Assignment -2
Data Visualization and Pre-processing

Assignment Date	27 September 2022
Team ID	PNT2022TMID45005
Student Name	Sivaranjani P
Student RollNumber	811219205015
Project Name	AI Based Discourse For Banking Industry
Maximum Marks	2 Marks

A - Load the dataset

```
import pandas as pd
df=pd.read_csv("Churn_Modelling.csv") # import dataset
print(df)
```

	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]

B - Perform Below Visualizations.

• Univarient Analysis

There are three ways to perform univarient analysis

• Summary statistics

```
# Summary statistics

import pandas as pd
df=pd.read_csv("Churn_Modelling.csv")

#mean of CreditScore
M=df['CreditScore'].mean()

#median of CreditScore
Me=df['CreditScore'].median()

# standard deviation of CreditScore
```

```
std = df['CreditScore'].std()

print("mean value of CreditScore is {}".format(M))
print("median value of CreditScore is {}".format(Me))
print("Standard deviation of CreditScore is {}".format(std))
```

```
mean value of CreditScore is
650.5288median value of CreditScore
is 652.0
Standard deviation of CreditScore is 96.65329873613061
```

- **Frequency table**

```
#Frequency table
import pandas as pd
df=pd.read_csv("Churn_Modelling.csv")

#frequency table for age
ft=df['Age'].value_counts()

print("Frequency table for Age is given below")
print("{}".format(ft))
```

```
Frequency table for Age is given below
37    478
38    477
35    474
36    456
34    447
      ...
92      2
82      1
88      1
85      1
83      1
Name: Age, Length: 70, dtype: int64
```

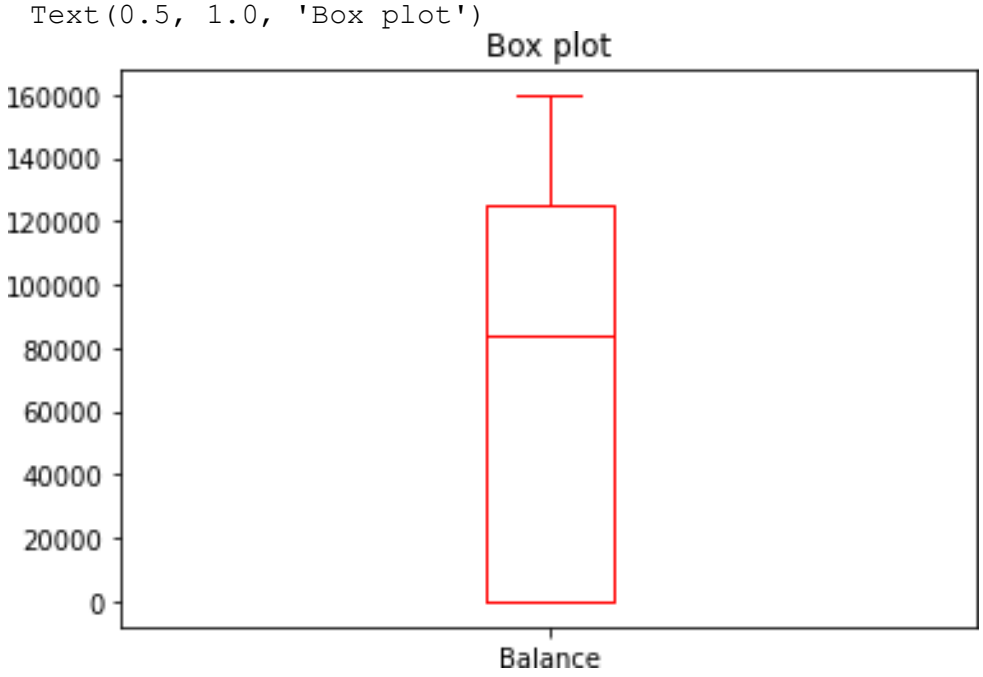
- **Charts**

```
#Chart

import matplotlib.pyplot as plt
dfs = df.head() # print first five table from top
print(dfs)

#box plot for Balance column

dfs.boxplot(column="Balance",grid=False,color="red")
plt.title('Box plot')
```

