

Name	Kaviraj Y
Roll No	210419104082
Assignment No	2

1.DownloadingDataset:Chrun_Modelling

2. Load The Dataset

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

df = pd.read_csv('/content/drive/MyDrive/Churn_Modelling.csv')
df.head()
```

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age
0	1	15634602	Hargrave	619	France	Female	42
1	2	15647311	Hill	608	Spain	Female	41
2	3	15619304	Onio	502	France	Female	42
3	4	15701354	Boni	699	France	Female	39
4	5	15737888	Mitchell	850	Spain	Female	43

	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	\
0	2	0.00	1	1	1	
1	1	83807.86	1	0	1	
2	8	159660.80	3	1	0	
3	1	0.00	2	0	0	
4	2	125510.82	1	1	1	

	EstimatedSalary	Exited	0
0	101348.88	1	
1	112542.58	0	
2	113931.57	1	
3	93826.63	0	4
	79084.10	0	

```
df = df.drop(columns=['RowNumber', 'CustomerId', 'Surname'])
df.head()
```

	CreditScore	Geography	Gender	Age	Tenure	Balance
0	619	France	Female	42	2	0.00
1						
1	608	Spain	Female	41	1	83807.86
2	502	France	Female	42	8	159660.80
3						
3	699	France	Female	39	1	0.00
2						
4	850	Spain	Female	43	2	125510.82
1						

	HasCrCard	IsActiveMember	EstimatedSalary	Exited	0
1		1	101348.88	1	
1	0	1	112542.58	0	
2	1	0	113931.57	1	
3	0	0	93826.63	0	4
	1		79084.10	0	

```
df['IsActiveMember'] = df['IsActiveMember'].astype('category')
df['Exited'] = df['Exited'].astype('category') df['HasCrCard']
= df['HasCrCard'].astype('category')
```


3. Perform

Univariate Analysis

Bi - Variate Analysis

Multi - Variate Analysis

```
sns.kdeplot(x='CreditScore', data = df , hue = 'Exited')
plt.show()
```



A bar chart with 'index' on the x-axis and 'Exited' on the y-axis. The y-axis ranges from 0.0 to 0.8 with increments of 0.1. There are two bars: a blue bar for index 0 with a height of 0.8, and an orange bar for index 1 with a height of 0.2.

index	Exited
0	0.8
1	0.2

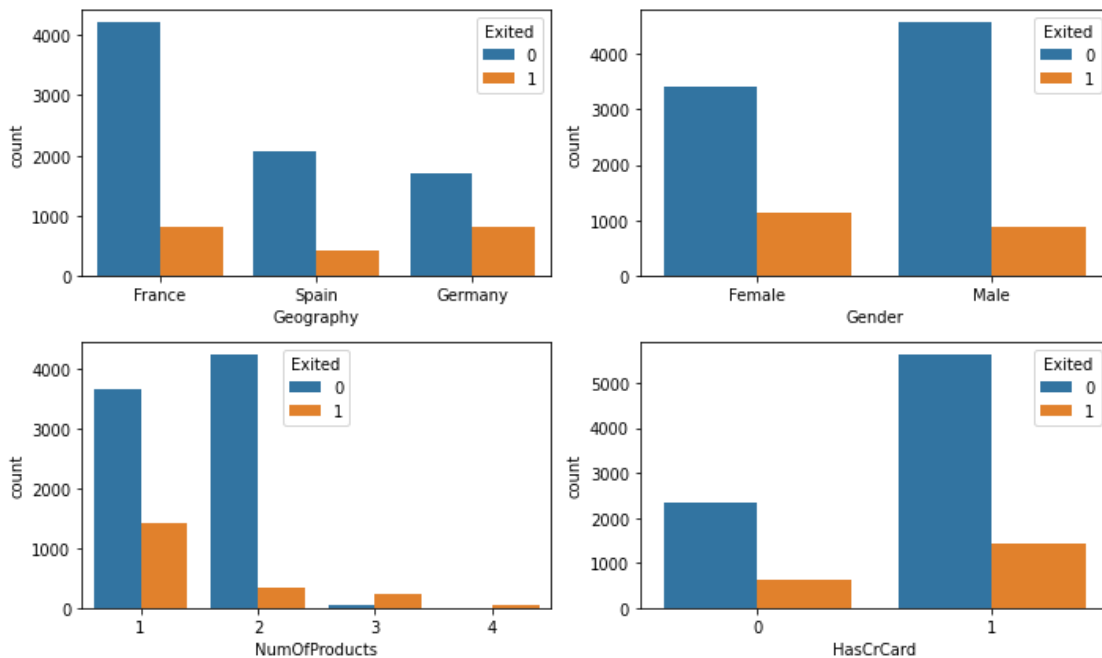
```

