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

```
a=pd.read_csv("/content/WA_Fn-UseC_-HR-Employee-Attrition.csv")
```

```
a
```

	Age	Attrition	BusinessTravel	DailyRate	Department	DistanceFromHome	Educa
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	
...	...	...	...	...	...	...	
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	

1470 rows × 35 columns

Read the data types

```
a.dtypes
```

```
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
```

```
a.shape
```

```
(1470, 35)
```

```
a.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
```

Statistics about the dataset

```
a.describe()
```

	Age	DailyRate	DistanceFromHome	Education	EmployeeCount	Employe
count	1470.000000	1470.000000	1470.000000	1470.000000	1470.0	1470
mean	36.923810	802.485714	9.192517	2.912925	1.0	1024
std	9.135373	403.509100	8.106864	1.024165	0.0	602
min	18.000000	102.000000	1.000000	1.000000	1.0	1
25%	30.000000	465.000000	2.000000	2.000000	1.0	491
50%	36.000000	802.000000	7.000000	3.000000	1.0	1020
75%	43.000000	1157.000000	14.000000	4.000000	1.0	1555
max	60.000000	1499.000000	29.000000	5.000000	1.0	2068

8 rows × 26 columns

Null values identification

```
a.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
```

```
a.isnull().sum()
```

```
    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
```

Data Visualization

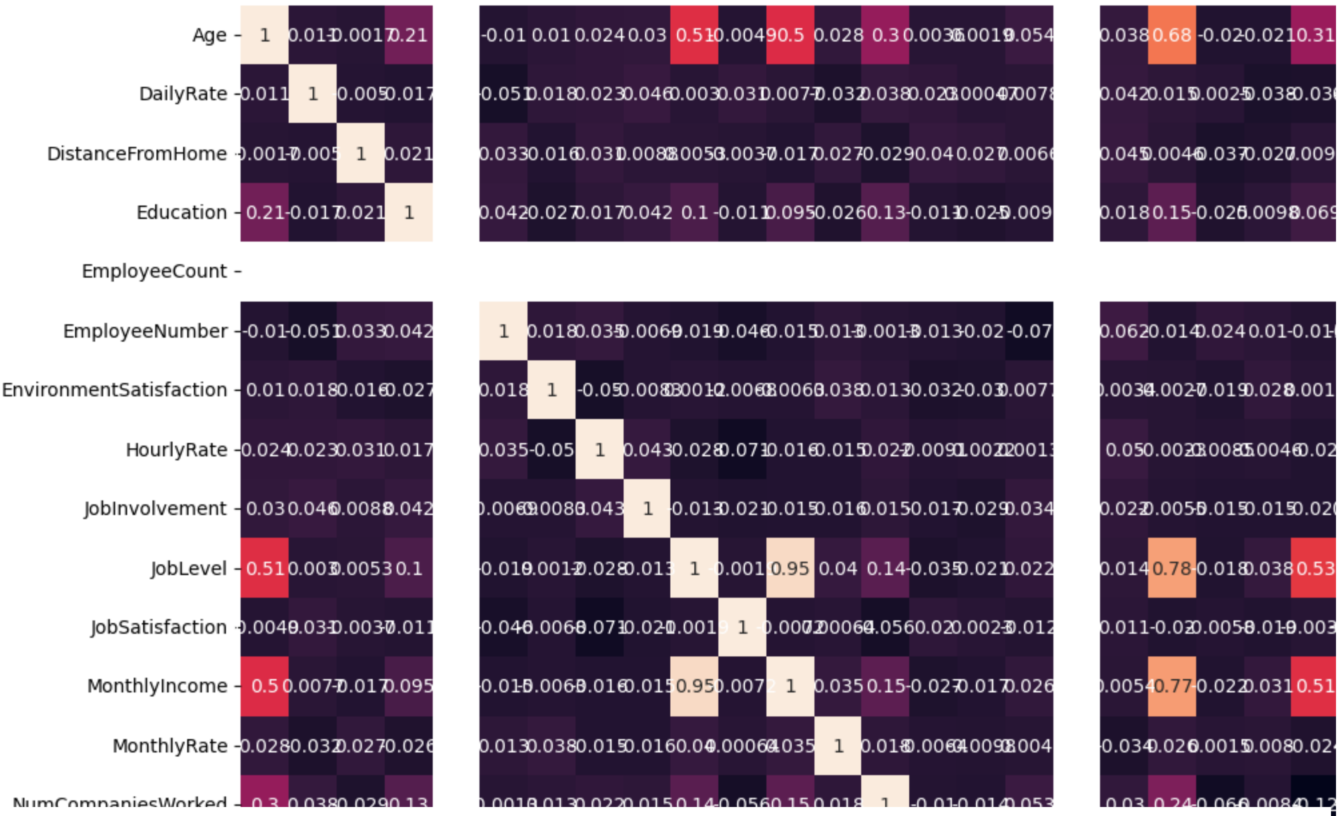
```
d=a.corr()
d
```

```
<ipython-input-13-385900cf86c7>:1: FutureWarning: The default value of numeric_only i
  d=a.corr()
```

