# Data Visualization and Pre-processing

# Assignment -2

| | |
|---|---|
| **ASSIGNMENT DATE** | 26 September 2022 |
| **TEAM ID** | PNT2022TMID15559 |
| **PROJECT NAME** | A GESTURE BASED TOOL FOR STERILE BROWSING OF RADIOLOGY IMAGES |
| **STUDENT NAME** | SWATHI J |
| **STUDENT ROLL NO** | 111519205049 |
| **MAXIMUM MARKS** | 2 Marks |

**Question-1:**

**Download the Dataset**

**SOLUTION:**

| RowNumb | CustomerId | Surname | CreditSco | Geograph | Gender | Age | Tenure | Balance | NumOfPr | HasCrCard | IsActiveM | EstimatedS | Exited |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15634602 | Hargrave | 619 | France | Female | 42 | 2 | 0 | 1 | 1 | 1 | 101348.9 | 1 |
| 2 | 15647311 | Hill | 608 | Spain | Female | 41 | 1 | 83807.86 | 1 | 0 | 1 | 112542.6 | 0 |
| 3 | 15619304 | Onio | 502 | France | Female | 42 | 8 | 159660.8 | 3 | 1 | 0 | 113931.6 | 1 |
| 4 | 15701354 | Boni | 699 | France | Female | 39 | 1 | 0 | 2 | 0 | 0 | 93826.63 | 0 |
| 5 | 15737888 | Mitchell | 850 | Spain | Female | 43 | 2 | 125510.8 | 1 | 1 | 1 | 79084.1 | 0 |
| 6 | 15574012 | Chu | 645 | Spain | Male | 44 | 8 | 113755.8 | 2 | 1 | 0 | 149756.7 | 1 |
| 7 | 15592531 | Bartlett | 822 | France | Male | 50 | 7 | 0 | 2 | 1 | 1 | 10062.8 | 0 |
| 8 | 15656148 | Obinna | 376 | Germany | Female | 29 | 4 | 115046.7 | 4 | 1 | 0 | 119346.9 | 1 |
| 9 | 15792365 | He | 501 | France | Male | 44 | 4 | 142051.1 | 2 | 0 | 1 | 74940.5 | 0 |
| 10 | 15592389 | H? | 684 | France | Male | 27 | 2 | 134603.9 | 1 | 1 | 1 | 71725.73 | 0 |
| 11 | 15767821 | Bearce | 528 | France | Male | 31 | 6 | 102016.7 | 2 | 0 | 0 | 80181.12 | 0 |
| 12 | 15737173 | Andrews | 497 | Spain | Male | 24 | 3 | 0 | 2 | 1 | 0 | 76390.01 | 0 |
| 13 | 15632264 | Kay | 476 | France | Female | 34 | 10 | 0 | 2 | 1 | 0 | 26260.98 | 0 |
| 14 | 15691483 | Chin | 549 | France | Female | 25 | 5 | 0 | 2 | 0 | 0 | 190857.8 | 0 |
| 15 | 15600882 | Scott | 635 | Spain | Female | 35 | 7 | 0 | 2 | 1 | 1 | 65951.65 | 0 |
| 16 | 15643966 | Goforth | 616 | Germany | Male | 45 | 3 | 143129.4 | 2 | 0 | 1 | 64327.26 | 0 |
| 17 | 15737452 | Romeo | 653 | Germany | Male | 58 | 1 | 132602.9 | 1 | 1 | 0 | 5097.67 | 1 |
| 18 | 15788218 | Henderso | 549 | Spain | Female | 24 | 9 | 0 | 2 | 1 | 1 | 14406.41 | 0 |
| 19 | 15661507 | Muldrow | 587 | Spain | Male | 45 | 6 | 0 | 1 | 0 | 0 | 158684.8 | 0 |
| 20 | 15568982 | Hao | 726 | France | Female | 24 | 6 | 0 | 2 | 1 | 1 | 54724.03 | 0 |
| 21 | 15577657 | McDonald | 732 | France | Male | 41 | 8 | 0 | 2 | 1 | 1 | 170886.2 | 0 |
| 22 | 15597945 | Dellucci | 636 | Spain | Female | 32 | 8 | 0 | 2 | 1 | 0 | 138555.5 | 0 |
| 23 | 15699309 | Gerasimo | 510 | Spain | Female | 38 | 4 | 0 | 1 | 1 | 0 | 118913.5 | 1 |
| 24 | 15725737 | Mosman | 669 | France | Male | 46 | 3 | 0 | 2 | 0 | 1 | 8487.75 | 0 |
| 25 | 15625047 | Yen | 846 | France | Female | 38 | 5 | 0 | 1 | 1 | 1 | 187616.2 | 0 |
| 26 | 15738191 | Maclean | 577 | France | Male | 25 | 3 | 0 | 2 | 0 | 1 | 124508.3 | 0 |
| 27 | 15736816 | Young | 756 | Germany | Male | 36 | 2 | 136815.6 | 1 | 1 | 1 | 170042 | 0 |
| 28 | 15700772 | Nebechi | 571 | France | Male | 44 | 9 | 0 | 2 | 0 | 0 | 38433.35 | 0 |
| 29 | 15728693 | McWillian | 574 | Germany | Female | 43 | 3 | 141349.4 | 1 | 1 | 1 | 100187.4 | 0 |
| 30 | 15656300 | Lucciano | 411 | France | Male | 29 | 0 | 59697.17 | 2 | 1 | 1 | 53483.21 | 0 |
| 31 | 15589475 | Azikiwe | 591 | Spain | Female | 39 | 3 | 0 | 3 | 1 | 0 | 140469.4 | 1 |
| 32 | 15706552 | Odinakach | 533 | France | Male | 36 | 7 | 85311.7 | 1 | 0 | 1 | 156731.9 | 0 |
| 33 | 15750181 | Sandersor | 553 | Germany | Male | 41 | 9 | 110112.5 | 2 | 0 | 0 | 81898.81 | 0 |
| 34 | 15659428 | Maggard | 520 | Spain | Female | 42 | 6 | 0 | 2 | 1 | 1 | 34410.55 | 0 |
| 35 | 15732963 | Clements | 722 | Spain | Female | 29 | 9 | 0 | 2 | 1 | 1 | 142033.1 | 0 |
| 36 | 15794171 | Lombardo | 475 | France | Female | 45 | 0 | 134264 | 1 | 1 | 0 | 27822.99 | 1 |
| 37 | 15788448 | Watson | 490 | Spain | Male | 31 | 3 | 145260.2 | 1 | 0 | 1 | 114066.8 | 0 |
| 38 | 15729599 | Lorenzo | 804 | Spain | Male | 33 | 7 | 76548.6 | 1 | 0 | 1 | 98453.45 | 0 |
| 39 | 15717426 | Armstrong | 850 | France | Male | 36 | 7 | 0 | 1 | 1 | 1 | 40812.9 | 0 |
| 40 | 15585768 | Cameron | 582 | Germany | Male | 41 | 6 | 70349.48 | 2 | 0 | 1 | 178074 | 0 |