rows = int(np.ceil(categorical.shape[1] / 2)) - 1
fig, axes = plt.subplots(nrows=rows, ncols=2, figsize=(10,6))
axes.flatten()

for row in range(rows):
    cols = min(2, categorical.shape[1] - row*2)
    for col in range(cols):
        col_name = categorical.columns[2 * row + col]
        ax = axes[row*2 + col]

        sns.countplot(data=categorical, x=col_name, hue="Exited",
ax=ax);
        plt.tight_layout()

```



4. Descriptive statistics **bold text**

```

df.info()

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10000 entries, 0 to 9999
Data columns (total 11 columns):
 #   Column              Non-Null Count  Dtype
---  -
 0   CreditScore         10000 non-null  int64
 1   Geography           10000 non-null  object
Gender              10000 non-null  object
 3   Age                 10000 non-null  int64
 4   Tenure              10000 non-null  int64
                    10000 non-null  float64
 5   Balance
 6   NumOfProducts       10000 non-null  int64
HasCrCard           10000 non-null  category

```

```
IsActiveMember    10000 non-null category    9
EstimatedSalary  10000 non-null float64    10  Exited
10000 non-null category dtypes: category(3),
float64(2), int64(4), object(2) memory usage: 654.8+
KB df.describe()
```

	CreditScore	Age	Tenure	Balance
NumOfProducts \				
count	10000.000000	10000.000000	10000.000000	10000.000000
mean	650.528800	38.921800	5.012800	76485.889288
std	96.653299	10.487806	2.892174	62397.405202
min	350.000000	18.000000	0.000000	0.000000
25%	584.000000	32.000000	3.000000	0.000000
50%	652.000000	37.000000	5.000000	97198.540000
75%	718.000000	44.000000	7.000000	127644.240000
max	850.000000	92.000000	10.000000	250898.090000

	EstimatedSalary
count	10000.000000
mean	100090.239881
std	57510.492818
min	11.580000
25%	51002.110000
50%	100193.915000
75%	149388.247500
max	199992.480000

5.

Handle Missing Values

```
df.isna().sum()
```

CreditScore	0
Geography	0
Gender	0
Age	0
Tenure	0
Balance	0
NumOfProducts	0
HasCrCard	0
IsActiveMember	0
EstimatedSalary	0

