HR-Employee-Attrition

July 22, 2025

[101]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import matplotlib.ticker as mtick
from sklearn.linear_model import LogisticRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_absolute_error
```

[85]:
```
df = pd.read_csv("WA_Fn-UseC_-HR-Employee-Attrition.csv")
```

[86]:
```
df.head()
```

[86]:

	Age	Attrition	BusinessTravel	DailyRate	Department	DistanceFromHome	Education	EducationField	EmployeeCount	EmployeeNumber	…	RelationshipSatisfaction	StandardHours	StockOptionLevel	TotalWorkingYears	TrainingTimesLastYear	WorkLifeBalance	YearsAtCompany
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

```
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]
```

[87]:
```
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
```

[88]:
```
df.isnull().sum()
```

[88]:
```
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
```

[89]:
```
df.describe()
```

[89]:

	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

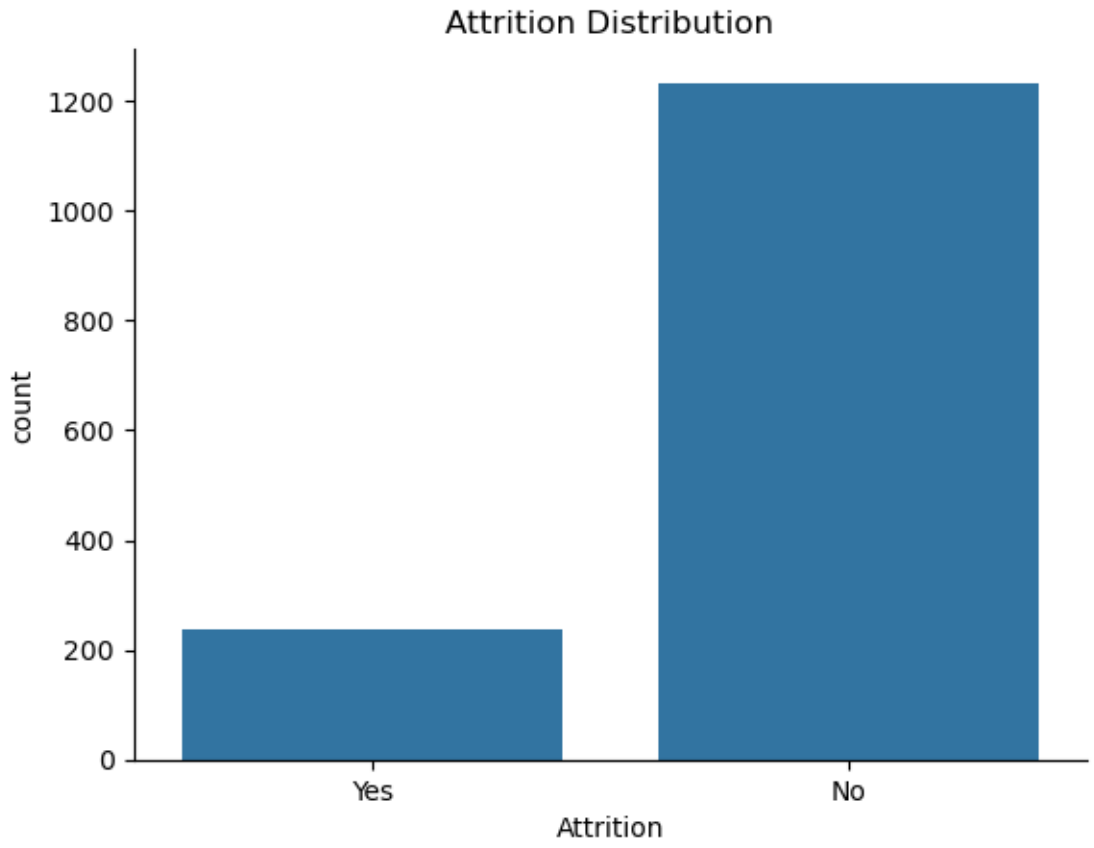
	StockOptionLevel	TotalWorkingYears	TrainingTimesLastYear
count	1470.000000	1470.000000	1470.000000
mean	0.793878	11.279592	2.799320
std	0.852077	7.780782	1.289271
min	0.000000	0.000000	0.000000
25%	0.000000	6.000000	2.000000
50%	1.000000	10.000000	3.000000
75%	1.000000	15.000000	3.000000
max	3.000000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