## Question-2.

## Load the dataset

## solution:

```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
import sklearn
data = pd.read_csv(r'/content/Churn_Modelling.csv')
data.head
```

```
<bound method NDFrame.head of       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
...         ...         ...        ...          ...       ...     ...  ...
9995       9996    15606229   Obijiaku          771    France    Male   39
9996       9997    15569892  Johnstone          516    France    Male   35
9997       9998    15584532        Liu          709    France  Female   36
9998       9999    15682355  Sabbatini          772   Germany    Male   42
9999      10000    15628319     Walker          792    France  Female   28

      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
...      ...        ...            ...        ...             ...
9995       5       0.00              2          1               0
9996      10   57369.61              1          1               1
9997       7       0.00              1          0               1
9998       3   75075.31              2          1               0
9999       4  130142.79              1          1               0

      EstimatedSalary  Exited
0           101348.88       1
1           112542.58       0
2           113931.57       1
3            93826.63       0
4            79084.10       0
...               ...     ...
9995         96270.64       0
9996        101699.77       0
9997         42085.58       1
9998         92888.52       1
9999         38190.78       0

[10000 rows x 14 columns]>
```

## Question-3.

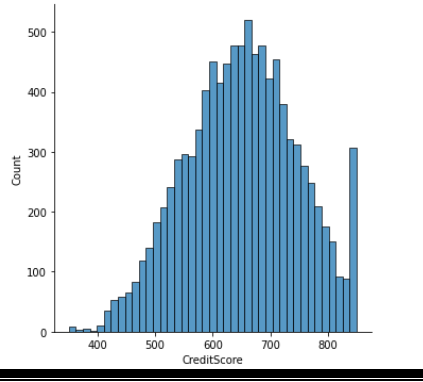
## Perform Below Visualizations.

