

Assignment -2
Python Programming

| | |
|---------------------|-----------------------|
| Assignment Date | 26-SEPTEMBER-2022 |
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| Student Roll Number | 113319104053 |
| Maximum Marks | 2 Marks |

Question-1:

Download the dataset: Dataset

Solution:

Downloaded successfully

Question-2:

Load the dataset.

Solution:

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

```
file=pd.read_csv("/content/Churn_Modelling (1).csv")
df=pd.DataFrame(file)
df.head()
```

| RowNumber | CustomerId | Surname | CreditScore | Geography | Gender | Age | Tenure | Balance | NumOfProducts | HasCrCard | IsActiveMember | EstimatedSalary |
|-----------|------------|----------|-------------|-----------|--------|--------|--------|---------|---------------|-----------|----------------|-----------------|
| 0 | 1 | 15634602 | Hargrave | 619 | France | Female | 42 | 2 | 0.00 | 1 | 1 | 101348.88 |
| 1 | 2 | 15647311 | Hill | 608 | Spain | Female | 41 | 1 | 83807.86 | 1 | 0 | 112542.58 |
| 2 | 3 | 15619304 | Onio | 502 | France | Female | 42 | 8 | 159660.80 | 3 | 1 | 113931.57 |
| 3 | 4 | 15701354 | Boni | 699 | France | Female | 39 | 1 | 0.00 | 2 | 0 | 93826.63 |
| 4 | 5 | 15737888 | Mitchell | 850 | Spain | Female | 43 | 2 | 125510.82 | 1 | 1 | 79084.10 |

```
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 | IsActiveMember | EstimatedSalary | Exited |
|-----|-------------|-----------|--------|-----|--------|-----------|---------------|-----------|----------------|-----------------|--------|
| 0 | 619 | France | Female | 42 | 2 | 0.00 | 1 | 1 | 1 | 101348.88 | 1 |
| 1 | 608 | Spain | Female | 41 | 1 | 83807.86 | 1 | 0 | 1 | 112542.58 | 0 |
| 2 | 502 | France | Female | 42 | 8 | 159660.80 | 3 | 1 | 0 | 113931.57 | 1 |
| 3 | 699 | France | Female | 39 | 1 | 0.00 | 2 | 0 | 0 | 93826.63 | 0 |
| 4 | 850 | Spain | Female | 43 | 2 | 125510.82 | 1 | 1 | 1 | 79084.10 | 0 |

Question 3:

Perform Below Visualizations:

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

Solution:

```
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
```

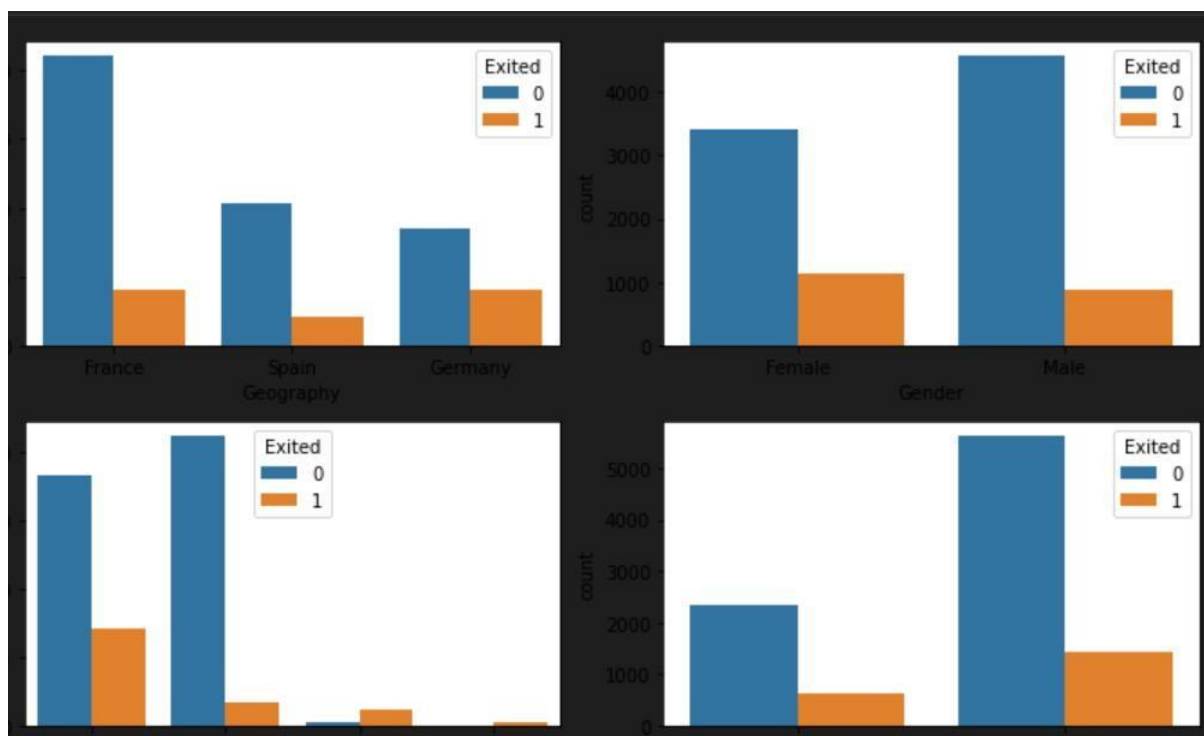
```
categorical = df.drop(columns=['CreditScore', 'Age', 'Tenure', 'Balance', 'EstimatedSalary'])
rows = int(np.ceil(categorical.shape[1] / 2)) - 1
```

