# Assignment -2

Data Visualization and Pre-Processing

| | |
|---|---|
| Assignment Date | 26 September 2022 |
| Student Name | J.Kavipriya |
| Student Roll Number | 9517201906020 |
| Maximum Marks | 2 Marks |

**Question 1 - Load the dataset.**

SOLUTION:

```
import pandas as pd

import numpy as np

import matplotlib.pyplot as plt

import seaborn as sns

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

OUTPUT:

Importing necessary libraries

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

Loading the dataset

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

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

**Question 2 - Perform  Univariate, Bivariate and Multivariate Analysis**

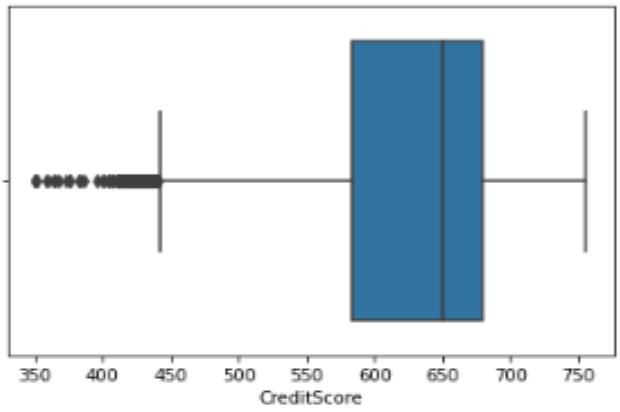
SOLUTION:

```
sns.boxplot(df['CreditScore'])
sns.boxplot(df['Age'])
sns.boxplot(df['Tenure'])
sns.boxplot(df['Balance'])
sns.boxplot(df['EstimatedSalary'])
sns.heatmap(df.corr(), annot=True)
```

OUTPUT:

```
[30] sns.boxplot(df['CreditScore'])
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pass th
  FutureWarning
<matplotlib.axes._subplots.AxesSubplot at 0x7f71c6c41090>
```

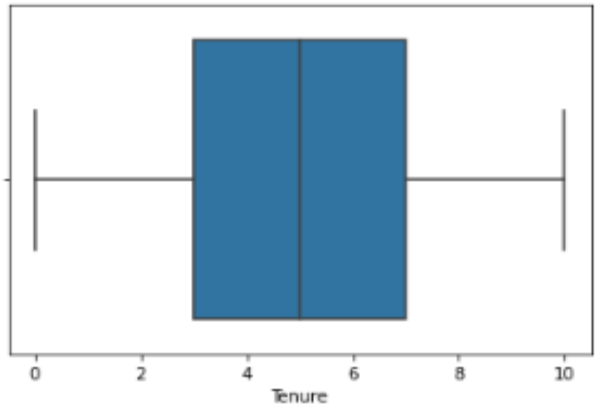



```
[31] sns.boxplot(df['Age'])
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pass th
  FutureWarning
<matplotlib.axes._subplots.AxesSubplot at 0x7f71c6868910>
```

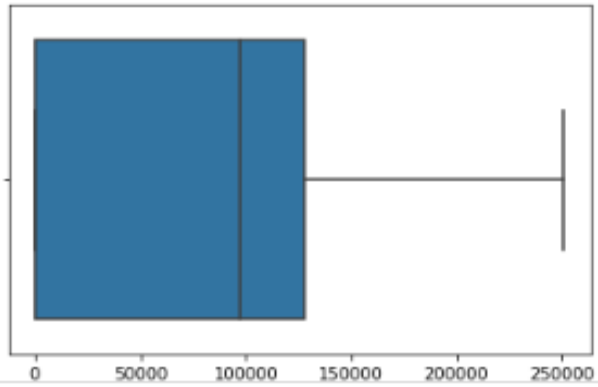
0s

[32]
```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pass the
  FutureWarning
<matplotlib.axes._subplots.AxesSubplot at 0x7f71c639d4d0>
```



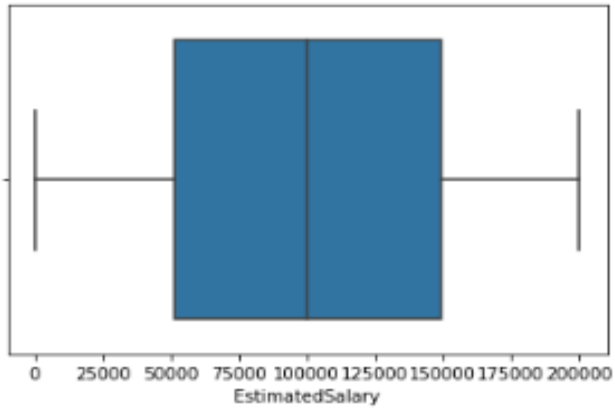

[33]
```
sns.boxplot(df['Balance'])
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pass the
  FutureWarning
<matplotlib.axes._subplots.AxesSubplot at 0x7f71c6319710>
```