## 3.1
## Univariate Analysis

## Solution:

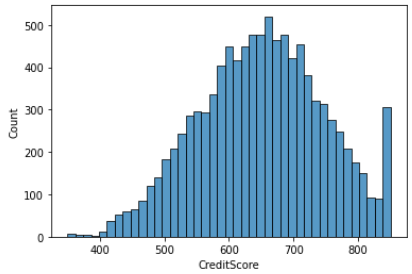
```
sns.displot(data['CreditScore'])
```

```
<seaborn.axisgrid.FacetGrid at 0x7f9ecb87d910>
```



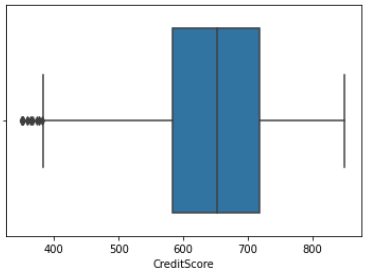
**sns.histplot(data['CreditScore'])**

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f9edc45e1d0>
```

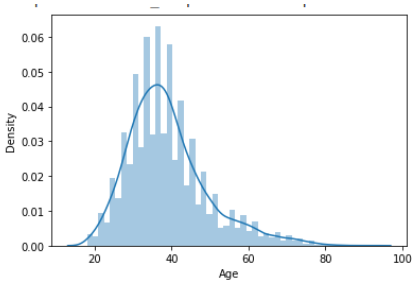



**sns.boxplot(x = data['CreditScore'])**

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f9ec6b6e8d0>
```

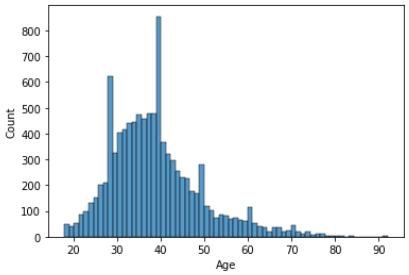



**sns.distplot(data['Age'])**

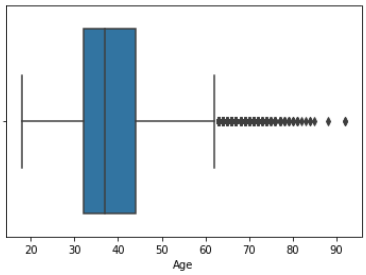



**sns.histplot(data['Age'])**

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f9ec6efbe10>
```



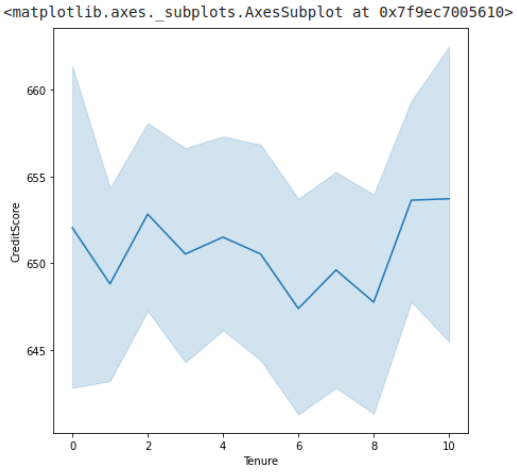
**sns.boxplot(data['Age'])**



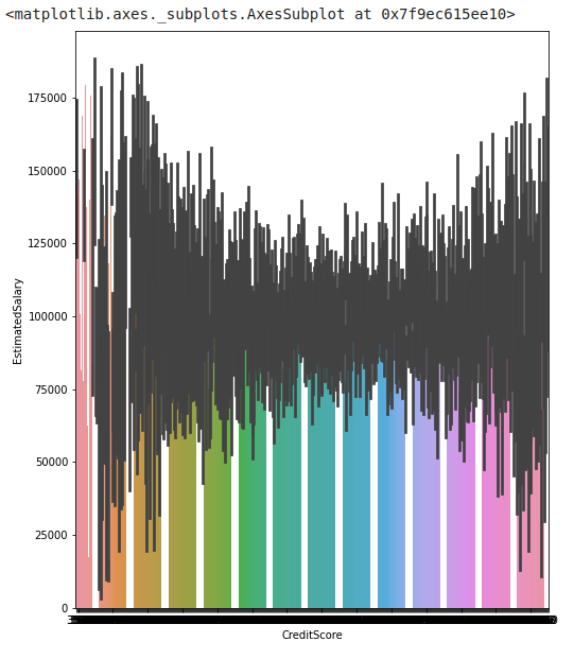

## 3.2 Bivariate Analysis

## Solution:

```
plt.figure(figsize=(7,7))
sns.lineplot(data = data, x = 'Tenure', y = 'CreditScore')
```

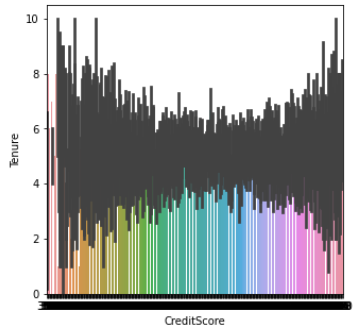