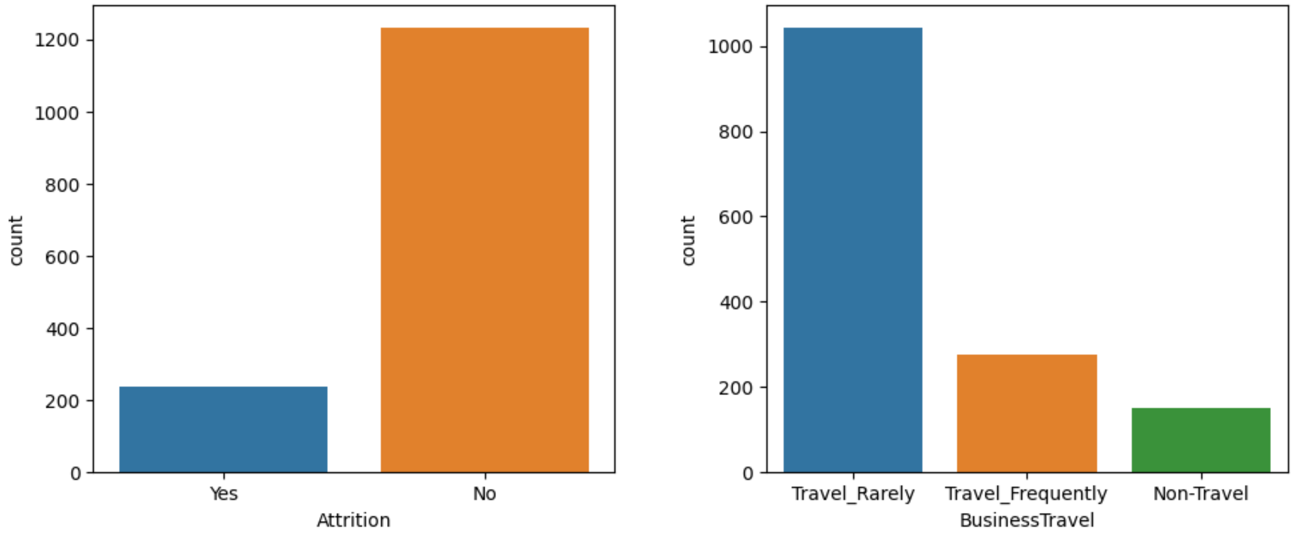
	Age	DailyRate	DistanceFromHome	Education	EmployeeCo
Age	1.000000	0.010661	-0.001686	0.208034	N
DailyRate	0.010661	1.000000	-0.004985	-0.016806	N
DistanceFromHome	-0.001686	-0.004985	1.000000	0.021042	N
Education	0.208034	-0.016806	0.021042	1.000000	N
EmployeeCount	NaN	NaN	NaN	NaN	N
EmployeeNumber	-0.010145	-0.050990	0.032916	0.042070	N
EnvironmentSatisfaction	0.010146	0.018355	-0.016075	-0.027128	N
HourlyRate	0.024287	0.023381	0.031131	0.016775	N
JobInvolvement	0.029820	0.046135	0.008783	0.042438	N
JobLevel	0.509604	0.002966	0.005303	0.101589	N
JobSatisfaction	-0.004892	0.030571	-0.003669	-0.011296	N
MonthlyIncome	0.497855	0.007707	-0.017014	0.094961	N
MonthlyRate	0.028051	-0.032182	0.027473	-0.026084	N
NumCompaniesWorked	0.299635	0.038153	-0.029251	0.126317	N
PercentSalaryHike	0.003634	0.022704	0.040235	-0.011111	N
PerformanceRating	0.001904	0.000473	0.027110	-0.024539	N
RelationshipSatisfaction	0.053535	0.007846	0.006557	-0.009118	N
StandardHours	NaN	NaN	NaN	NaN	N
StockOptionLevel	0.037510	0.042143	0.044872	0.018422	N
TotalWorkingYears	0.680381	0.014515	0.004628	0.148280	N
TrainingTimesLastYear	-0.019621	0.002453	-0.036942	-0.025100	N

```
plt.subplots(figsize=(15,15))
sns.heatmap(d,annot=True)
```

```
<Axes: >
```