```
+ Code + Text
[34] sns.boxplot(df['EstimatedSalary'])

/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pass the f
  FutureWarning
<matplotlib.axes._subplots.AxesSubplot at 0x7f71c6380a50>
```




```
sns.heatmap(df.corr(), annot=True)

<matplotlib.axes._subplots.AxesSubplot at 0x7f71c768e250>
```


**Question 3 - Perform descriptive statistics on the dataset.**

SOLUTION:

```
df.describe()
```

OUTPUT:

Descriptive statistics of the dataset

```
df.describe()
```

| | RowNumber | CustomerId | CreditScore | Age | Tenure | Balance | NumOfProducts | HasCrCard | IsActiveMember | EstimatedSalary | Exited |
|---|---|---|---|---|---|---|---|---|---|---|---|
| count | 10000.00000 | 1.000000e+04 | 10000.000000 | 10000.000000 | 10000.000000 | 10000.000000 | 10000.000000 | 10000.00000 | 10000.000000 | 10000.000000 | 10000.000000 |
| mean | 5000.50000 | 1.569094e+07 | 650.528800 | 38.921800 | 5.012800 | 76485.889288 | 1.530200 | 0.70550 | 0.515100 | 100090.239881 | 0.203700 |
| std | 2886.89568 | 7.193619e+04 | 96.653299 | 10.487806 | 2.892174 | 62397.405202 | 0.581654 | 0.45584 | 0.499797 | 57510.492818 | 0.402769 |
| min | 1.00000 | 1.556570e+07 | 350.000000 | 18.000000 | 0.000000 | 0.000000 | 1.000000 | 0.00000 | 0.000000 | 11.580000 | 0.000000 |
| 25% | 2500.75000 | 1.562853e+07 | 584.000000 | 32.000000 | 3.000000 | 0.000000 | 1.000000 | 0.00000 | 0.000000 | 51002.110000 | 0.000000 |
| 50% | 5000.50000 | 1.569074e+07 | 652.000000 | 37.000000 | 5.000000 | 97198.540000 | 1.000000 | 1.00000 | 1.000000 | 100193.915000 | 0.000000 |
| 75% | 7500.25000 | 1.575323e+07 | 718.000000 | 44.000000 | 7.000000 | 127644.240000 | 2.000000 | 1.00000 | 1.000000 | 149388.247500 | 0.000000 |
| max | 10000.00000 | 1.581569e+07 | 850.000000 | 92.000000 | 10.000000 | 250898.090000 | 4.000000 | 1.00000 | 1.000000 | 199992.480000 | 1.000000 |

**Question 4 – Handle the missing values**

SOLUTION:

```
df.duplicated().sum()

df.nunique()

df.info()
```

OUTPUT:

+ Code + Text

## Handling missing values

```
[7] df.duplicated().sum()
```

```
0
```

```
[8] df.isna().sum()
```

```
RowNumber          0
CustomerId         0
Surname            0
CreditScore        0
Geography          0
Gender             0
Age                0
Tenure             0
Balance            0
NumOfProducts      0
HasCrCard          0
IsActiveMember     0
EstimatedSalary    0
Exited             0
dtype: int64
```

