ASSESMENT 2

ASSESMENT DATE	26-09-2022
STUDENT NAME	Santhavaliyan.m
STUDENT ROLL NUMBER	713119205007
MAXIMUM MARKS	2 Marks

1. **Download the dataset**
2. **Load the dataset**

Solution:

```
import pandas as pd
import numpy as np
df=pd.read_csv("C:\\Users\\PC\\Desktop\\Churn_Modelling.csv")
df
```

output:

Out[7]:

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	Estimate
0	1	15634602	Hargrave	619	France	Female	42	2	0.00	1	1	1	10
1	2	15647311	Hill	608	Spain	Female	41	1	83807.86	1	0	1	11
2	3	15619304	Onio	502	France	Female	42	8	159660.80	3	1	0	11
3	4	15701354	Boni	699	France	Female	39	1	0.00	2	0	0	9
4	5	15737888	Mitchell	850	Spain	Female	43	2	125510.82	1	1	1	7
...	...	...	...	...	...	...	...	...	...	...	...	...	
9995	9996	15606229	Obijiaku	771	France	Male	39	5	0.00	2	1	0	9
9996	9997	15569892	Johnstone	516	France	Male	35	10	57369.61	1	1	1	10
9997	9998	15584532	Liu	709	France	Female	36	7	0.00	1	0	1	4
9998	9999	15682355	Sabbatini	772	Germany	Male	42	3	75075.31	2	1	0	9

df.head()

Out[8]:

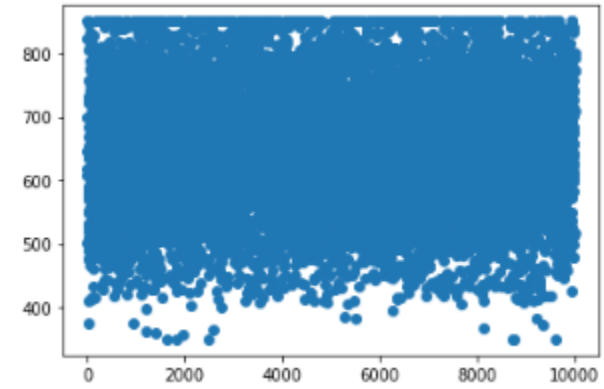
	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary
0	1	15634602	Hargrave	619	France	Female	42	2	0.00	1	1	1	101348.88
1	2	15647311	Hill	608	Spain	Female	41	1	83807.86	1	0	1	112542.58
2	3	15619304	Onio	502	France	Female	42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

3.perform following operations

- **univariate analysis**

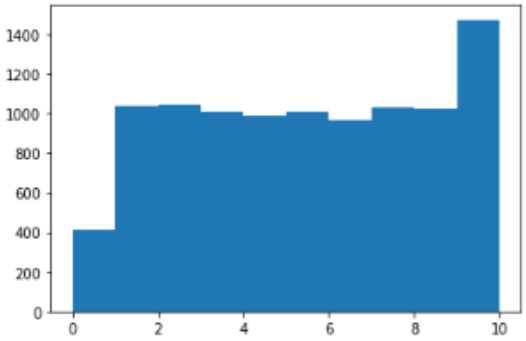
  import matplotlib.pyplot as plt
  import seaborn as sns
  plt.scatter(df.index,df['CreditScore'])
  plt.show()

output:



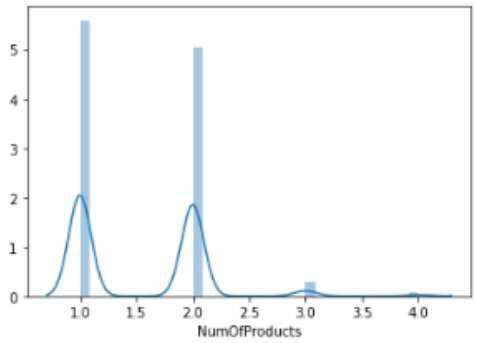
plt.hist(df['Tenure'])

```
Out[12]: (array([ 413., 1035., 1048., 1009.,  989., 1012.,  967., 1028., 1025.,
         1474.]),
 array([ 0.,  1.,  2.,  3.,  4.,  5.,  6.,  7.,  8.,  9., 10.]),
 <a list of 10 Patch objects>)
```



