1. Download the dataset: Dataset

2. Load the dataset.

```
import pandas as pd
import numpy as np
```

```
file=pd.read_csv("C:/Users/deva/Desktop/2nd year online class/nalaiya thiran/assignment 2/Modelling.csv
df=pd.DataFrame(file)
df.head()
```

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfP
0	1	15634602	Hargrave	619	France	Female	42	2	0.00	
1	2	15647311	Hill	608	Spain	Female	41	1	83807.86	
2	3	15619304	Onio	502	France	Female	42	8	159660.80	
3	4	15701354	Boni	699	France	Female	39	1	0.00	
4	5	15737888	Mitchell	850	Spain	Female	43	2	125510.82	

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

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

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

```
df.head()
```

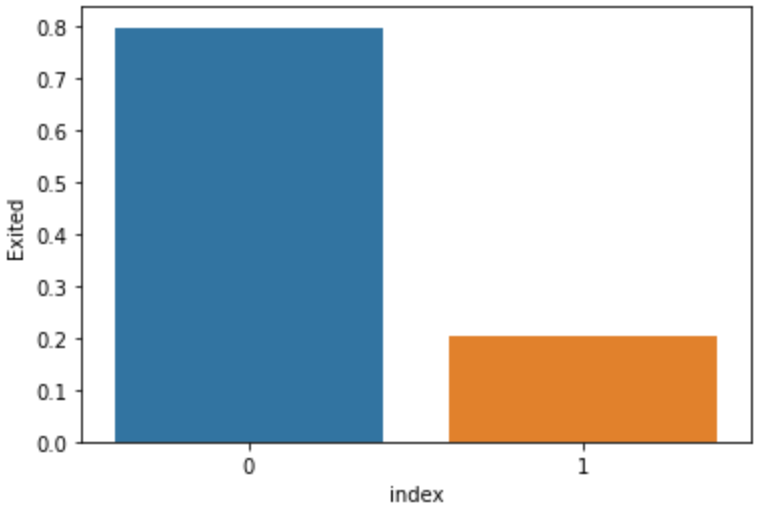
	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMembe
0	619	France	Female	42	2	0.00	1	1	
1	608	Spain	Female	41	1	83807.86	1	0	
2	502	France	Female	42	8	159660.80	3	1	
3	699	France	Female	39	1	0.00	2	0	
4	850	Spain	Female	43	2	125510.82	1	1	

3. Perform Below Visualizations.

- Univariate Analysis
- Bi - Variate Analysis
- Multi - Variate Analysis

```
import seaborn as sns
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



▾ the data is significantly imbalanced

