# Assignment -2

## DataVisualizationandPre-processing

| | |
|---|---|
| Team ID | PNT2022TMID3148 |
| Project  Title | Real-Time Communication System Powered By AI For Specially |
| MaximumMarks | 2Marks |

**ToPerformBelowTaskstocompletetheassignment:-**

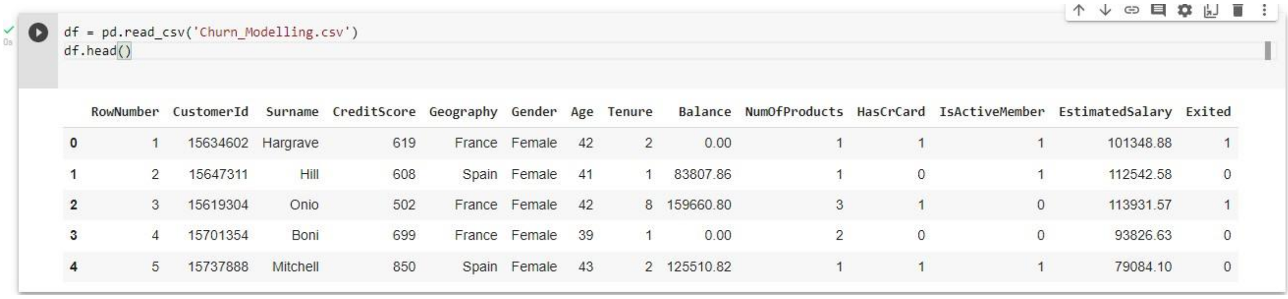
Step1.Downloadthedataset:Dataset

Step2.Loadthedataset.

```
import pandas as
pdimportnumpyasn
p
importmatplotlib.pyplot as
pltimportseaborn assns

df=pd.read_csv('Churn_Modelling.csv')d
f.head()
```

Output:



```
df = pd.read_csv('Churn_Modelling.csv')
df.head()
```

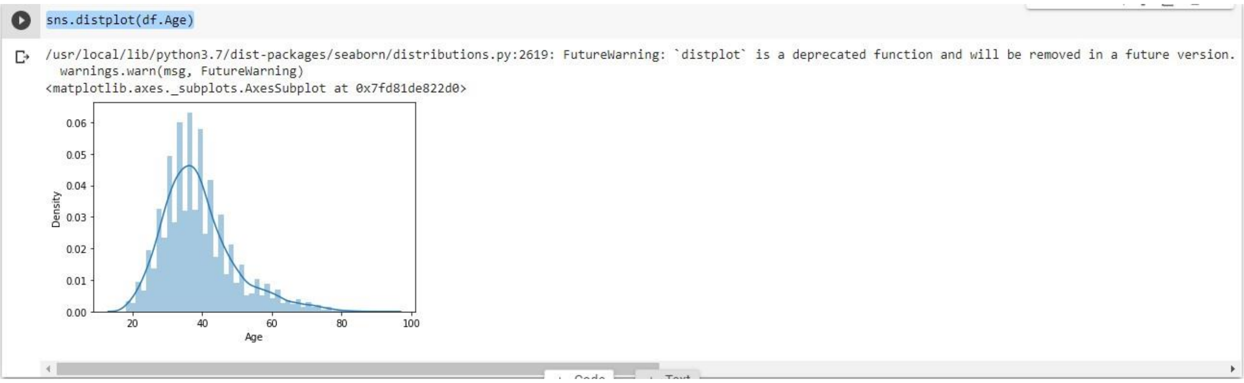
| | RowNumber | CustomerId | Surname | CreditScore | Geography | Gender | Age | Tenure | Balance | NumOfProducts | HasCrCard | IsActiveMember | EstimatedSalary | Exited |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 15634602 | Hargrave | 619 | France | Female | 42 | 2 | 0.00 | 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 |

Step3.PerformBelowVisualizations.

● UnivariateAnalysis

sns.distplot(df.Age)Out

put:

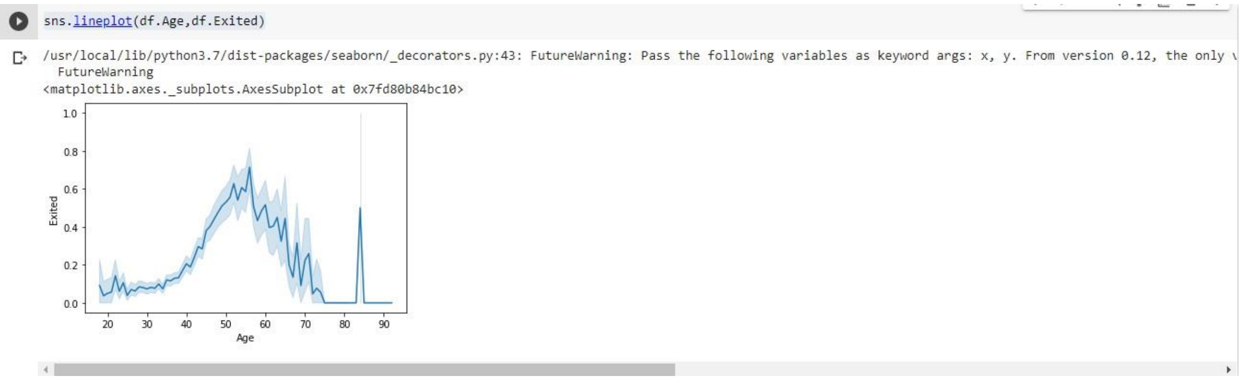


```
sns.distplot(df.Age)
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/distributions.py:2619: FutureWarning: `distplot` is a deprecated function and will be removed in a future version.
  warnings.warn(msg, FutureWarning)
<matplotlib.axes._subplots.AxesSubplot at 0x7fd81de822d0>
```

sns.lineplot(df.Age,df.Exited)