\	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age

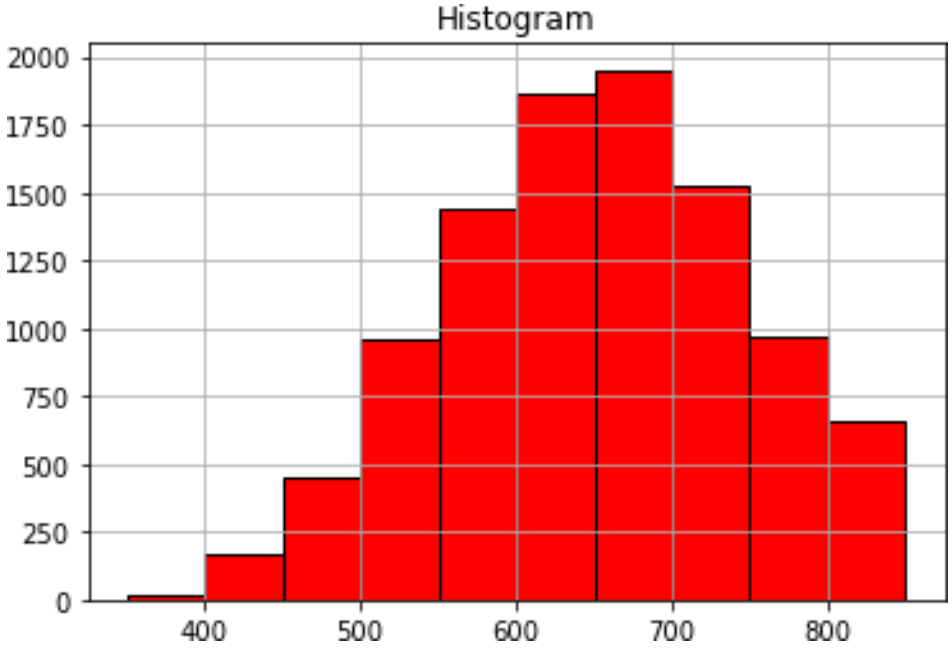
0	1	15634602	Hargrave	619	France	Female	42
1	2	15647311	Hill	608	Spain	Female	41
2	3	15619304	Onio	502	France	Female	42
3	4	15701354	Boni	699	France	Female	39
4	5	15737888	Mitchell	850	Spain	Female	43

```
   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
Exited0  101348.88       1
1        112542.58       0
2        113931.57       1
3         93826.63       0
4         79084.10       0

Text(0.5, 1.0, 'Box plot')
```



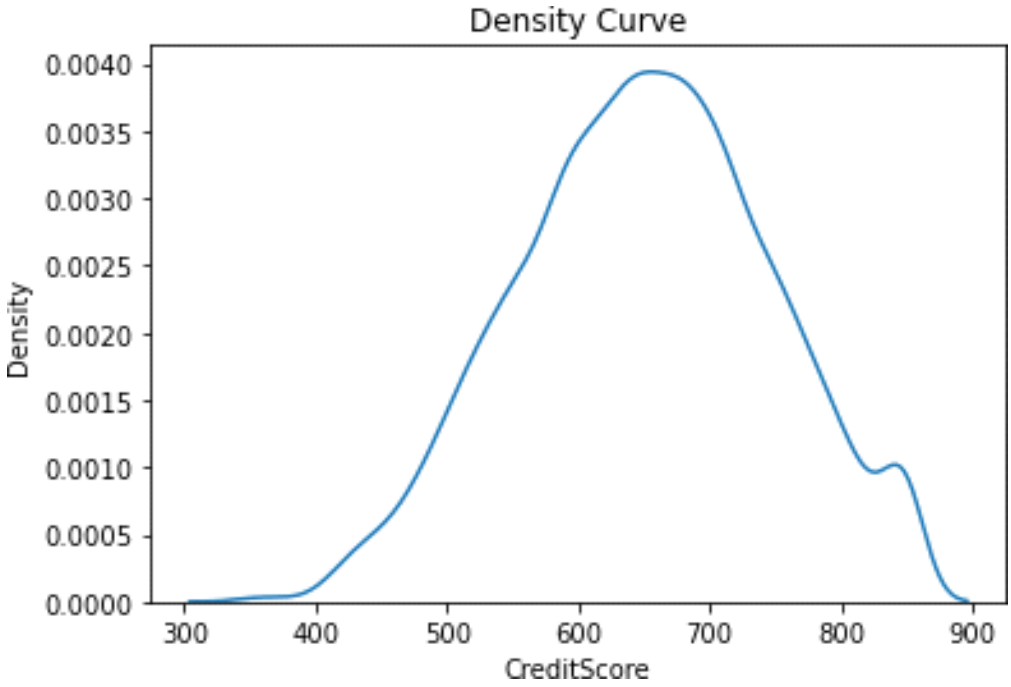

```
# Histogram for Credit Score

df.hist(column="CreditScore" ,grid=True, edgecolor ='black', color
='red')
plt.title('Histogram
')
```

```
Text(0.5, 1.0, 'Histogram')
```




```
# Density curve

import seaborn as sns  #statistical data visualization

sns.kdeplot(df['CreditScore'
])plt.title('Density Curve')
```

```
Text(0.5, 1.0, 'Density Curve')
```

