Name: Satyam Mishra Reg : 21BCE8247 Assignment 4

1. Perfrom Data Preprocessing2. Model Building using Logistic Regression and Decision Tree
2. Calculate Performance metrics

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

from sklearn.preprocessing import LabelEncoder, OneHotEncoder

df = pd.read_csv("dataset/HR-Employee-Attrition.csv")

df.head()
```

```
   Age Attrition     BusinessTravel  DailyRate              Department
\
0   41       Yes      Travel_Rarely       1102                   Sales

1   49        No  Travel_Frequently        279  Research & Development

2   37       Yes      Travel_Rarely       1373  Research & Development

3   33        No  Travel_Frequently       1392  Research & Development

4   27        No      Travel_Rarely        591  Research & Development


   DistanceFromHome  Education EducationField  EmployeeCount
EmployeeNumber  \
0                 1          2  Life Sciences              1
1
1                 8          1  Life Sciences              1
2
2                 2          2          Other              1
4
3                 3          4  Life Sciences              1
5
4                 2          1        Medical              1
7

   ...  RelationshipSatisfaction StandardHours  StockOptionLevel  \
0  ...                         1            80                 0
1  ...                         4            80                 1
2  ...                         2            80                 0
3  ...                         3            80                 0
4  ...                         4            80                 1