Output:

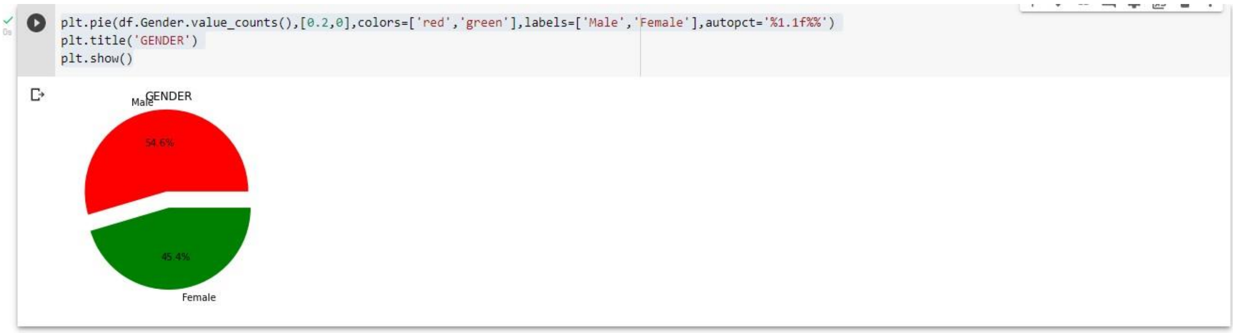


```
sns.lineplot(df.Age,df.Exited)
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pass the following variables as keyword args: x, y. From version 0.12, the only
  FutureWarning
<matplotlib.axes._subplots.AxesSubplot at 0x7fd80b84bc10>
```

plt.pie(df.Gender.value_counts(),[0.2,0],colors=['red','green'],labels=['Male','Female'],autopct='%1.1f%%')plt.title('GENDER')
plt.show()

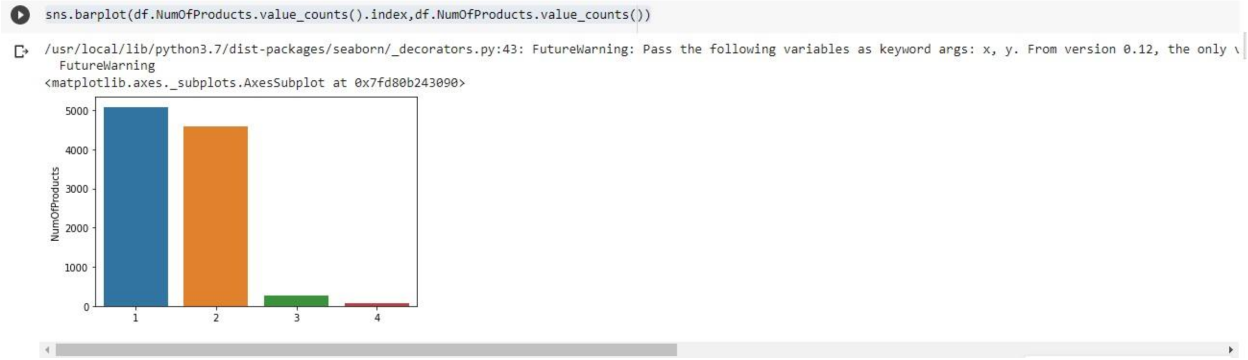
Output:



```
plt.pie(df.Gender.value_counts(),[0.2,0],colors=['red','green'],labels=['Male','Female'],autopct='%1.1f%%')
plt.title('GENDER')
plt.show()
```

sns.barplot(df.NumOfProducts.value_counts().index,df.NumOfProducts.value_counts())

Output:



```
sns.barplot(df.NumOfProducts.value_counts().index,df.NumOfProducts.value_counts())
```