```
import matplotlib.pyplot as plt
```

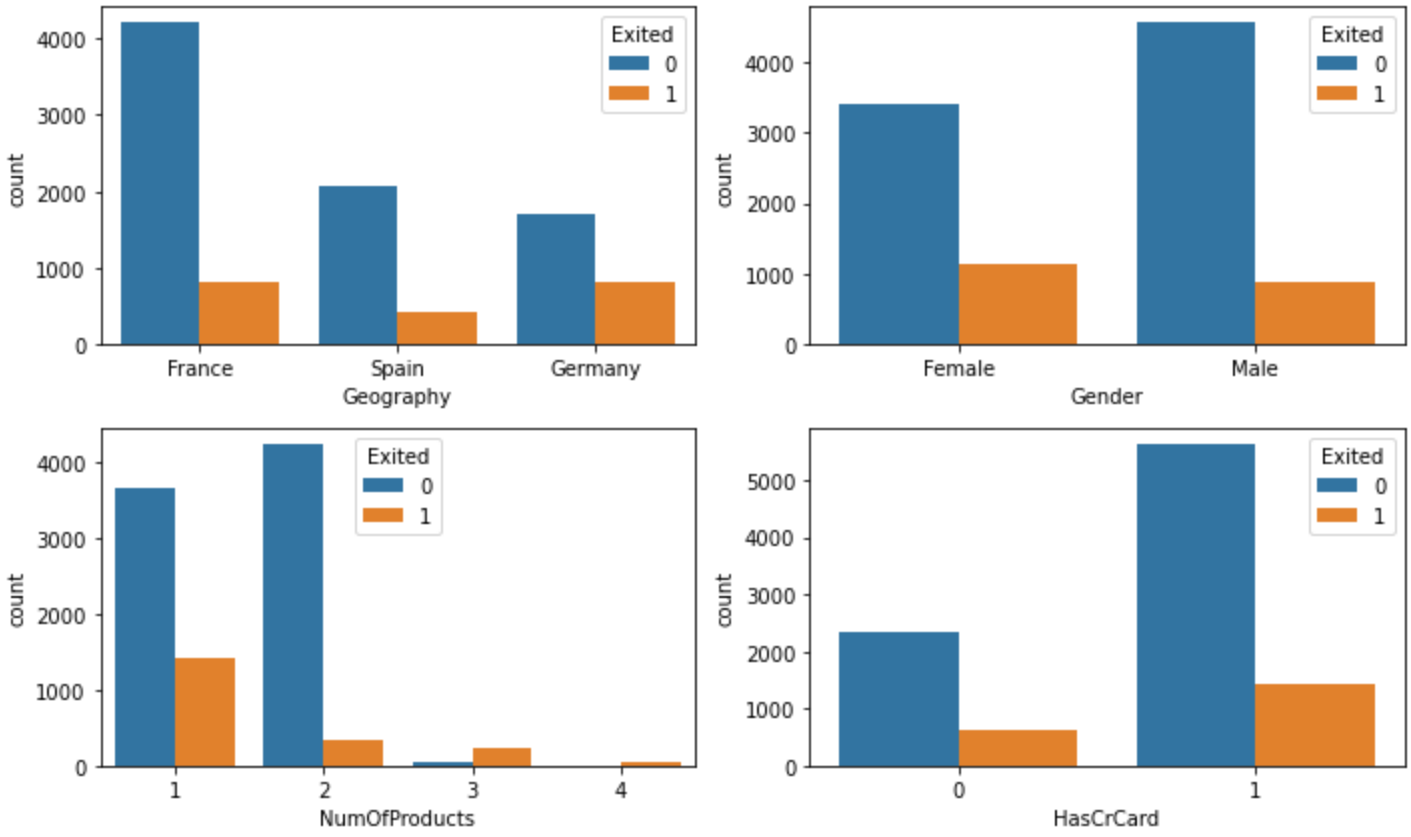
```
categorical = df.drop(columns=['CreditScore', 'Age', 'Tenure', 'Balance', 'EstimatedSalary'])
rows = int(np.ceil(categorical.shape[1] / 2)) - 1

# create sub-plots anf title them
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. Perform descriptive statistics on the dataset.

```
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: 654.7+ KB
```

```
df.describe()
```

	CreditScore	Age	Tenure	Balance	NumOfProducts	EstimatedSalary
count	10000.000000	10000.000000	10000.000000	10000.000000	10000.000000	10000.000000
mean	650.561300	38.660800	5.012800	76485.889288	1.527200	100090.239881
std	96.558702	9.746704	2.892174	62397.405202	0.570081	57510.492818
min	383.000000	18.000000	0.000000	0.000000	1.000000	11.580000
25%	584.000000	32.000000	3.000000	0.000000	1.000000	51002.110000
50%	652.000000	37.000000	5.000000	97198.540000	1.000000	100193.915000
75%	718.000000	44.000000	7.000000	127644.240000	2.000000	149388.247500
max	850.000000	62.000000	10.000000	250898.090000	3.500000	199992.480000