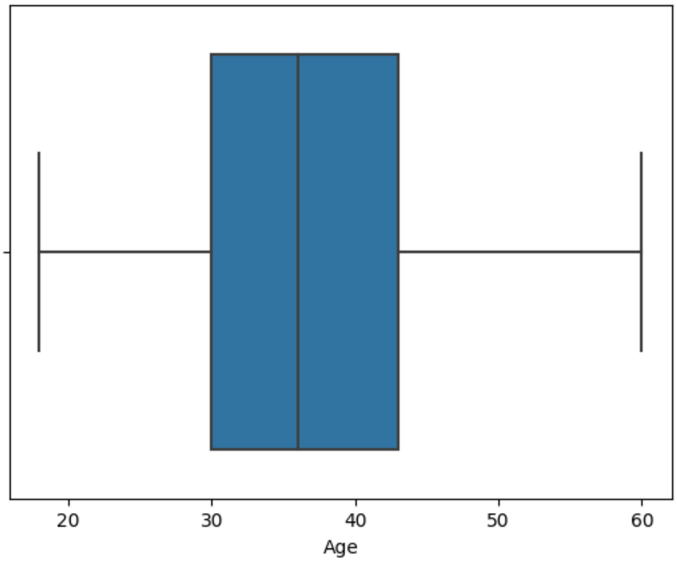
```
f = plt.figure()
f.set_figwidth(15)
f.set_figheight(12)

# Subplot 1
plt.subplot(3, 3, 1)
sns.countplot(x="Attrition", data=a)

# Subplot 2
plt.subplot(3, 3, 2)
sns.countplot(x="BusinessTravel", data=a)

# Subplot 5
plt.subplot(3, 3, 3)
sns.countplot(x="Department", data=a)

# Subplot 8
plt.subplot(3, 3, 4)
sns.countplot(x="EducationField", data=a)

# Subplot 9
plt.subplot(3, 3, 5)
sns.countplot(x="OverTime", data=a)

# Adjust layout
plt.tight_layout()

# Show the plots
plt.show()
```



Outlier Detection

```
sns.boxplot(x="Age",data=a)
```

```
<Axes: xlabel='Age'>
```

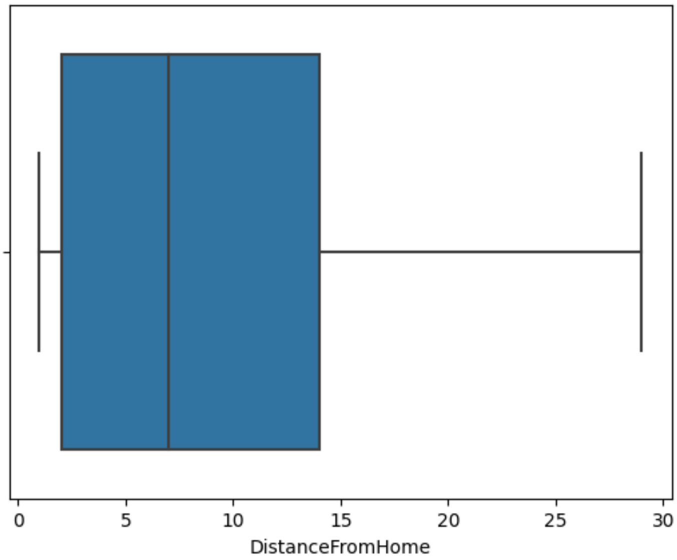


```
sns.boxplot(x="DailyRate",data=a)
```

```
<Axes: xlabel='DailyRate'>
```

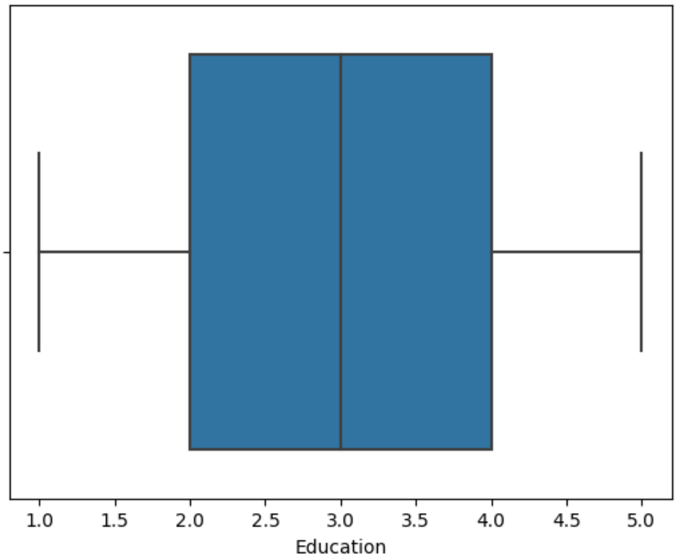
```
sns.boxplot(x="DistanceFromHome",data=a)
```

```
<Axes: xlabel='DistanceFromHome'>
```



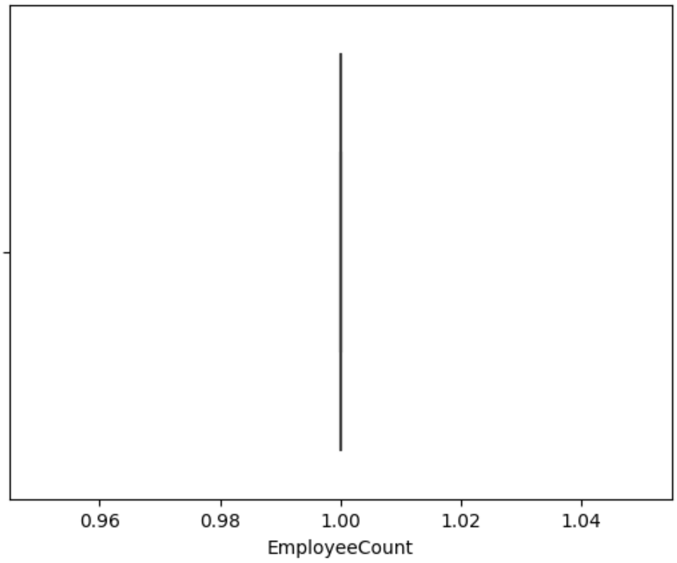
```
sns.boxplot(x="Education",data=a)
```

```
<Axes: xlabel='Education'>
```