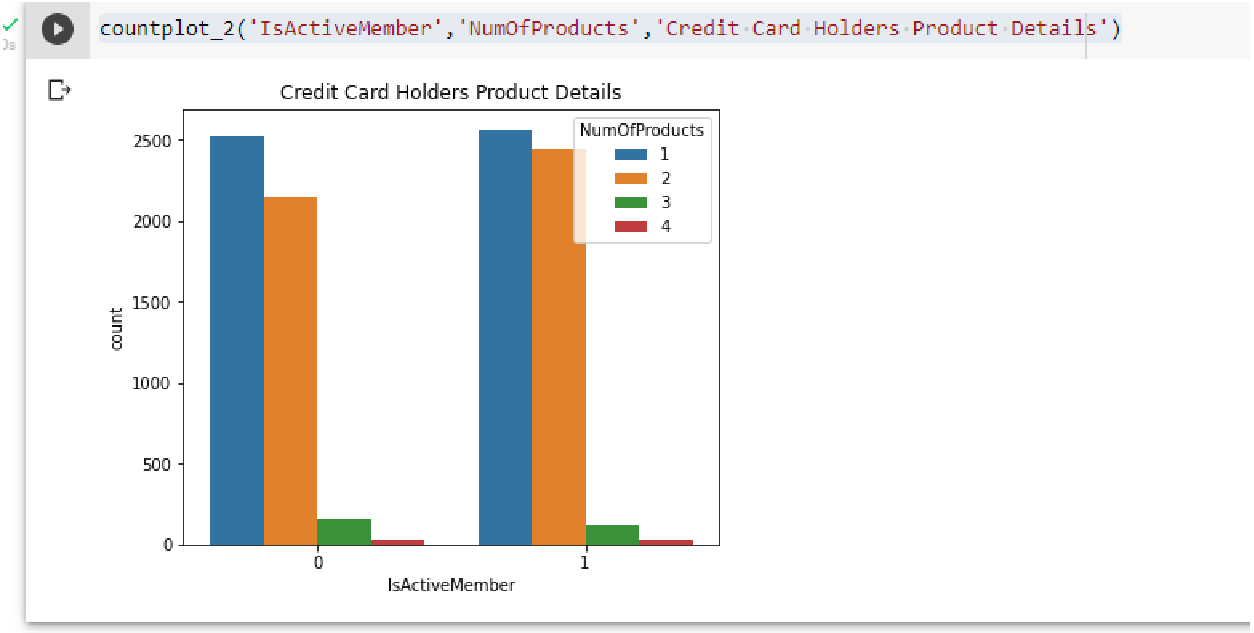
```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pass the following variables as keyword args: x, y. From version 0.12, the only \
  FutureWarning
<matplotlib.axes._subplots.AxesSubplot at 0x7fd80b243090>
```

- Bi-VariateAnalysis

```
defcountplot_2(x,hue,title=None,figsize=(6,5)):
  plt.figure(figsize=figsize)sns.countplot(data=df
  [[x,hue]],x=x,hue=hue)plt.title(title)
  plt.show()
```

```
countplot_2('IsActiveMember','NumOfProducts','CreditCardHoldersProductDetails')
```

Output:

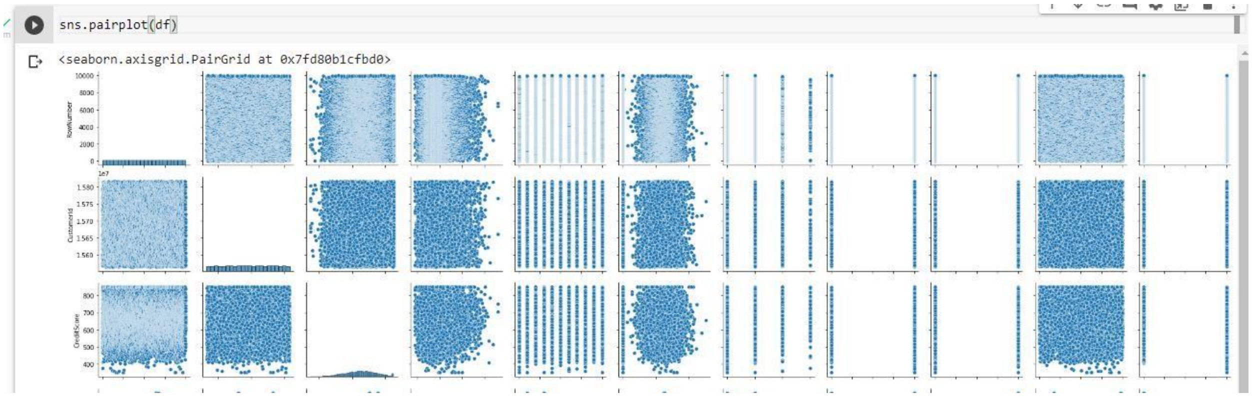


```
countplot_2('IsActiveMember','NumOfProducts','Credit Card Holders Product Details')
```

- Multi-VariateAnalysis

sns.pairplot(df)

Output:

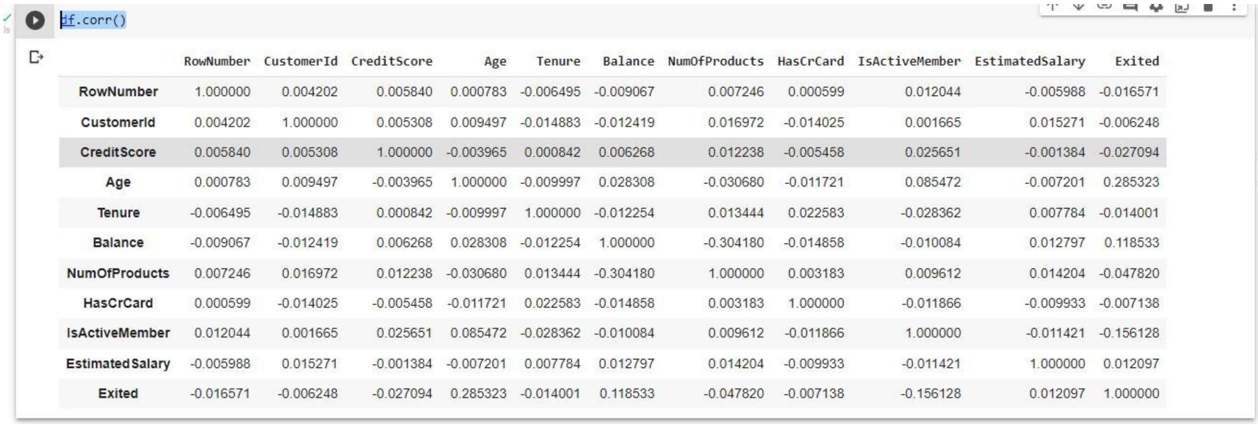


```
sns.pairplot(df)
```

```
<seaborn.axisgrid.PairGrid at 0x7fd80b1cfbd0>
```

df.corr()