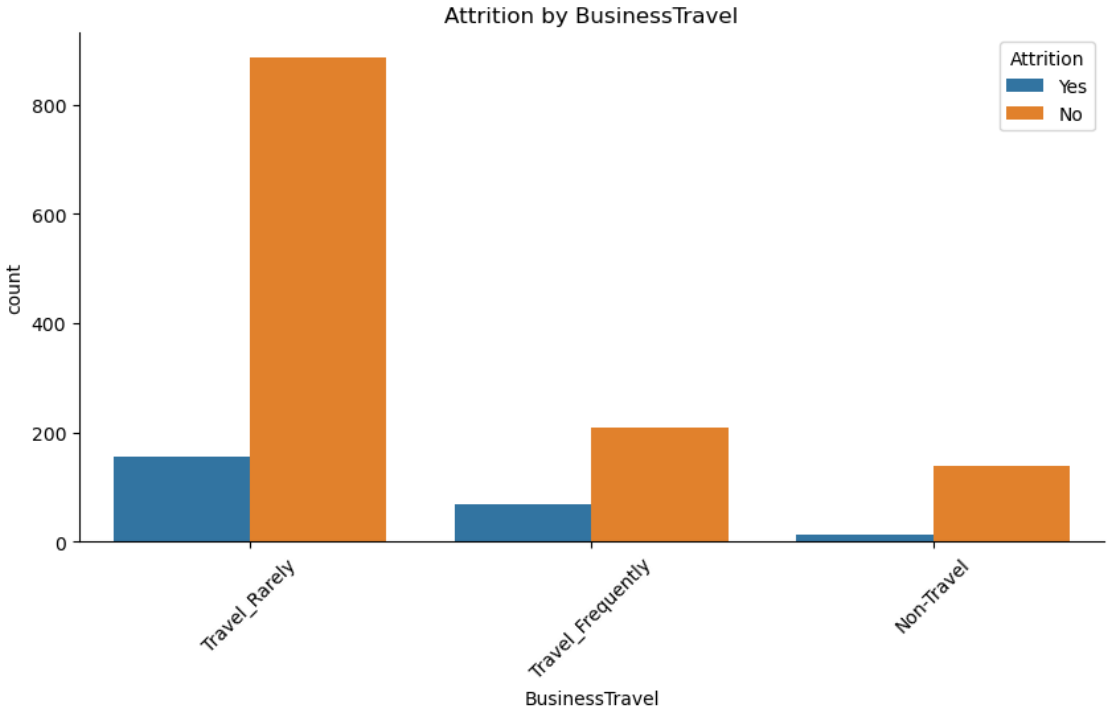
0.0.1 1. Attrition distribution

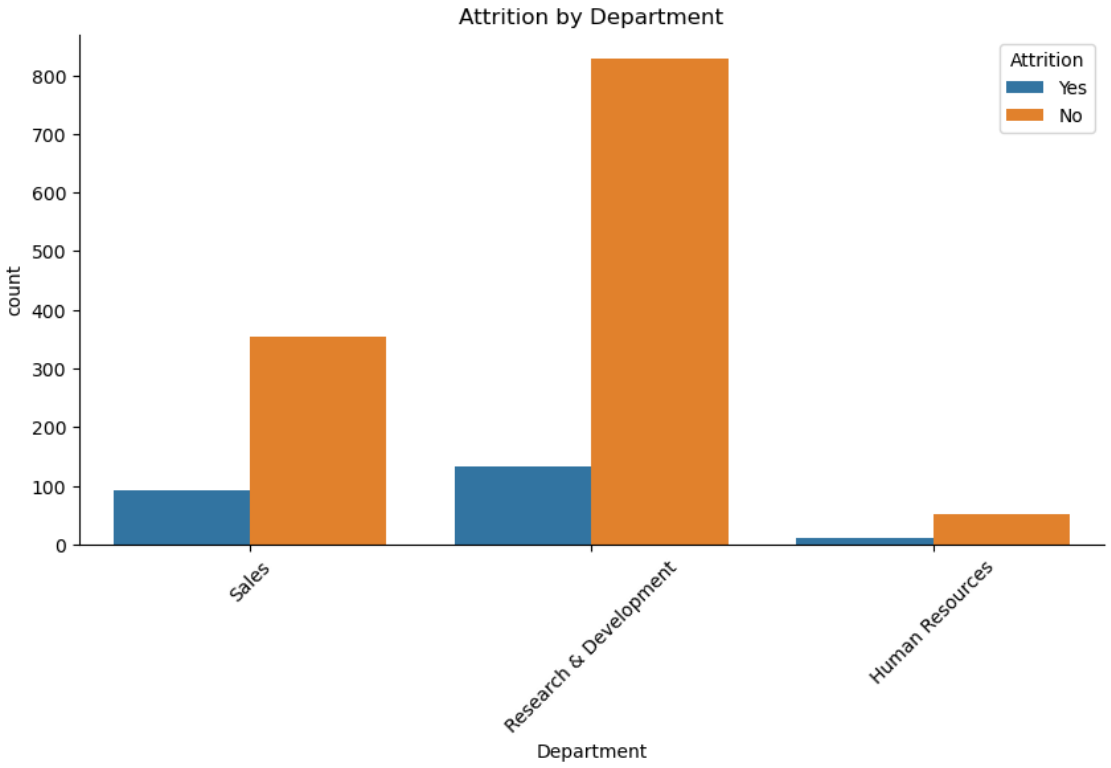
[78]:
```
sns.countplot(data=df, x='Attrition')
plt.title('Attrition Distribution')
sns.despine(top=True, right=True)
plt.show()
```

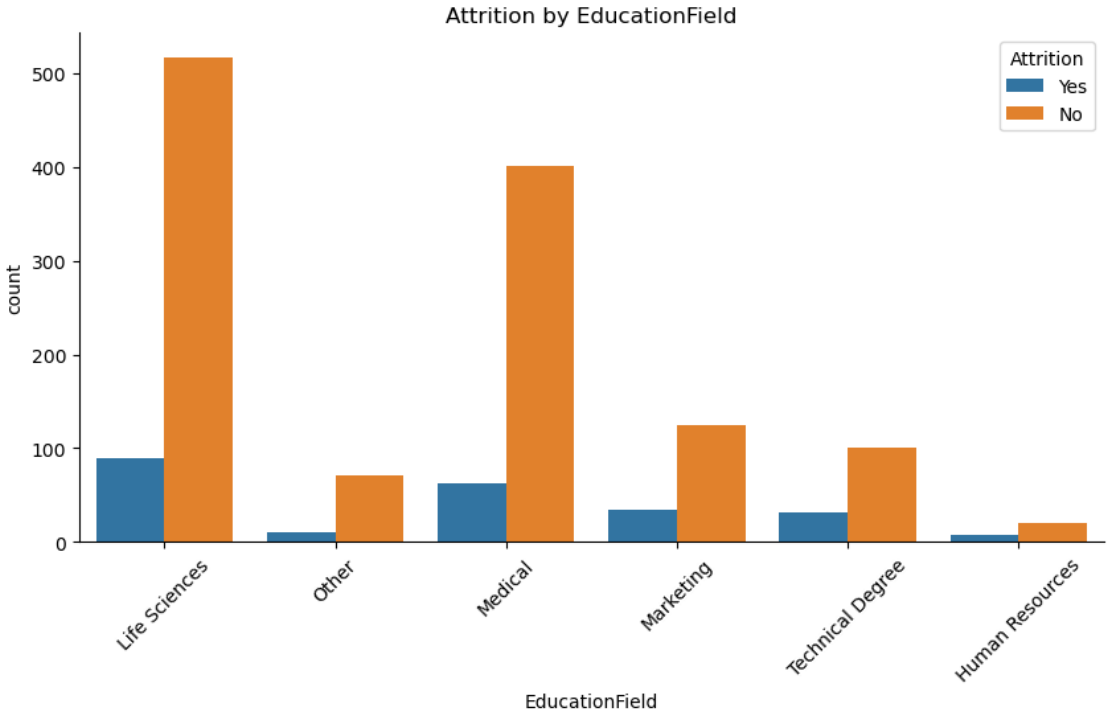


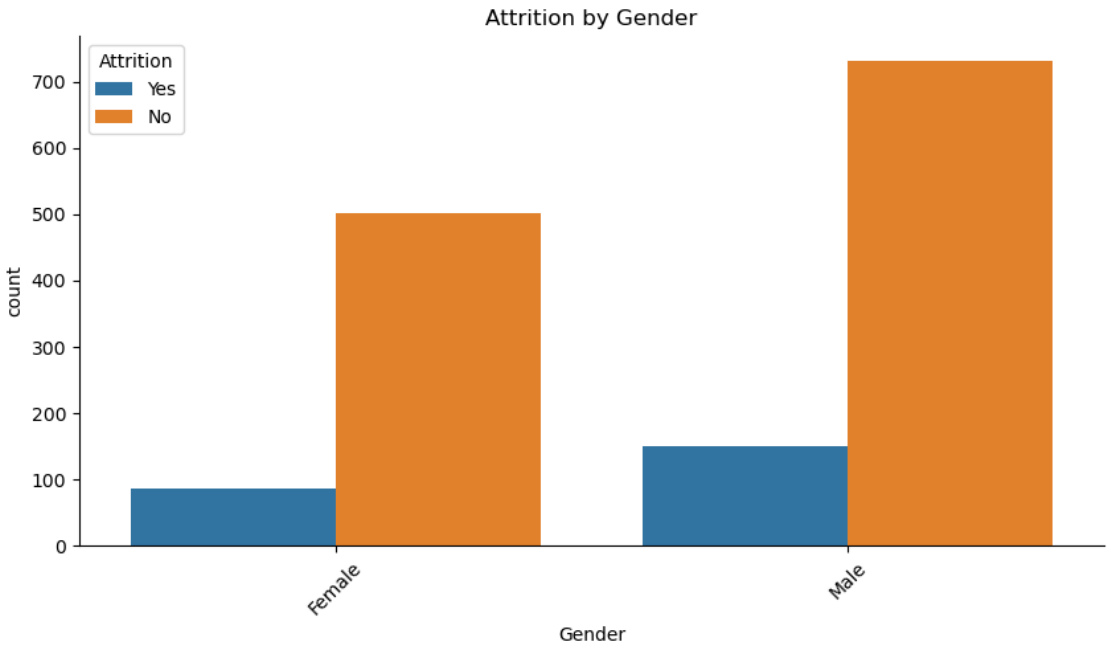
0.0.2 2. Attrition by 'BusinessTravel', 'Department', 'EducationField', 'Gender', 'JobRole', 'MaritalStatus', 'OverTime' (Categorical Value)

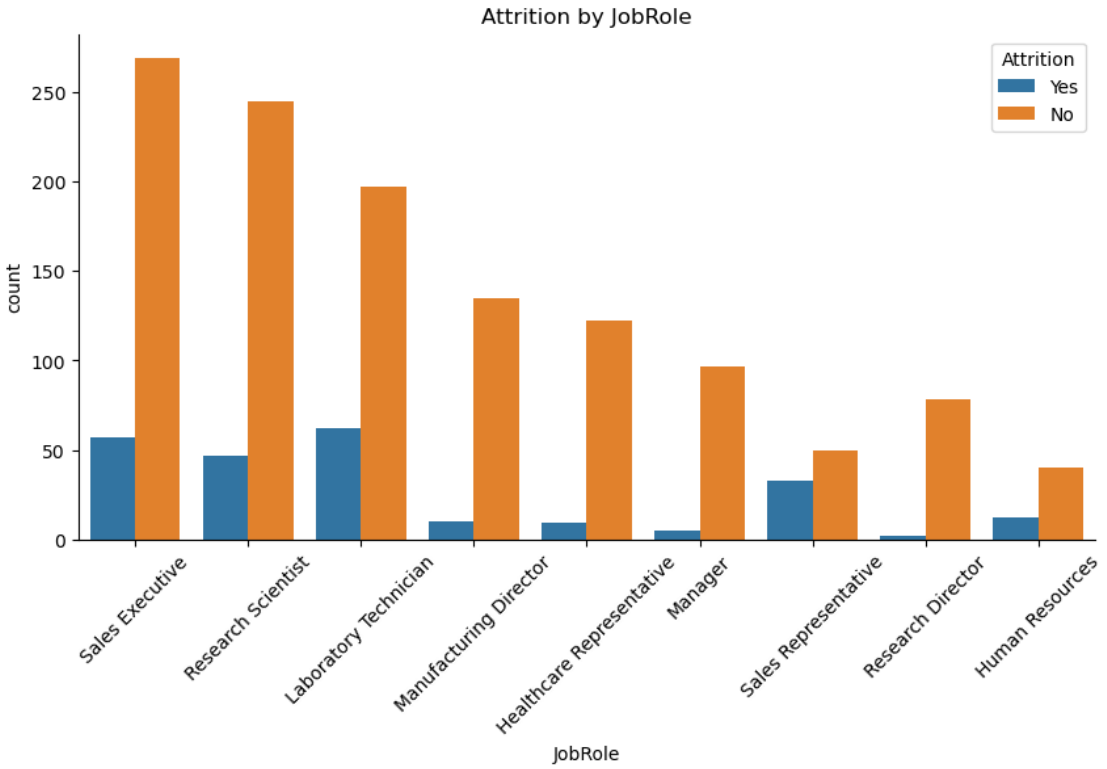
[40]:
```
# Categorical columns
cat_cols = ['BusinessTravel', 'Department', 'EducationField', 'Gender',
            'JobRole', 'MaritalStatus', 'OverTime']