   TotalWorkingYears  TrainingTimesLastYear WorkLifeBalance
```

```
YearsAtCompany  \
0                   8                         0                1
6
1                  10                         3                3
10
2                   7                         3                3
0
3                   8                         3                3
8
4                   6                         3                3
2

  YearsInCurrentRole  YearsSinceLastPromotion  YearsWithCurrManager
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]
```

```
df.shape
```

```
(1470, 35)
```

```
df.Attrition.value_counts()
```

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

```
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

df.describe()

                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]
```

```
df.isnull().any()
```

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

```
sns.countplot(x='Attrition', data=df)
plt.title('Attrition Counts')
plt.xlabel('Attrition')
plt.ylabel('Count')
plt.show()
```

```
E:\Installed softwares\Py 3.10.7\lib\site-packages\seaborn\
_oldcore.py:1498: FutureWarning: is_categorical_dtype is deprecated
and will be removed in a future version. Use isinstance(dtype,
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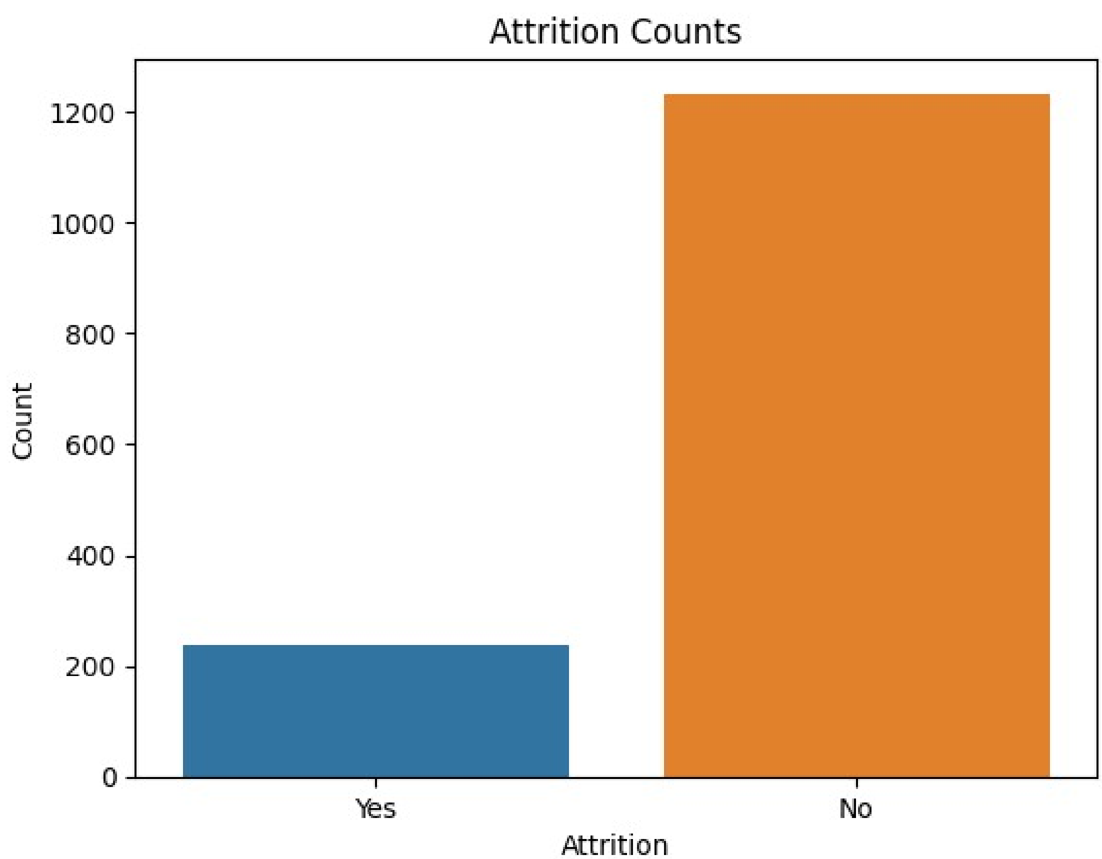

```
sns.histplot(data=df, x='Age', hue='Attrition', kde=True)
plt.title('Distribution of Age by Attrition')
plt.xlabel('Age')
plt.ylabel('Count')
plt.show()
```

```
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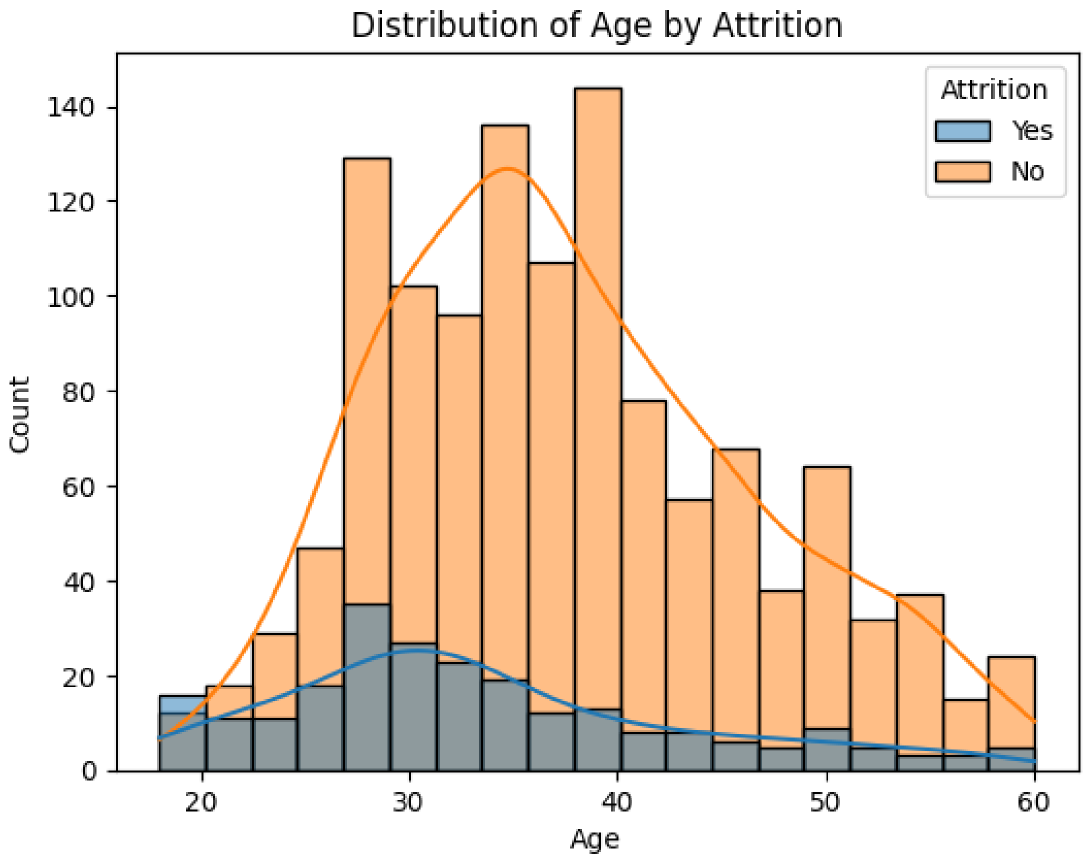