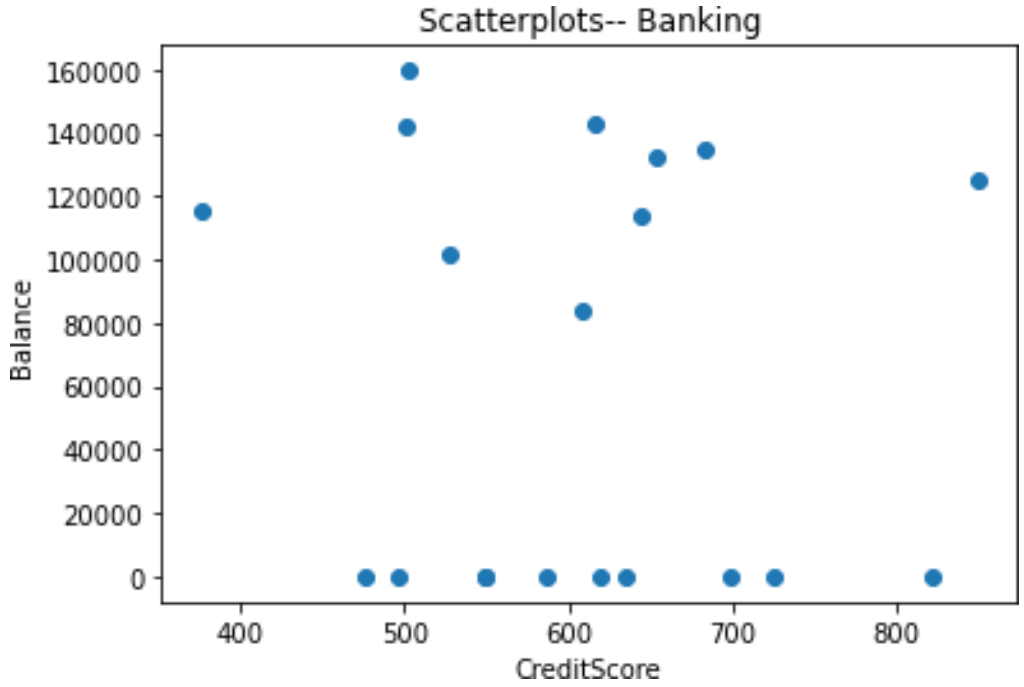


- **Bi - Variate Analysis**

There are three common ways to perform bivariate analysis:

- **Scatterplots**

```
import matplotlib.pyplot as plt # library for charts

dfs1 = df.head(20)
plt.scatter(dfs1.CreditScore,dfs1.Balanc
e)plt.title('Scatterplots-- Banking')
plt.xlabel("CreditScore")
plt.ylabel("Balance")


Text(0, 0.5, 'Balance')
```



- **Correlation Coefficient**

```
df.corr()
```

	RowNumber	CustomerId	CreditScore	Age	Tenure \
RowNumber	1.000000	0.004202	0.005840	0.000783	-
0.006495					
CustomerId	0.004202	1.000000	0.005308	0.009497	-
0.014883					
CreditScore	0.005840	0.005308	1.000000	-0.003965	
0.000842					
Age	0.000783	0.009497	-0.003965	1.000000	-
0.009997					
Tenure	-0.006495	-0.014883	0.000842	-0.009997	
1.000000					
Balance	-0.009067	-0.012419	0.006268	0.028308	-
0.012254					
NumOfProducts	0.007246	0.016972	0.012238	-0.030680	
0.013444					
HasCrCard	0.000599	-0.014025	-0.005458	-0.011721	
0.022583					
IsActiveMember	0.012044	0.001665	0.025651	0.085472	-
0.028362					
EstimatedSalary	-0.005988	0.015271	-0.001384	-0.007201	
0.007784					
Exited	-0.016571	-0.006248	-0.027094	0.285323	-
0.014001					

	Balance	NumOfProducts	HasCrCard	IsActiveMember	\
RowNumber	-0.009067	0.007246	0.000599	0.012044	
CustomerId	-0.012419	0.016972	-0.014025	0.001665	
CreditScore	0.006268	0.012238	-0.005458	0.025651	
Age	0.028308	-0.030680	-0.011721	0.085472	
Tenure	-0.012254	0.013444	0.022583	-0.028362	
Balance	1.000000	-0.304180	-0.014858	-0.010084	
NumOfProducts	-0.304180	1.000000	0.003183	0.009612	
HasCrCard	-0.014858	0.003183	1.000000	-0.011866	
IsActiveMember	-0.010084	0.009612	-0.011866	1.000000	
EstimatedSalary	0.012797	0.014204	-0.009933	-0.011421	
Exited	0.118533	-0.047820	-0.007138	-0.156128	

	EstimatedSalary	Exited
RowNumber	-0.005988	-0.016571
CustomerId	0.015271	-0.006248
CreditScore	-0.001384	-0.027094
Age	-0.007201	0.285323
Tenure	0.007784	-0.014001
Balance	0.012797	0.118533
NumOfProducts	0.014204	-0.047820
HasCrCard	-0.009933	-0.007138
IsActiveMember	-0.011421	-0.156128
EstimatedSalary	1.000000	0.012097
Exited	0.012097	1.000000

