```
import matplotlib.pyplot as plt
%matplotlib inline

#loaddataset
df = pd.read_csv(r"/content/Churn_Modelling.csv")df.head(10)
```

```
     RowNumber    CustomerId                    CreditSc                     Age
\
0            1      15634602       I                                          42

1            2      15647311                                                  41

2            3      15619304                                                  42

3            4      15701354                                                  39

4            5      15737888                                                  43

5            6      15574012                                                  44

6            7      15592531                                                  50

7            8      15656148                                                  29

8            9      15792365                                                  44

9           10      15592389                                                  27


      Tenure      Balance     NumOfPro                                  \

0          2         0.00
1          1     83807.86
2          8    159660.80
3          1         0.00
4          2    125510.82
5          8    113755.78
6          7         0.00
7          4    115046.74
8          4    142051.07
9          2    134603.88

     EstimatedSalary        Exited
0          101348.88             1
1          112542.58             0
```

```
3                    93826.63          0
4                    79084.10          0
5                   149756.71          1
6                    10062.80          0
7                   119346.88          1
8                    74940.50          0
9                    71725.73          0
```

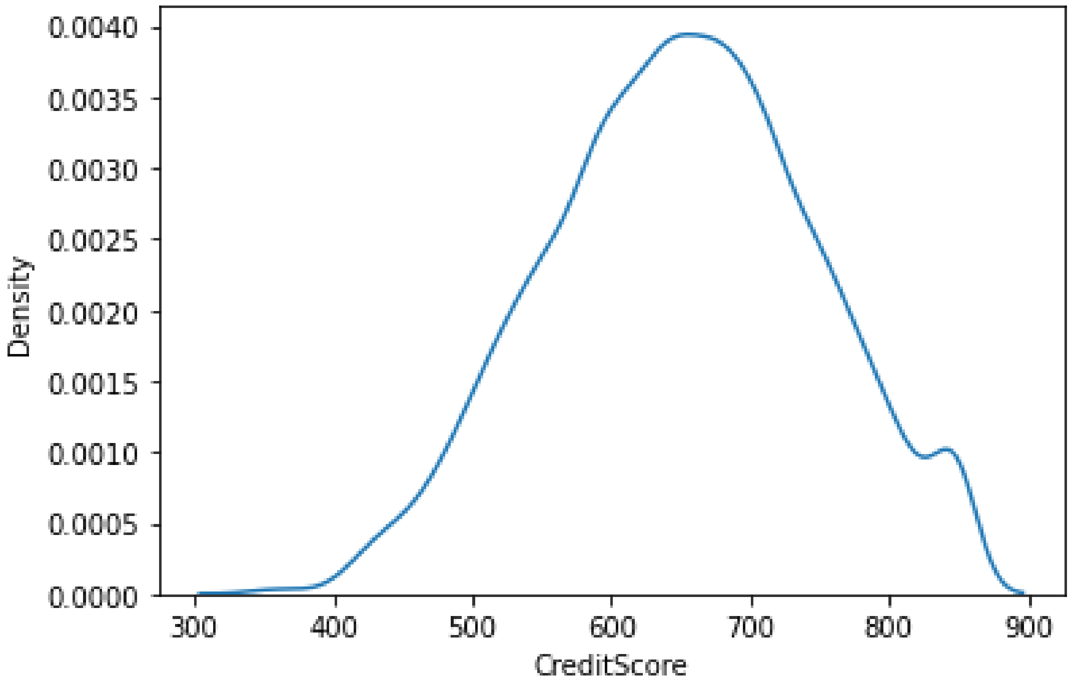
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>RangeIndex: 10000
entries, 0 to 9999 Data columns (total 14 columns):
  #      Column                    Non-Null Count  Dtype
----    ---------------------------------------------------
  1      RowNumber                 10000 non-null   int64
  2      CustomerId                10000 non-null   int64
  3      Surname                   10000 non-null  object
  4      CreditScore               10000 non-null   int64
  5      Geography                 10000 non-null   object
  6      Gender                    10000 non-null   object