```
plt.figure(figsize=(8,10))
sns.barplot(data = data, x = 'CreditScore', y ='EstimatedSalary')
```

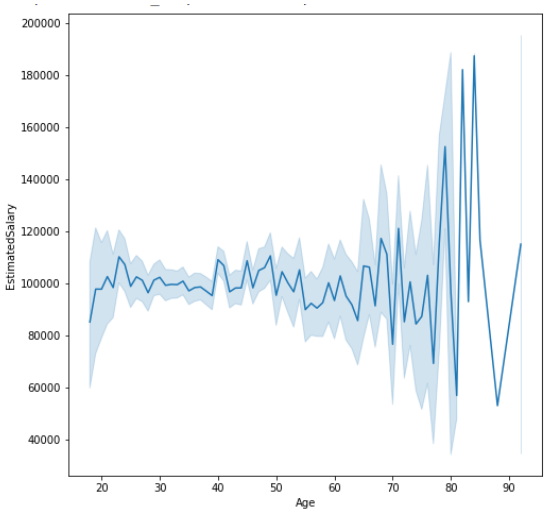


```
plt.figure(figsize=(10,10))
sns.barplot(data = data, x = 'CreditScore', y = 'Tenure')
```

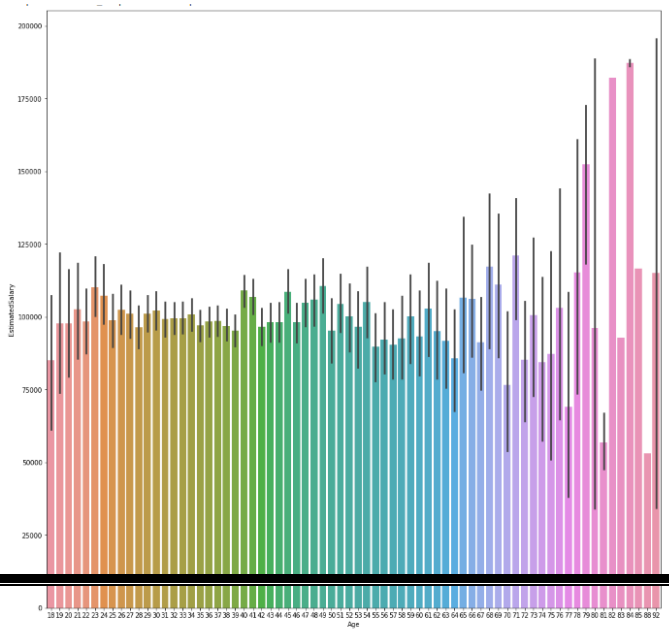
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f9ec34bca10>
```




```
plt.figure(figsize=(8,8))
sns.lineplot(data['Age'], data['EstimatedSalary'])
```

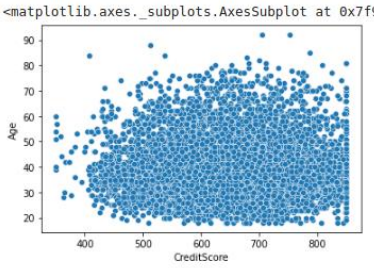



```
plt.figure(figsize=(17,17))
sns.barplot(data['Age'], data['EstimatedSalary'])
```



```
sns.scatterplot(data = data, x = 'CreditScore', y = 'Age')
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f9ec025a250>
```

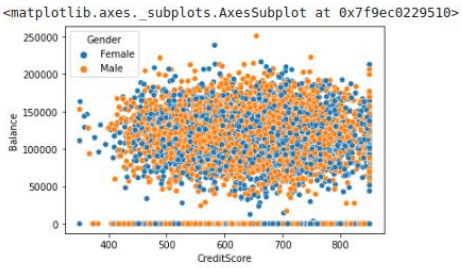



## 3.3 Multivariate Analysis

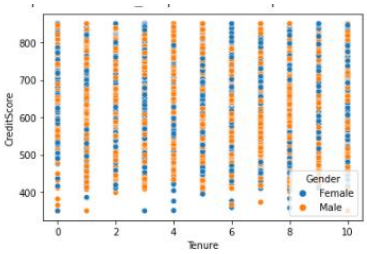
## Solution:

```
sns.scatterplot(data = data, x = 'CreditScore', y = 'Balance', hue = 'Gender')
```

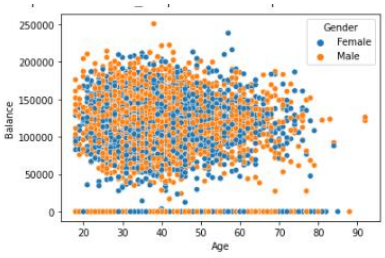
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f9ec0229510>
```



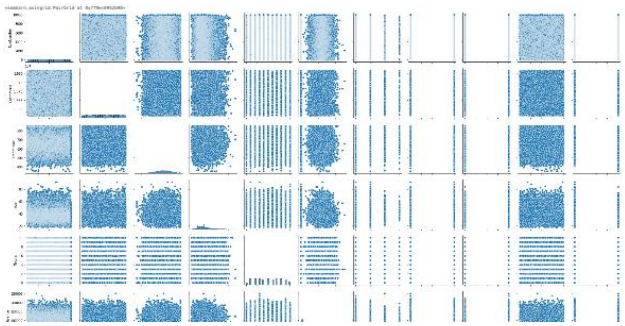