```
sns.countplot(x='JobSatisfaction', hue='Attrition', data=df)
plt.title('Job Satisfaction vs. Attrition')
plt.xlabel('Job Satisfaction')
plt.ylabel('Count')
plt.show()

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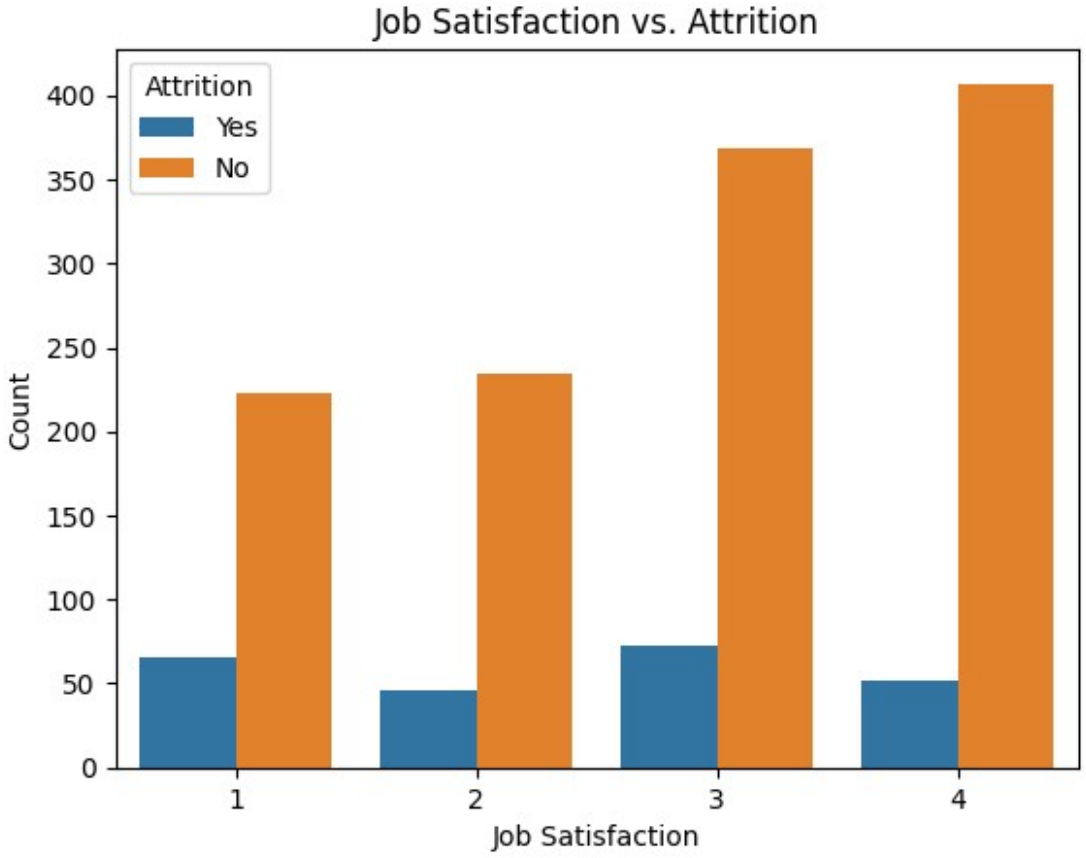


```
sns.histplot(data=df, x='YearsAtCompany', hue='Attrition', kde=True)
plt.title('Distribution of Years at Company by Attrition')
plt.xlabel('Years at Company')
plt.ylabel('Count')
plt.show()