# Plot countplots with attrition breakdown
for col in cat_cols:
    plt.figure(figsize=(10,5))
    sns.countplot(x=col, hue='Attrition', data=df)
    plt.xticks(rotation=45)
    plt.title(f"Attrition by {col}")
    sns.despine(top=True, right=True)
    plt.show()
```

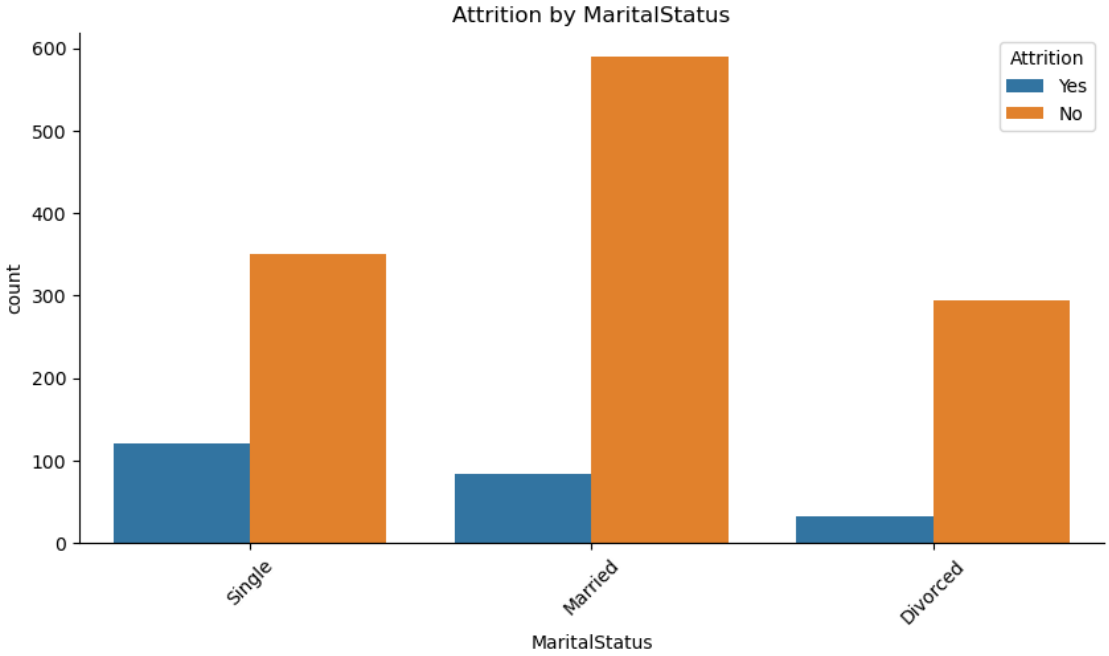

Attrition by BusinessTravel
Attrition
Yes
No
count
0
200
400
600
800
Travel_Rarely
Travel_Frequently
Non-Travel
BusinessTravel

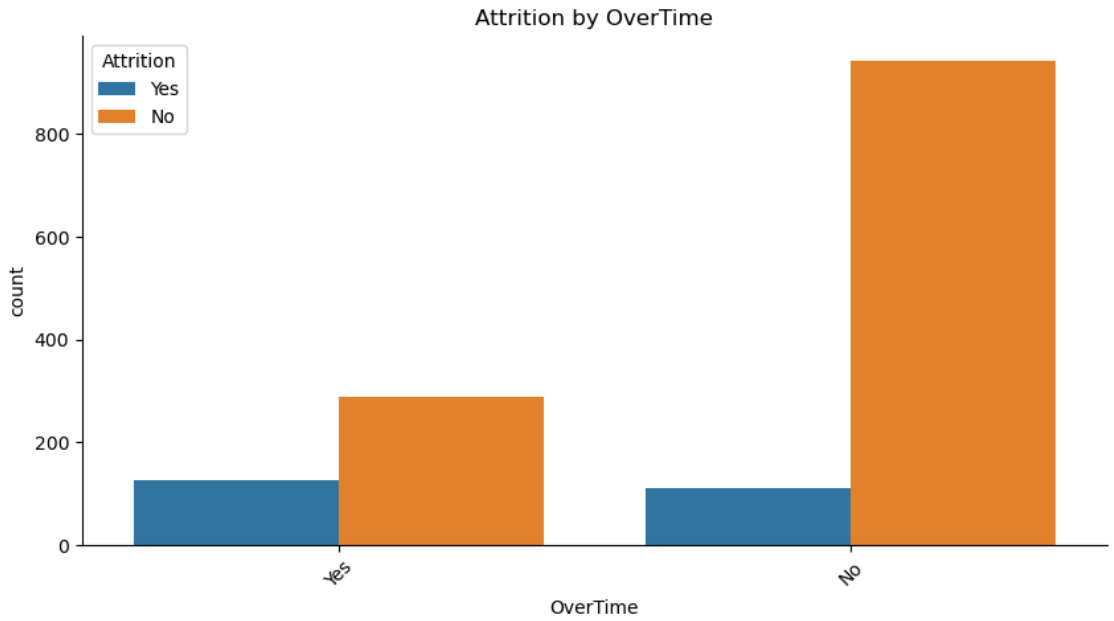

Attrition by Department
Attrition
Yes
No
count
0
100
200
300
400
500
600
700
800
Sales
Research & Development
Human Resources
Department


Attrition by EducationField
Attrition
Yes
No
count
0
100
200
300
400
500
Life Sciences
Other
Medical
Marketing
Technical Degree
Human Resources
EducationField


Attrition by Gender
Attrition
Yes
No
count
0
100
200