```
sns.scatterplot(data['Tenure'], data['CreditScore'], hue = data['Gender'])
```




```
sns.scatterplot(data['Age'], data['Balance'], hue = data['Gender'])
```



sns.pairplot(data)



## Question-4

## Perform descriptive statistics on the dataset.

## Solution:

data.mean(numeric_only = True)

```
RowNumber          5.000500e+03
CustomerId         1.569094e+07
CreditScore        6.505288e+02
Age                3.892180e+01
Tenure             5.012800e+00
Balance            7.648589e+04
NumOfProducts      1.530200e+00
HasCrCard          7.055000e-01
IsActiveMember     5.151000e-01
EstimatedSalary    1.000902e+05
Exited             2.037000e-01
dtype: float64
```

```
data.median(numeric_only = True)
```

```
RowNumber          5.000500e+03
CustomerId         1.569074e+07
CreditScore        6.520000e+02
Age                3.700000e+01
Tenure             5.000000e+00
Balance            9.719854e+04
NumOfProducts      1.000000e+00
HasCrCard          1.000000e+00
IsActiveMember     1.000000e+00
EstimatedSalary    1.001939e+05
Exited             0.000000e+00
dtype: float64
```

```
data['CreditScore'].mode()
```

```
0    850
dtype: int64
```

```
data['EstimatedSalary'].mode()
```

```
0    24924.92
dtype: float64
```

```
data['HasCrCard'].unique()
```

```
array([1, 0])
```

```
data['Tenure'].unique()
```

```
array([ 2,  1,  8,  7,  4,  6,  3, 10,  5,  9,  0])
```

```
data.std(numeric_only=True)
```

```
RowNumber           2886.895680
CustomerId         71936.186123
CreditScore           96.653299
Age                   10.487806
Tenure                 2.892174
Balance            62397.405202
NumOfProducts          0.581654
HasCrCard              0.455840
IsActiveMember         0.499797
EstimatedSalary    57510.492818
Exited                 0.402769
dtype: float64
```

```
data.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 |

```
data['Tenure'].value_counts()
```

```
2     1048
1     1035
7     1028
8     1025
5     1012
3     1009
4      989
9      984
6      967
10     490
0      413
Name: Tenure, dtype: int64
```

Question-5:

Handle the Missing values.

## *Solution:*

```
data.isnull().any()
```

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

```
data.isnull().sum()
```

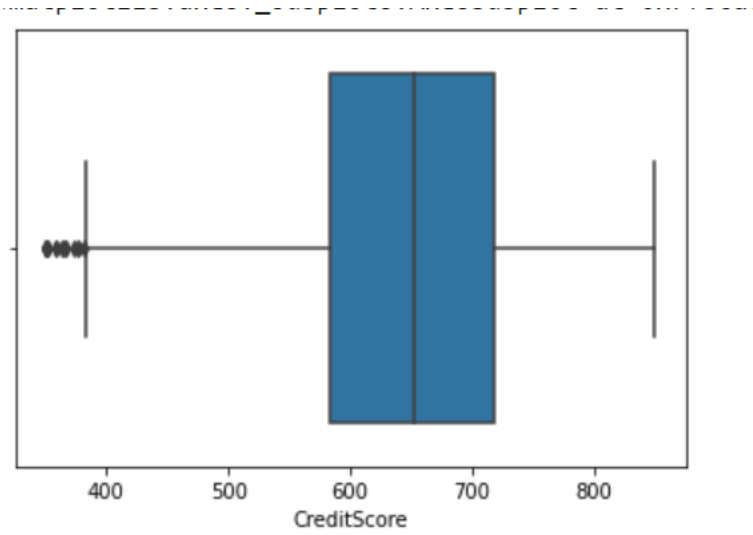
```
RowNumber          0
CustomerId         0
Surname            0
CreditScore        0
Geography          0
Gender             0
Age                0
Tenure             0
Balance            0
NumOfProducts      0
HasCrCard          0
IsActiveMember     0
EstimatedSalary    0
Exited             0
dtype: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

Question-6.

Find the outliers and replace the outliers

**SOLUTION:**

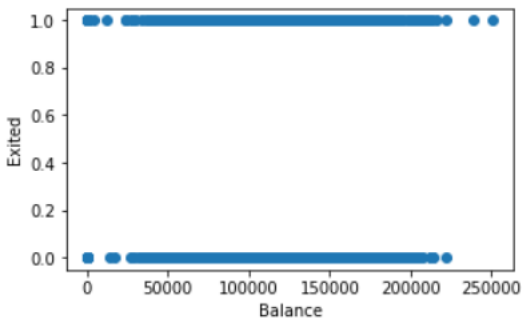
```
sns.boxplot(data['CreditScore'])#Outlier detection - box plot
```



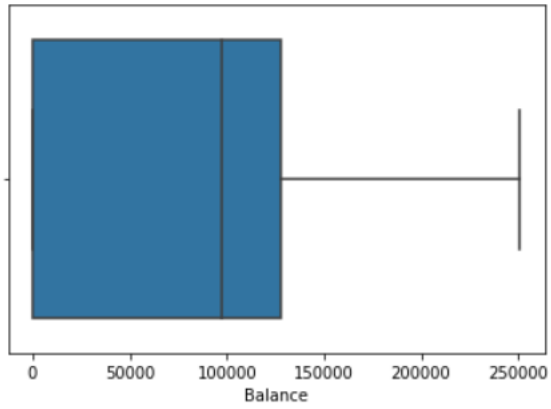