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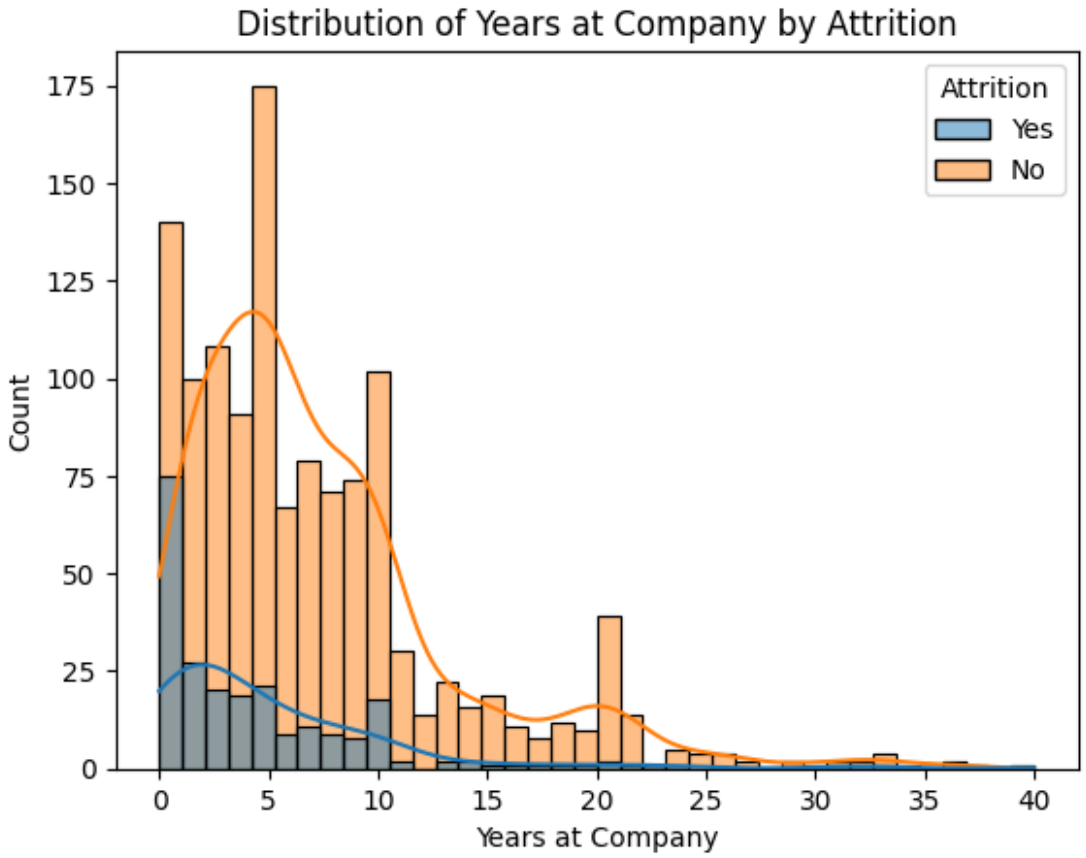
```




```
sns.countplot(x='Department', hue='Attrition', data=df)
plt.title('Attrition by Department')
plt.xlabel('Department')
plt.ylabel('Count')
plt.show()

E:\Installed softwares\Py 3.10.7\lib\site-packages\seaborn\
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```
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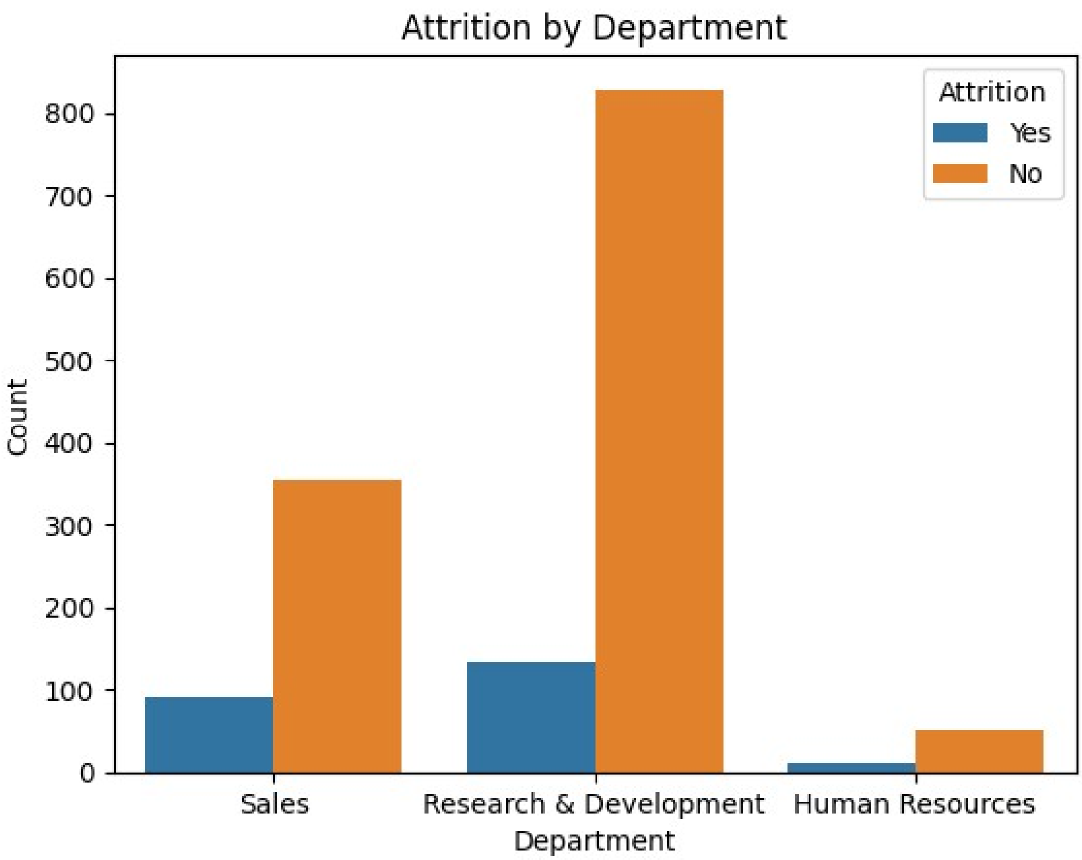