300
400
500
600
700
Female
Male
Gender

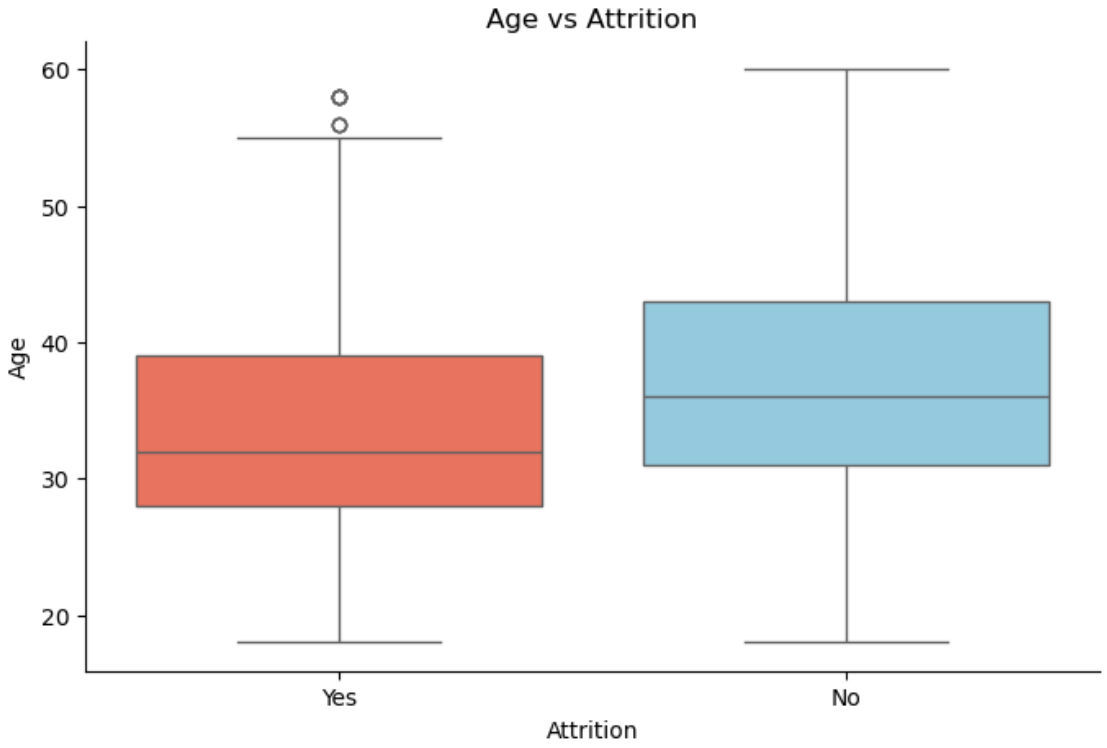

Attrition by JobRole
Attrition
Yes
No
count
0
50
100
150
200
250
Sales Executive
Research Scientist
Laboratory Technician
Manufacturing Director
Healthcare Representative
Manager
Sales Representative
Research Director
Human Resources
JobRole

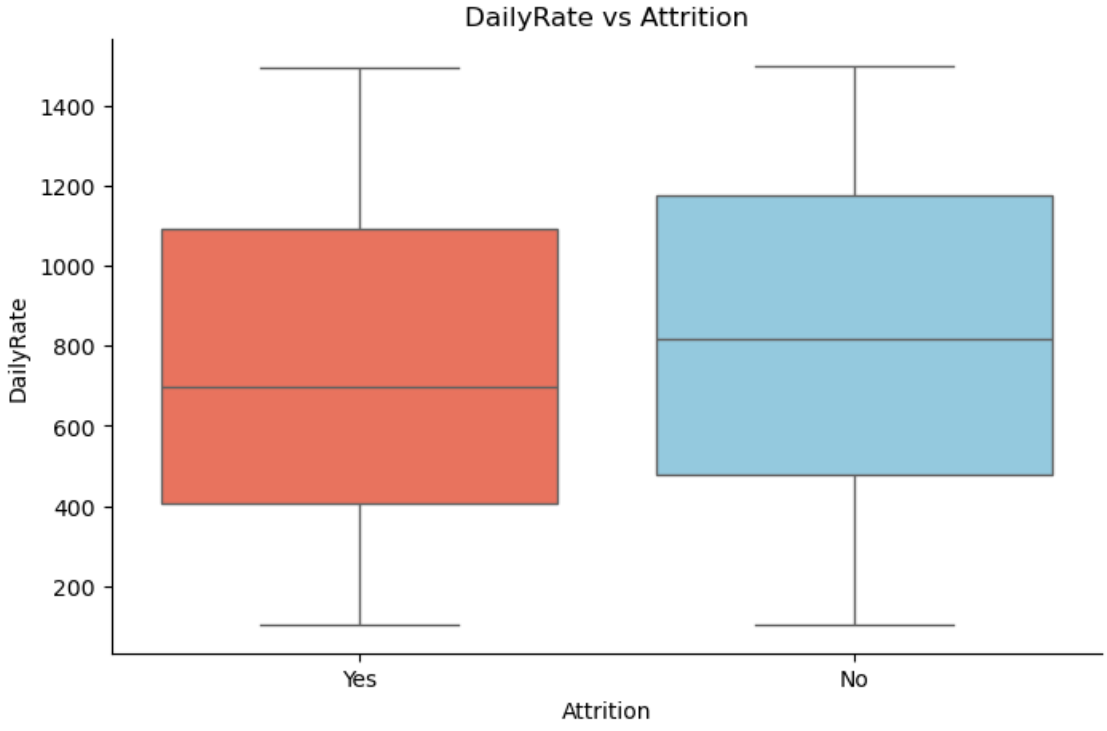

Attrition by MaritalStatus
Attrition
Yes
No
count
0
100
200
300
400
500
600
Single
Married
Divorced
MaritalStatus

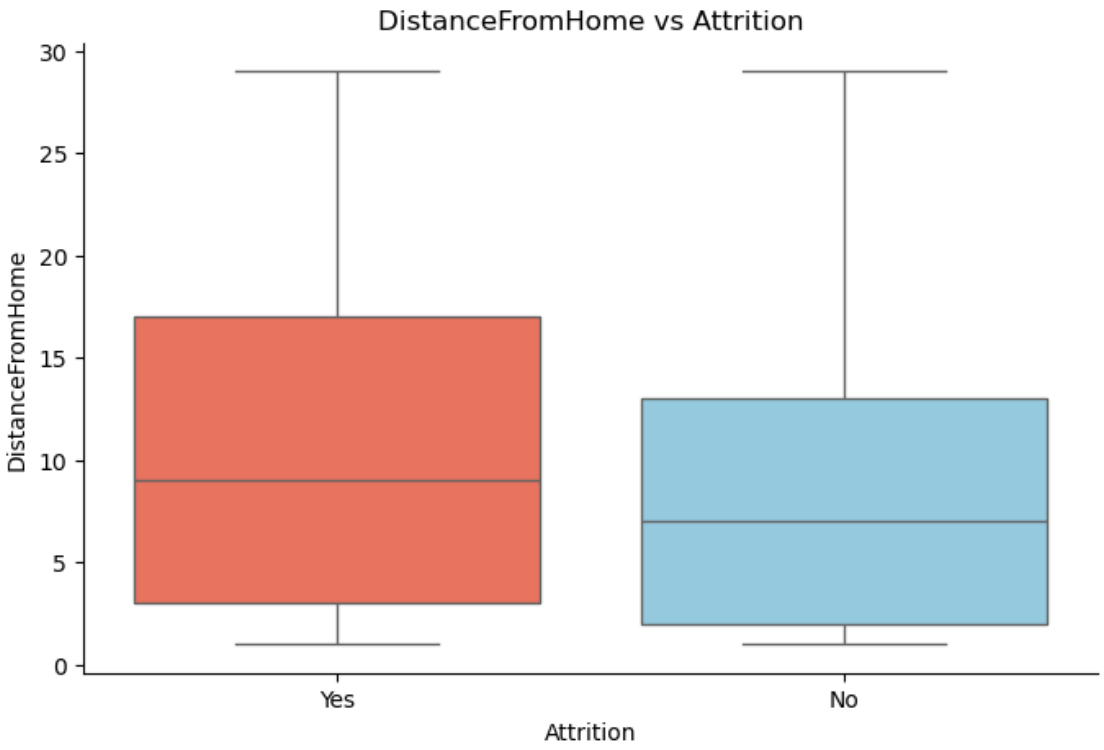


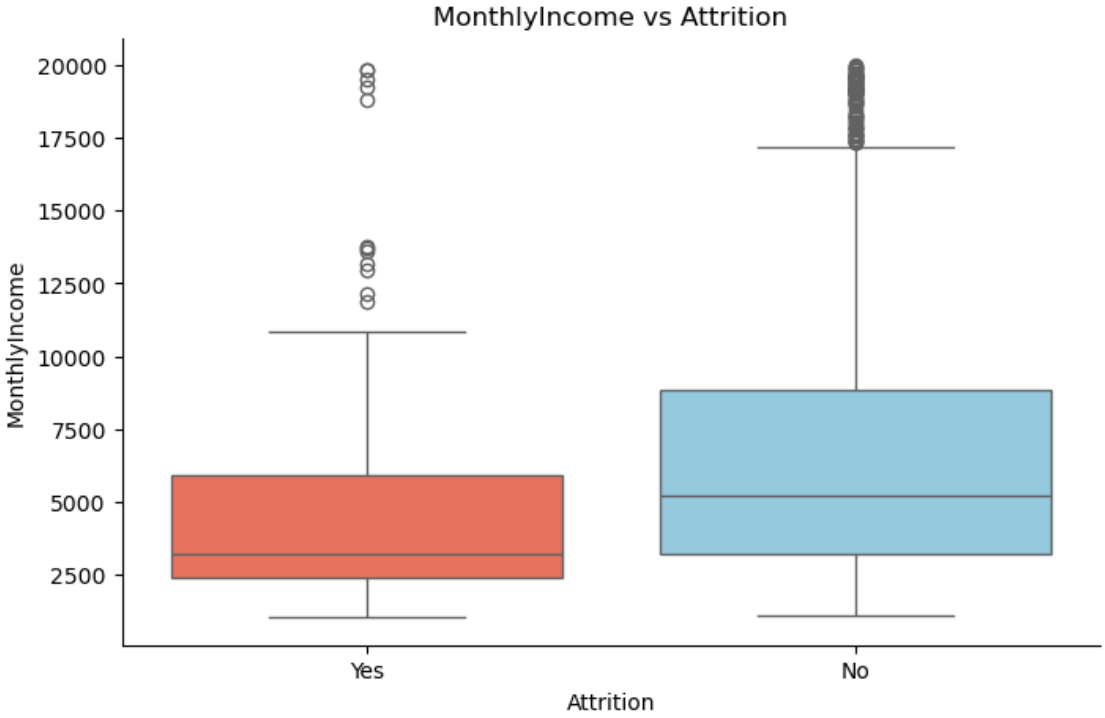
0.0.3 3. Attrition by 'Age', 'DailyRate', 'DistanceFromHome', 'MonthlyIncome', 'YearsAtCompany', 'YearsSinceLastPromotion' (Numerical Value)

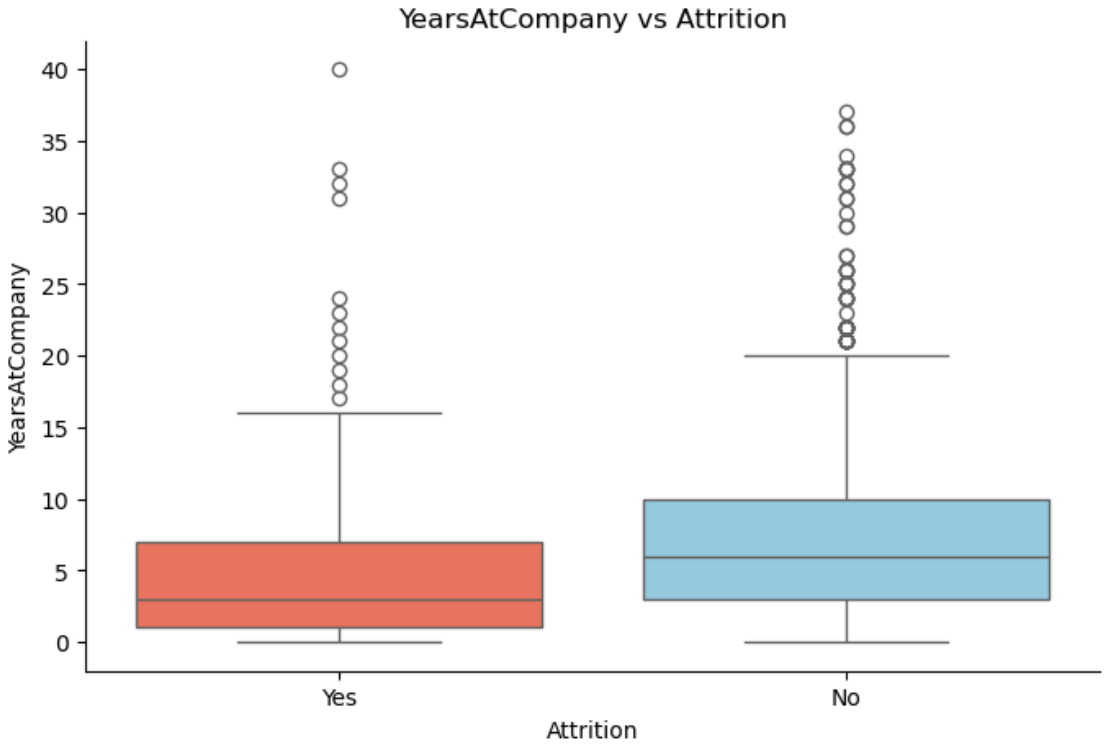
[41]:
```
# Boxplots for numerical features with proper palette and hue
for col in num_cols:
    plt.figure(figsize=(8, 5))
    sns.boxplot(x='Attrition', y=col, data=df,
                hue='Attrition', palette={'Yes': 'tomato', 'No': 'skyblue'},␣
 ↪dodge=False)
    plt.title(f"{col} vs Attrition")
    plt.legend([], [], frameon=False)
    sns.despine(top=True, right=True)
    plt.show()
```

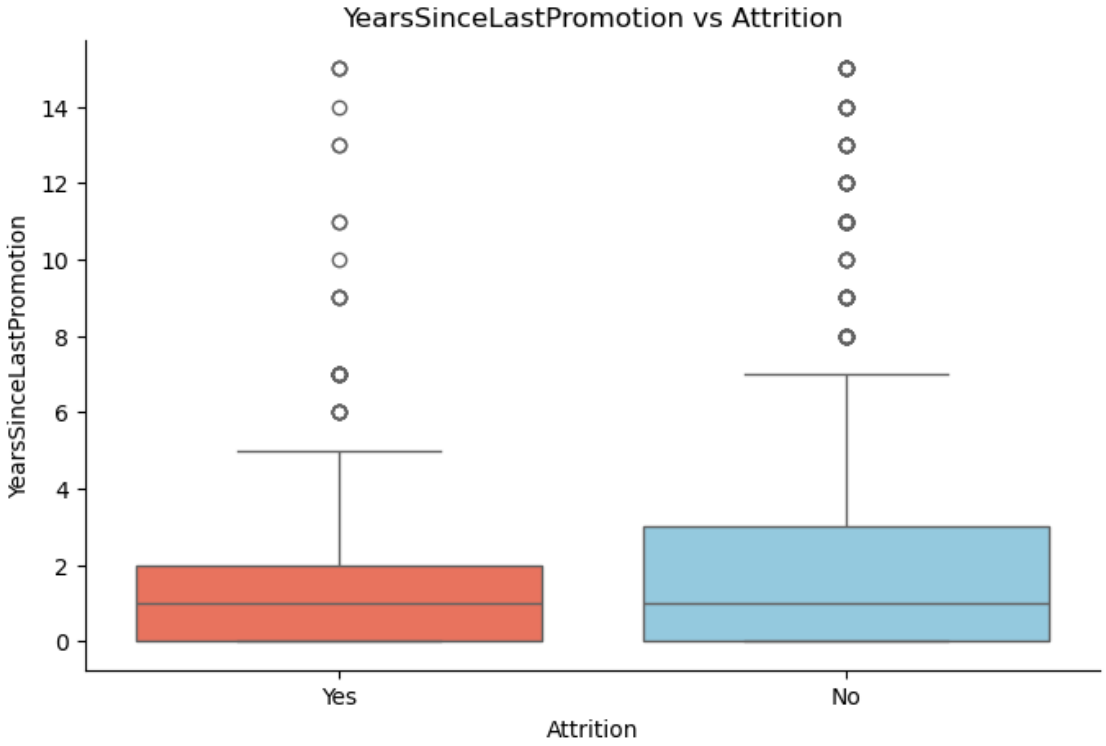

Age vs Attrition
60
50
40
30
20
Age
Yes
No
Attrition


DailyRate vs Attrition
1400
1200
1000
800
600
400
200
DailyRate
Yes
No
Attrition


DistanceFromHome vs Attrition
DistanceFromHome
30
25
20
15
10
5
0
Yes
No
Attrition

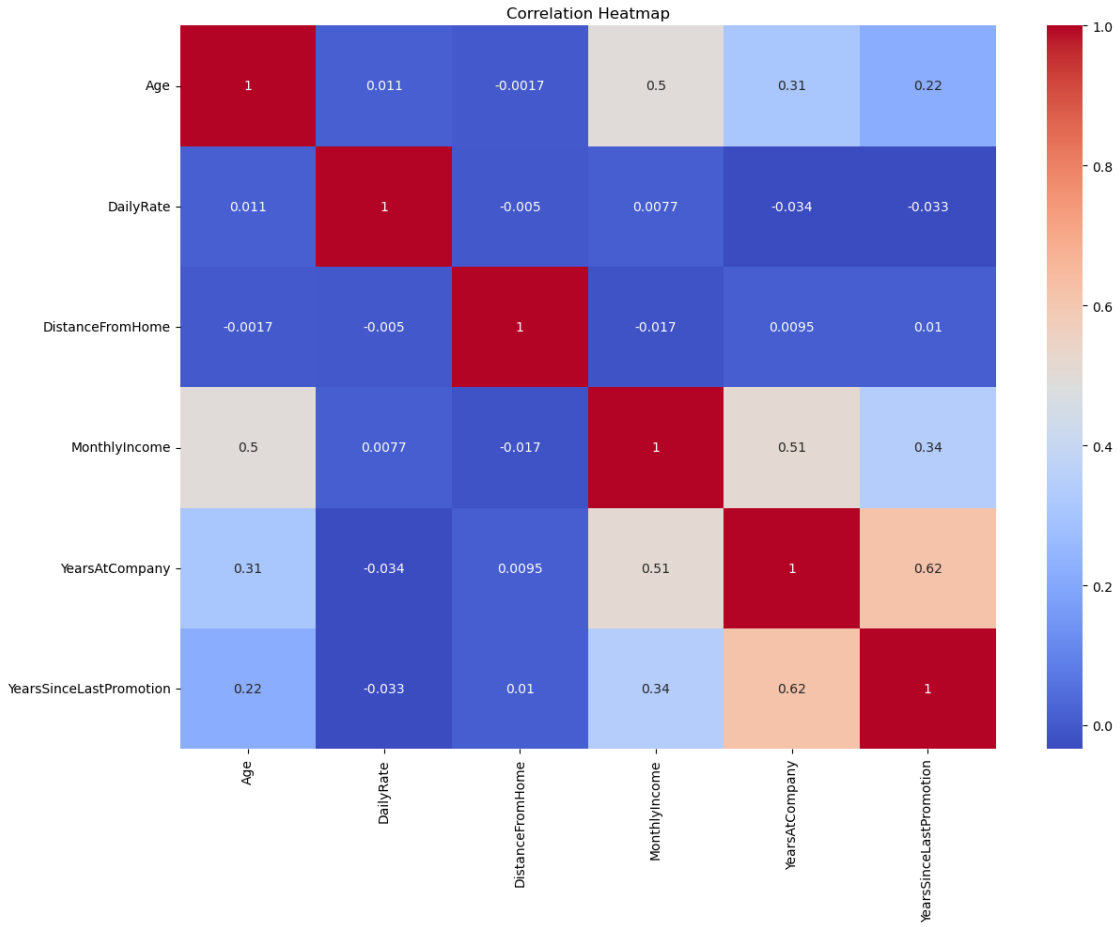

MonthlyIncome vs Attrition
MonthlyIncome
20000
17500
15000
12500
10000
7500
5000
2500
Yes
No
Attrition


YearsAtCompany vs Attrition
YearsAtCompany
0
5
10
15
20
25
30
35
40
Yes
No
Attrition


YearsSinceLastPromotion vs Attrition
YearsSinceLastPromotion
0
2
4
6
8
10
12
14
Yes
No
Attrition

0.0.4 4. Co-relation heatmap between numerical values

[35]:
```
plt.figure(figsize=(14,10))
sns.heatmap(df[num_cols].corr(), annot=True, cmap='coolwarm')
plt.title('Correlation Heatmap')
plt.show()
```



0.0.5 Train Test and Split

0.0.6 Drop the unnecessary column

[90]:
```
df.drop(columns=['EmployeeCount', 'EmployeeNumber'], inplace=True)
```

[91]:
```
df['Attrition'] = df['Attrition'].map({'Yes': 1, 'No': 0})
```

0.0.7 Converting categorical value into numerical value (One-hot encode categorical features)

[92]:
```
df = pd.get_dummies(df, drop_first=True)
```

[94]:
```
X = df.drop('Attrition', axis = 1)
```

[95]:
```
y = df['Attrition']
```

[98]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.1,␣
↪stratify=y, random_state=42)
```