```
[9] df.nunique()
```

```
RowNumber          10000
CustomerId         10000
Surname             2932
CreditScore          460
Geography              3
Gender                 2
Age                   70
Tenure                11
Balance             6382
NumOfProducts          4
```

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10000 entries, 0 to 9999
Data columns (total 14 columns):
 #   Column           Non-Null Count  Dtype  
---  ------           --------------  -----  
 0   RowNumber        10000 non-null  int64  
 1   CustomerId       10000 non-null  int64  
 2   Surname          10000 non-null  object 
 3   CreditScore      10000 non-null  int64  
 4   Geography        10000 non-null  object 
 5   Gender           10000 non-null  int64  
 6   Age              10000 non-null  int64  
 7   Tenure           10000 non-null  int64  
 8   Balance          10000 non-null  float64
 9   NumOfProducts    10000 non-null  int64  
 10  HasCrCard        10000 non-null  int64  
 11  IsActiveMember   10000 non-null  int64  
 12  EstimatedSalary  10000 non-null  float64
 13  Exited           10000 non-null  int64  
dtypes: float64(2), int64(10), object(2)
memory usage: 1.1+ MB
```

**Question 5 - Find the outliers and replace the outliers**

**SOLUTION:**

out = df.drop(columns=['Gender', 'Tenure', 'HasCrCard', 'IsActiveMember', 'NumOfProducts', 'Exited']).quantile(q=[0.25, 0.50])

out

Handling outliers

```
[14] out = df.drop(columns=['Gender', 'Tenure', 'HasCrCard', 'IsActiveMember', 'NumOfProducts', 'Exited']).quantile(q=[0.25, 0.50])
     out
```

| | RowNumber | CustomerId | CreditScore | Age | Balance | EstimatedSalary |
|---|---|---|---|---|---|---|
| 0.25 | 2500.75 | 15628528.25 | 584.0 | 32.0 | 0.00 | 51002.110 |
| 0.50 | 5000.50 | 15690738.00 | 652.0 | 37.0 | 97198.54 | 100193.915 |

Q1 = out.iloc[0]

Q3 = out.iloc[1]

iqr = Q3 - Q1

iqr

```
Q1 = out.iloc[0]
Q3 = out.iloc[1]
iqr = Q3 - Q1
iqr
```

```
RowNumber            2499.750
CustomerId          62209.750
CreditScore            68.000
Age                     5.000
Balance             97198.540
EstimatedSalary     49191.805
dtype: float64
```

upper = out.iloc[1] + 1.5*iqr

upper

```
upper = out.iloc[1] + 1.5*iqr
upper
```

```
RowNumber           8.750125e+03
CustomerId          1.578405e+07
CreditScore         7.540000e+02
Age                 4.450000e+01
Balance             2.429964e+05
EstimatedSalary     1.739816e+05
dtype: float64
```

lower = out.iloc[0] - 1.5*iqr

lower

```
lower = out.iloc[0] - 1.5*iqr
lower
```

```
RowNumber         -1.248875e+03
CustomerId         1.553521e+07
CreditScore        4.820000e+02
Age                2.450000e+01
Balance           -1.457978e+05
EstimatedSalary   -2.278560e+04
dtype: float64
```

**Replace outliers**

SOLUTION:

```
df['CreditScore'] = np.where(df['CreditScore']>756, 650.5288, df['CreditScore'])
df['Age'] = np.where(df['Age']>62, 38.9218, df['Age'])
```

**Question 6 - Check for Categorical columns and perform encoding.**

SOLUTION:

```
df['Gender'].replace({'Male': 1, 'Female': 0}, inplace=True)

df.head(10)
```

OUTPUT:

Check for categorical columns and perform encoding

```
df['Gender'].replace({'Male': 1, 'Female': 0}, inplace=True)
df.head(10)
```

| | RowNumber | CustomerId | Surname | CreditScore | Geography | Gender | Age | Tenure | Balance | NumOfProducts | HasCrCard | IsActiveMember | EstimatedSalary | Exited |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 15634602 | Hargrave | 619 | France | 0 | 42 | 2 | 0.00 | 1 | 1 | 1 | 101348.88 | 1 |
| 1 | 2 | 15647311 | Hill | 608 | Spain | 0 | 41 | 1 | 83807.86 | 1 | 0 | 1 | 112542.58 | 0 |
| 2 | 3 | 15619304 | Onio | 502 | France | 0 | 42 | 8 | 159660.80 | 3 | 1 | 0 | 113931.57 | 1 |
| 3 | 4 | 15701354 | Boni | 699 | France | 0 | 39 | 1 | 0.00 | 2 | 0 | 0 | 93826.63 | 0 |
| 4 | 5 | 15737888 | Mitchell | 850 | Spain | 0 | 43 | 2 | 125510.82 | 1 | 1 | 1 | 79084.10 | 0 |
| 5 | 6 | 15574012 | Chu | 645 | Spain | 1 | 44 | 8 | 113755.78 | 2 | 1 | 0 | 149756.71 | 1 |
| 6 | 7 | 15592531 | Bartlett | 822 | France | 1 | 50 | 7 | 0.00 | 2 | 1 | 1 | 10062.80 | 0 |
| 7 | 8 | 15656148 | Obinna | 376 | Germany | 0 | 29 | 4 | 115046.74 | 4 | 1 | 0 | 119346.88 | 1 |
| 8 | 9 | 15792365 | He | 501 | France | 1 | 44 | 4 | 142051.07 | 2 | 0 | 1 | 74940.50 | 0 |
| 9 | 10 | 15592389 | H? | 684 | France | 1 | 27 | 2 | 134603.88 | 1 | 1 | 1 | 71725.73 | 0 |