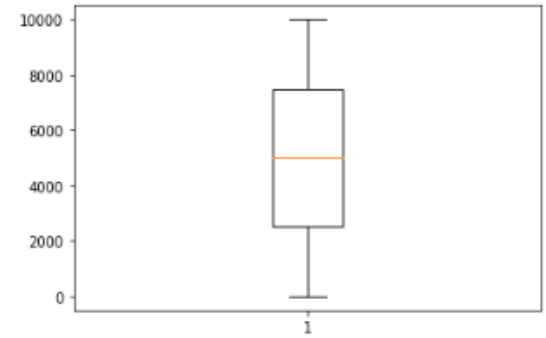
sns.distplot(df['NumOfProducts'])

```
Out[13]: <matplotlib.axes._subplots.AxesSubplot at 0x25dff3899c8>
```

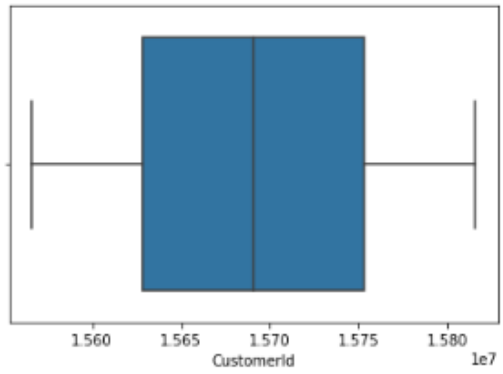


plt.boxplot(df['RowNumber'])

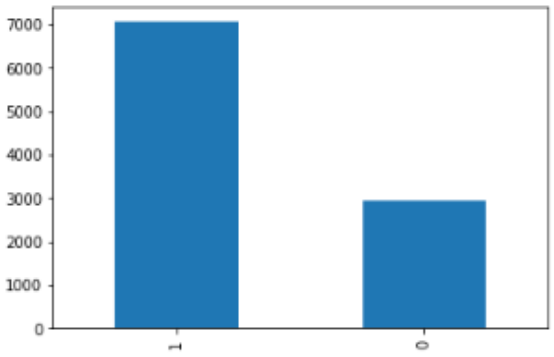
plt.show()



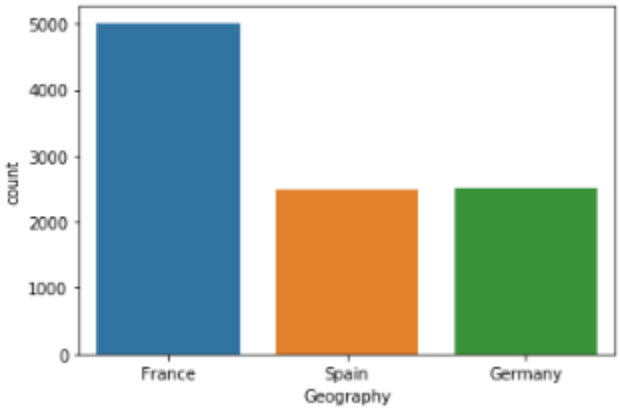
sns.boxplot(df['CustomerId'])



df['HasCrCard'].value_counts().plot.bar()



sns.countplot(df['Geography'])