5. Handle the 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
```

there is no missing values in dataset

[ ] ↳ *1 cell hidden*

6. Find the outliers and replace the outliers

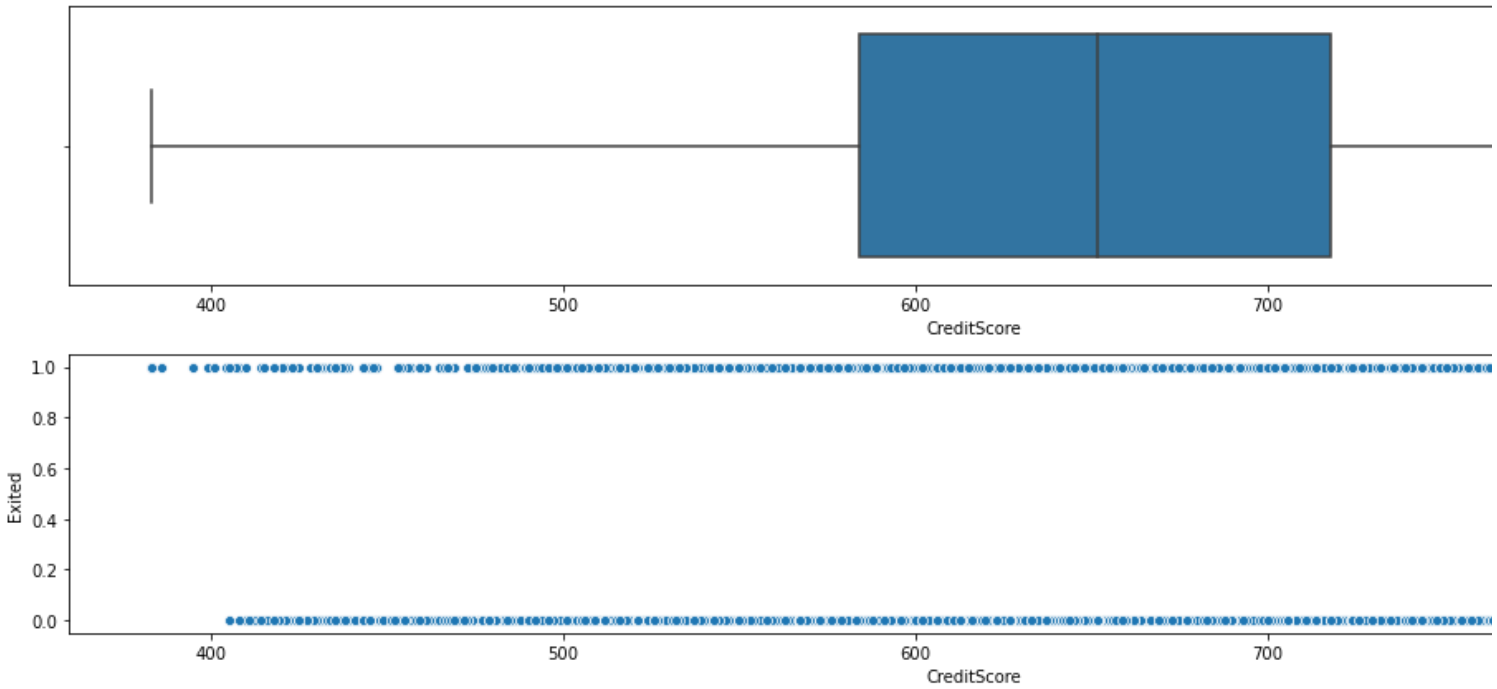
Checking for outliers