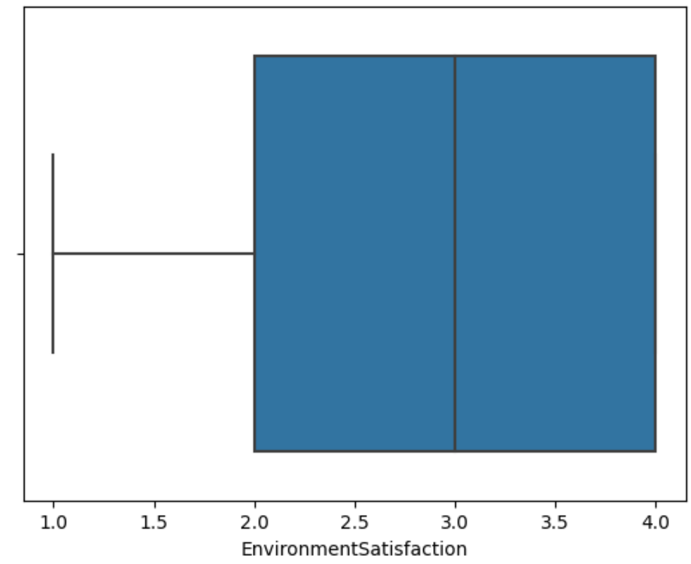
```
sns.boxplot(x="EmployeeCount",data=a)
```

```
<Axes: xlabel='EmployeeCount'>
```



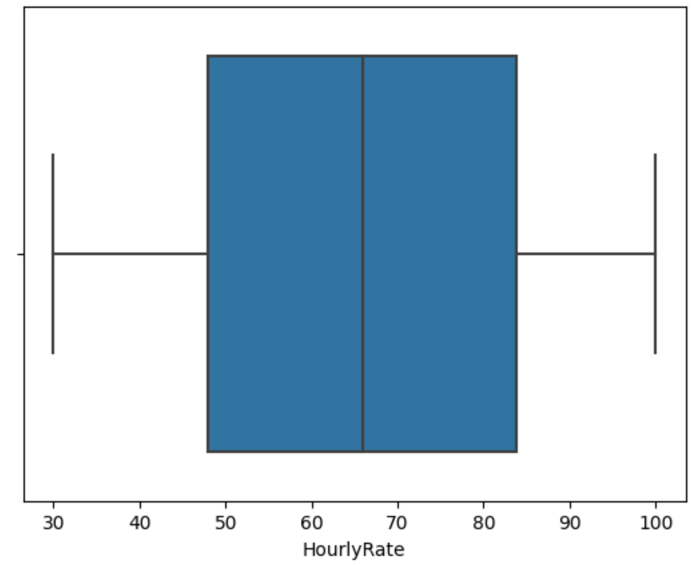
```
sns.boxplot(x="EnvironmentSatisfaction",data=a)
```

```
<Axes: xlabel='EnvironmentSatisfaction'>
```



```
sns.boxplot(x="HourlyRate",data=a)
```

```
<Axes: xlabel='HourlyRate'>
```



Splitting dependent and independent variables

```
x=a.drop(columns=["Attrition"],axis=1)
x.head()
```

	Age	BusinessTravel	DailyRate	Department	DistanceFromHome	Education	EducationField	EmployeeCount	EmployeeNumber	Environm
0	41	Travel_Rarely	1102	Sales	1	2	Life Sciences	1	1	
1	49	Travel_Frequently	279	Research & Development	8	1	Life Sciences	1	2	
2	37	Travel_Rarely	1373	Research & Development	2	2	Other	1	4	
3	33	Travel_Frequently	1392	Research & Development	3	4	Life Sciences	1	5	
4	27	Travel_Rarely	591	Research & Development	2	1	Medical	1	7	

5 rows × 34 columns

```
x.shape
```

```
(1470, 34)
```

```
y=a["Attrition"]
y.head()
```

```
0    Yes
1     No
2    Yes
3     No
4     No
Name: Attrition, dtype: object
```

```
y.shape
```

```
(1470,)
```

Encoding

```
from sklearn.preprocessing import LabelEncoder
```

```
l=LabelEncoder()
```

```
x["Gender"]=l.fit_transform(x["Gender"])
x['Gender']
```

```
0       0
1       1
2       1
3       0
4       1
       ..
1465    1
1466    1
1467    1
1468    1
1469    1
Name: Gender, Length: 1470, dtype: int64
```

```
x['Gender'].value_counts()
```

```
1    882
0    588
Name: Gender, dtype: int64
```

```
x['Gender'].nunique()
```

```
2
```

```
x.head()
```