Output:

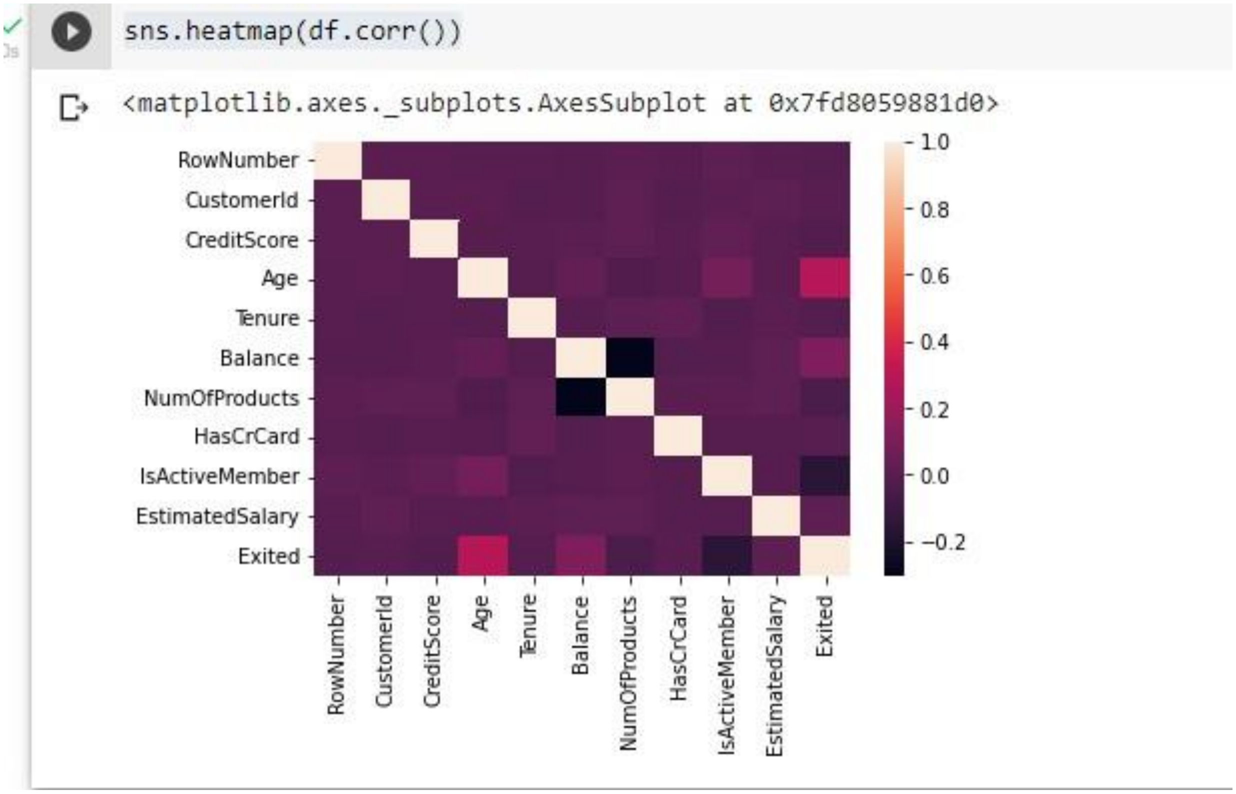


```
df.corr()
```

| | RowNumber | CustomerId | CreditScore | Age | Tenure | Balance | NumOfProducts | HasCrCard | IsActiveMember | EstimatedSalary | Exited |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **RowNumber** | 1.000000 | 0.004202 | 0.005840 | 0.000783 | -0.006495 | -0.009067 | 0.007246 | 0.000599 | 0.012044 | -0.005988 | -0.016571 |
| **CustomerId** | 0.004202 | 1.000000 | 0.005308 | 0.009497 | -0.014883 | -0.012419 | 0.016972 | -0.014025 | 0.001665 | 0.015271 | -0.006248 |
| **CreditScore** | 0.005840 | 0.005308 | 1.000000 | -0.003965 | 0.000842 | 0.006268 | 0.012238 | -0.005458 | 0.025651 | -0.001384 | -0.027094 |
| **Age** | 0.000783 | 0.009497 | -0.003965 | 1.000000 | -0.009997 | 0.028308 | -0.030680 | -0.011721 | 0.085472 | -0.007201 | 0.285323 |
| **Tenure** | -0.006495 | -0.014883 | 0.000842 | -0.009997 | 1.000000 | -0.012254 | 0.013444 | 0.022583 | -0.028362 | 0.007784 | -0.014001 |
| **Balance** | -0.009067 | -0.012419 | 0.006268 | 0.028308 | -0.012254 | 1.000000 | -0.304180 | -0.014858 | -0.010084 | 0.012797 | 0.118533 |
| **NumOfProducts** | 0.007246 | 0.016972 | 0.012238 | -0.030680 | 0.013444 | -0.304180 | 1.000000 | 0.003183 | 0.009612 | 0.014204 | -0.047820 |
| **HasCrCard** | 0.000599 | -0.014025 | -0.005458 | -0.011721 | 0.022583 | -0.014858 | 0.003183 | 1.000000 | -0.011866 | -0.009933 | -0.007138 |
| **IsActiveMember** | 0.012044 | 0.001665 | 0.025651 | 0.085472 | -0.028362 | -0.010084 | 0.009612 | -0.011866 | 1.000000 | -0.011421 | -0.156128 |
| **EstimatedSalary** | -0.005988 | 0.015271 | -0.001384 | -0.007201 | 0.007784 | 0.012797 | 0.014204 | -0.009933 | -0.011421 | 1.000000 | 0.012097 |
| **Exited** | -0.016571 | -0.006248 | -0.027094 | 0.285323 | -0.014001 | 0.118533 | -0.047820 | -0.007138 | -0.156128 | 0.012097 | 1.000000 |

sns.heatmap(df.corr())