```
Exited          0
dtype: int64
```

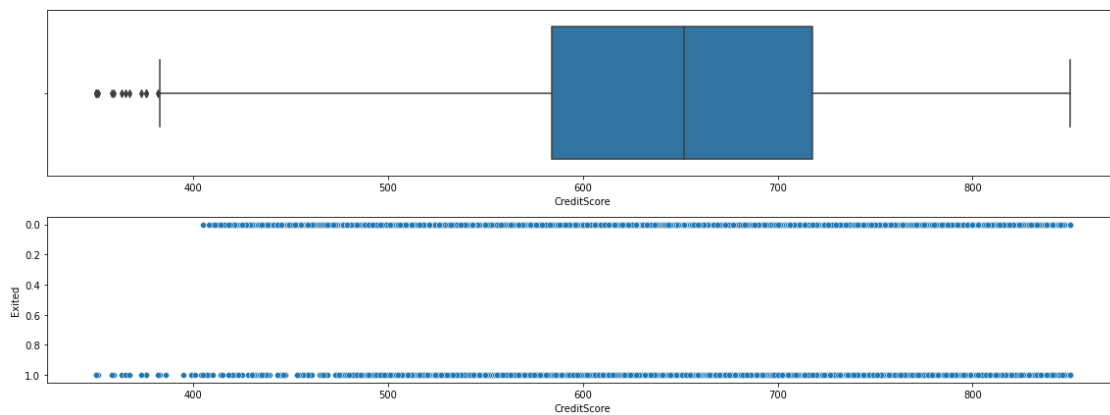
In this dataset there is no missing values

6. Find the outliers and replace the outliers Finding

Outliers

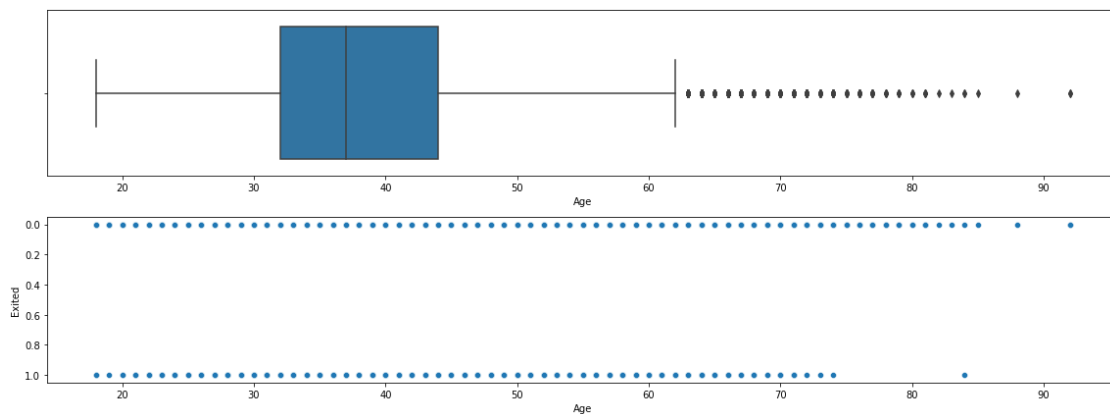
```
def box_scatter(data, x, y):
    fig, (ax1, ax2) = plt.subplots(nrows=2, ncols=1, figsize=(16,6))
    sns.boxplot(data=data, x=x, ax=ax1)
    sns.scatterplot(data=data, x=x, y=y, ax=ax2)
    box_scatter(df, 'CreditScore', 'Exited');
    plt.tight_layout()
    print(f"# of Bivariate Outliers: {len(df.loc[df['CreditScore'] < 400])}")
```

of Bivariate Outliers: 19



```
box_scatter(df, 'Age', 'Exited');
plt.tight_layout()
print(f"# of Bivariate Outliers: {len(df.loc[df['Age'] > 87])}")
```

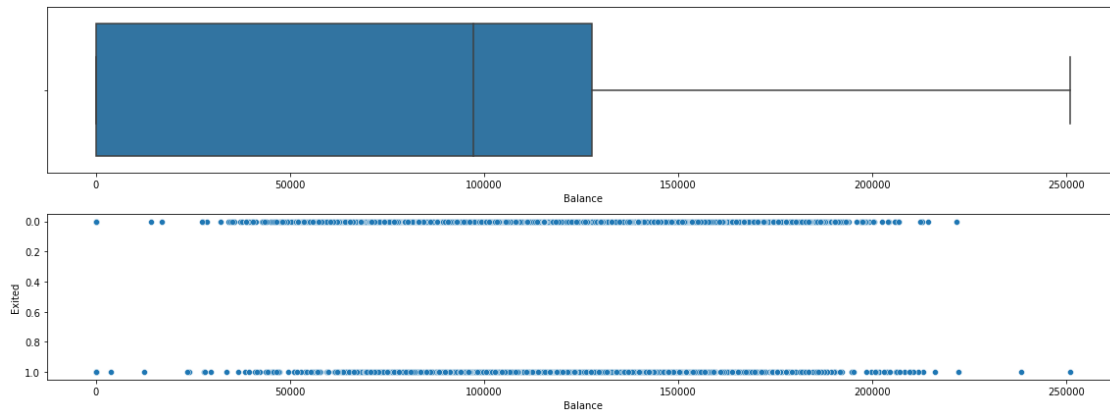
of Bivariate Outliers: 3



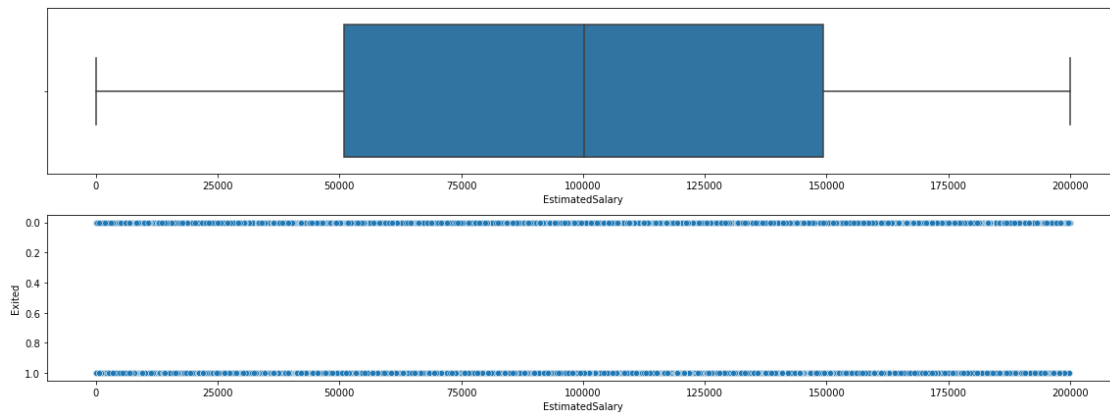
```
box_scatter(df, 'Balance', 'Exited');
plt.tight_layout()
```