**Question 7 – Split the data into dependent and independent variables.**

SOLUTION:

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

df.head()

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

| | CreditScore | Gender | Age | Tenure | Balance | NumOfProducts | HasCrCard | IsActiveMember | EstimatedSalary | Exited |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 619.0000 | 0 | 42.0 | 2 | 0.00 | 1 | 1 | 1 | 101348.88 | 1 |
| 1 | 608.0000 | 0 | 41.0 | 1 | 83807.86 | 1 | 0 | 1 | 112542.58 | 0 |
| 2 | 502.0000 | 0 | 42.0 | 8 | 159660.80 | 3 | 1 | 0 | 113931.57 | 1 |
| 3 | 699.0000 | 0 | 39.0 | 1 | 0.00 | 2 | 0 | 0 | 93826.63 | 0 |
| 4 | 650.5288 | 0 | 43.0 | 2 | 125510.82 | 1 | 1 | 1 | 79084.10 | 0 |

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

Split into dependent and independent variables

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

| | CreditScore | Gender | Age | Tenure | Balance | NumOfProducts | HasCrCard | IsActiveMember | EstimatedSalary |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 619.0000 | 0 | 42.0 | 2 | 0.00 | 1 | 1 | 1 | 101348.88 |
| 1 | 608.0000 | 0 | 41.0 | 1 | 83807.86 | 1 | 0 | 1 | 112542.58 |
| 2 | 502.0000 | 0 | 42.0 | 8 | 159660.80 | 3 | 1 | 0 | 113931.57 |
| 3 | 699.0000 | 0 | 39.0 | 1 | 0.00 | 2 | 0 | 0 | 93826.63 |
| 4 | 650.5288 | 0 | 43.0 | 2 | 125510.82 | 1 | 1 | 1 | 79084.10 |

y = df.iloc[:, -1]

y.head()

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

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

**Question 8 – Scale the independent variables**

SOLUTION:

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

OUTPUT:

Scale the Independent variables

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

```
array([[-0.13284832, -1.09598752,  0.48205148, ...,  0.64609167,
         0.97024255,  0.02188649],
       [-0.28182929, -1.09598752,  0.36638802, ..., -1.54776799,
         0.97024255,  0.21653375],
       [-1.71746409, -1.09598752,  0.48205148, ...,  0.64609167,
        -1.03067011,  0.2406869 ],
       ...,
       [ 1.08608688, -1.09598752, -0.21192932, ..., -1.54776799,
         0.97024255, -1.00864308],
       [ 0.29416906,  0.91241915,  0.48205148, ...,  0.64609167,
        -1.03067011, -0.12523071],
       [ 0.29416906, -1.09598752, -1.13723705, ...,  0.64609167,
        -1.03067011, -1.07636976]])
```

**Question 9 - Split the data into training and testing**

SOLUTION:

```
from sklearn.model_selection import train_test_split

x_train, y_test = train_test_split(x, y, test_size=0.2, random_state=0)

print(x_train.shape)

print(x_test.shape)

print(y_train.shape)

print(y_test.shape)
```

OUTPUT:

Split into Training and Testing data

```
[28] 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=0)
```

```
print(x_train.shape)
print(x_test.shape)
print(y_train.shape)
print(y_test.shape)
```

```
(8000, 9)
(2000, 9)
(8000,)
(2000,)
```