	Age	BusinessTravel	DailyRate	Department	DistanceFromHome	Education	EducationField	EmployeeCount	EmployeeNumber	Environm
0	41	Travel_Rarely	1102	Sales	1	2	Life Sciences	1	1	
1	49	Travel_Frequently	279	Research & Development	8	1	Life Sciences	1	2	
2	37	Travel_Rarely	1373	Research & Development	2	2	Other	1	4	
3	33	Travel_Frequently	1392	Research & Development	3	4	Life Sciences	1	5	
4	27	Travel_Rarely	591	Research & Development	2	1	Medical	1	7	

5 rows × 34 columns

```
Dept = pd.get_dummies(a, columns=["Department"])
print(Dept)
```

```
4              3              2              2
...          ...            ...            ...
1465           3              5              2
1466           3              7              7
1467           3              6              2
1468           2              9              6
1469           4              4              3

      YearsSinceLastPromotion YearsWithCurrManager  \
0                           0                    5
1                           1                    7
2                           0                    0
3                           3                    0
4                           2                    2
...                       ...                  ...
1465                        0                    3
1466                        1                    7
1467                        0                    3
1468                        0                    8
1469                        1                    2

      Department_Human Resources  Department_Research & Development  \
0                              0                                  0
1                              0                                  1
2                              0                                  1
3                              0                                  1
4                              0                                  1
...                          ...                                ...
1465                           0                                  1
1466                           0                                  1
1467                           0                                  1
1468                           0                                  0
1469                           0                                  1

      Department_Sales
0                    1
1                    0
2                    0
3                    0
4                    0
...                ...
1465                 0
1466                 0
1467                 0
1468                 1
1469                 0

[1470 rows x 37 columns]
```

```
print(x)
```

```
1466                 6          1        Medical              1
1467                 4          3  Life Sciences              1
1468                 2          3        Medical              1
1469                 8          3        Medical              1

      EmployeeNumber  EnvironmentSatisfaction  ...  RelationshipSatisfaction  \
0                  1                        2  ...                         1
1                  2                        3  ...                         4
2                  4                        4  ...                         2
3                  5                        4  ...                         3
4                  7                        1  ...                         4
...              ...                      ...  ...                       ...
1465            2061                        3  ...                         3
1466            2062                        4  ...                         1
1467            2064                        2  ...                         2
1468            2065                        4  ...                         4
1469            2068                        2  ...                         1
```

```
1466                   5               3             7
1467                   0               3             6
1468                   3               2             9
1469                   3               4             4

      YearsInCurrentRole  YearsSinceLastPromotion  YearsWithCurrManager
0                      4                        0                     5
1                      7                        1                     7
2                      0                        0                     0
3                      7                        3                     0
4                      2                        2                     2
...                  ...                      ...                   ...
1465                   2                        0                     3
1466                   7                        1                     7
1467                   2                        0                     3
1468                   6                        0                     8
1469                   3                        1                     2

[1470 rows x 34 columns]
```

```
a.head()
```

	Age	Attrition	BusinessTravel	DailyRate	Department	DistanceFromHome	Educatic
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	

5 rows × 35 columns

```
x.head()
```

	Age	BusinessTravel	DailyRate	Department	DistanceFromHome	Education	EducationField	EmployeeCount	EmployeeNumber	Environm
0	41	Travel_Rarely	1102	Sales	1	2	Life Sciences	1	1	
1	49	Travel_Frequently	279	Research & Development	8	1	Life Sciences	1	2	
2	37	Travel_Rarely	1373	Research & Development	2	2	Other	1	4	
3	33	Travel_Frequently	1392	Research & Development	3	4	Life Sciences	1	5	
4	27	Travel_Rarely	591	Research & Development	2	1	Medical	1	7	

5 rows × 34 columns

```
Dept=pd.get_dummies(x["Department"],drop_first=True)
Dept
```

```
x=pd.concat([x,Dept],axis=1)
```

```
x.head()
```

	Age	BusinessTravel	DailyRate	Department	DistanceFromHome	Education	EducationField	EmployeeCount	EmployeeNumber	Environm
0	41	Travel_Rarely	1102	Sales	1	2	Life Sciences	1	1	
1	49	Travel_Frequently	279	Research & Development	8	1	Life Sciences	1	2	
2	37	Travel_Rarely	1373	Research & Development	2	2	Other	1	4	
3	33	Travel_Frequently	1392	Research & Development	3	4	Life Sciences	1	5	
4	27	Travel_Rarely	591	Research & Development	2	1	Medical	1	7	

5 rows × 38 columns

Feature Scaling

```
from sklearn.preprocessing import StandardScaler
```

```
scaler = StandardScaler()
```

```
X = a[['Age', 'MonthlyIncome', 'YearsAtCompany', 'JobSatisfaction', 'EnvironmentSatisfaction','YearsWithCurrManager','WorkLifeBalance']]
Y = a['Attrition']
```

```
X.head()
```

	Age	MonthlyIncome	YearsAtCompany	JobSatisfaction	EnvironmentSatisfaction	YearsWithCurrManager	WorkLifeBalance
0	41	5993	6	4	2	5	1
1	49	5130	10	2	3	7	3
2	37	2090	0	3	4	0	3
3	33	2909	8	3	4	0	3
4	27	3468	2	2	1	2	3

```
x.tail()
```