```
sns.countplot(x='Education', hue='Attrition', data=df)
plt.title('Attrition by Education Level')
plt.xlabel('Education Level')
```

```
plt.ylabel('Count')
plt.show()

E:\Installed softwares\Py 3.10.7\lib\site-packages\seaborn\
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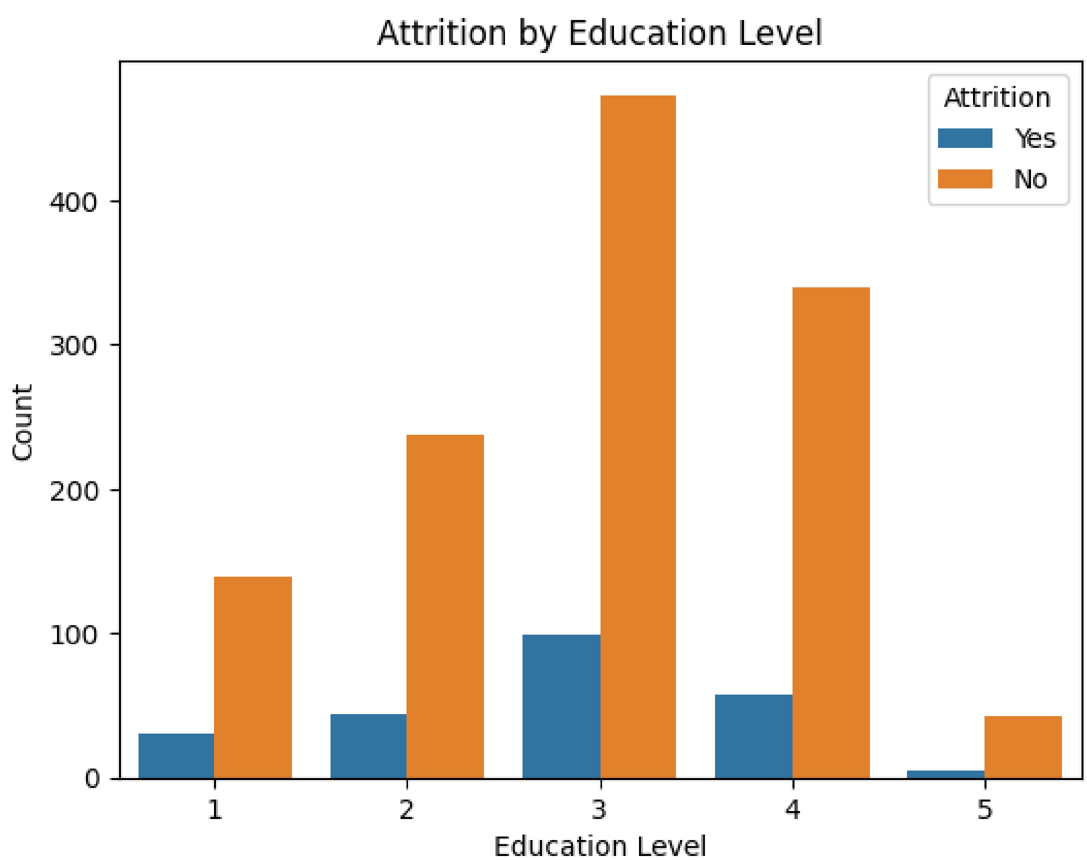

```python
sns.histplot(data=df, x='MonthlyIncome', hue='Attrition', kde=True)
plt.title('Distribution of Monthly Income by Attrition')
plt.xlabel('Monthly Income')
plt.ylabel('Count')
plt.show()
```

```
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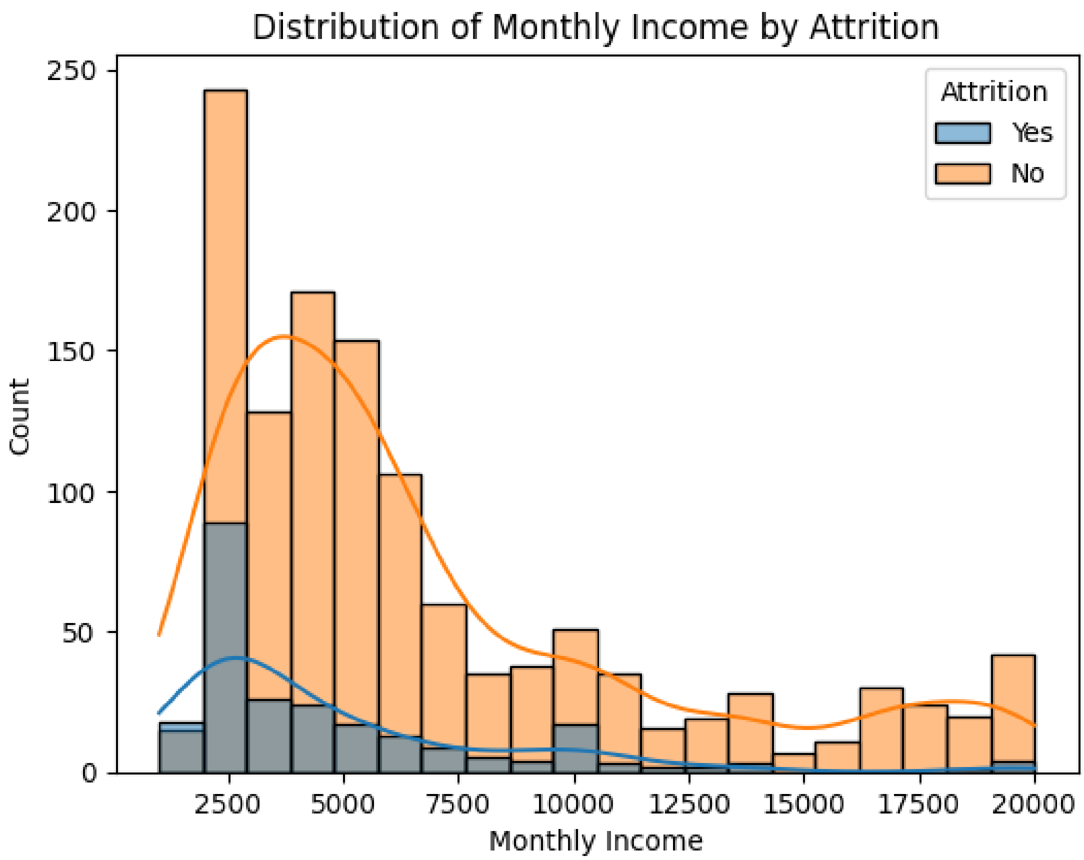


```
sns.countplot(x='WorkLifeBalance', hue='Attrition', data=df)
plt.title('Attrition by Work-Life Balance')
plt.xlabel('Work-Life Balance')
plt.ylabel('Count')
plt.show()