```
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
```

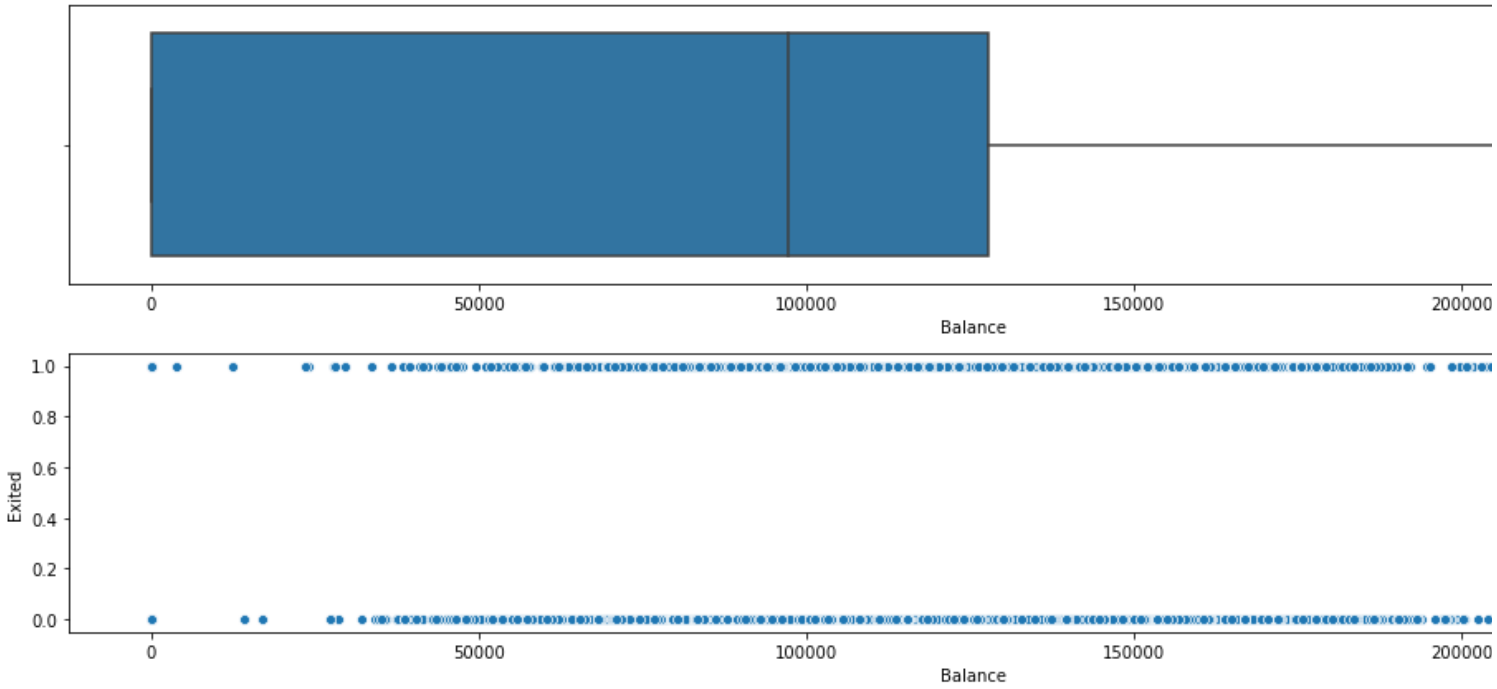



```
box_scatter(df,'Age','Exited');
plt.tight_layout()
print(f"# of Bivariate Outliers: {len(df.loc[df['Age'] > 87])}")
```

```
# of Bivariate Outliers: 0
```

```
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()
```

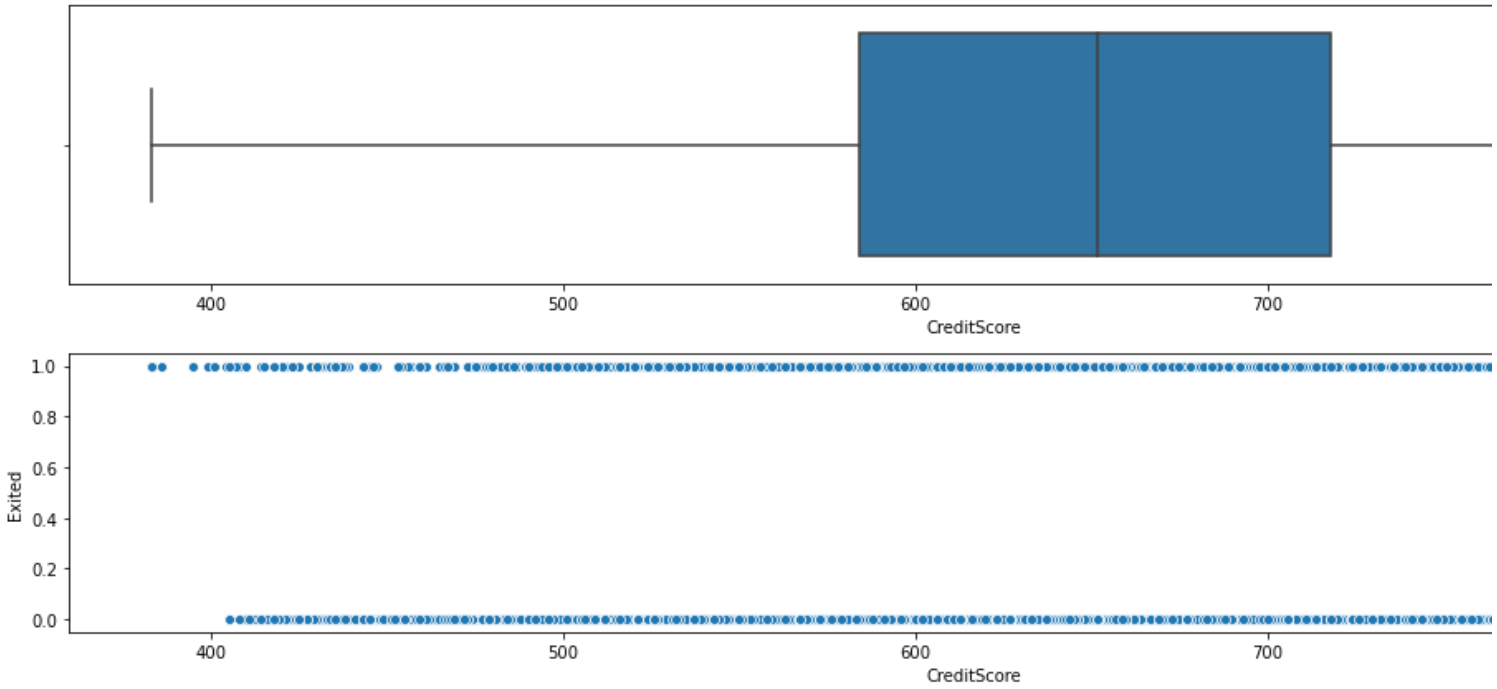
Removing outliers

