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Assignment Number	01

1.DownloadDataset: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     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()
```

```
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               1         79084.10       0
```

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

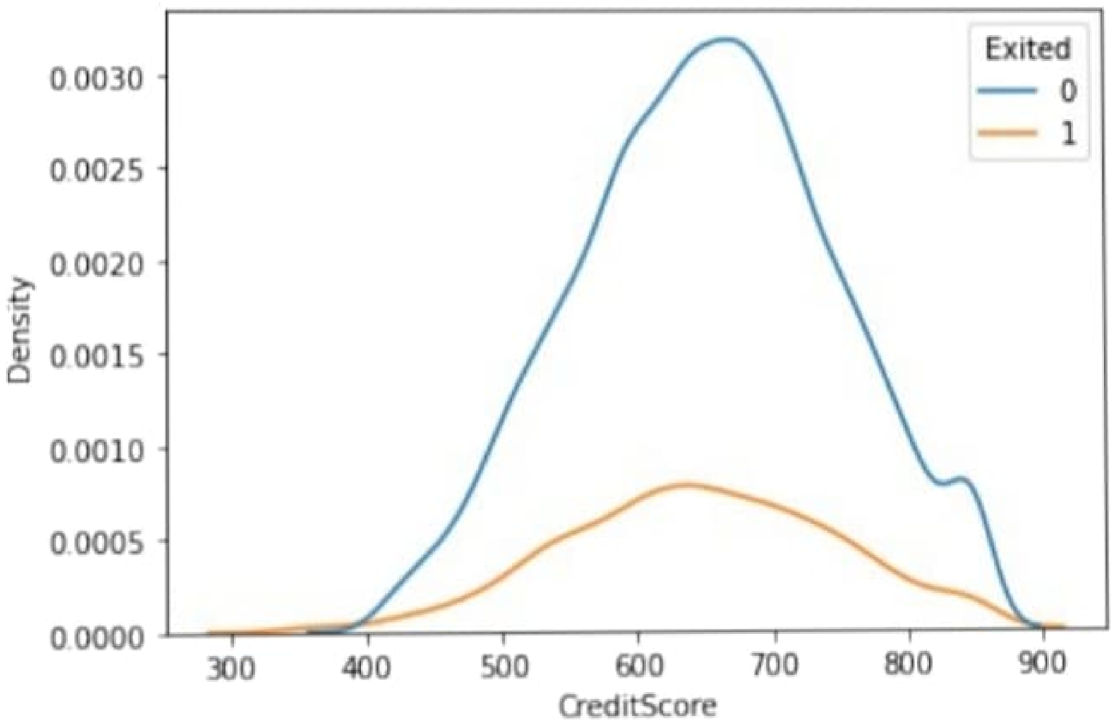
3. Perform

Univariate Analysis

Bi - Variate Analysis

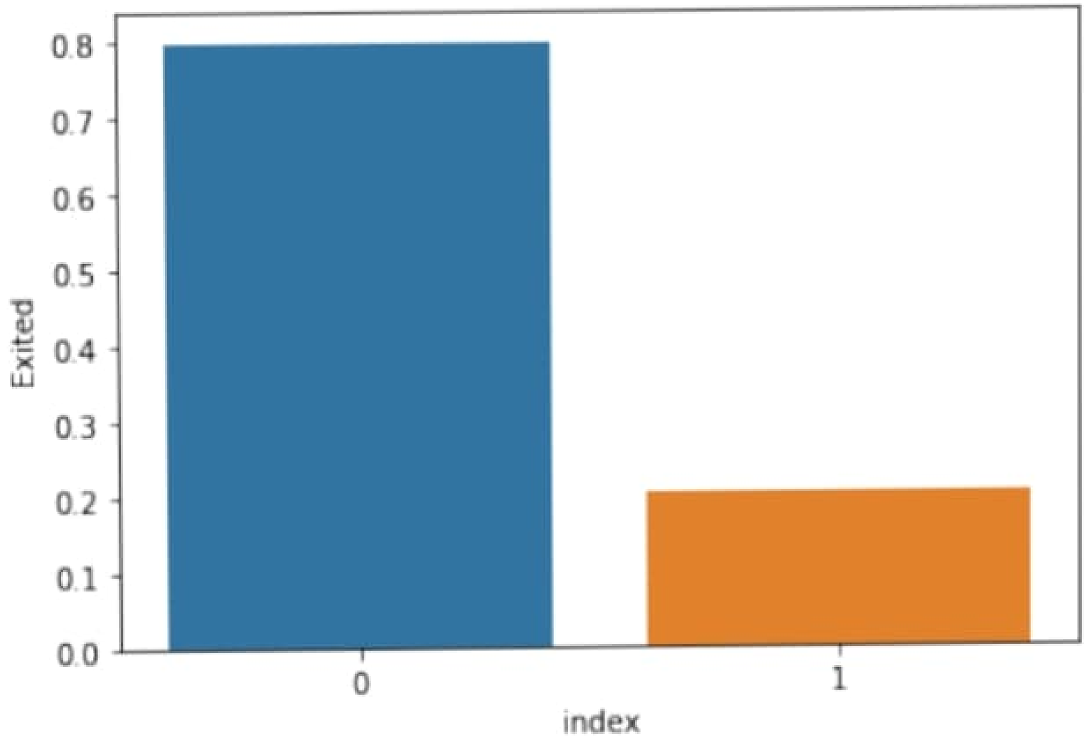
Multi - Variate Analysis

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