  7      Age                       10000 non-null   int64
  8      Tenure                    10000 non-null   int64
  9      Balance                   10000 non-null   float64
  10     NumOfProducts             10000 non-null   int64
  11     HasCrCard                 10000 non-null   int64
  12     IsActiveMember            10000 non-null   int64
  13     EstimatedSalary   10000 non-null  float64
  14     Exited                    10000 non-null int64dtypes:
float64(2), int64(9), object(3) memory usage: 1.1+ MB
```

```
#Visualizations#Univariate
Analysisimport seaborn as sns

sns.kdeplot(df['CreditScore'])
```

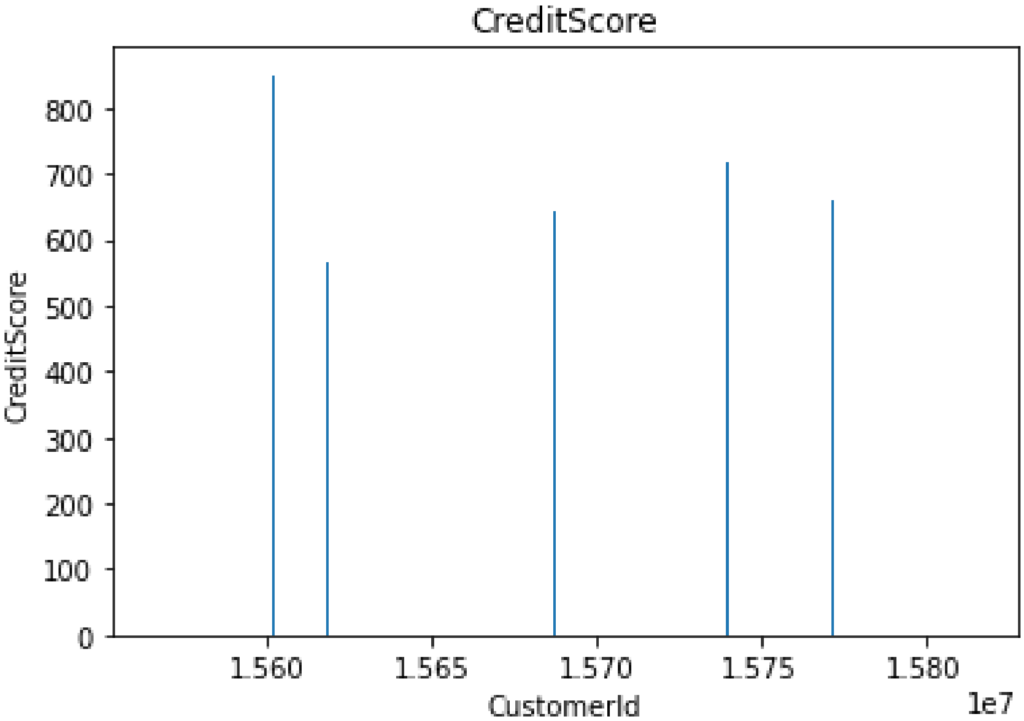
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fc4a0cd2790>
```



#Bi-VariateAnalysis

```
plt.bar(df.CustomerId, df.CreditScore)plt.title('CreditScore')
plt.xlabel('CustomerId') plt.ylabel('CreditScore')
```

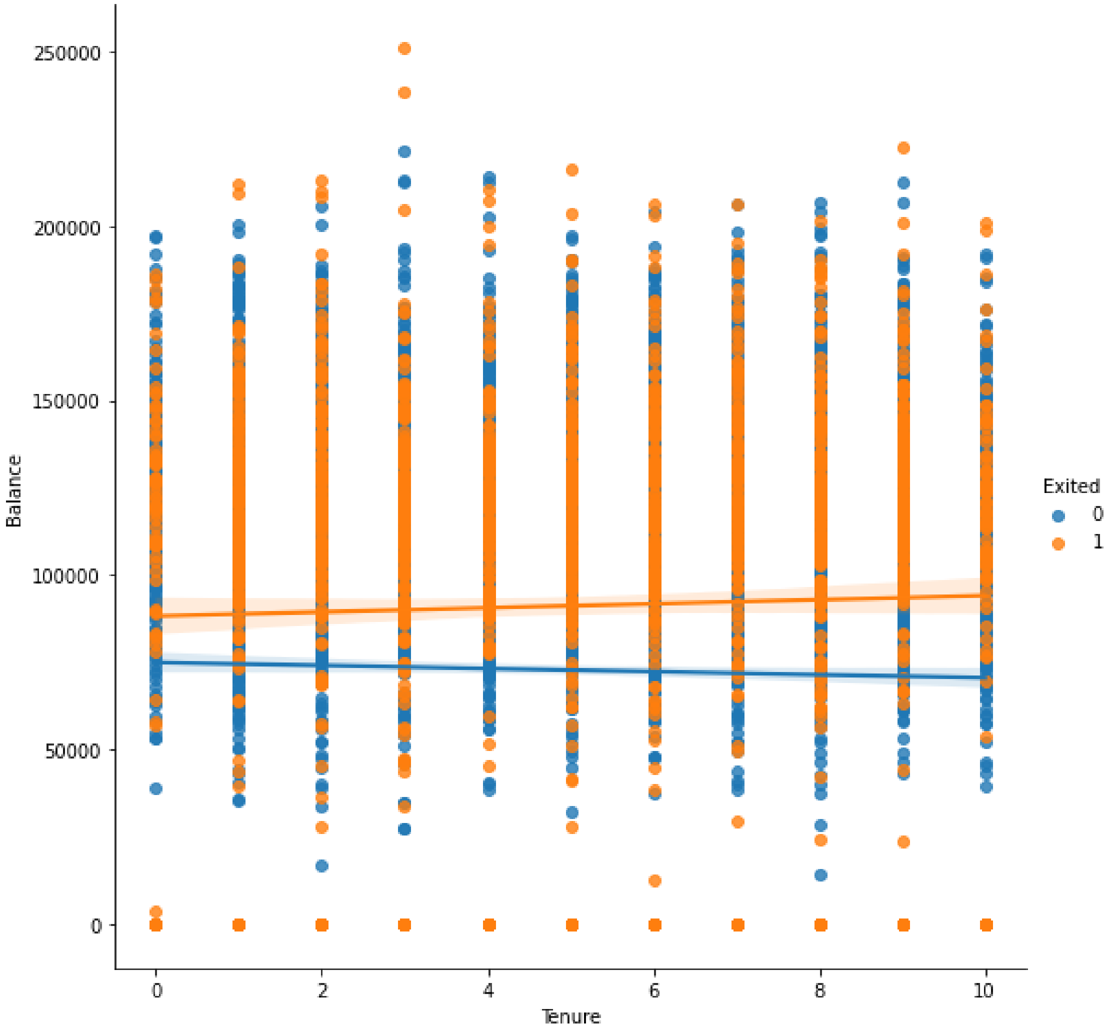
```
Text(0, 0.5, 'CreditScore')
```



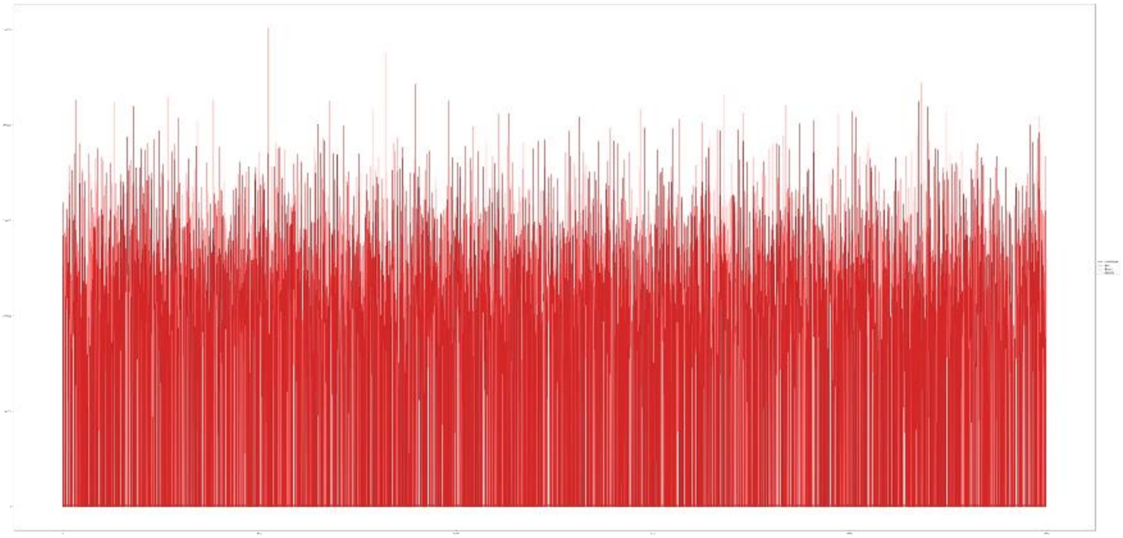
```
sns.lmplot(x='Tenure', y='Balance', data=df ,hue='Exited',size=8)
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/regression.py:581: UserWarning: The `size` parameter has been renamed to
`height`; pleaseupdate your code.