```
# create sub-plots and 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()
```



Question 4:

Perform descriptive statistics on the dataset.

Solution:

```
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 |

Question 5:

Handle the Missing values.

Solution:

```
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

```
for i in df:
```

```
if df[i].dtype == 'object' or df[i].dtype == 'category':
    print("unique of " + i + " is " + str(len(set(df[i]))) + " they are " + str(set(df[i])))
```

unique of Geography is 3 they are {'France', 'Germany', 'Spain'}

unique of Gender is 2 they are {'Male', 'Female'}

unique of Has CrCard is 2 they are {0,1}

unique of Is Active Member is 2 they are {0,1}

unique of Exited is 2 they are {0,1}

Question 6:

Find the outliers and replace the outliers.

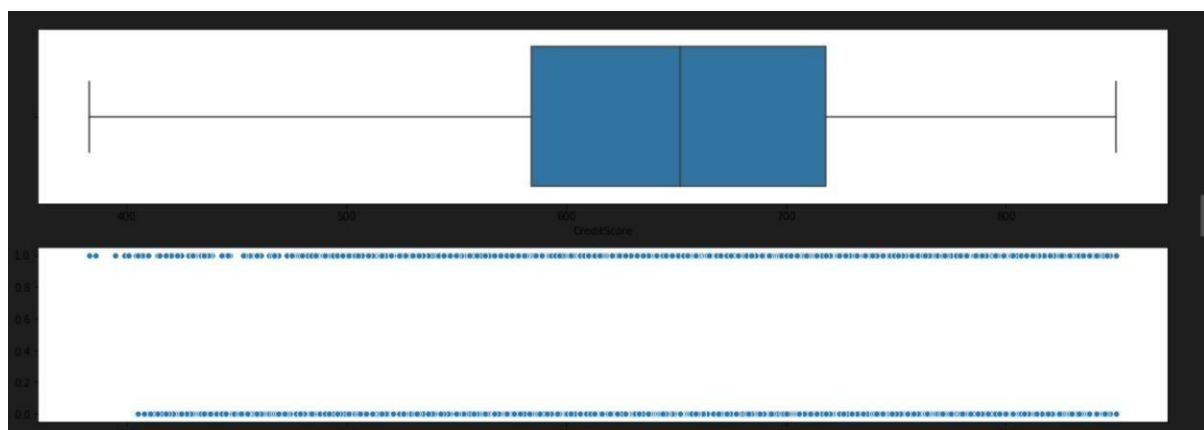
Solution:

Checking for outliers

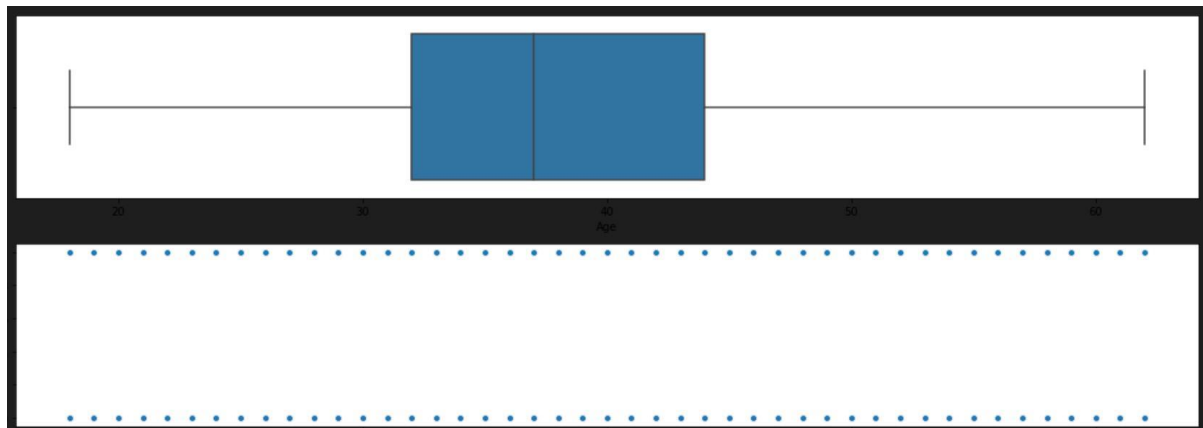
```
def box_scatter(data, x, y):
    fig, (ax1, ax2) = plt.subplots(nrows=2, ncols=1, figsize=(16,6))
    sns.boxplot(data=data, x=x, ax=ax1)
    sns.scatterplot(data=data, x=x, y=y, ax=ax2)
```

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

of bivariate Outliers: 19

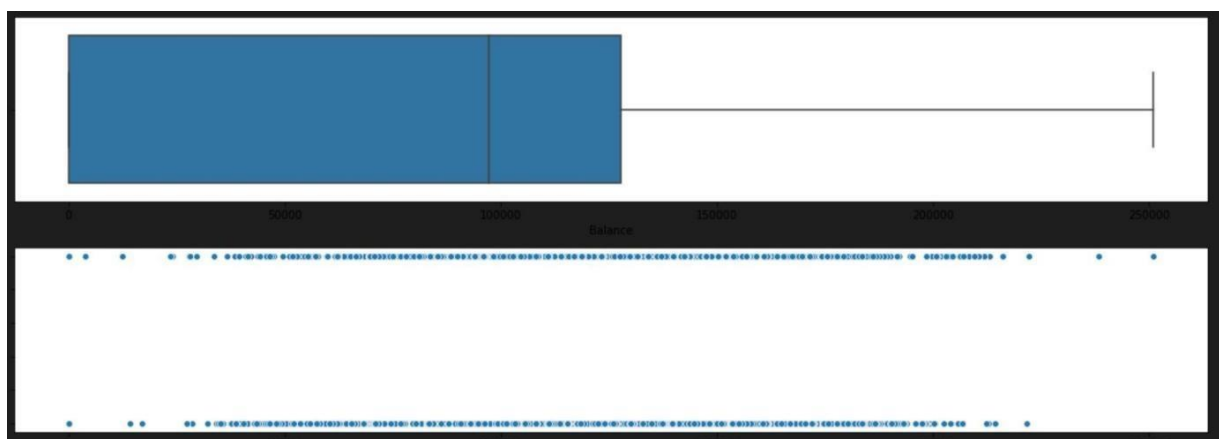


```
box_scatter(df, 'Age', 'Exited');
plt.tight_layout()
print(f"# of Bivariate Outliers: {len(df.loc[df['Age'] > 87])}")
# of bivariate Outliers: 0
```

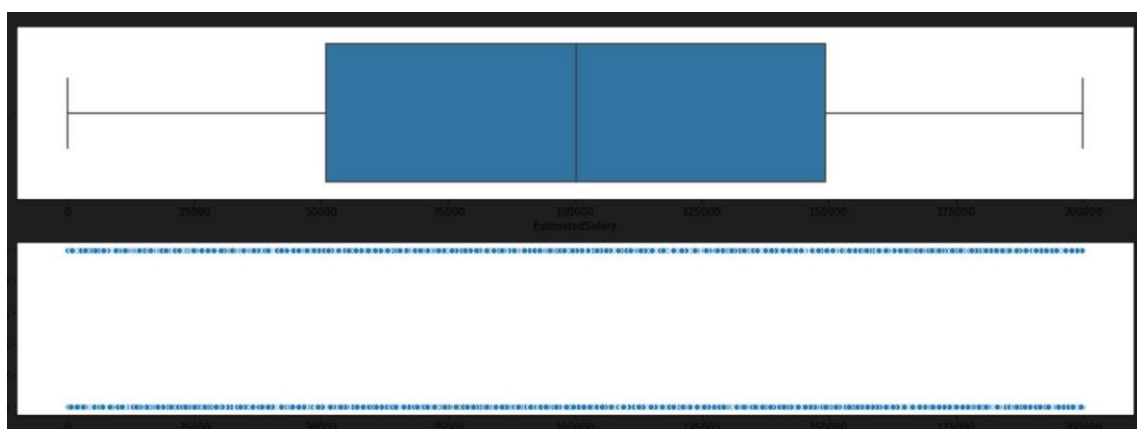