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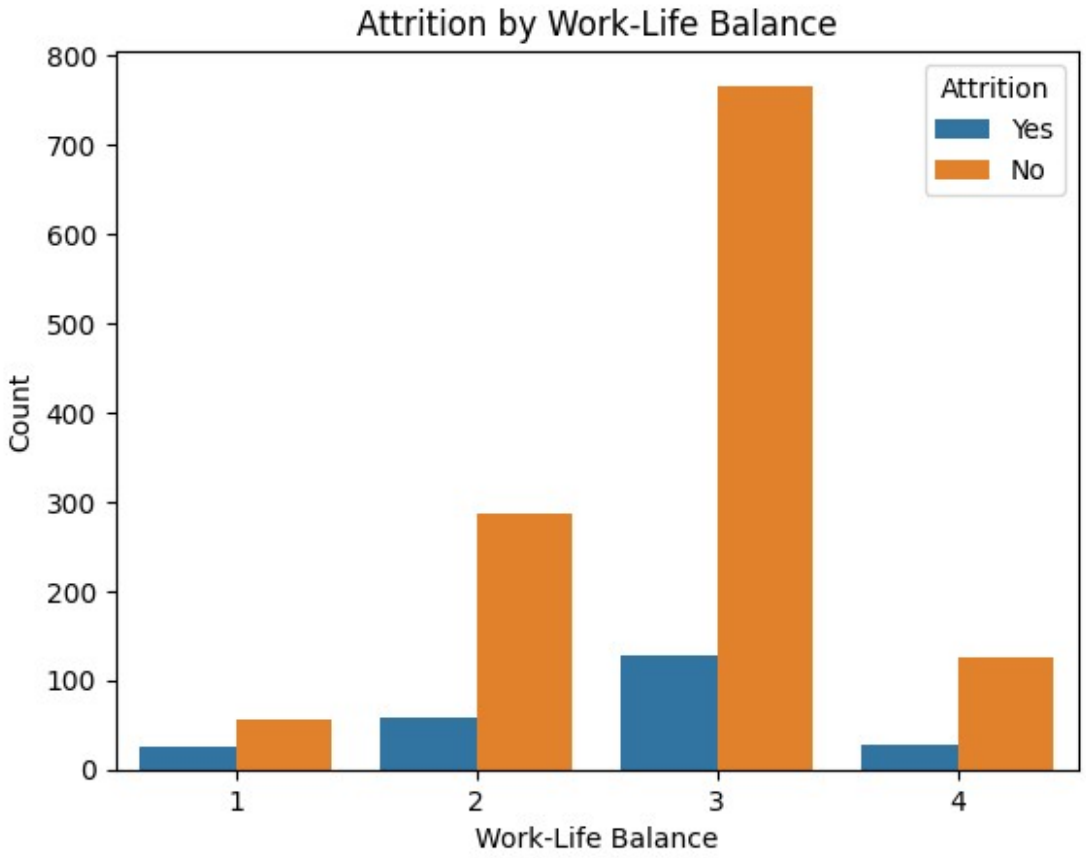
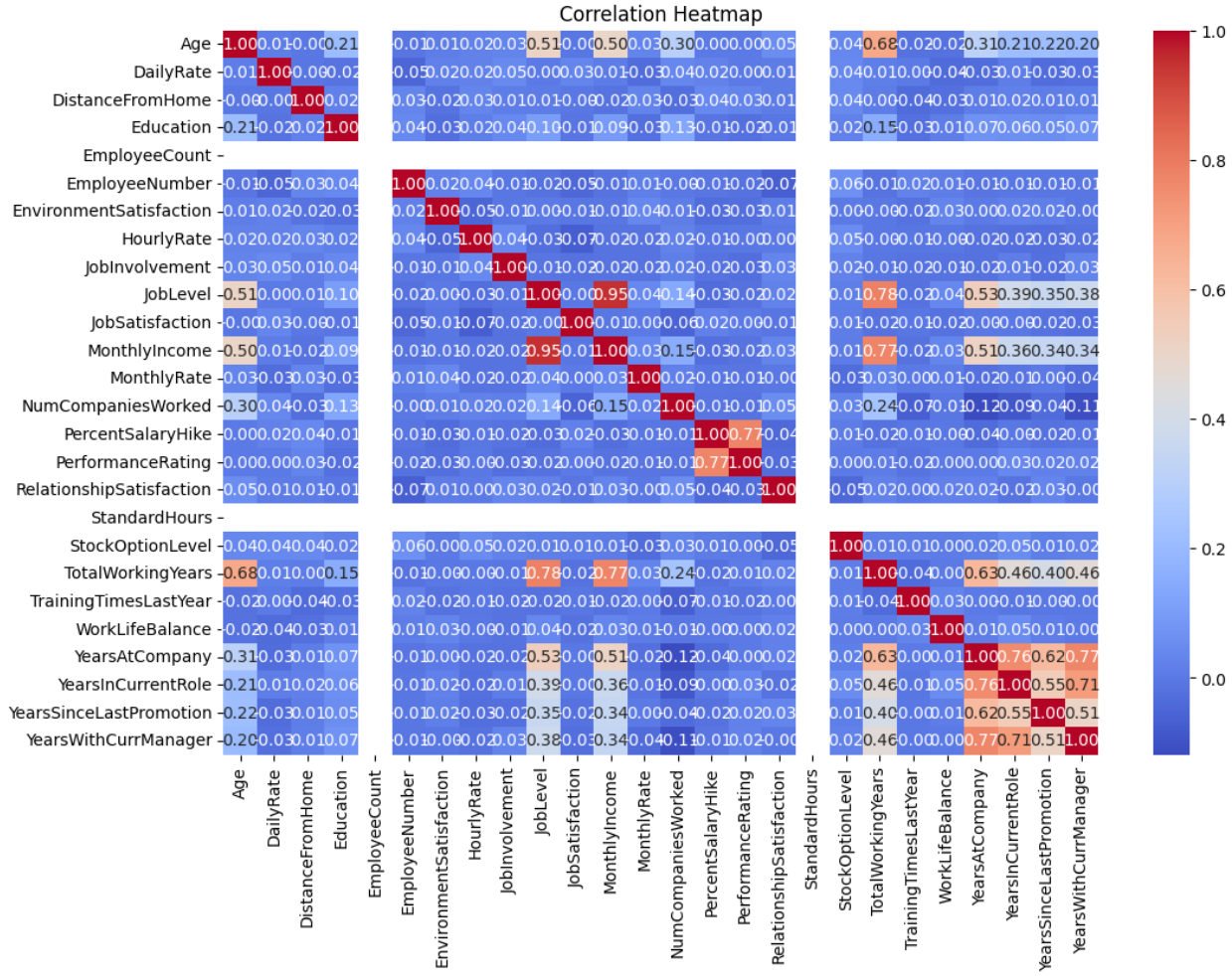



```
correlation_matrix = df.corr(numeric_only=True)
plt.figure(figsize=(12, 8))
sns.heatmap(correlation_matrix, annot=True, cmap='coolwarm',