    warnings.warn(msg, UserWarning)
```

```
<seaborn.axisgrid.FacetGrid at 0x7fc4a149e2d0>
```



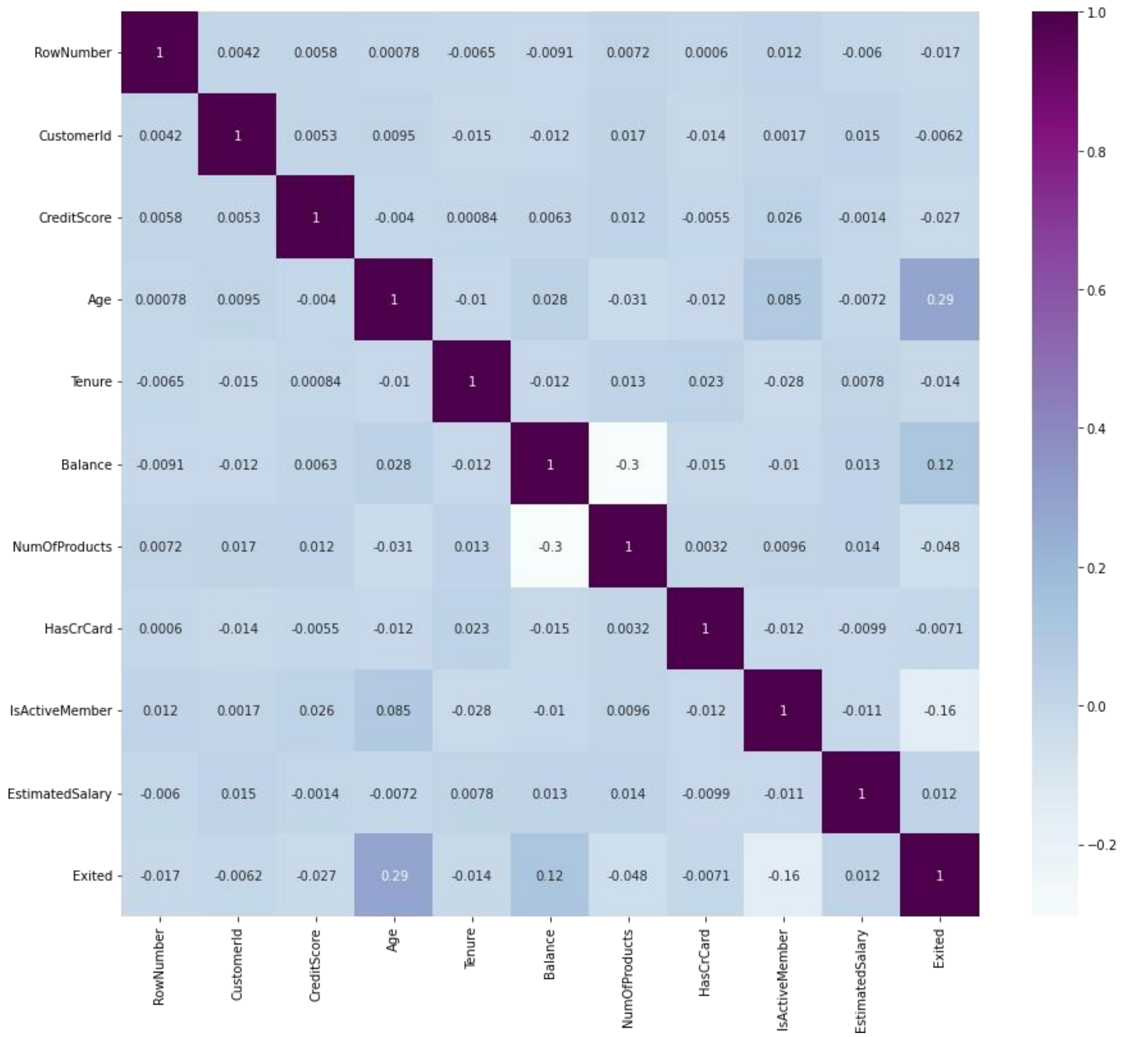
```
#Multi-VariateAnalysis
ax = df[["CreditScore","Age","Tenure","Balance"]].plot(figsize=(80,40))ax.legend(loc='center left',
bbox_to_anchor=(1, 0.5));
```



```
df.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
```

```
plt.figure(figsize=(15,13)) sns.heatmap(df.corr(),annot=True,cmap='BuPu')plt.show()
```



```
df.drop(['RowNumber', 'CustomerId','Surname'],axis=1,inplace=True)df.head()
```

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

    HasCrCard    IsActiveMember   EstimatedSalary   Exited0                   1
               1                        101348.88        1
```

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

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>RangeIndex: 10000
entries, 0 to 9999 Data columns (total 11 columns):
 #      Column                   Non-Null Count  Dtype
---     -------                  -----------------------.     -----
 1      CreditScore              10000 non-null int64
 2      Geography                10000 non-null   object
 3      Gender                   10000 non-null   object
 4      Age                      10000 non-null   int64
 5      Tenure                   10000 non-null   int64
 6      Balance                  10000 non-null  float64
 7      NumOfProducts            10000 non-null   int64
 8      HasCrCard                10000 non-null   int64
 9      IsActiveMember           10000 non-null   int64
 10     EstimatedSalary   10000 non-null  float64
 11     Exited                   10000 non-null int64dtypes:
float64(2), int64(7), object(2) memory usage: 859.5+ KB
```

```
df["Geography"].unique()
```

```
array(['France', 'Spain', 'Germany'], dtype=object)df["Gender"].unique()