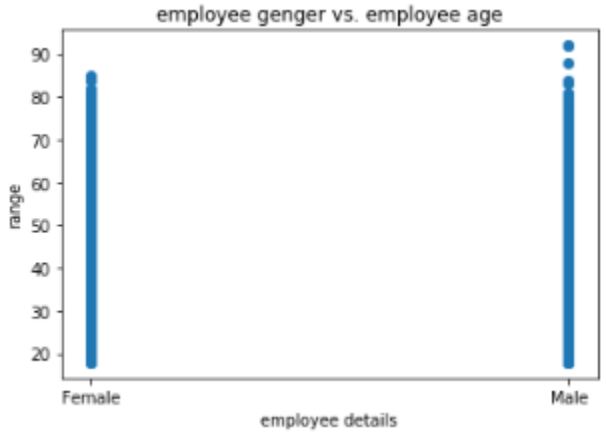


- **Bivariate analysis**

plt.scatter(df.Gender, df.Age)

plt.title('employee genger vs. employee age')

plt.xlabel('employee details') plt.ylabel('range')



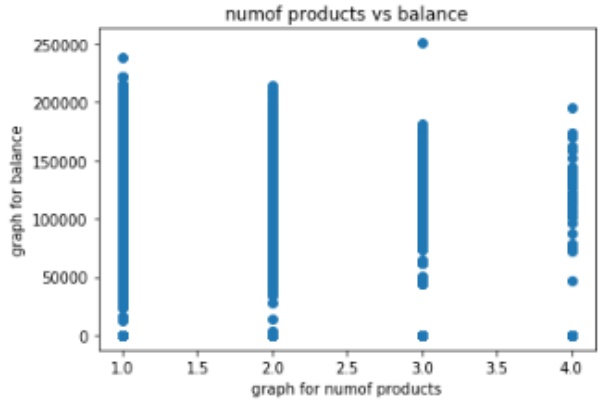
plt.scatter(df.NumOfProducts, df.Balance)

plt.title('numof products vs balance')

plt.xlabel('graph for numof products')

plt.ylabel('graph for balance')

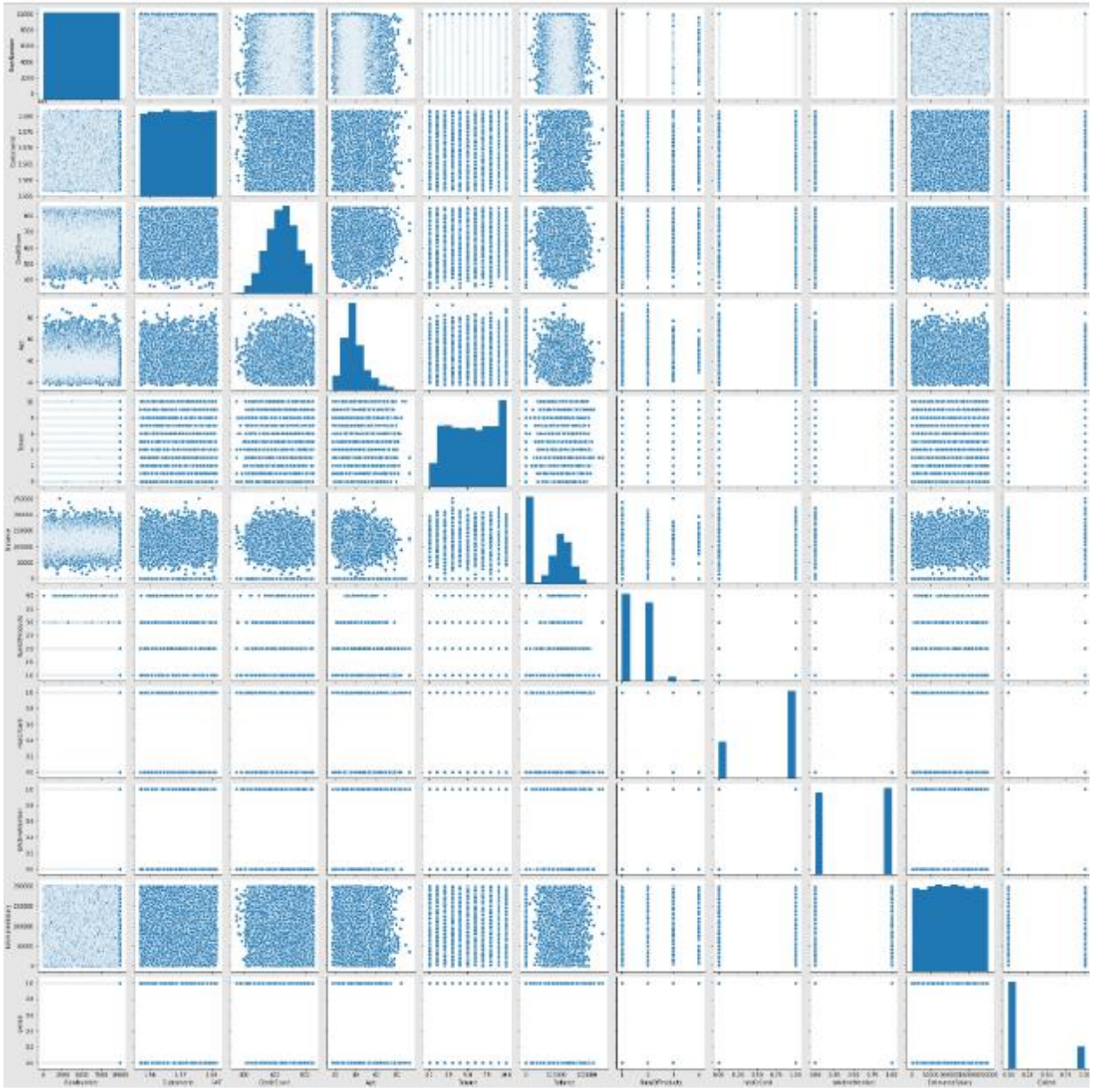
```
Out[20]: Text(0, 0.5, 'graph for balance')
```