- **Simple Linear Regression**

```
import statsmodels.api as sm
# response variable
y = df['CreditScore']

# explanatory variable
x = df[['Balance']]

#add constant to predictor variables
x = sm.add_constant(x)

#fit linear regression model
model = sm.OLS(y, x).fit()

#view model summary
print(model.summary())
```

```
                            OLS Regression Results

==============================================================================
=
```

========
Dep. Variable: CreditScore R-squared:0.000

Model:	OLS	Adj. R-squared:
-0.000		
Method:	Least Squares	F-statistic:
0.3929		
Date:	Sun, 25 Sep 2022	Prob (F-statistic):
0.531		
Time:	13:06:05	Log-Likelihood:
-59900.		
No. Observations:	10000	AIC:
1.198e+05		
Df Residuals:	9998	BIC:
1.198e+05		
Df Model:	1	

Covariance Type: nonrobust

==========
=
========

	coef	std err	t	P>|t|	[0.025 0.975]
const	649.7861	1.529	424.948	0.000	646.789 652.783
Balance	9.71e-06	1.55e-05	0.627	0.531	-2.07e-05 4.01e-05

==========
=
========

Omnibus:	132.594	Durbin-Watson:	2.014
Prob(Omnibus):	0.000	Jarque-Bera (JB):84.114	
Skew:	-0.072	Prob(JB):	5.43e-19
Kurtosis:	2.574	Cond. No.1.56e+05	

==========
=
========

Notes:
• Standard Errors assume that the covariance matrix of the errors iscorrectly specified.

• The condition number is large, 1.56e+05. This might indicate thatthere are
strong multicollinearity or other numerical problems.

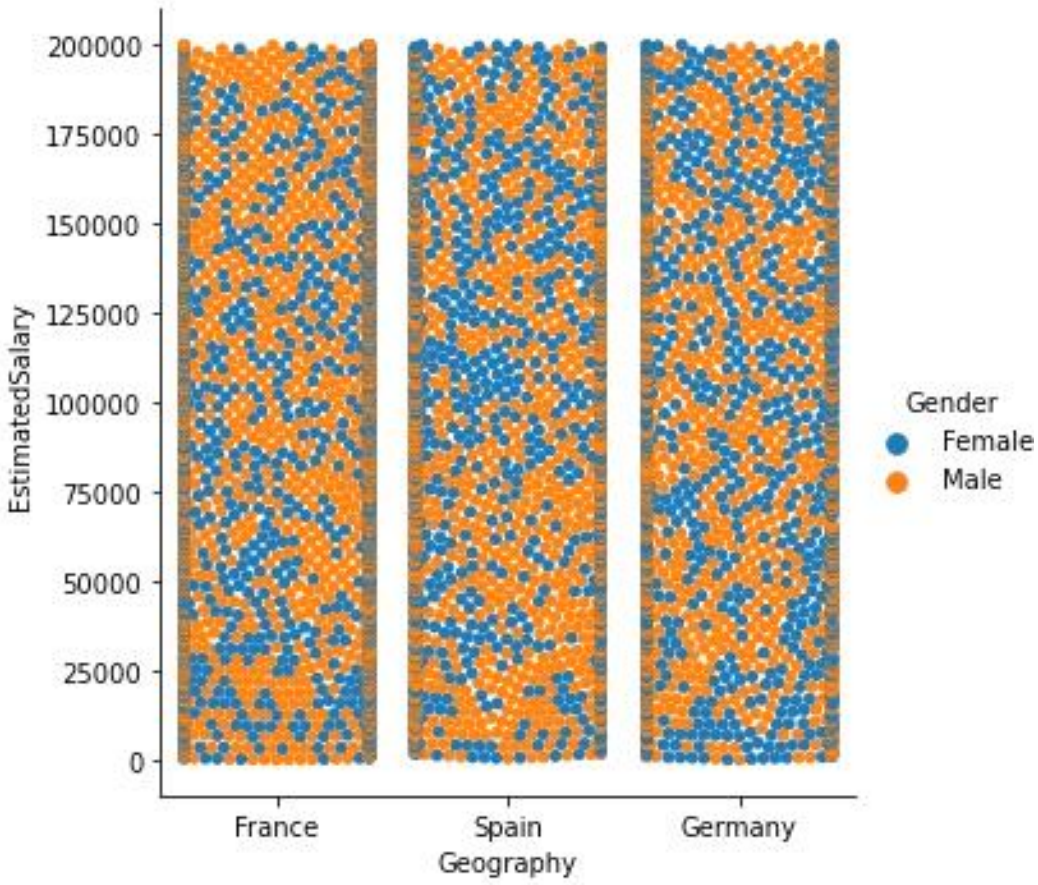
• Multi - Variate Analysis

```
import pandas as
pdimport numpy as
np
import matplotlib.pyplot as
pltimport seaborn as sns
```