```

```
array(['Female', 'Male'], dtype=object)
```

```
geo=pd.get_dummies(df["Geography"],drop_first=False)geo.head()
```

```
     France   Germany   Spain0        1
0             0
1             0               0        1
2             1               0        0
3             1               0        0
4             0               0        1
```

```
gen=pd.get_dummies(df["Gender"],drop_first=False)df=pd.concat([df, geo,gen], axis=1)
```

```
df
```

```
            CreditScore Geography   Gender   Age   Tenure                              Balance
NumOfProducts \
0                 619      France    Female    42        2       0.00
1
1                 608       Spain    Female    41        1   83807.86
1
2                 502      France    Female    42        8  159660.80
3
3                 699      France    Female    39        1       0.00
2
4                 850       Spain    Female    43        2  125510.82
1
...               ...         ...       ...   ...      ...        ...
...
9995              771      France      Male    39        5       0.00
2
9996              516      France      Male    35       10   57369.61
1
9997              709      France    Female    36        7       0.00
1
9998              772     Germany      Male    42        3   75075.31
2
9999              792      France    Female    28        4  130142.79
1

      HasCrCard IsActiveMember EstimatedSalary Exited FranceGermany \

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

        Spain   Female   Male
0           0        1      0
```

```
1                1           1        0
2                0           1        0
3                0           1        0
4                1           1        0
...              ...         ...      ...