- **Multivariate analysis**

seaborn.pairplot(df)

plt.show()



4.describtive function

df.describe()

Out[6]:

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

5.handle the missing data

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
```

df.isnull()

Out[14]:

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSal
0	False	False	False	False	False	False	False	False	False	False	False	False	Fa
1	False	False	False	False	False	False	False	False	False	False	False	False	Fa
2	False	False	False	False	False	False	False	False	False	False	False	False	Fa
3	False	False	False	False	False	False	False	False	False	False	False	False	Fa
4	False	False	False	False	False	False	False	False	False	False	False	False	Fa
...	...	...	...	...	...	...	...	...	...	...	...	...	
9995	False	False	False	False	False	False	False	False	False	False	False	False	Fa
9996	False	False	False	False	False	False	False	False	False	False	False	False	Fa
9997	False	False	False	False	False	False	False	False	False	False	False	False	Fa
9998	False	False	False	False	False	False	False	False	False	False	False	False	Fa
9999	False	False	False	False	False	False	False	False	False	False	False	False	Fa

10000 rows × 14 columns

df.notnull()

Out[15]:

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSala
0	True	True	True	True	True	True	True	True	True	True	True	True	Tr
1	True	True	True	True	True	True	True	True	True	True	True	True	Tr
2	True	True	True	True	True	True	True	True	True	True	True	True	Tr
3	True	True	True	True	True	True	True	True	True	True	True	True	Tr
4	True	True	True	True	True	True	True	True	True	True	True	True	Tr
...	...	...	...	...	...	...	...	...	...	...	...	...	...
9995	True	True	True	True	True	True	True	True	True	True	True	True	Tr
9996	True	True	True	True	True	True	True	True	True	True	True	True	Tr
9997	True	True	True	True	True	True	True	True	True	True	True	True	Tr
9998	True	True	True	True	True	True	True	True	True	True	True	True	Tr
9999	True	True	True	True	True	True	True	True	True	True	True	True	Tr

10000 rows × 14 columns

df.fillna(0)

Out[16]:

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSa
0	1	15634602	Hargrave	619	France	Female	42	2	0.00	1	1	1	10134
1	2	15647311	Hill	608	Spain	Female	41	1	83807.86	1	0	1	11254
2	3	15619304	Onio	502	France	Female	42	8	159660.80	3	1	0	11393
3	4	15701354	Boni	699	France	Female	39	1	0.00	2	0	0	9382
4	5	15737888	Mitchell	850	Spain	Female	43	2	125510.82	1	1	1	7908
...	...	...	...	...	...	...	...	...	...	...	...	...	...
9995	9996	15606229	Obijiaku	771	France	Male	39	5	0.00	2	1	0	9627
9996	9997	15569892	Johnstone	516	France	Male	35	10	57369.61	1	1	1	10169
9997	9998	15584532	Liu	709	France	Female	36	7	0.00	1	0	1	4208
9998	9999	15682355	Sabbatini	772	Germany	Male	42	3	75075.31	2	1	0	9288