	Age	BusinessTravel	DailyRate	Department	DistanceFromHome	Education	EducationField	EmployeeCount	EmployeeNumber	Envir
1465	36	Travel_Frequently	884	Research & Development	23	2	Medical	1	2061	
1466	39	Travel_Rarely	613	Research & Development	6	1	Medical	1	2062	
1467	27	Travel_Rarely	155	Research & Development	4	3	Life Sciences	1	2064	
1468	49	Travel_Frequently	1023	Sales	2	3	Medical	1	2065	
1469	34	Travel_Rarely	628	Research & Development	8	3	Medical	1	2068	

5 rows × 38 columns

```
x
```

	Age	BusinessTravel	DailyRate	Department	DistanceFromHome	Education	EducationField	EmployeeCount	EmployeeNumber	Envir
0	41	Travel_Rarely	1102	Sales	1	2	Life Sciences	1	1	
1	49	Travel_Frequently	279	Research & Development	8	1	Life Sciences	1	2	
2	37	Travel_Rarely	1373	Research & Development	2	2	Other	1	4	
3	33	Travel_Frequently	1392	Research & Development	3	4	Life Sciences	1	5	
4	27	Travel_Rarely	591	Research & Development	2	1	Medical	1	7	
...	...	...	...	...	...	...	...	...	...	
1465	36	Travel_Frequently	884	Research & Development	23	2	Medical	1	2061	
1466	39	Travel_Rarely	613	Research & Development	6	1	Medical	1	2062	
1468	49	Travel_Frequently	1023	Sales	2	3	Medical	1	2065	

Splitting data into test and train

```
from sklearn.model_selection import train_test_split
X_train, X_test, Y_train, Y_test = train_test_split(X, Y, test_size=0.2, random_state=42)
```

```
X_train,X_test,Y_train,Y_test.shape
```

```
 860    22          2853              0              4
 1459   29          4025              4              2
 1126   50         19331              1              3

       EnvironmentSatisfaction  YearsWithCurrManager  WorkLifeBalance
 1097                        3                     0                3
 727                         2                     0                3
 254                         4                     2                3
 1175                        4                     0                3
 1341                        2                     2                3
 ...                       ...                   ...              ...
 1130                        2                     8                2
 1294                        2                     2                1
 860                         3                     0                3
 1459                        4                     3                3
 1126                        3                     0                3

 [1176 rows x 7 columns],
       Age  MonthlyIncome  YearsAtCompany  JobSatisfaction  \
 1041   28           8463               5                1
 184    53           4450               4                1
 1222   24           1555               1                3
 67     45           9724               1                1
 220    36           5914              13                2
 ...   ...            ...             ...              ...
 567    34           6274               6                4
 560    34           5121               0                1
 945    50          16880               3                1
 522    37           4680               1                4
 651    47           4537               7                4

       EnvironmentSatisfaction  YearsWithCurrManager  WorkLifeBalance
 1041                        4                     3                3
 184                         4                     3                3
 1222                        4                     0                3
 67                          2                     0                3
 220                         4                     7                4
 ...                       ...                   ...              ...
 567                         4                     4                3
 560                         2                     0                3
 945                         4                     2                3
 522                         4                     0                3
 651                         3                     7                3

 [294 rows x 7 columns],
 1097     No
 727      No
 Name: Attrition, Length: 1176, dtype: object,
 (294,))
```

Logistic Regression

Model Building & Import the model building Libraries

```
from sklearn.linear_model import LogisticRegression
model=LogisticRegression()
```

```
model.fit(X_train, Y_train)
```

```
▾ LogisticRegression
LogisticRegression()
```

```
pred=model.predict(X_test)
```

```
pred
```

```
array(['No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No',
       'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No',
       'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No',
       'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No',
       'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No',
       'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No',
       'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No',
       'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No',
       'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No',
       'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No',
       'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No',
       'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No',
       'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No',
       'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No',
       'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No',
       'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No',
       'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No',
       'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No',
       'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No',
       'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No',
       'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No',
       'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No',
       'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No',
       'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No',
       'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No',
       'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No',
       'No', 'No', 'No', 'No', 'No', 'No', 'No', 'No'], dtype=object)
```

```
Y_test
```

```
1041     No
184      No
1222    Yes
67       No
220      No
       ...
567      No
560      No
945      No
522      No
651      No
Name: Attrition, Length: 294, dtype: object
```

```
a
```

Attrition	BusinessTravel	DailyRate	Department	DistanceFromHome	Education	EducationField	EmployeeCount	EmployeeNu
Yes	Travel_Rarely	1102	Sales	1	2	Life Sciences	1	
No	Travel_Frequently	279	Research & Development	8	1	Life Sciences	1	
Yes	Travel_Rarely	1373	Research & Development	2	2	Other	1	
No	Travel_Frequently	1392	Research & Development	3	4	Life Sciences	1	
No	Travel_Rarely	591	Research & Development	2	1	Medical	1	
No	Travel_Frequently	884	Research &	23	2	Medical	1	