9995             0           0        1
9996             0           0        1
9997             0           1        0
9998             0           0        1
9999             0           1        0
```

```
[10000 rows x 16 columns] df.drop(["Geography","Gender"], axis=1, inplace=True)df.head()
```

```
    CreditScore  Age  Tenure          Balance  NumOfProducts  HasCrCard  \0          61942
2                      0.00           1       1
1                608   41             1      83807.86                  1             0
2                502   42             8   159660.80                    3             1
3                699   39             1            0.00                2             0
4                850   43             2   125510.82                    1             1

    IsActiveMember EstimatedSalary Exited France Germany SpainFemale \
0                  1                101348.88       1        1          0         0
1
1                  1                112542.58       0        0          0         1
1
2                  0                113931.57       1        1          0         0
1
3                  0                 93826.63       0        1          0         0
1
4                  1                 79084.10       0        0          0         1
1

     Male
0     0
1     0
2     0
3     0
4     0
```

```
x=df.drop('Exited',axis=1)x
```

```
            CreditScore    Age    Tenure      Balance    NumOfProducts    HasCrCard   \
0                   619     42         2         0.00                1            1
1                   608     41         1     83807.86                1            0
```

```
2                  502     42          8  159660.80                      3              1
3                  699     39          1              0.00               2              0
4                  850     43          2  125510.82                      1              1
...                ...     ...       ...            ...                ...           ...
9995               771     39          5              0.00               2              1
9996               516     35         10    57369.61                     1              1
9997               709     36          7              0.00               1              0
9998               772     42          3    75075.31                     2              1
9999               792     28          4  130142.79                      1              1

        IsActiveMember          EstimatedSalary          France  Germany     Spain    Female
Male
0                      1               101348.88              1         0         0         1
0
1                      1               112542.58              0         0         1         1
0
2                      0               113931.57              1         0         0         1
0
3                      0                 93826.63             1         0         0         1
0
4                      1                 79084.10             0         0         1         1
0
...                    ...                   ...           ...       ...       ...       ...
... 9995
                       0                                      1         0         0         0
                                         96270.64
1
9996                   1               101699.77              1         0         0         0
1
9997                   1                 42085.58             1         0         0         1
0
9998                   0                 92888.52             0         1         0         0
1
9999                   0                 38190.78             1         0         0         1
0

[10000 rows x 13 columns]y=df['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: int64df.shape

(10000, 14)

x.shape (10000, 13)

y.shape

(10000,)

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) x_train.shape(8000,

13)

x_test.shape(2000, 13)

y_test.shape(2000,)

from sklearn.preprocessing import StandardScalersc = StandardScaler()

x_train = sc.fit_transform(x_train)x_train

            array([[ 0.16958176,   -0.46460796,   0.00666099,                    ...,          1.74309049,
                     1.09168714,   -1.09168714],
                  [-2.30455945,     0.30102557, -1.37744033,                    ...,         -0.57369368,
                    -0.91601335,     0.91601335],
                   [-1.19119591,   -0.94312892, -1.031415               ,      ...,         -0.57369368,
                  1.09168714,      -1.09168714],
            ...,
                    [ 0.9015152 ,   -0.36890377,  0.00666099,                   ...,         -0.57369368,
                    -0.91601335,     0.91601335],
                  [-0.62420521,   -0.08179119, 1.39076231,                     ...,          1.74309049,
                     1.09168714,   -1.09168714],
                  [-0.28401079,     0.87525072, -1.37744033,                    ...,         -0.57369368,
                     1.09168714,   -1.09168714]])

x_test = sc.transform(x_test)
```

x_test

```
array([[-0.55204276, -0.36890377,  1.04473698, ..., -0.57369368,
                    1.09168714, -1.09168714],
                            [-1.31490297,     0.10961719, -1.031415                         ,        ...,          -0.57369368,
                              1.09168714,   -1.09168714],
                              [ 0.57162971,     0.30102557, 1.04473698,                              ...,            1.74309049,
                    1.09168714,            -1.09168714],
               ...,
               [-0.74791227,               -0.27319958, -1.37744033,                                 ...,            1.74309049,
                           -0.91601335,     0.91601335],
                           [-0.00566991,   -0.46460796, -0.33936434,                                 ...,          -0.57369368,
                           -0.91601335,     0.91601335],
                           [-0.79945688,   -0.84742473, 1.04473698,                                  ...,          -0.57369368,
                           -0.91601335,     0.91601335]])
```