9999	10000	15628319	Walker	792	France	Female	28	4	130142.79	1	1	0	3819

10000 rows × 14 columns

df["Gender"].fillna("No Gender", inplace = True)

df

Out[21]:

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSa
0	1	15634602	Hargrave	619	France	Female	42	2	0.00	1	1	1	10134
1	2	15647311	Hill	608	Spain	Female	41	1	83807.86	1	0	1	11254
2	3	15619304	Onio	502	France	Female	42	8	159660.80	3	1	0	11393
3	4	15701354	Boni	699	France	Female	39	1	0.00	2	0	0	9382
4	5	15737888	Mitchell	850	Spain	Female	43	2	125510.82	1	1	1	7908
...	...	...	...	...	...	...	...	...	...	...	...	...	...
9995	9996	15606229	Obijiaku	771	France	Male	39	5	0.00	2	1	0	9627
9996	9997	15569892	Johnstone	516	France	Male	35	10	57369.61	1	1	1	10169
9997	9998	15584532	Liu	709	France	Female	36	7	0.00	1	0	1	4208
9998	9999	15682355	Sabbatini	772	Germany	Male	42	3	75075.31	2	1	0	9288
9999	10000	15628319	Walker	792	France	Female	28	4	130142.79	1	1	0	3819

10000 rows × 14 columns

df.drop("RowNumber",axis=1,inplace=True)

df

Out[28]:

	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary
0	15634602	Hargrave	619	France	Female	42	2	0.00	1	1	1	101348.88
1	15647311	Hill	608	Spain	Female	41	1	83807.86	1	0	1	112542.58
2	15619304	Onio	502	France	Female	42	8	159660.80	3	1	0	113931.57
3	15701354	Boni	699	France	Female	39	1	0.00	2	0	0	93826.63
4	15737888	Mitchell	850	Spain	Female	43	2	125510.82	1	1	1	79084.10
...	...	...	...	...	...	...	...	...	...	...	...	...
9995	15606229	Obijiaku	771	France	Male	39	5	0.00	2	1	0	96270.64
9996	15569892	Johnstone	516	France	Male	35	10	57369.61	1	1	1	101699.77
9997	15584532	Liu	709	France	Female	36	7	0.00	1	0	1	42085.58
9998	15682355	Sabbatini	772	Germany	Male	42	3	75075.31	2	1	0	92888.52
9999	15628319	Walker	792	France	Female	28	4	130142.79	1	1	0	38190.78

10000 rows × 12 columns

print(df.isnull().sum())

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

updated_df = df.dropna(axis=1)

updated_df.info()

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10000 entries, 0 to 9999
Data columns (total 12 columns):
 #   Column           Non-Null Count  Dtype
---  ------           --------------  -----
 0   CustomerId       10000 non-null  int64
 1   Surname          10000 non-null  object
 2   CreditScore      10000 non-null  int64
 3   Geography        10000 non-null  object
 4   Gender           10000 non-null  object
 5   Age              10000 non-null  int64
 6   Tenure           10000 non-null  int64
 7   Balance          10000 non-null  float64
 8   NumOfProducts    10000 non-null  int64
 9   HasCrCard        10000 non-null  int64
 10  IsActiveMember   10000 non-null  int64
 11  EstimatedSalary  10000 non-null  float64
dtypes: float64(2), int64(7), object(3)
memory usage: 937.6+ KB
```