0.0.8 Standardize for logistic regression

[99]:
```
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
X_train_scaled = scaler.fit_transform(X_train)
X_test_scaled = scaler.transform(X_test)
```

0.0.9 Logistic regression

[102]:
```
lr_model = LogisticRegression()
```

[103]:
```
lr_model
```

[103]:
```
LogisticRegression()
```

0.0.10 Fit the data into lr_model

[104]:
```
lr_model.fit(X_train_scaled, y_train)
```

[104]:
```
LogisticRegression()
```

[111]:
```
y_pred_lr = lr_model.predict(X_test_scaled)
```

[112]:
```
y_prob_lr = lr_model.predict_proba(X_test_scaled)[:, 1]
```

[120]:
```
from sklearn.metrics import confusion_matrix, classification_report,␣
↪roc_auc_score
print("Logistic Regression")
print(confusion_matrix(y_test, y_pred_lr))
print(classification_report(y_test, y_pred_lr))
print("Receiver Operating Characteristic Area Under the Curve")
print("ROC AUC Score:", roc_auc_score(y_test, y_prob_lr))
```

```
Logistic Regression
[[119   4]
 [ 17   7]]
```

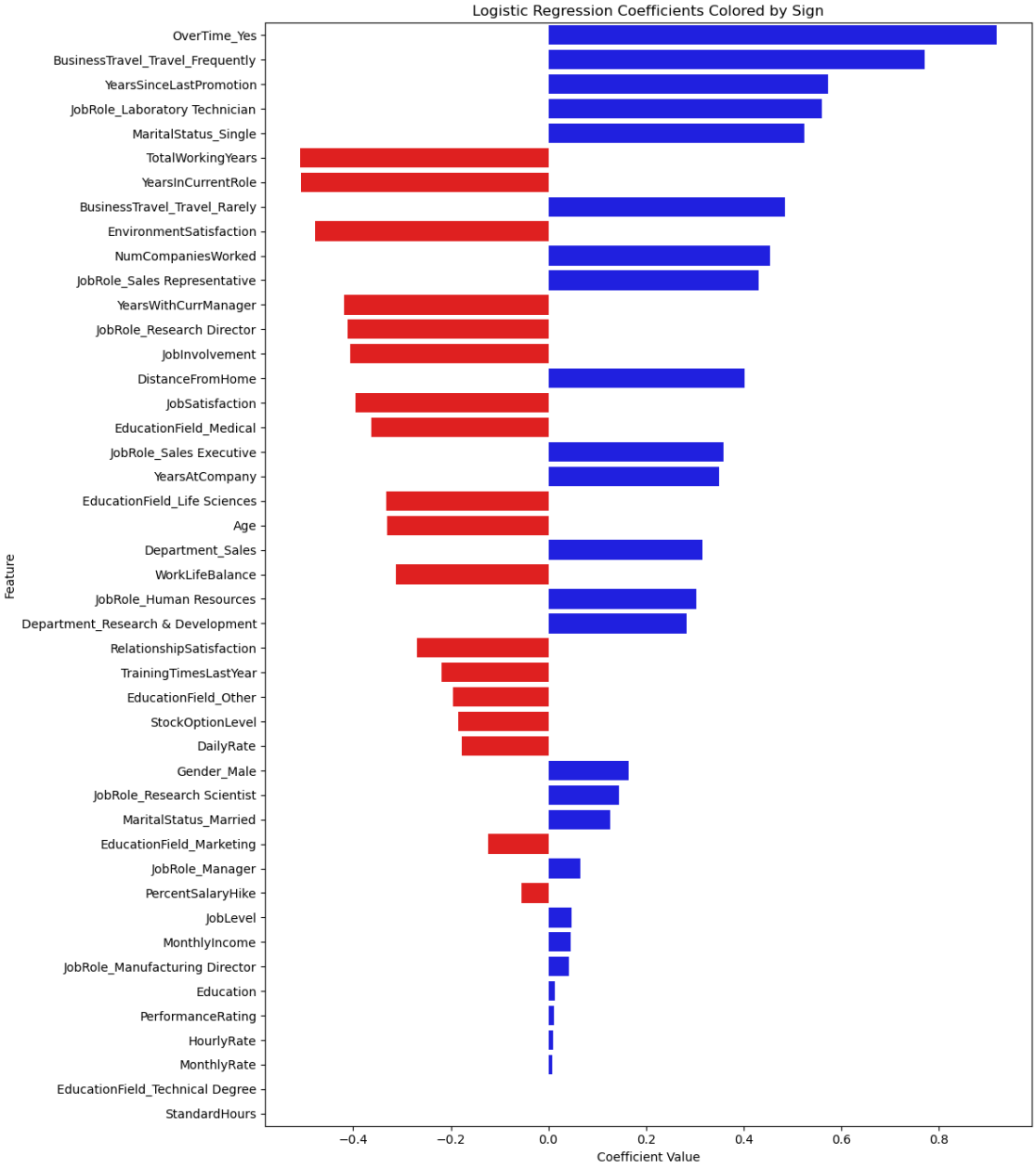
```
              precision    recall  f1-score   support

           0       0.88      0.97      0.92       123
           1       0.64      0.29      0.40        24

    accuracy                           0.86       147
   macro avg       0.76      0.63      0.66       147
weighted avg       0.84      0.86      0.83       147

Receiver Operating Characteristic Area Under the Curve
ROC AUC Score: 0.7872628726287262
```

0.0.11 Create a Series of coefficients sorted by absolute value (ascending for readability)

[125]:
```
coefs = pd.Series(lr_model.coef_[0], index=X.columns).sort_values(key=abs,␣
 ↪ascending=False)
```

0.0.12 Bar graph showing which features affect the predictive model the most (i.e., feature importance).

[130]:
```
# Prepare DataFrame for seaborn
df_coefs = coefs.reset_index()
df_coefs.columns = ['Feature', 'Coefficient']

# Add a column for sign to use as hue
df_coefs['Sign'] = df_coefs['Coefficient'].apply(lambda x: 'Positive' if x >= 0␣
 ↪else 'Negative')

plt.figure(figsize=(12, max(6, 0.3 * len(coefs))))
sns.barplot(data=df_coefs, x='Coefficient', y='Feature', hue='Sign',␣
 ↪dodge=False,
            palette={'Positive': 'blue', 'Negative': 'red'})

plt.title('Logistic Regression Coefficients Colored by Sign')
plt.xlabel('Coefficient Value')
plt.ylabel('Feature')
plt.legend([], [], frameon=False)
plt.tight_layout()
plt.show()
```


Logistic Regression Coefficients Colored by Sign
OverTime_Yes
BusinessTravel_Travel_Frequently
YearsSinceLastPromotion
JobRole_Laboratory Technician
MaritalStatus_Single
TotalWorkingYears
YearsInCurrentRole
BusinessTravel_Travel_Rarely
EnvironmentSatisfaction
NumCompaniesWorked
JobRole_Sales Representative
YearsWithCurrManager
JobRole_Research Director
JobInvolvement
DistanceFromHome
JobSatisfaction
EducationField_Medical
JobRole_Sales Executive
YearsAtCompany
EducationField_Life Sciences
Age
Department_Sales
WorkLifeBalance
JobRole_Human Resources
Department_Research & Development
RelationshipSatisfaction
TrainingTimesLastYear
EducationField_Other
StockOptionLevel
DailyRate
Gender_Male
JobRole_Research Scientist
MaritalStatus_Married
EducationField_Marketing
JobRole_Manager
PercentSalaryHike
JobLevel
MonthlyIncome
JobRole_Manufacturing Director
Education
PerformanceRating
HourlyRate
MonthlyRate
EducationField_Technical Degree
StandardHours
Feature
−0.4
−0.2
0.0
0.2
0.4
0.6
0.8
Coefficient Value

[ ]: