

```
X_train, X_test, y_train, y_test = train_test_split(X_scaled, y, test_size=0.2,␣
↪random_state=42)
```

[24]:
```
from sklearn.linear_model import LogisticRegression
from sklearn.tree import DecisionTreeClassifier
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import accuracy_score, classification_report
import joblib
```

[25]:
```
logistic_model = LogisticRegression(random_state=42)
decision_tree_model = DecisionTreeClassifier(random_state=42)
random_forest_model = RandomForestClassifier(random_state=42)
```

[26]:
```
logistic_model.fit(X_train, y_train)
logistic_predictions = logistic_model.predict(X_test)

# Training and testing the Decision Tree model
decision_tree_model.fit(X_train, y_train)
decision_tree_predictions = decision_tree_model.predict(X_test)

# Training and testing the Random Forest model
random_forest_model.fit(X_train, y_train)
random_forest_predictions = random_forest_model.predict(X_test)
```

[27]:
```
logistic_accuracy = accuracy_score(y_test, logistic_predictions)
logistic_report = classification_report(y_test, logistic_predictions)

print("Logistic Regression Model Accuracy:", logistic_accuracy)
print("Logistic Regression Model Classification Report:")
print(logistic_report)
```

```
Logistic Regression Model Accuracy: 0.891156462585034
Logistic Regression Model Classification Report:
              precision    recall  f1-score   support

          No       0.91      0.97      0.94       255
         Yes       0.67      0.36      0.47        39

    accuracy                           0.89       294
   macro avg       0.79      0.67      0.70       294
weighted avg       0.88      0.89      0.88       294
```

[28]:
```
decision_tree_accuracy = accuracy_score(y_test, decision_tree_predictions)
decision_tree_report = classification_report(y_test, decision_tree_predictions)

print("Decision Tree Model Accuracy:", decision_tree_accuracy)
```

```
print("Decision Tree Model Classification Report:")
print(decision_tree_report)
```

```
Decision Tree Model Accuracy: 0.7721088435374149
Decision Tree Model Classification Report:
              precision    recall  f1-score   support

          No       0.87      0.86      0.87       255
         Yes       0.17      0.18      0.17        39

    accuracy                           0.77       294
   macro avg       0.52      0.52      0.52       294
weighted avg       0.78      0.77      0.78       294
```

[29]:
```
random_forest_accuracy = accuracy_score(y_test, random_forest_predictions)
random_forest_report = classification_report(y_test, random_forest_predictions)

print("Random Forest Model Accuracy:", random_forest_accuracy)
print("Random Forest Model Classification Report:")
print(random_forest_report)
```

```
Random Forest Model Accuracy: 0.8775510204081632
Random Forest Model Classification Report:
              precision    recall  f1-score   support

          No       0.88      1.00      0.93       255
         Yes       0.80      0.10      0.18        39

    accuracy                           0.88       294
   macro avg       0.84      0.55      0.56       294
weighted avg       0.87      0.88      0.83       294
```