```
density = df['Exited'].value_counts(normalize=True).reset_index()
sns.barplot(data=density, x='index', y='Exited', );
density
```

```
   index  Exited
0      0  0.7963
1      1  0.2037
```

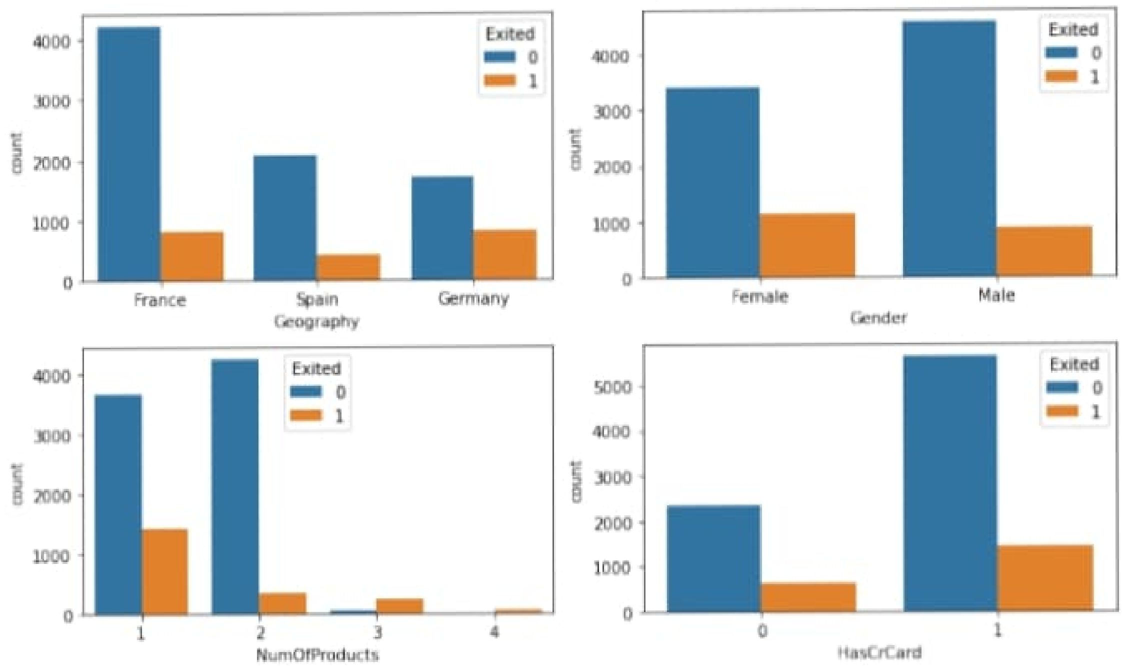



```
categorical = df.drop(columns=['CreditScore', 'Age', 'Tenure',
'Balance', 'EstimatedSalary'])
rows = int(np.ceil(categorical.shape[1] / 2)) - 1
fig, axes = plt.subplots(nrows=rows, ncols=2, figsize=(10,6))
axes = axes.flatten()

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
 2   Gender           10000 non-null  object
 3   Age              10000 non-null  int64
 4   Tenure           10000 non-null  int64
 5   Balance          10000 non-null  float64
 6   NumOfProducts    10000 non-null  int64
 7   HasCrCard        10000 non-null  category
 8   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
10000.000000
mean     650.528800     38.921800      5.012800   76485.889288
1.530200
```