fmt=".2f")
plt.title('Correlation Heatmap')
plt.show()
```




```
sns.boxplot(x='Age', data=df)
plt.title('Box Plot for Age')
plt.show()
```

```
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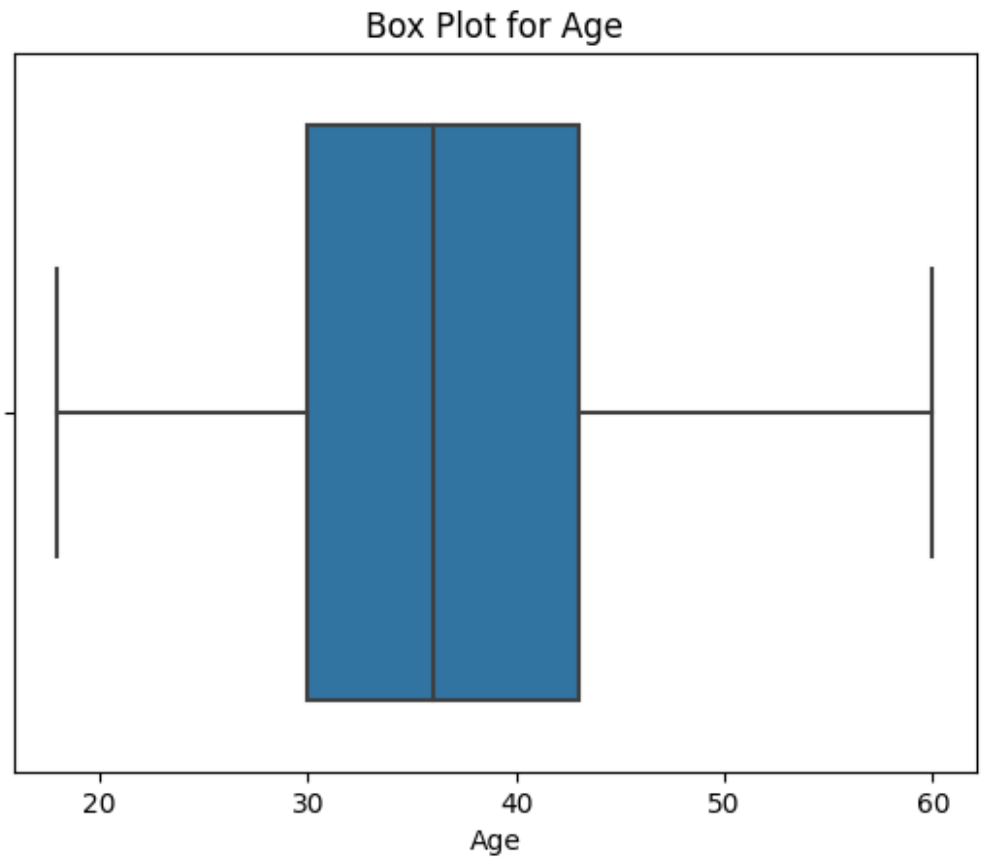