```
print(f"# of Bivariate Outliers: {len(df.loc[df['Balance'] >
220000])}")
```

of Bivariate Outliers: 4



```
box_scatter(df, 'EstimatedSalary', 'Exited');
plt.tight_layout()
```

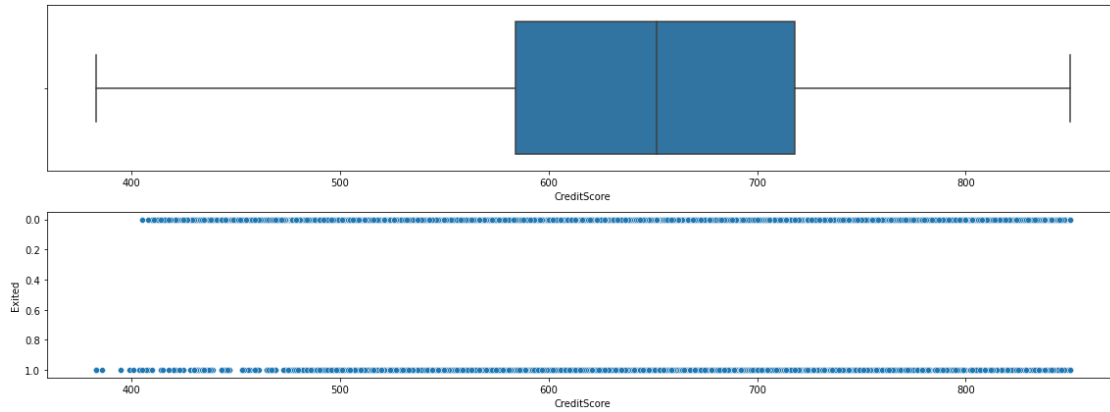


Removing The Outliers

```
for i in df:    if df[i].dtype=='int64' or
df[i].dtypes=='float64':
q1=df[i].quantile(0.25)    q3=df[i].quantile(0.75)
iqr=q3-q1    upper=q3+1.5*iqr    lower=q1-
1.5*iqr
df[i]=np.where(df[i] >upper, upper, df[i])
df[i]=np.where(df[i] <lower, lower, df[i])