- A Matrix Scatterplot
- A Scatterplot with the Data Points Labelled by their Group
- A Profile Plot
- Calculating Summary Statistics for Multivariate Data
- Means and Variances Per Group
- Between-groups Variance and Within-groups Variance for a Variable
- Between-groups Covariance and Within-groups Covariance for Two Variables
- Calculating Correlations for Multivariate Data
- Standardising Variables

```
df=sns.catplot(x="Geography",y="EstimatedSalary",hue="Gender",kind="
swarm",data=df)
print(df)
```

```
/home/lokesh/anaconda3/lib/python3.9/site-packages/seaborn/
categorical.py:1296: UserWarning: 80.8% of the points cannot be
placed; you may want to decrease the size of the markers or use
stripplot.
  warnings.warn(msg, UserWarning)
/home/lokesh/anaconda3/lib/python3.9/site-
packages/seaborn/categorical
.py:1296: UserWarning: 62.1% of the points cannot be placed; you may
want to decrease the size of the markers or use stripplot.
  warnings.warn(msg, UserWarning)
/home/lokesh/anaconda3/lib/python3.9/site-
packages/seaborn/categorical
.py:1296: UserWarning: 62.6% of the points cannot be placed; you may
want to decrease the size of the markers or use stripplot.
  warnings.warn(msg, UserWarning)

<seaborn.axisgrid.FacetGrid object at 0x7ffb0fd0b1c0>
```



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

```
#load data set into ld
ld=  pd.read_csv("Churn_Modelling.csv")
five = ld.head() #for print first five
rows

# information about used data set
ld.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		object
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(9),
object(3)memory usage: 1.1+ MB

```
ld.describe() #description of the data in the Dataset
```

	RowNumber	CustomerId	CreditScore	Age	Tenure \
count	10000.00000	1.000000e+04	10000.000000	10000.000000	10000.000000
mean	5000.50000	1.569094e+07	650.528800	38.921800	5.012800
std	2886.89568	7.193619e+04	96.653299	10.487806	2.892174
min	1.00000	1.556570e+07	350.000000	18.000000	0.000000
25%	2500.75000	1.562853e+07	584.000000	32.000000	3.000000
50%	5000.50000	1.569074e+07	652.000000	37.000000	5.000000
75%	7500.25000	1.575323e+07	718.000000	44.000000	7.000000
max	10000.00000	1.581569e+07	850.000000	92.000000	10.000000

	Balance	NumOfProducts	HasCrCard	IsActiveMember	\
count	10000.000000	10000.000000	10000.00000	10000.000000	
mean	76485.889288	1.530200	0.70550	0.515100	
std	62397.405202	0.581654	0.45584	0.499797	
min	0.000000	1.000000	0.00000	0.000000	
25%	0.000000	1.000000	0.00000	0.000000	
50%	97198.540000	1.000000	1.00000	1.000000	
75%	127644.240000	2.000000	1.00000	1.000000	
max	250898.090000	4.000000	1.00000	1.000000	

	EstimatedSalary	Exited
count	10000.000000	10000.000000
mean	100090.239881	0.203700
std	57510.492818	0.402769
min	11.580000	0.000000
25%	51002.110000	0.000000
50%	100193.915000	0.000000

75%	149388.247500	0.000000
max	199992.480000	1.000000

- **Handle the Missing values.**