6.Finding outliers and replace

Q1 = df.quantile(0.25)

Q3 = df.quantile(0.75)

IQR = Q3 - Q1

print(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
```

print(df < (Q1 - 1.5 * IQR))

(df > (Q3 + 1.5 * IQR))

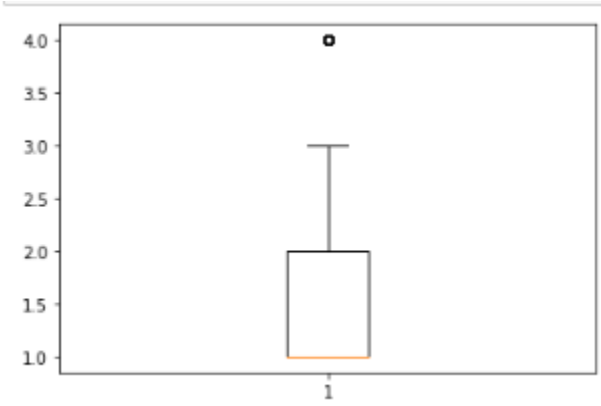
```
        Age  Balance  CreditScore  CustomerId  EstimatedSalary  Exited  \
0     False    False        False       False            False   False
1     False    False        False       False            False   False
2     False    False        False       False            False   False
3     False    False        False       False            False   False
4     False    False        False       False            False   False
...     ...      ...          ...         ...              ...     ...
9995  False    False        False       False            False   False
9996  False    False        False       False            False   False
9997  False    False        False       False            False   False
9998  False    False        False       False            False   False
9999  False    False        False       False            False   False

      Gender  Geography  HasCrCard  IsActiveMember  NumOfProducts  RowNumber  \
0      False      False      False           False          False      False
1      False      False      False           False          False      False
2      False      False      False           False          False      False
3      False      False      False           False          False      False
4      False      False      False           False          False      False
...      ...        ...        ...             ...            ...        ...
9995   False      False      False           False          False      False
9996   False      False      False           False          False      False
9997   False      False      False           False          False      False
9998   False      False      False           False          False      False
9999   False      False      False           False          False      False

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

```
plt.boxplot(df["NumOfProducts"])

plt.show()
```




```
np.where(df.Age>42,42, df.Age)
```

```
Out[16]: array([42, 41, 42, ..., 36, 42, 28], dtype=int64)
```

```
print(df['Age'].skew())
```

```
1.0113202630234552
```

```
print(df['Age'].quantile(0.25))

print(df['Age'].quantile(0.75))

df['Age'] = np.where(df['Age'] > 39, 41, df['Age'])

df.describe()
```

```
32.0
41.0
```

Out[22]:

	RowNumber	CustomerId	CreditScore	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	
count	10000.00000	1.000000e+04	10000.000000	10000.000000	10000.000000	10000.000000	10000.000000	10000.00000	10000.000000	10000.000000	1
mean	5000.50000	1.569094e+07	650.528800	35.788600	5.012800	76485.889288	1.530200	0.70550	0.515100	100090.239881	
std	2886.89568	7.193619e+04	96.653299	5.659409	2.892174	62397.405202	0.581654	0.45584	0.499797	57510.492818	
min	1.00000	1.556570e+07	350.000000	18.000000	0.000000	0.000000	1.000000	0.00000	0.000000	11.580000	
25%	2500.75000	1.562853e+07	584.000000	32.000000	3.000000	0.000000	1.000000	0.00000	0.000000	51002.110000	
50%	5000.50000	1.569074e+07	652.000000	37.000000	5.000000	97198.540000	1.000000	1.00000	1.000000	100193.915000	
75%	7500.25000	1.575323e+07	718.000000	41.000000	7.000000	127644.240000	2.000000	1.00000	1.000000	149388.247500	
max	10000.00000	1.581569e+07	850.000000	41.000000	10.000000	250898.090000	4.000000	1.00000	1.000000	199992.480000	