```
std        96.653299     10.487806      2.892174   62397.405202
0.581654
min       350.000000     18.000000      0.000000       0.000000
1.000000
25%       584.000000     32.000000      3.000000       0.000000
1.000000
50%       652.000000     37.000000      5.000000   97198.540000
1.000000
75%       718.000000     44.000000      7.000000  127644.240000
2.000000
max       850.000000     92.000000     10.000000  250898.090000
4.000000

       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

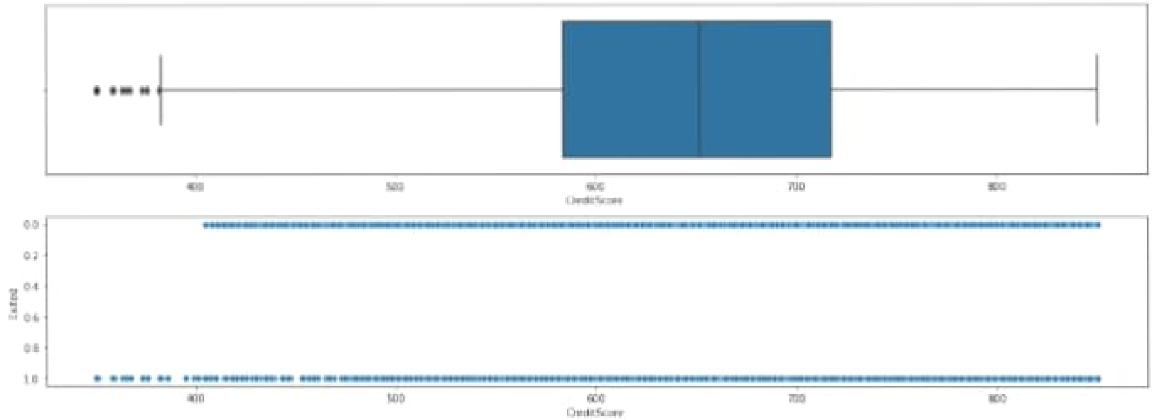
6. Find the outliers and replace the outliers

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)
```

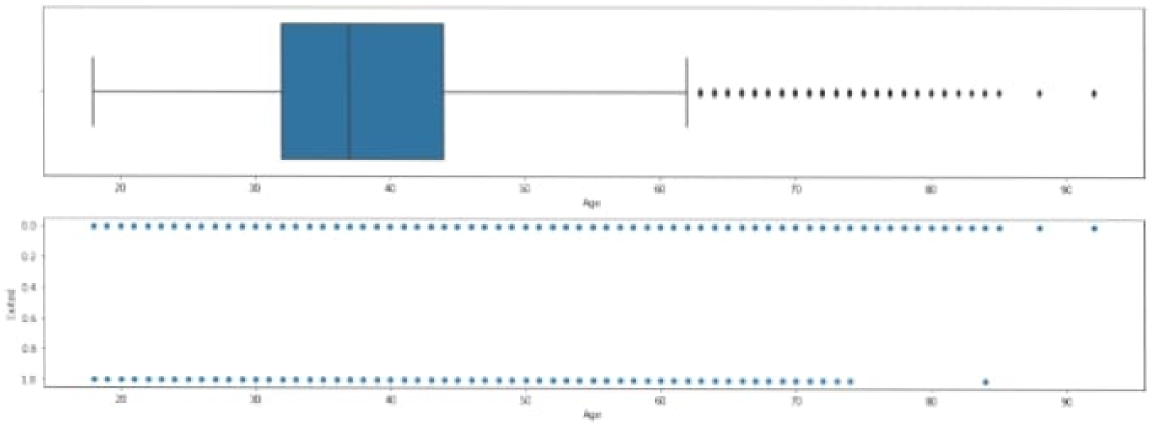
```
box_scatter(df,'CreditScore','Exited');
plt.tight_layout()
print(f"# of Bivariate Outliers: {len(df.loc[df['CreditScore'] <
400])}")
```