Evaluation of classification model

```
#Accuracy score
from sklearn.metrics import accuracy_score,confusion_matrix,classification_report,roc_auc_score,roc_curve


accuracy = accuracy_score(Y_test, pred)


report = classification_report(Y_test, pred, zero_division=1)


print(f'Accuracy: {accuracy}')
print(f'Classification Report:\n{report}')
```

```
Accuracy: 0.8673469387755102
Classification Report:
              precision    recall  f1-score   support

          No       0.87      1.00      0.93       255
         Yes       1.00      0.00      0.00        39

    accuracy                           0.87       294
   macro avg       0.93      0.50      0.46       294
weighted avg       0.88      0.87      0.81       294
```

```
confusion_matrix(Y_test,pred)
```

```
array([[255,   0],
       [ 39,   0]])
```

```
pd.crosstab(Y_test,pred)
```

col_0	No
Attrition	
No	255
Yes	39

Roc-AUC curve

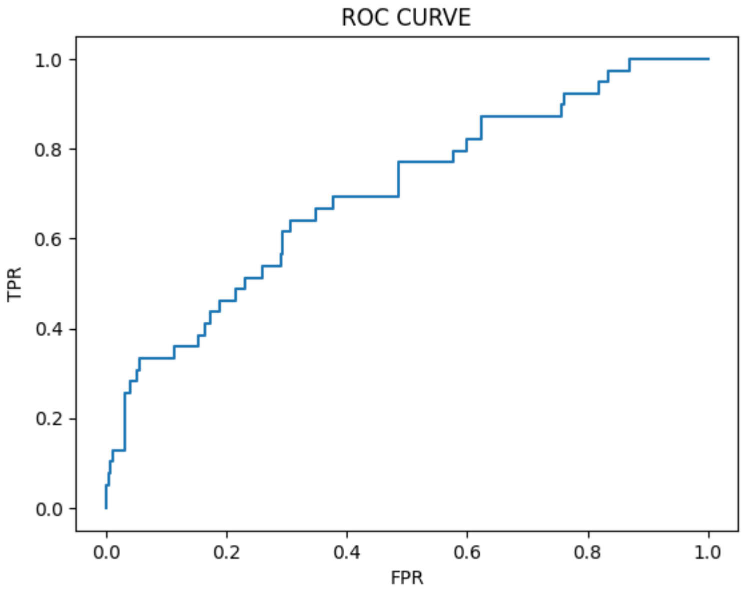
```
probability=model.predict_proba(X_test)[:,1]
```

```
probability
```

```
array([0.14873939, 0.17373604, 0.25084589, 0.1865791 , 0.11911736,
       0.14963007, 0.15969356, 0.20644099, 0.08193936, 0.18537088,
       0.16096129, 0.02189805, 0.15660552, 0.11782876, 0.18248771,
       0.13287268, 0.14334387, 0.0892007 , 0.06858367, 0.05708061,
       0.1753651 , 0.14395111, 0.10012064, 0.15057687, 0.2329628 ,
       0.03338823, 0.27116899, 0.15771847, 0.18762417, 0.10029771,
       0.10548668, 0.15048832, 0.12644386, 0.14778903, 0.2030313 ,
       0.06737083, 0.04935137, 0.35253675, 0.19926437, 0.23846212,
       0.08198467, 0.28864726, 0.23955634, 0.19282515, 0.22246873,
       0.11288909, 0.17545014, 0.24051176, 0.14059822, 0.32377579,
       0.08977525, 0.15148043, 0.01896052, 0.14635136, 0.20158982,
       0.10191406, 0.10573264, 0.08537077, 0.1631479 , 0.12443613,
       0.10510977, 0.33623452, 0.11027653, 0.05493965, 0.28005007,
       0.18450873, 0.12499531, 0.17197795, 0.17873294, 0.06110176,
       0.18127058, 0.08791989, 0.15005295, 0.15959692, 0.19866202,
       0.07388538, 0.19341696, 0.19100387, 0.08712656, 0.08033949,
       0.02928375, 0.13253218, 0.05956382, 0.16844953, 0.08753921,
       0.17957672, 0.12899389, 0.16872069, 0.16947305, 0.12397644,
       0.1099147 , 0.24576674, 0.07821105, 0.2716565 , 0.12140547,
       0.06524951, 0.1337184 , 0.14536957, 0.18726004, 0.10915274,
       0.04570312, 0.10169758, 0.07390408, 0.22704117, 0.07208355,
       0.08035364, 0.18593691, 0.16647288, 0.10818369, 0.05315879,
       0.17696614, 0.18973955, 0.22476227, 0.17342537, 0.21403334,
       0.16943373, 0.16771766, 0.09747364, 0.11387728, 0.2559594 ,
       0.32393512, 0.08431327, 0.13118746, 0.10751731, 0.09837008,
       0.25991497, 0.18954525, 0.11954205, 0.10534474, 0.09694665,
       0.07268098, 0.30507638, 0.06501248, 0.14080365, 0.1255734 ,
       0.11537899, 0.23299235, 0.17264787, 0.24765337, 0.06927027,
       0.21512755, 0.09901074, 0.16646941, 0.08047622, 0.03233445,
       0.15363939, 0.14131117, 0.25851265, 0.26761484, 0.1665985 ,
       0.10685997, 0.11549038, 0.19827264, 0.19076354, 0.13247131,
       0.26173972, 0.17180386, 0.21324175, 0.04115976, 0.15054569,
       0.16012435, 0.09434315, 0.09921354, 0.22000675, 0.06421677,
       0.16643204, 0.12016002, 0.14827189, 0.08450615, 0.05725373,
       0.12102272, 0.02681568, 0.18300015, 0.21076054, 0.11715199,
       0.16127828, 0.18483891, 0.09043029, 0.14086669, 0.20253644,
       0.0594472 , 0.10383826, 0.01617733, 0.15428555, 0.08595314,
       0.22434066, 0.11577713, 0.07998958, 0.07811109, 0.12006351,
       0.12845942, 0.14824842, 0.10405812, 0.19816497, 0.1162661 ,
       0.21477996, 0.24395257, 0.04972863, 0.2156586 , 0.16831872,
       0.17867722, 0.15398516, 0.21871738, 0.03416769, 0.07072713,
       0.22242289, 0.10244091, 0.10919764, 0.12517809, 0.0706504 ,
       0.07399615, 0.24438034, 0.17159597, 0.17617076, 0.10663942,
       0.13898632, 0.15178097, 0.10545546, 0.2723432 , 0.07462743,
       0.23465253, 0.26405405, 0.10124306, 0.3028089 , 0.12410107,
       0.1909214 , 0.20302625, 0.13276688, 0.0401135 , 0.18943046,
       0.23129363, 0.25951761, 0.08630086, 0.21347439, 0.20469075,
       0.13330949, 0.08581729, 0.10996842, 0.06690194, 0.04616928,
       0.18853288, 0.11542819, 0.21231547, 0.03597583, 0.07176025,
       0.17130681, 0.11593175, 0.23407496, 0.1533375 , 0.09696206,
       0.16256038, 0.06366454, 0.04689748, 0.0855508 , 0.23703024,
       0.07106702, 0.18067446, 0.2069784 , 0.22648723, 0.02715875,
       0.17170263, 0.14167865, 0.276632  , 0.10463943, 0.12037205,
       0.21133882, 0.02933273, 0.0973697 , 0.23466029, 0.23184945,
       0.1882965 , 0.04906958, 0.19036583, 0.1399965 , 0.11412922,
       0.22223015, 0.12517666, 0.24824295, 0.07113102, 0.07508479,
       0.14609486, 0.15491467, 0.18318556, 0.09382192, 0.04811606,
```

```
from sklearn.preprocessing import LabelBinarizer
lb = LabelBinarizer()
Y_test_bin = lb.fit_transform(Y_test)
fpr, tpr, thresholds = roc_curve(Y_test_bin, probability)
```

```
plt.plot(fpr,tpr)
plt.xlabel('FPR')
plt.ylabel('TPR')
plt.title('ROC CURVE')
plt.show()
```