```
fig, ax = plt.subplots(figsize = (5,3)) #Outlier detection - Scatter plot
ax.scatter(data['Balance'], data['Exited'])

# x-axis label
ax.set_xlabel('Balance')

# y-axis label
ax.set_ylabel('Exited')
plt.show()
sns.boxplot(x=data['Balance'])
```




```
<matplotlib.axes._subplots.AxesSubplot at 0x7f8cadb22ad0>
```




```
from scipy import stats #Outlier detection - zscore
zscore = np.abs(stats.zscore(data['CreditScore']))
print(zscore)
print('No. of Outliers : ', np.shape(np.where(zscore>3)))
```

```
0       0.326221
1       0.440036
2       1.536794
3       0.501521
4       2.063884
          ...
9995    1.246488
9996    1.391939
9997    0.604988
9998    1.256835
9999    1.463771
Name: CreditScore, Length: 10000, dtype: float64
No. of Outliers :  (1, 8)
```

```
q = data.quantile([0.75,0.25])
q
```

| | RowNumber | CustomerId | CreditScore | Age | Tenure | Balance | NumOfProducts | HasCrCard | IsActiveMember | EstimatedSalary | Exited |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **0.75** | 7500.25 | 15753233.75 | 718.0 | 44.0 | 7.0 | 127644.24 | 2.0 | 1.0 | 1.0 | 149388.2475 | 0.0 |
| **0.25** | 2500.75 | 15628528.25 | 584.0 | 32.0 | 3.0 | 0.00 | 1.0 | 0.0 | 0.0 | 51002.1100 | 0.0 |

```
iqr = q.iloc[0] - q.iloc[1]
iqr
```

```
RowNumber           4999.5000
CustomerId        124705.5000
CreditScore          134.0000
Age                   12.0000
Tenure                 4.0000
Balance           127644.2400
NumOfProducts          1.0000
HasCrCard              1.0000
IsActiveMember         1.0000
EstimatedSalary    98386.1375
Exited                 0.0000
dtype: float64
```

```
u = q.iloc[0] + (1.5*iqr)
u
```

```
RowNumber          1.499950e+04
CustomerId         1.594029e+07
CreditScore        9.190000e+02
Age                6.200000e+01
Tenure             1.300000e+01
Balance            3.191106e+05
NumOfProducts      3.500000e+00
HasCrCard          2.500000e+00
IsActiveMember     2.500000e+00
EstimatedSalary    2.969675e+05
Exited             0.000000e+00
dtype: float64
```

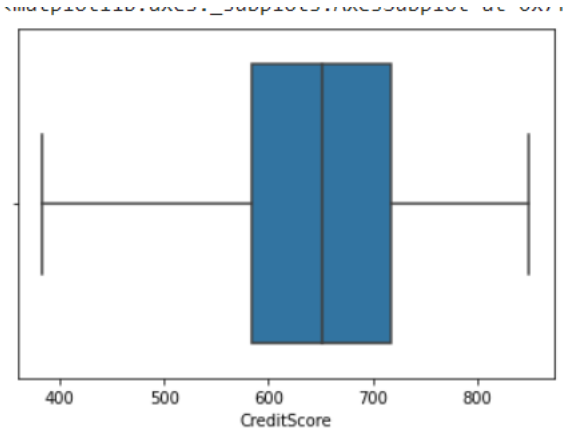
```
l = q.iloc[1] - (1.5*iqr)
l
```