```
# of Bivariate Outliers: 19
```



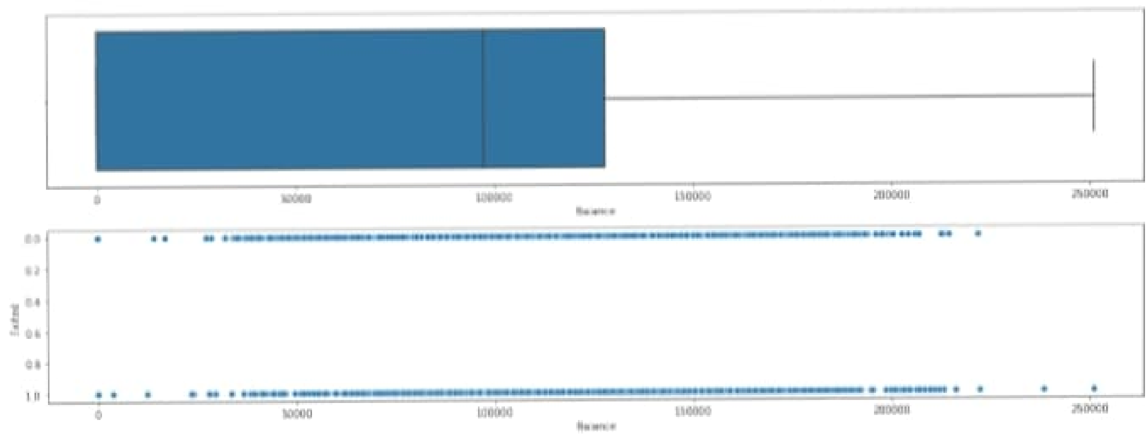
```
box_scatter(df,'Age','Exited');
plt.tight_layout()
print(f"# of Bivariate Outliers: {len(df.loc[df['Age'] > 87])}")
```

```
# of Bivariate Outliers: 3
```

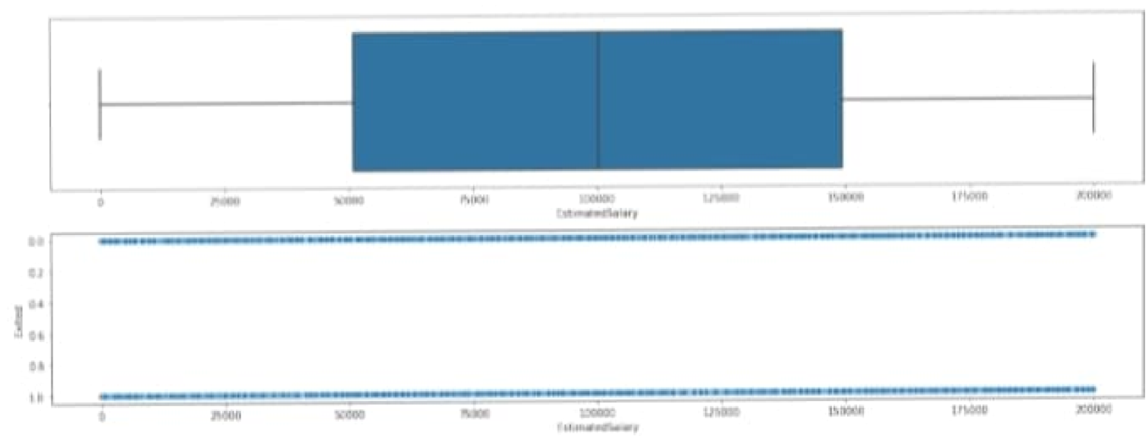


```
box_scatter(df,'Balance','Exited');
plt.tight_layout()
print(f"# of Bivariate Outliers: {len(df.loc[df['Balance'] >
220000])}")
```

```
# of Bivariate Outliers: 4
```



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

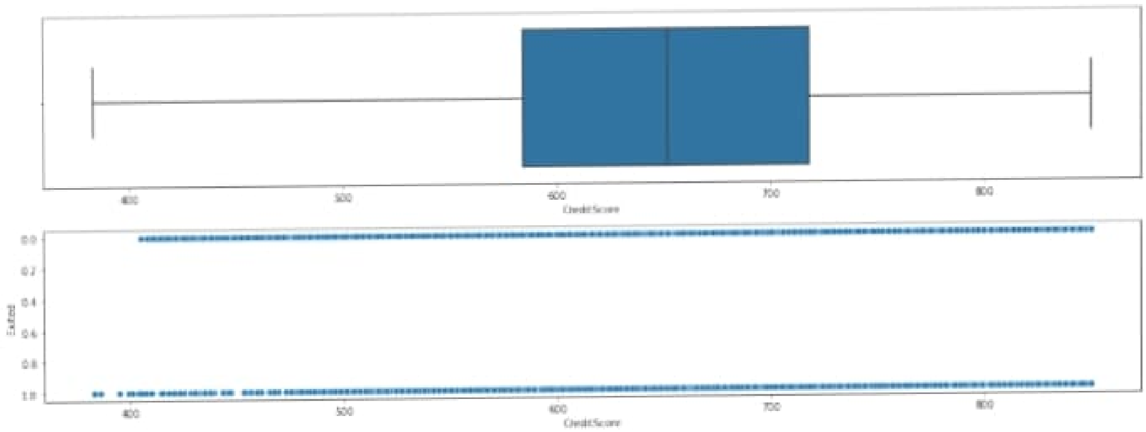


Removing The Outliers