7.categorical column

df["CustomerId"].value_counts()

```
Out[23]: 15812607    1
         15741078    1
         15635776    1
         15740223    1
         15738174    1
                    ..
         15743714    1
         15639265    1
         15641312    1
         15684319    1
         15695872    1
         Name: CustomerId, Length: 10000, dtype: int64
```

df.dtypes

```
Out[27]: RowNumber             int64
         CustomerId            int64
         Surname            category
         CreditScore           int64
         Geography            object
         Gender               object
         Age                   int64
         Tenure                int64
         Balance             float64
         NumOfProducts         int64
         HasCrCard             int64
         IsActiveMember        int64
         EstimatedSalary     float64
         Exited                int64
         dtype: object
```

df["Age"].value_counts().sort_index()

```
Out[32]: 18      22
         19      27
         20      40
         21      53
         22      84
         23      99
         24     132
         25     154
         26     200
         27     209
         28     273
         29     348
         30     327
         31     404
         32     418
         33     442
         34     447
         35     474
         36     456
         37     478
         38     477
         39     423
         41    4013
         Name: Age, dtype: int64
```

df_categorical = df[categorical_columns]

df_categorical.head()

Out[35]:

	Geography	Gender
0	France	Female
1	Spain	Female
2	France	Female
3	France	Female
4	Spain	Female

pd.get_dummies(df, columns=["Age"]).head()

Out[36]:

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Tenure	Balance	NumOfProducts	HasCrCard	...	Age_31	Age_32	Age_33	Age_34
0	1	15634602	Hargrave	619	France	Female	2	0.00	1	1	...	0	0	0	0
1	2	15647311	Hill	608	Spain	Female	1	83807.86	1	0	...	0	0	0	0
2	3	15619304	Onio	502	France	Female	8	159660.80	3	1	...	0	0	0	0
3	4	15701354	Boni	699	France	Female	1	0.00	2	0	...	0	0	0	0
4	5	15737888	Mitchell	850	Spain	Female	2	125510.82	1	1	...	0	0	0	0

5 rows × 36 columns

8.split the data into dependent and independent variables

print(df.size)

```
140000
```

X = df.iloc[:, :-1].values

print(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]]
```

Y = df.iloc[:, -1].values

print(Y)

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

9.minmaxscaler

```
from sklearn.preprocessing import MinMaxScaler

df

scaler = MinMaxScaler()

print(scaler.fit(df))
```

```
MinMaxScaler(copy=True, feature_range=(0, 1))
```

10.train –split data

```
import pandas as pd

from sklearn.linear_model import LinearRegression

from sklearn.model_selection import train_test_split

df=pd.read_csv("C:\\Users\\PC\\Desktop\\Churn_Modelling.csv")

df.head()
```

Out[77]:

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

```
y= df.Tenure

y.head()
```

```
Out[78]: 0    2
         1    1
         2    8
         3    1
         4    2
         Name: Tenure, dtype: int64
```

x=df.drop('Tenure',axis=1)

x.head()

Out[80]:

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

x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.2)

x_train.shape

```
Out[82]: (8000, 13)
```

y_train.shape

```
Out[83]: (8000,)
```

x_test.shape

```
Out[84]: (2000, 13)
```

y_test.shape

```
Out[85]: (2000,)
```