```
ld.isnull().any()
```

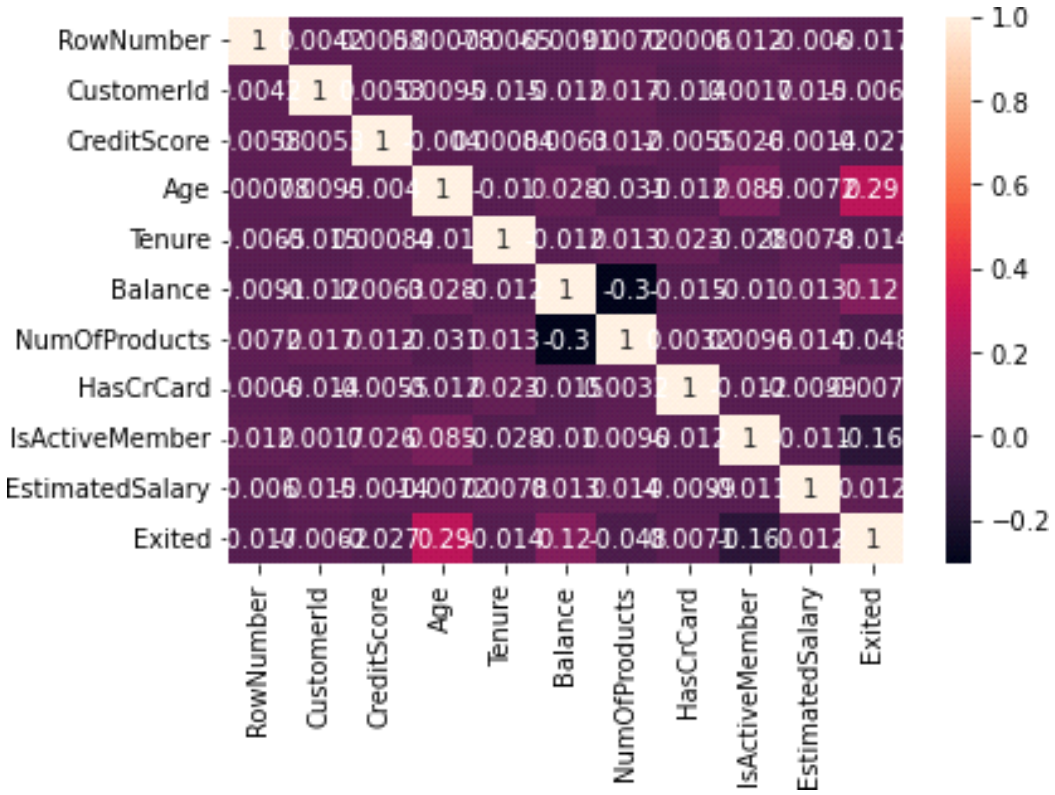
```
RowNumber          False
CustomerId         False
Surname            False
CreditScore        False
Geography          False
Gender             False
Age                False
Tenure             False
Balance            False
NumOfProducts      False
HasCrCard          False
IsActiveMember    False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

```
ld.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
```

```
sns.heatmap(ld.corr(),annot=True) # heatmap -a plot of rectangular
data as a color-encoded matrix
```

```
<AxesSubplot:>
```

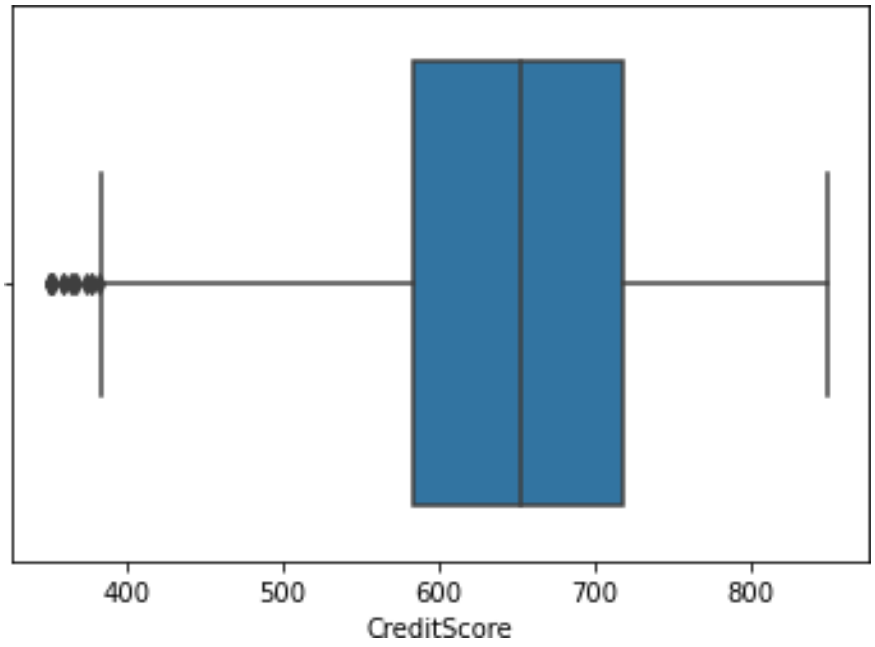


- **Find the outliers and replace the outliers**

```
#occurence of outliers
ld1= pd.read_csv("Churn_Modelling.csv")
sns.boxplot(ld1.CreditScore)
```