```
RowNumber         -4.998500e+03
CustomerId         1.544147e+07
CreditScore        3.830000e+02
Age                1.400000e+01
Tenure            -3.000000e+00
Balance           -1.914664e+05
NumOfProducts     -5.000000e-01
HasCrCard         -1.500000e+00
IsActiveMember    -1.500000e+00
EstimatedSalary   -9.657710e+04
Exited             0.000000e+00
dtype: float64
```

```
Q1 = data['EstimatedSalary'].quantile(0.25) #Outlier detection - IQR
Q3 = data['EstimatedSalary'].quantile(0.75)
iqr = Q3 - Q1
print(iqr)
upper=Q3 + 1.5 * iqr
lower=Q1 - 1.5 * iqr
count = np.size(np.where(data['EstimatedSalary'] >upper))
count = count + np.size(np.where(data['EstimatedSalary'] <lower))
print('No. of outliers : ', count)
```

```
98386.1375
No. of outliers :  0
```

```
data['CreditScore'] = np.where(np.logical_or(data['CreditScore']>900, data['
CreditScore']<383), 650, data['CreditScore'])
sns.boxplot(data['CreditScore'])
```




```
upper = data.Age.mean() + (3 * data.Age.std()) #Outlier detection - 3 sigma
lower = data.Age.mean() - (3 * data.Age.std())
columns = data[ ( data['Age'] > upper ) | ( data['Age']<lower ) ]
print('Upper range : ', upper)
print('Lower range : ', lower)
print('No. of Outliers : ', len(columns))
```

```
Upper range :  70.38521935511383
Lower range :  7.458380644886169
No. of Outliers :  133
```

```
columns = ['EstimatedSalary', 'Age', 'Balance', 'NumOfProducts', 'Tenure', '
CreditScore'] #After outlier removal
for i in columns:
 Q1 = data[i].quantile(0.25)
 Q3 = data[i].quantile(0.75)
 iqr = Q3 - Q1
 upper=Q3 + 1.5 * iqr
 lower=Q1 - 1.5 * iqr
 count = np.size(np.where(data[i] >upper))
 count = count + np.size(np.where(data[i] <lower))
 print('No. of outliers in ', i, ' : ', count)
```

```
No. of outliers in  EstimatedSalary  :  0
No. of outliers in  Age  :  359
No. of outliers in  Balance  :  0
No. of outliers in  NumOfProducts  :  60
No. of outliers in  Tenure  :  0
No. of outliers in  CreditScore  :  0
```

Question-7.

Check for Categorical columns and perform encoding

**SOLUTION:**

```
from sklearn.preprocessing import LabelEncoder, OneHotEncoder
le = LabelEncoder()
oneh = OneHotEncoder()
data['Surname'] = le.fit_transform(data['Surname'])
data['Gender'] = le.fit_transform(data['Gender'])
data['Geography'] = le.fit_transform(data['Geography'])
data.head()
```

| | RowNumber | CustomerId | Surname | CreditScore | Geography | Gender | Age | Tenure | Balance | NumOfProducts | HasCrCard | IsActiveMember | EstimatedSalary | Exited |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 1 | 15634602 | 1115 | 619 | 0 | 0 | 42 | 2 | 0.00 | 1 | 1 | 1 | 101348.88 | 1 |
| **1** | 2 | 15647311 | 1177 | 608 | 2 | 0 | 41 | 1 | 83807.86 | 1 | 0 | 1 | 112542.58 | 0 |
| **2** | 3 | 15619304 | 2040 | 502 | 0 | 0 | 42 | 8 | 159660.80 | 3 | 1 | 0 | 113931.57 | 1 |
| **3** | 4 | 15701354 | 289 | 699 | 0 | 0 | 39 | 1 | 0.00 | 2 | 0 | 0 | 93826.63 | 0 |
| **4** | 5 | 15737888 | 1822 | 850 | 2 | 0 | 43 | 2 | 125510.82 | 1 | 1 | 1 | 79084.10 | 0 |

Question-8.

Split the data into dependent and independent variables split the data in X and Y

SOLUTION:

```
# independent values (inputs)
x = data.iloc[:, 0:13]
x
```

| | RowNumber | CustomerId | Surname | CreditScore | Geography | Gender | Age | Tenure | Balance | NumOfProducts | HasCrCard | IsActiveMember | EstimatedSalary |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 1 | 15634602 | 1115 | 619 | 0 | 0 | 42 | 2 | 0.00 | 1 | 1 | 1 | 101348.88 |
| **1** | 2 | 15647311 | 1177 | 608 | 2 | 0 | 41 | 1 | 83807.86 | 1 | 0 | 1 | 112542.58 |
| **2** | 3 | 15619304 | 2040 | 502 | 0 | 0 | 42 | 8 | 159660.80 | 3 | 1 | 0 | 113931.57 |
| **3** | 4 | 15701354 | 289 | 699 | 0 | 0 | 39 | 1 | 0.00 | 2 | 0 | 0 | 93826.63 |
| **4** | 5 | 15737888 | 1822 | 850 | 2 | 0 | 43 | 2 | 125510.82 | 1 | 1 | 1 | 79084.10 |
| **...** | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| **9995** | 9996 | 15606229 | 1999 | 771 | 0 | 1 | 39 | 5 | 0.00 | 2 | 1 | 0 | 96270.64 |
| **9996** | 9997 | 15569892 | 1336 | 516 | 0 | 1 | 35 | 10 | 57369.61 | 1 | 1 | 1 | 101699.77 |
| **9997** | 9998 | 15584532 | 1570 | 709 | 0 | 0 | 36 | 7 | 0.00 | 1 | 0 | 1 | 42085.58 |
| **9998** | 9999 | 15682355 | 2345 | 772 | 1 | 1 | 42 | 3 | 75075.31 | 2 | 1 | 0 | 92888.52 |
| **9999** | 10000 | 15628319 | 2751 | 792 | 0 | 0 | 28 | 4 | 130142.79 | 1 | 1 | 0 | 38190.78 |

10000 rows × 13 columns

```
 # dependent values (output)
y = data['Exited']
y
```

```
0       1
1       0
2       1
3       0
4       0
       ..
9995    0
9996    0
9997    1
9998    1
9999    0
Name: Exited, Length: 10000, dtype: int64
```

Question-9.

Scale the independent variables

**SOLUTION:**

```
from sklearn.preprocessing import StandardScaler, MinMaxScaler
sc = StandardScaler()
x_scaled = sc.fit_transform(x)
x_scaled
```

```
array([[-1.73187761, -0.78321342, -0.46418322, ...,  0.64609167,
         0.97024255,  0.02188649],
       [-1.7315312 , -0.60653412, -0.3909112 , ..., -1.54776799,
         0.97024255,  0.21653375],
       [-1.73118479, -0.99588476,  0.62898807, ...,  0.64609167,
        -1.03067011,  0.2406869 ],
       ...,
       [ 1.73118479, -1.47928179,  0.07353887, ..., -1.54776799,
         0.97024255, -1.00864308],
       [ 1.7315312 , -0.11935577,  0.98943914, ...,  0.64609167,
        -1.03067011, -0.12523071],
       [ 1.73187761, -0.87055909,  1.4692527 , ...,  0.64609167,
        -1.03067011, -1.07636976]])
```

Question-10:

Split x and y 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_scaled, y, test_size =
 0.3, random_state = 0)
x_train
```

```
array([[ 0.92889885, -0.79703192, -1.47580983, ...,  0.64609167,
         0.97024255, -0.77021814],
       [ 1.39655257,  0.71431365, -1.58808148, ...,  0.64609167,
        -1.03067011, -1.39576675],
       [-0.4532777 ,  0.96344969, -0.24082173, ..., -1.54776799,
         0.97024255, -1.49965629],
       ...,
       [-0.60119484, -1.62052514, -0.36136603, ...,  0.64609167,
        -1.03067011,  1.41441489],
       [ 1.67853045, -0.37403866,  0.72589622, ...,  0.64609167,
         0.97024255,  0.84614739],
       [-0.78548505, -1.36411841,  1.3829808 , ...,  0.64609167,
        -1.03067011,  0.32630495]])
```

x_train.shape

```
(7000, 13)
```

x_test

```
array([[ 1.52229946, -1.04525042,  1.39834429, ...,  0.64609167,
         0.97024255,  1.61304597],
       [-1.42080128, -0.50381294, -0.78208925, ...,  0.64609167,
        -1.03067011,  0.49753166],
       [-0.90118604, -0.7932923 ,  0.41271742, ...,  0.64609167,
         0.97024255, -0.4235611 ],
       ...,
       [ 1.49216178, -0.14646448,  0.6868966 , ...,  0.64609167,
         0.97024255,  1.17045451],
       [ 1.1758893 , -1.29228727, -1.38481071, ...,  0.64609167,
         0.97024255, -0.50846777],
       [ 0.08088677, -1.38538833,  1.11707427, ...,  0.64609167,
         0.97024255, -1.15342685]])
```

x_test.shape

```
(3000, 13)
```

y_train.shape

```
7681    1
9031    0
3691    0
202     1
5625    0
       ..
9225    0
4859    0
3264    0
9845    0
2732    1
Name: Exited, Length: 7000, dtype: int64
```

y_test

```
9394    0
898     1
2398    0
5906    0
2343    0
       ..
4004    0
7375    0
9307    0
8394    0
5233    1
Name: Exited, Length: 3000, dtype: int64
```

```
y_test.shape
```

```
(3000,)
```