```
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])
```

After removing outliers, boxplot will be like

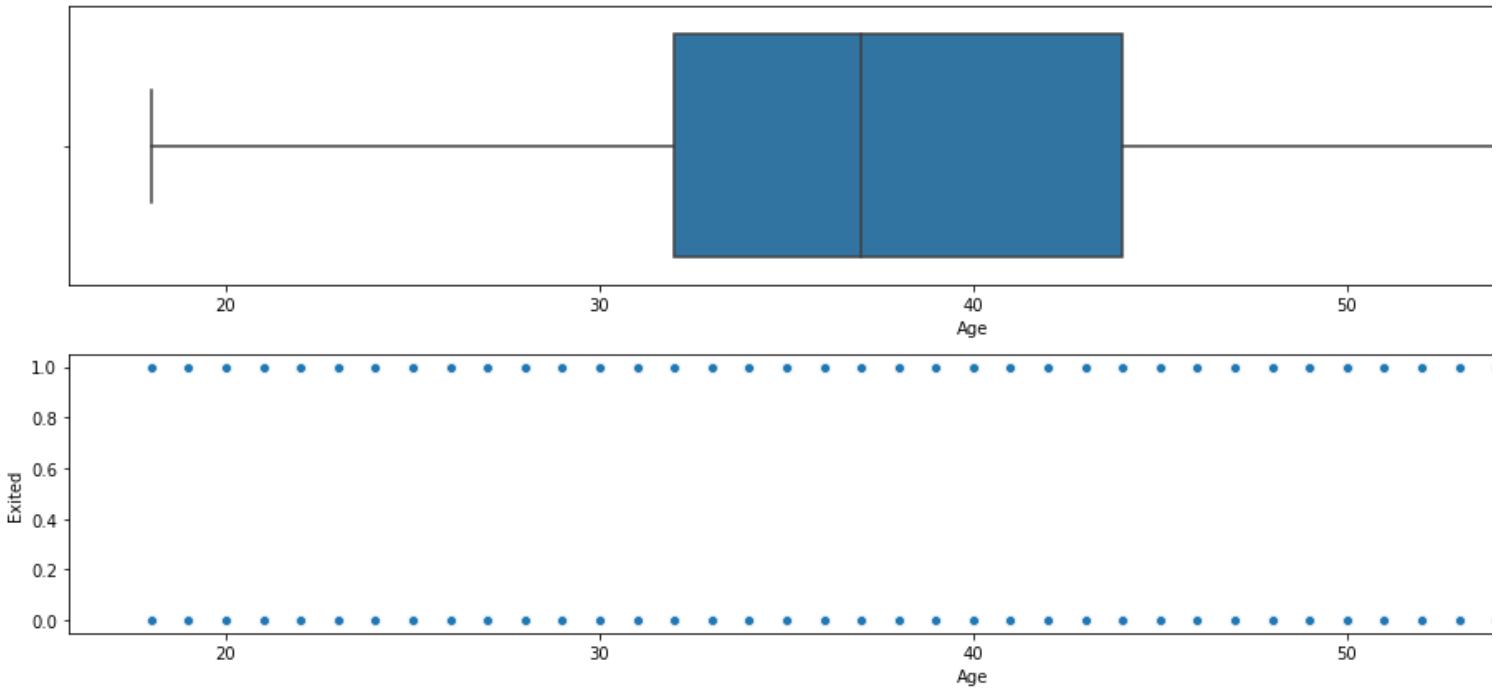
```
box_scatter(df,'CreditScore','Exited');
plt.tight_layout()
print(f"# of Bivariate Outliers: {len(df.loc[df['CreditScore'] < 400])}")
```

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



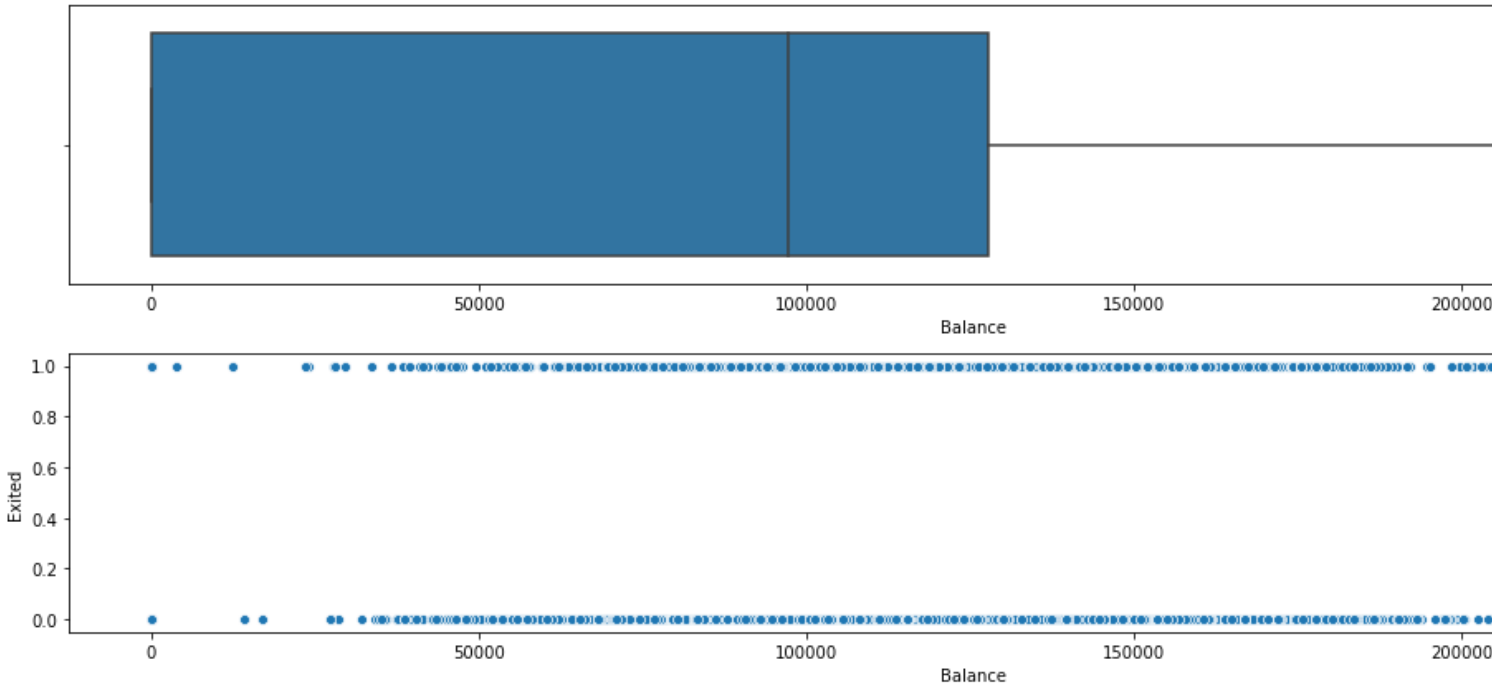

```
box_scatter(df,'Age','Exited');
plt.tight_layout()
print(f"# of Bivariate Outliers: {len(df.loc[df['Age'] > 87])}")
```

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

```
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)
```

```
x
```

```
array([[-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=0.33)
```

```
x_train.shape
```

```
(6700, 10)
```

```
x_test.shape
```

```
(3300, 10)
```

```
y_train.shape
```

```
(6700,)
```

```
y_test.shape
```

```
(3300,)
```