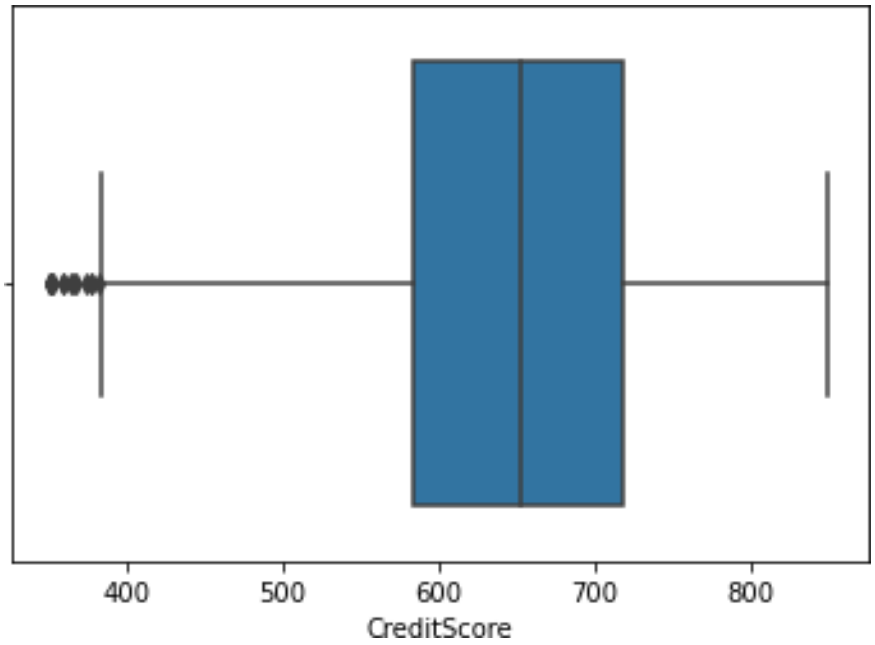
```
/home/lokesh/anaconda3/lib/python3.9/site-packages/seaborn/
_decorators.py:36: FutureWarning: Pass the following variable as a
keyword arg: x. From version 0.12, the only valid positional
argumentwill be `data`, and passing other arguments without an
explicit keyword will result in an error or misinterpretation.
  warnings.warn(
```

```
<AxesSubplot:xlabel='CreditScore'>
```




```
#Use Mean Detection and Nearest Fill Methods - Outliers

Q1= ld1.CreditScore.quantile(0.25)
Q3=ld1.CreditScore.quantile(0.75)
IQR=Q3-Q1
upper_limit    =Q3    +
1.5*IQR lower_limit  =Q1
-                1.5*IQR
ld1['CreditScore'] =
np.where(ld1['CreditScore']>upper_limit,30,ld1['CreditScore'])
sns.boxplot(ld1.CreditScore)
```

```
/home/lokesh/anaconda3/lib/python3.9/site-packages/seaborn/
_decorators.py:36: FutureWarning: Pass the following variable as a
keyword arg: x. From version 0.12, the only valid positional
argumentwill be `data`, and passing other arguments without an
explicit keyword will result in an error or misinterpretation.
  warnings.warn(

<AxesSubplot:xlabel='CreditScore'>
```



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

```
ld1.head(5)
```

\	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age
0	1	15634602	Hargrave	619	France	0	42
1	2	15647311	Hill	608	Spain	0	41
2	3	15619304	Onio	502	France	0	42
3	4	15701354	Boni	699	France	0	39
4	5	15737888	Mitchell	850	Spain	0	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
```

```
#label encoder
from sklearn.preprocessing import LabelEncoder
le=LabelEncoder()
ld1.Gender= le.fit_transform(ld1.Gender)
ld1.head(5)
```

\	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age
0	1	15634602	Hargrave	619	France	0	42
1	2	15647311	Hill	608	Spain	0	41
2	3	15619304	Onio	502	France	0	42
3	4	15701354	Boni	699	France	0	39
4	5	15737888	Mitchell	850	Spain	0	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

```
#one hot encoding
ld1_main=pd.get_dummies(ld1,columns=['Geography'])
ld1_main.head()
```

0		15634602	Hargrave	619		42	
1		15647311	Hill	608		41	
2		15619304	Onio	502		42	
3		15701354	Boni	699		39	

```
   RowNumber  CustomerId   Surname CreditScore Gender Age
Tenure \
```

```
4          5    15737888  Mitchell          850       0   43        2


     Balance NumOfProducts HasCrCard IsActiveMember
EstimatedSalary \
0       0.00              1          1               1
101348.88
1   83807.86              1          0               1
112542.58
2  159660.80              3          1               0
113931.57
3       0.00              2          0               0
93826.63
4  125510.82              1          1               1
79084.10

   Exited  Geography_France  Geography_Germany
Geography_Spain0          1                  1                0 0
1       0                 0                  0                1
2       1                 1                  0                0
3       0                 1                  0                0
4       0                 0                  0                1
```

- **Split the data into dependent and independent variables.**

```
#Splitting the Dataset into the Independent Feature Matrix
df=pd.read_csv("Churn_Modelling.csv")
X = df.iloc[:, :-
1].valuesprint(X)
```

```
[[1 15634602 'Hargrave' ...  1 1 101348.88]
 [2 15647311 'Hill' ... 0 1  112542.58]
 [3 15619304 'Onio' ... 1 0  113931.57]
 ...
 [9998 15584532 'Liu' ... 0  1 42085.58]
 [9999 15682355 'Sabbatini' ... 1 0 92888.52]
 [10000 15628319 'Walker' ... 1 0 38190.78]]
```