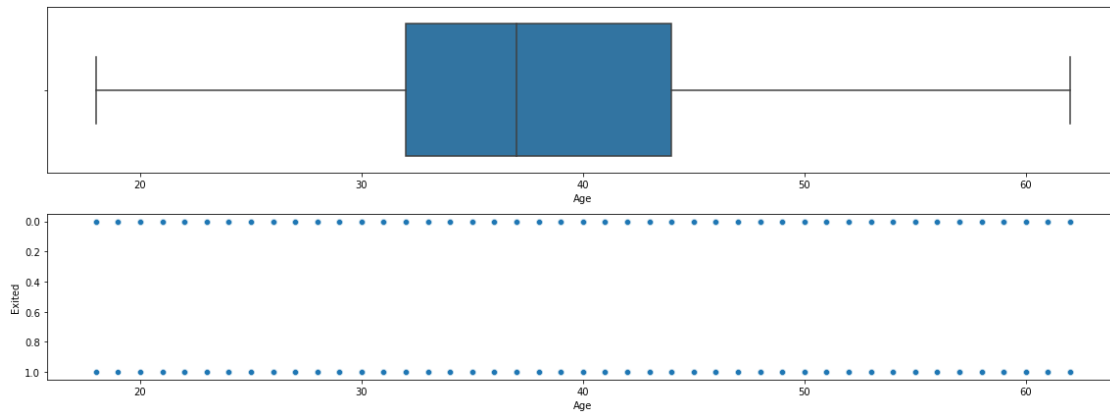
box_scatter(df, 'CreditScore', 'Exited');
plt.tight_layout()
print(f"# of Bivariate Outliers: {len(df.loc[df['CreditScore'] <
400])}")
```

of Bivariate Outliers: 19



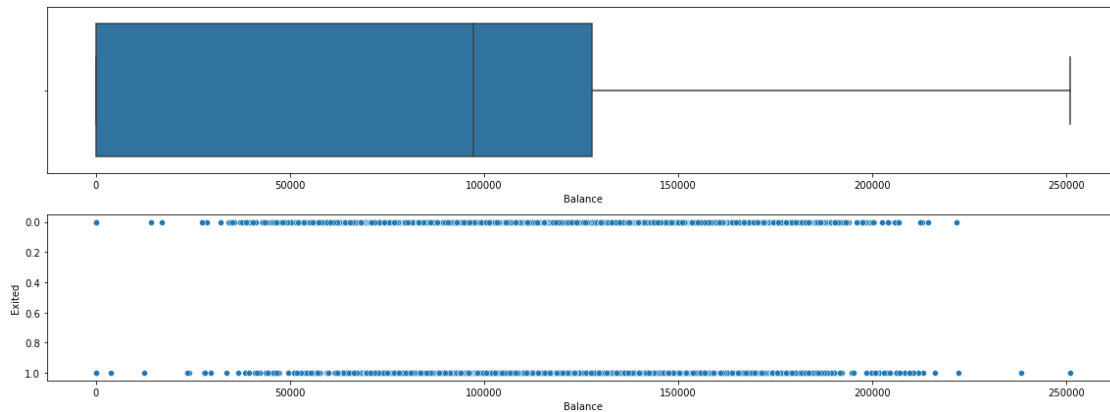
```
box_scatter(df, 'Age', 'Exited');
plt.tight_layout()
print(f"# of Bivariate Outliers: {len(df.loc[df['Age'] > 87])}")

# of Bivariate Outliers: 0
```



```
box_scatter(df, 'Balance', 'Exited');
plt.tight_layout()
print(f"# of Bivariate Outliers: {len(df.loc[df['Balance'] > 220000])}")

# of Bivariate Outliers: 4
```



7. Check for Categorical columns and perform encoding.


```
from sklearn.preprocessing import LabelEncoder
encoder=LabelEncoder() for i in df: if
df[i].dtype=='object' or df[i].dtype=='category':
df[i]=encoder.fit_transform(df[i])
```

8. Split the data into dependent and independent variables.

```
x=df.iloc[:, :-1]
x.head()
```

	CreditScore	Geography	Gender	Age	Tenure	Balance
0	619.0	0	0	42.0	2.0	0.00
1	608.0	2	0	41.0	1.0	83807.86
2	502.0	0	0	42.0	8.0	159660.80
3	699.0	0	0	39.0	1.0	0.00
4	850.0	2	0	43.0	2.0	125510.82

	HasCrCard	IsActiveMember	EstimatedSalary
0	1	1	101348.88
1	0	1	112542.58
2	1	0	113931.57
3	0	0	93826.63
	1		79084.10

```
y=df.iloc[:, -1]
y.head()
```

```
0    1
1    0
2    1
3    0
4    0
Name: Exited, dtype: int64
```

9. Scale the independent variables

```
from sklearn.preprocessing import StandardScaler
scaler=StandardScaler()
x=scaler.fit_transform(x) print(x)
```

```
[[-0.32687761 -0.90188624 -1.09598752 ... 0.64609167 0.97024255
 0.02188649]
 [-0.44080365 1.51506738 -1.09598752 ... -1.54776799 0.97024255
 0.21653375]]
```

```

[-1.53863634 -0.90188624 -1.09598752 ...  0.64609167 -1.03067011
0.2406869 ]
...
[ 0.60524449 -0.90188624 -1.09598752 ... -1.54776799  0.97024255
-1.00864308]
[ 1.25772996  0.30659057  0.91241915 ...  0.64609167 -1.03067011
-0.12523071]
[ 1.4648682  -0.90188624 -1.09598752 ...  0.64609167 -1.03067011  -
1.07636976]]

```

10. Split the data into training and testing.

```

from sklearn.model_selection import train_test_split
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.20)

print(x_train.shape)
print(x_test.shape)

(8000, 10)
(2000, 10)

print(y_train.shape)
print(y_test.shape)

(8000,)
(2000,)

```