Output:

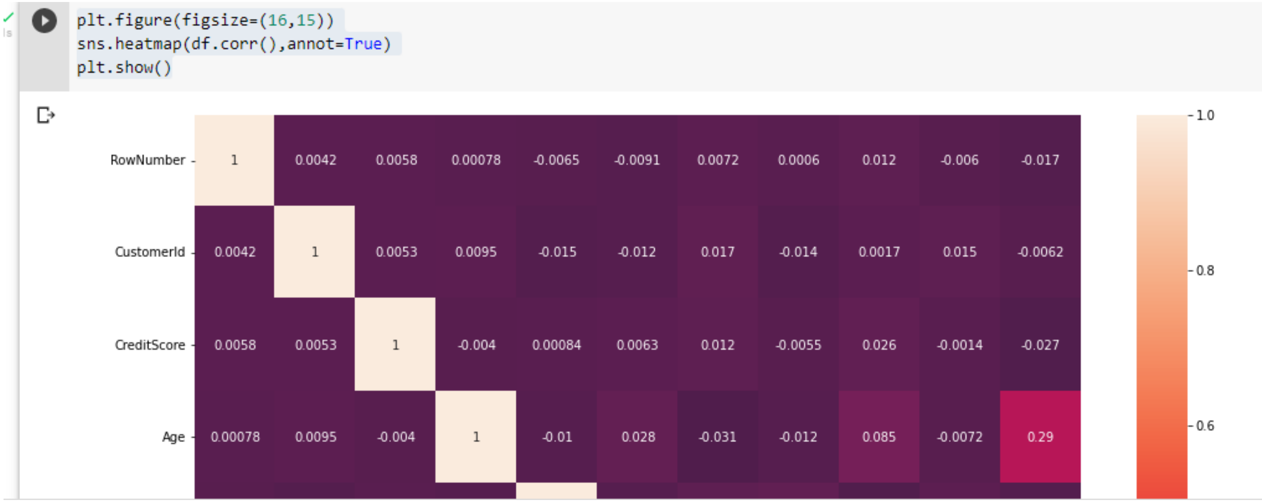


```
sns.heatmap(df.corr())
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd8059881d0>
```

plt.figure(figsize=(16,15))sns.heatmap(df.corr(),annot=True)plt.show()

Output:



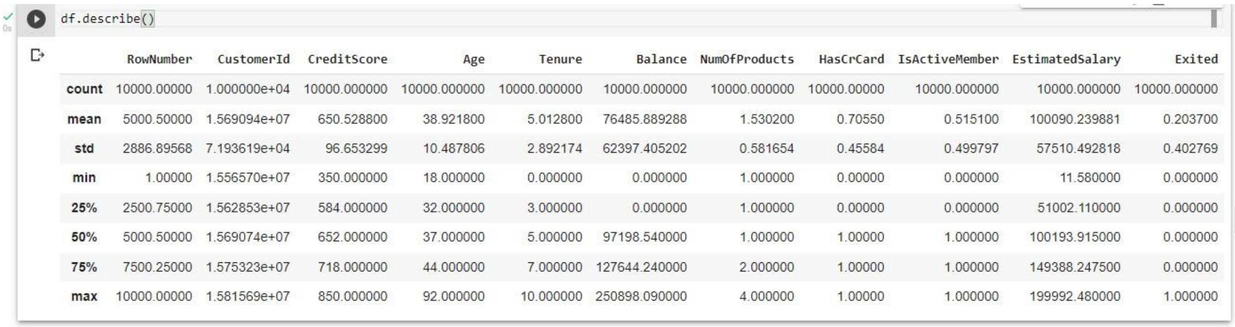
```
plt.figure(figsize=(16,15))
sns.heatmap(df.corr(),annot=True)
plt.show()
```

RowNumber 1 0.0042 0.0058 0.00078 -0.0065 -0.0091 0.0072 0.0006 0.012 -0.006 -0.017
CustomerId 0.0042 1 0.0053 0.0095 -0.015 -0.012 0.017 -0.014 0.0017 0.015 -0.0062
CreditScore 0.0058 0.0053 1 -0.004 0.00084 0.0063 0.012 -0.0055 0.026 -0.0014 -0.027
Age 0.00078 0.0095 -0.004 1 -0.01 0.028 -0.031 -0.012 0.085 -0.0072 0.29
1.0
0.8
0.6

Step4.Performdescriptivestatisticsonthedataset.

df.describe()

Output:

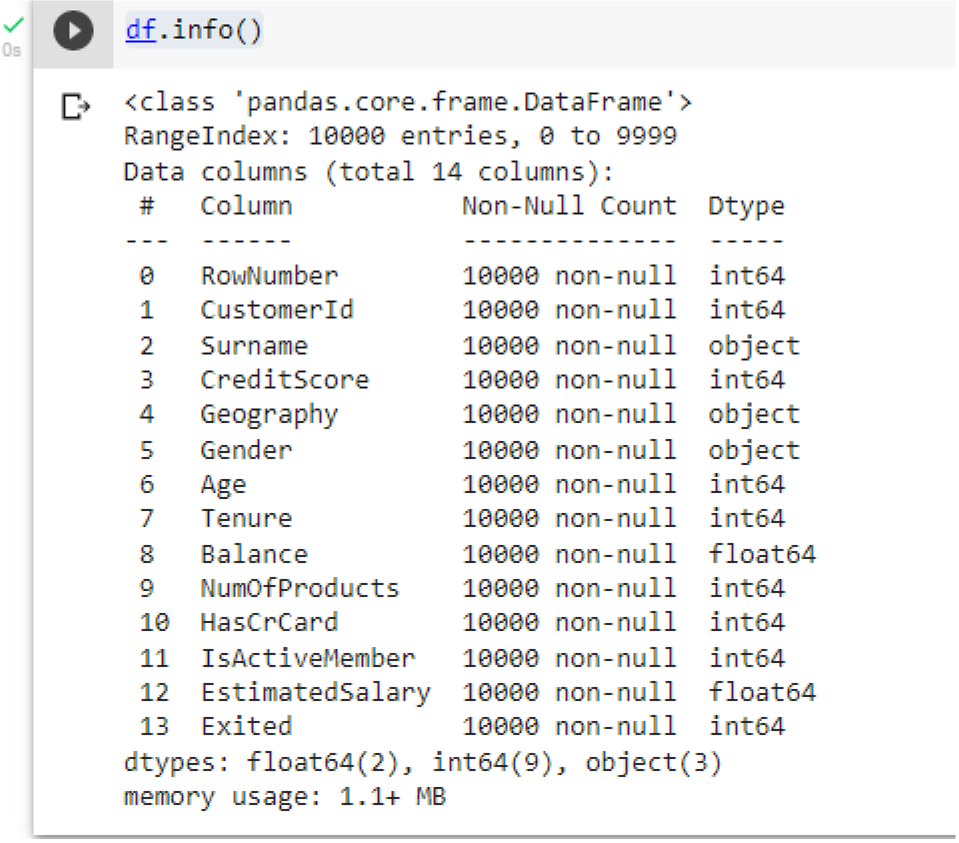


```
df.describe()
```

|  | 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 |

df.info()

Output:



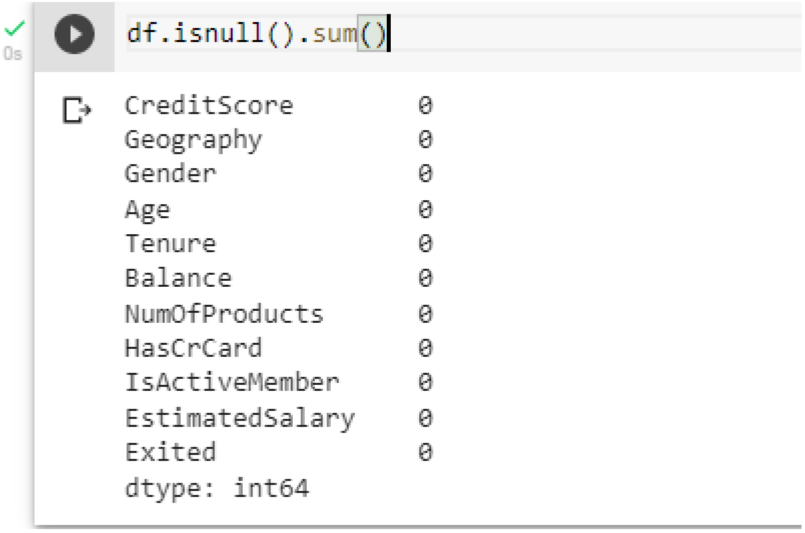
```
df.info()
```

```
<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  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
```

Step5. HandletheMissingvalues.

df=df.drop(columns=['RowNumber','CustomerId','Surname']) df.isnull().sum()

Output:

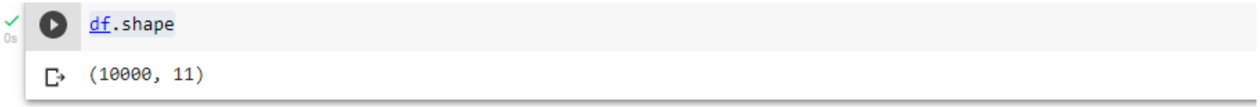


```
df.isnull().sum()
```

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

df.shape

Output:



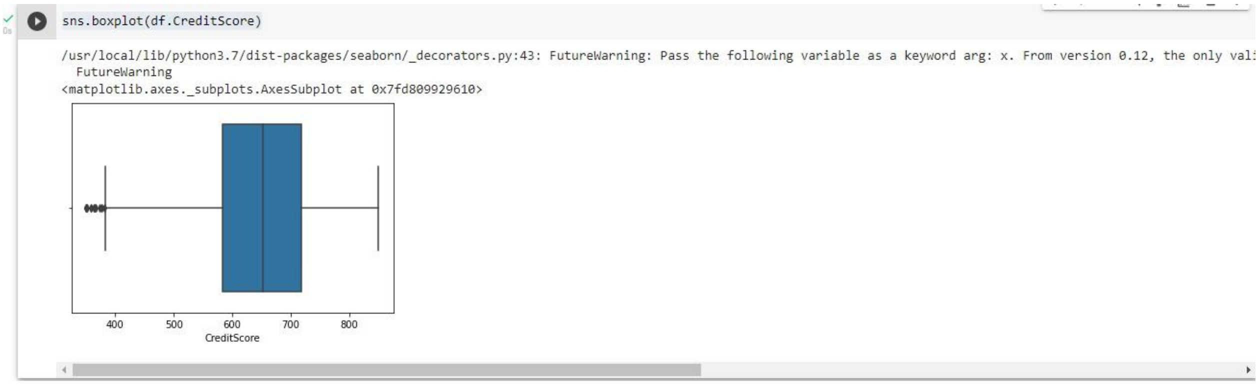
```
df.shape
```

```
(10000, 11)
```

Step6.Findtheoutliersandreplacethe outliers

sns.boxplot(df.CreditScore)

Output:



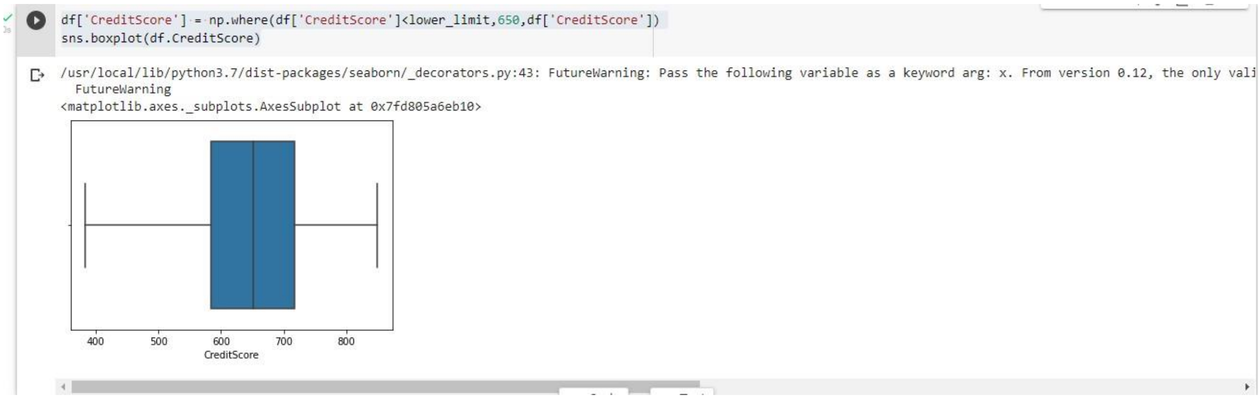
```
sns.boxplot(df.CreditScore)
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pass the following variable as a keyword arg: x. From version 0.12, the only vali
  FutureWarning
<matplotlib.axes._subplots.AxesSubplot at 0x7fd809929610>
```

Q1 =
df.CreditScore.quantile(0.25)Q3=d
f.CreditScore.quantile(0.75)
IQR=Q3-Q1
upper_limit = Q3 +
(1.5*IQR)lower_limit= Q1-
(1.5*IQR)

df['CreditScore']=np.where(df['CreditScore']<lower_limit,650,df['CreditScore'])sns.boxplot(df.CreditScore)

Output:



```
df['CreditScore'] = np.where(df['CreditScore']<lower_limit,650,df['CreditScore'])
sns.boxplot(df.CreditScore)
```

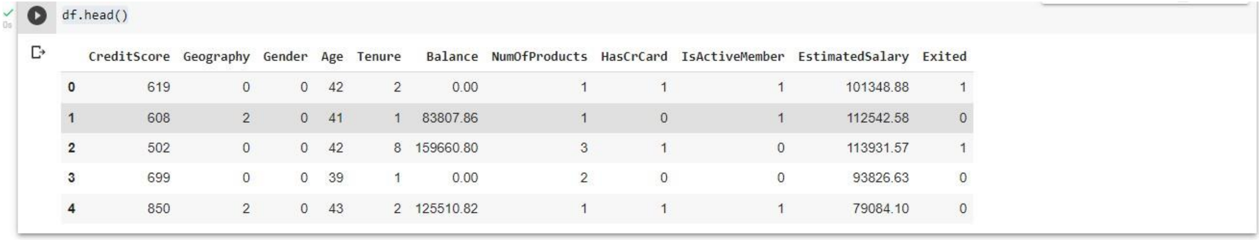
```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pass the following variable as a keyword arg: x. From version 0.12, the only vali
  FutureWarning
<matplotlib.axes._subplots.AxesSubplot at 0x7fd805a6eb10>
```

Step 7. Check for Categorical columns and perform

encoding.fromsklearn.preprocessing importLabelEncoder
le= LabelEncoder()
df.Geography=le.fit_transform(df.Geography)d
f.Gender=le.fit_transform(df.Gender)

df.head()

Output:



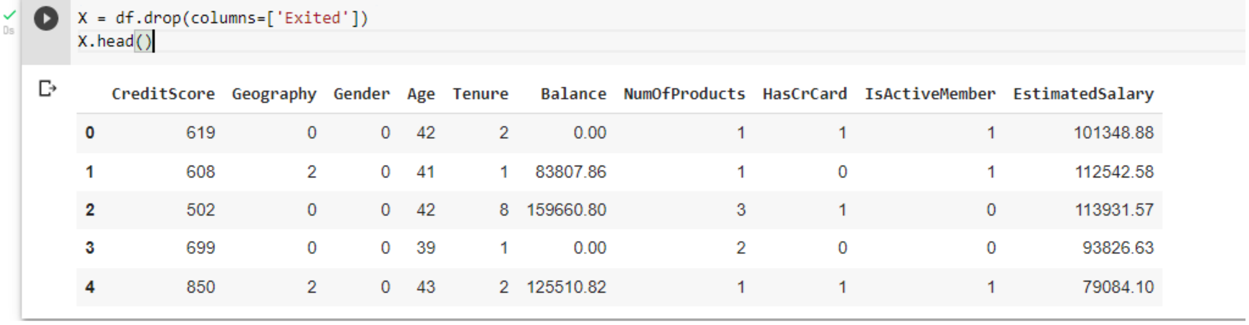
```
df.head()
```

| | CreditScore | Geography | Gender | Age | Tenure | Balance | NumOfProducts | HasCrCard | IsActiveMember | EstimatedSalary | Exited |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 619 | 0 | 0 | 42 | 2 | 0.00 | 1 | 1 | 1 | 101348.88 | 1 |
| **1** | 608 | 2 | 0 | 41 | 1 | 83807.86 | 1 | 0 | 1 | 112542.58 | 0 |
| **2** | 502 | 0 | 0 | 42 | 8 | 159660.80 | 3 | 1 | 0 | 113931.57 | 1 |
| **3** | 699 | 0 | 0 | 39 | 1 | 0.00 | 2 | 0 | 0 | 93826.63 | 0 |
| **4** | 850 | 2 | 0 | 43 | 2 | 125510.82 | 1 | 1 | 1 | 79084.10 | 0 |

Step8.Splitthedataintodependentandindependentvariables.

X=df.drop(columns=['Exited'])
X.head()

Output:

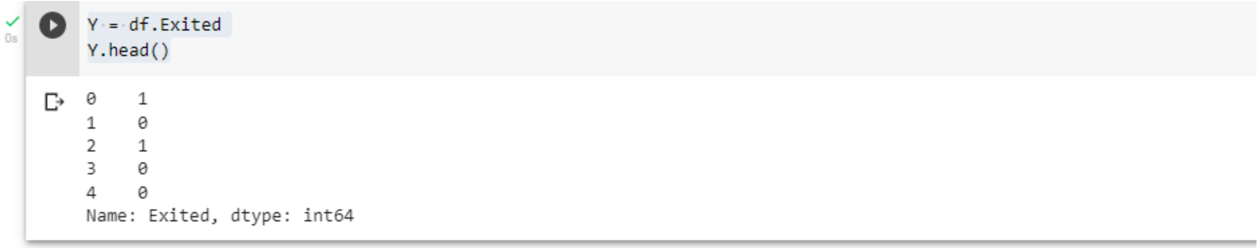


```
X = df.drop(columns=['Exited'])
X.head()
```

| | CreditScore | Geography | Gender | Age | Tenure | Balance | NumOfProducts | HasCrCard | IsActiveMember | EstimatedSalary |
|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 619 | 0 | 0 | 42 | 2 | 0.00 | 1 | 1 | 1 | 101348.88 |
| **1** | 608 | 2 | 0 | 41 | 1 | 83807.86 | 1 | 0 | 1 | 112542.58 |
| **2** | 502 | 0 | 0 | 42 | 8 | 159660.80 | 3 | 1 | 0 | 113931.57 |
| **3** | 699 | 0 | 0 | 39 | 1 | 0.00 | 2 | 0 | 0 | 93826.63 |
| **4** | 850 | 2 | 0 | 43 | 2 | 125510.82 | 1 | 1 | 1 | 79084.10 |

Y =
df.ExitedY.h
ead()

Output:



```
Y = df.Exited
Y.head()
```

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

Step9.Scaletheindependentvariables

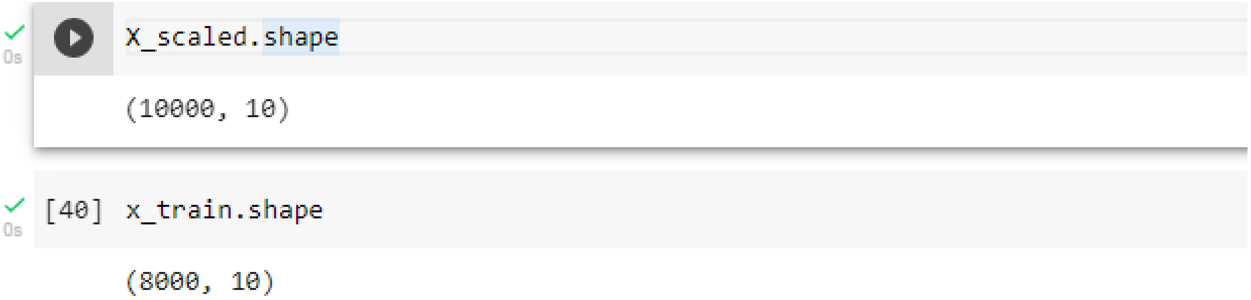
fromsklearn.preprocessing import
MinMaxScalerscale=MinMaxScaler()
X_scaled =

pd.DataFrame(scale.fit_transform(X),columns=X.columns)Step10.Spli

tthe data into training andtesting

```
fromsklearn.model_selectionimporttrain_test_split
x_train,y_train,x_test,y_test=train_test_split(X_scaled,Y,test_size=0.2,random_state=0)
```

Output:



```
X_scaled.shape

(10000, 10)

[40] x_train.shape

(8000, 10)
```