```
#Extracting the Dataset to Get the Dependent Vector
Y = df.iloc[:, -
1].valuesprint(Y)

[1 0 1 ... 1 1 0]
```

- **Scale the independent variables**

```
w = df.head()
```

```
q = w[['Age','Balance','EstimatedSalary']] #spliting the dataset into measureable values
q
```

	Age	Balance	EstimatedSalary
0	42	0.00	101348.88
1	41	83807.86	112542.58
2	42	159660.80	113931.57
3	39	0.00	93826.63
4	43	125510.82	79084.10

```
from sklearn.preprocessing import scale # library for scallling
from sklearn.preprocessing import MinMaxScaler
mm = MinMaxScaler()

x_scaled =
mm.fit_transform(q)x_scaled
```

```
            array([[0.75      , 0.        ,
                                0.63892099],
       [0.5       , 0.52491194, 0.96014087],
       [0.75      , 1.        , 1.        ],
       [0.        , 0.        , 0.42305883],
         [1.        , 0.78610918, 0.        ]])
```

from sklearn.preprocessing import sc = StandardScaler() x_ss = sc.fit_transform(q) x_ss	StandardScaler
array([[0.44232587, -1.13763618,	0.09337626],
[-0.29488391, 0.15434425,	0.96285595],
[0.44232587, 1.32369179,	1.07074687],
[-1.76930347, -1.13763618,	-0.49092058],
[1.17953565, 0.79723632,	-1.6360585]])
from sklearn.preprocessing import	scale

```
X_scaled=pd.DataFrame(scale(q),columns=q.columns)
X_scale=X_scaled.head()
X_scale
```

	Age	Balance	EstimatedSalary
0	0.442326	-1.137636	0.093376
1	-0.294884	0.154344	0.962856
2	0.442326	1.323692	1.070747
3	-1.769303	-1.137636	-0.490921
4	1.179536	0.797236	-1.636059

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

```
x=
df[['Age','Balance','EstimatedSalary']]x
```

	Age	Balance	EstimatedSalary
0	42	0.00	101348.88
1	41	83807.86	112542.58
2	42	159660.80	113931.57
3	39	0.00	93826.63
4	43	125510.82	79084.10
...	...	...	...
9995	39	0.00	96270.64
9996	35	57369.61	101699.77
9997	36	0.00	42085.58
9998	42	75075.31	92888.52
9999	28	130142.79	38190.78

```
[10000 rows x 3 columns]

y =
df['Balance']y
```

```
0            0.00
1        83807.86
2       159660.80
3            0.00
4       125510.82
          ...
```

9995	0.00
9996	57369.61
9997	0.00
9998	75075.31
9999	130142.79
Name:	Balance, Length: 10000, dtype: float64

```
#scaling
from sklearn.preprocessing import StandardScaler,
MinMaxScalersc = StandardScaler()
x_scaled1 =
sc.fit_transform(x)x_scaled1
```

array([[0.29351742,	-1.22584767,	0.02188649],
[0.19816383,	0.11735002,	0.21653375],
[0.29351742,	1.33305335,	0.2406869],
...,		
[-0.27860412,	-1.22584767,	-1.00864308],
[0.29351742,	-0.02260751,	-0.12523071],
[-1.04143285,	0.85996499,	-1.07636976]])

```
#train and test data
```

```
from sklearn.model_selection import train_test_split
x_train, x_test, y_train, y_test = train_test_split(x_scaled1, y,
test_size = 0.3, random_state = 0)

x_train

          array([[-0.56466489,  1.11721307, -
                                 0.77021814],
      [ 0.00745665, -1.22584767, -1.39576675],
      [ 3.53553951,  1.35419118, -1.49965629],
```

...,		
[-0.37395771,	1.35890908,	1.41441489],
[-0.08789694,	-1.22584767,	0.84614739],
[0.86563897,	0.50630343,	0.32630495]])
x_train.shape		
(7000, 3)		
x_test		
array([[-0.37395771,	0.87532296,	1.61304597],
[0.10281024,	0.42442221,	0.49753166],
[0.29351742,	0.30292727,	-0.4235611],
...,		
[0.10281024,	1.46672809,	1.17045451],
[2.86806437,	1.25761599,	-0.50846777],
[0.96099256,	0.19777742,	-1.15342685]])

```
x_test.sha

pe(3000,

3)

y_train
```

7681	146193.60
9031	0.00
3691	160979.68
202	0.00
5625	143262.04
	...
9225	120074.97
4859	114440.24
3264	161274.05
9845	0.00
2732	108076.33
Name:	Balance, Length: 7000, dtype: float64
y_test	
9394	131101.04

898	102967.41	
2398	95386.82	
5906	112079.58	
2343	163034.82	
	...	
4004	0.00	
7375	80926.02	
9307	168001.34	
8394	154953.94	
5233	88826.07	
Name:	Balance, Length:	3000, dtype: float64