```
sns.boxplot(x='DailyRate', data=df)
plt.title('Box Plot for DailyRate')
plt.show()
```

```
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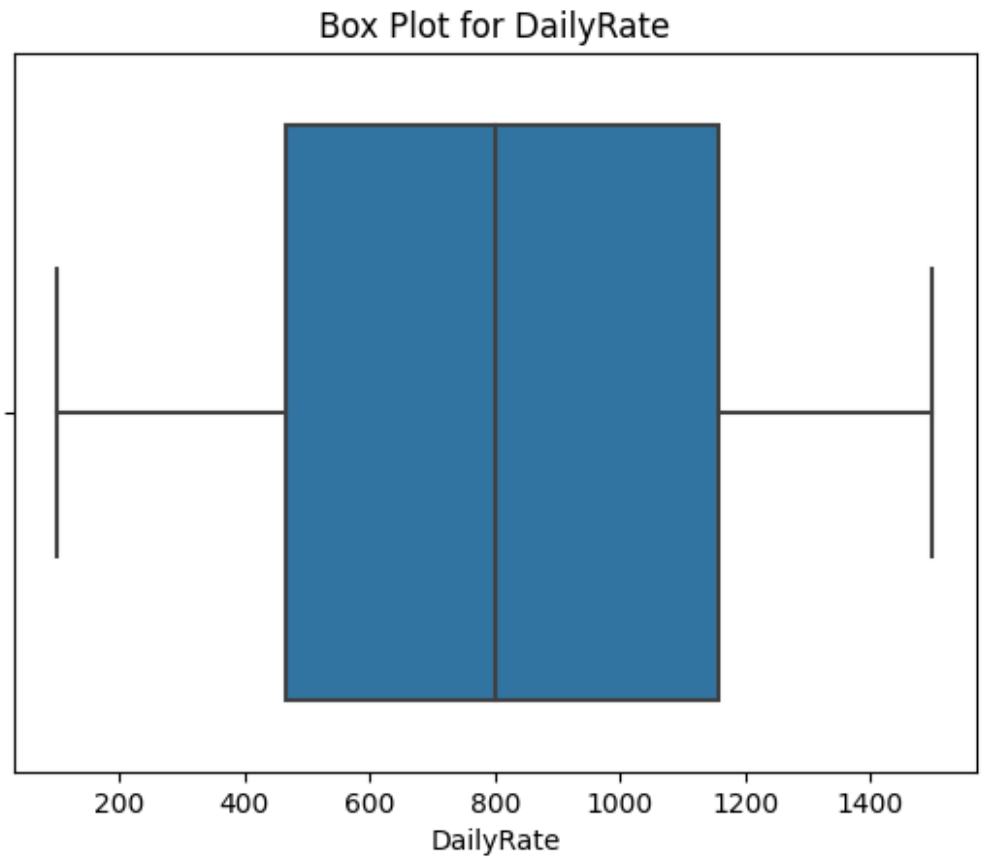
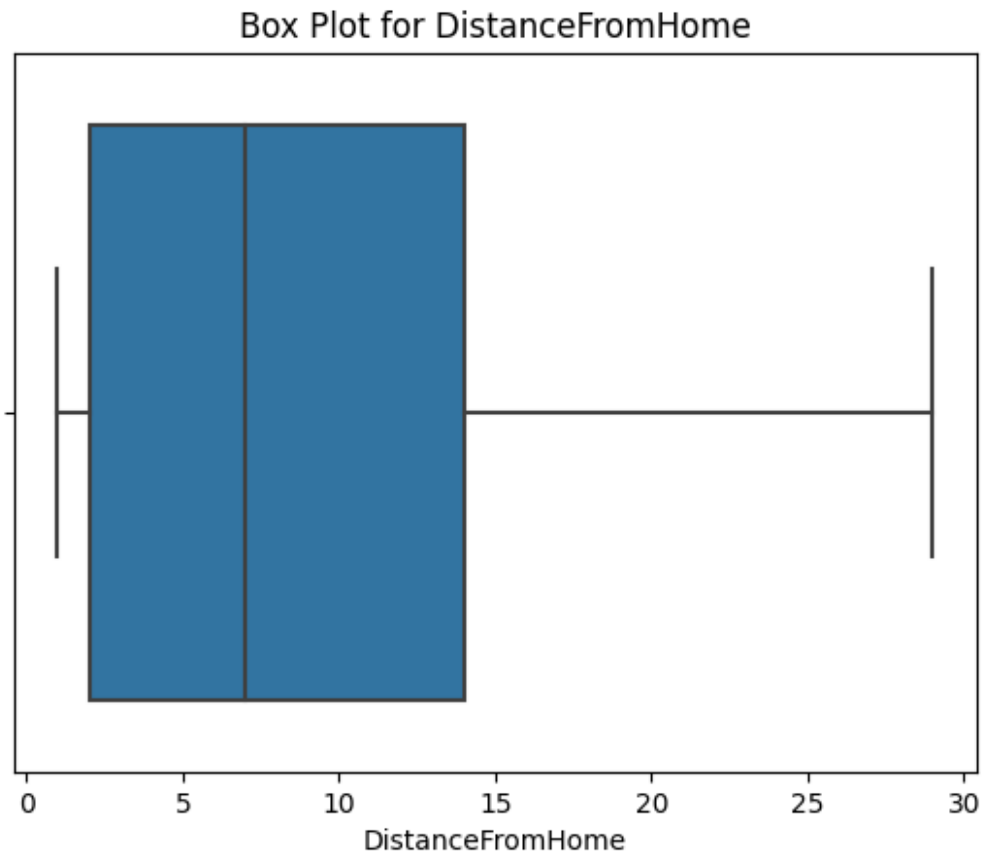
  if pd.api.types.is_categorical_dtype(vector):
```




```
sns.boxplot(x='DistanceFromHome', data=df)
plt.title('Box Plot for DistanceFromHome')
plt.show()
```

```
E:\Installed softwares\Py 3.10.7\lib\site-packages\seaborn\
_oldcore.py:1498: FutureWarning: is_categorical_dtype is deprecated
and will be removed in a future version. Use isinstance(dtype,
CategoricalDtype) instead
  if pd.api.types.is_categorical_dtype(vector):
```




```
# dependent variables
y = df['Attrition']

# independent variables (features)
X = df.drop('Attrition', axis=1)

# one-hot encoding on categorical columns
X_encoded = pd.get_dummies(X, drop_first=True)

X_encoded
```

	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]
```

```
from sklearn.preprocessing import MinMaxScaler

scaler = MinMaxScaler()

X_scaled = scaler.fit_transform(X_encoded)
```

```
# scaled features to DataFrame
X_scaled_df = pd.DataFrame(X_scaled, columns=X_encoded.columns)

X_scaled_df
```

```
           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]
```

```
from sklearn.model_selection import train_test_split

# data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X_scaled, y,
test_size=0.2, random_state=0)

from sklearn.linear_model import LogisticRegression
from sklearn.tree import DecisionTreeClassifier
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import accuracy_score, classification_report


logistic_model = LogisticRegression(random_state=0)
decision_tree_model = DecisionTreeClassifier(random_state=0)

# Logistic Regression model
logistic_model.fit(X_train, y_train)
logistic_predictions = logistic_model.predict(X_test)

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

# Evaluation of Logistic Regression model
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: 0.8843537414965986
Logistic Regression Model Classification Report:
              precision    recall  f1-score   support

          No       0.89      0.98      0.93       245
         Yes       0.80      0.41      0.54        49

    accuracy                           0.88       294
   macro avg       0.85      0.69      0.74       294
weighted avg       0.88      0.88      0.87       294
```

```
# Evaluation of Decision Tree model
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: 0.7891156462585034
Decision Tree Model Classification Report:
              precision    recall  f1-score   support

          No       0.87      0.88      0.87       245
         Yes       0.36      0.33      0.34        49

    accuracy                           0.79       294
   macro avg       0.61      0.60      0.61       294
weighted avg       0.78      0.79      0.79       294
```