```
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])
```

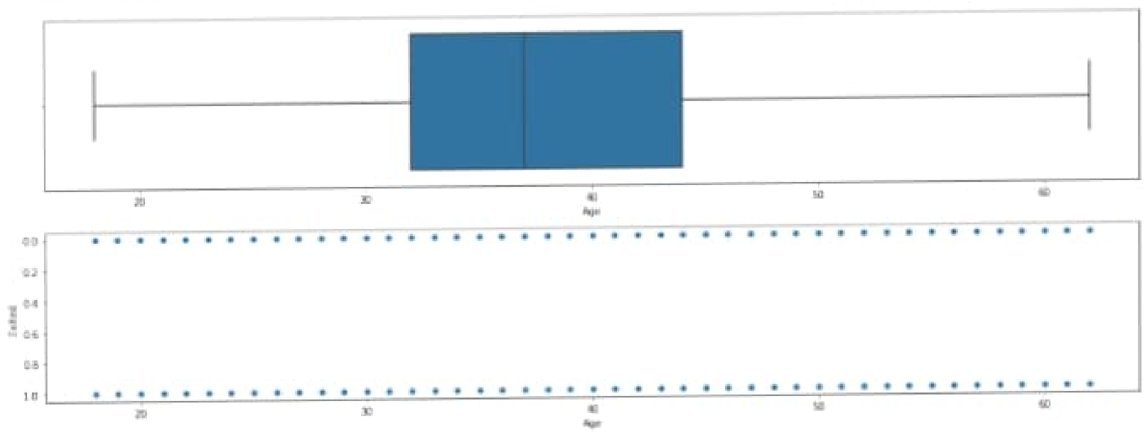
```
box_scatter(df,'CreditScore','Exited');
plt.tight_layout()
print(f"# of Bivariate Outliers: {len(df.loc[df['CreditScore'] <
400])}")
```

```
# of Bivariate Outliers: 19
```



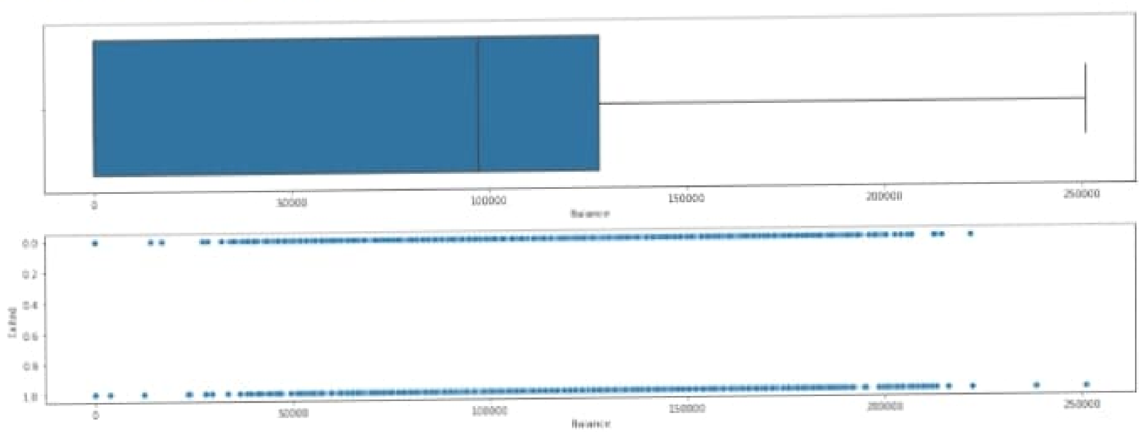
```
box_scatter(df,'Age','Exited');
plt.tight_layout()
print(f"# of Bivariate Outliers: {len(df.loc[df['Age'] > 87])}")
```

```
# 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  
NumOfProducts  \
0        619.0          0       0  42.0     2.0       0.00  
1.0
1        608.0          2       0  41.0     1.0   83807.86  
1.0
2        502.0          0       0  42.0     8.0  159660.80  
3.0
3        699.0          0       0  39.0     1.0       0.00  
2.0
4        850.0          2       0  43.0     2.0  125510.82  
1.0

   HasCrCard  IsActiveMember  EstimatedSalary
0          1               1        101348.88
1          0               1        112542.58
2          1               0        113931.57
3          0               0         93826.63
4          1               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,)
```