```
box_scatter(df,'Balance','Exited');
plt.tight_layout()
print(f"# of Bivariate Outliers: {len(df.loc[df['Balance'] > 220000])}")
```

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].dtype == '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

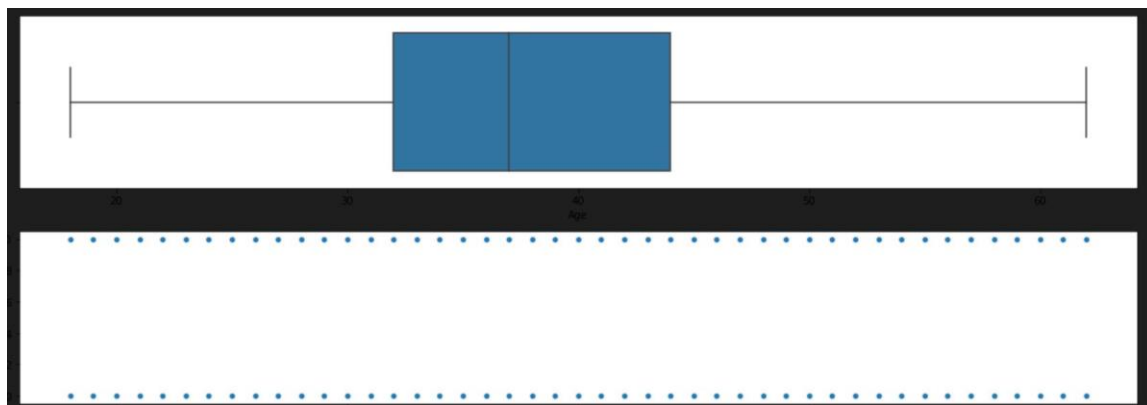
```
box_scatter(df, 'CreditScore', 'Exited');
plt.tight_layout()
print(f"# of Bivariate Outliers: {len(df.loc[df['CreditScore'] < 400])}")
```

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



Question 7:

Check for Categorical columns and perform encoding.

Solution:

```
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])
```

Question 8:

Split the data into dependent and independent variables.

Solution:

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


| | CreditScore | Geography | Gender | Age | Tenure | Balance | NumOfProducts | HasCrCard | IsActiveMember | EstimatedSalary |
|---|-------------|-----------|--------|-----|--------|---------|---------------|-----------|----------------|-----------------|
| 0 | 619.0 | | 0 | 0 | 42.0 | 2.0 | 0.00 | 1.0 | 1 | 101348.88 |
| 1 | 608.0 | | 2 | 0 | 41.0 | 1.0 | 83807.86 | 1.0 | 0 | 112542.58 |
| 2 | 502.0 | | 0 | 0 | 42.0 | 8.0 | 159660.80 | 3.0 | 1 | 113931.57 |
| 3 | 699.0 | | 0 | 0 | 39.0 | 1.0 | 0.00 | 2.0 | 0 | 93826.63 |
| 4 | 850.0 | | 2 | 0 | 43.0 | 2.0 | 125510.82 | 1.0 | 1 | 79084.10 |

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

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

Question 9:

Scale the independent variables

Solution:

```
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]])
```

Question 10:

Split the data into training and testing

Solution:

```
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
```

Python

```
(6700, 10)
```

```
x_test.shape
```

Python

```
(3300, 10)
```

```
y_train.shape
```

Python

```
(6700,)
```

```
y_test.shape
```

Python

```
(3300,)
```