Decision Tree

```
from sklearn.tree import DecisionTreeClassifier
from sklearn.metrics import accuracy_score, classification_report
```

```
dt_model = DecisionTreeClassifier(random_state=50)
```

```
dt_model.fit(X_train, Y_train)
```

```
▾        DecisionTreeClassifier
DecisionTreeClassifier(random_state=50)
```

```
dt_predictions = dt_model.predict(X_test)
```

```
dt_accuracy = accuracy_score(Y_test, dt_predictions)
```

```
dt_report = classification_report(Y_test, dt_predictions)
```

```
print(f'Decision Tree Accuracy: {dt_accuracy}')
```

```
Decision Tree Accuracy: 0.7789115646258503
```

```
print(f'Decision Tree Classification Report:\n{dt_report}')
```

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

          No       0.90      0.84      0.87       255
         Yes       0.28      0.41      0.33        39

    accuracy                           0.78       294
   macro avg       0.59      0.62      0.60       294
weighted avg       0.82      0.78      0.80       294
```

Random Forest Classifier

```
from sklearn.ensemble import RandomForestClassifier
```

```
rf_model = RandomForestClassifier(random_state=50)
```

```
rf_model.fit(X_train, Y_train)
```

```
▾        RandomForestClassifier
RandomForestClassifier(random_state=50)
```

```
rf_predictions = rf_model.predict(X_test)
```

```
rf_accuracy = accuracy_score(Y_test, rf_predictions)
```

```
rf_report = classification_report(Y_test, rf_predictions)
```

```
print(f'Random Forest Accuracy: {rf_accuracy}')
```

```
Random Forest Accuracy: 0.8435374149659864
```

```
print(f'Random Forest Classification Report:\n{rf_report}')
```

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

          No       0.88      0.95      0.91       255
         Yes       0.33      0.18      0.23        39

    accuracy                           0.84       294
   macro avg       0.61      0.56      0.57       294
weighted avg       0.81      0.84      0.82       294
```