Assignment -2
Python Programming

Assignment Date	29 September 2022
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Maximum Marks	2 Marks

Assignment 2

Question-1:

Load the dataset

Data Visualization & Pre-processing

Loading Dataset

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns


df=pd.read_csv(r'/content/Churn_Modelling.csv')

df.shape

(10000, 14)

df.columns

Index(['RowNumber', 'CustomerId', 'Surname', 'CreditScore', 'Geography',
       'Gender', 'Age', 'Tenure', 'Balance', 'NumOfProducts', 'HasCrCard',
       'IsActiveMember', 'EstimatedSalary', 'Exited'],
      dtype='object')

df.head()

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

```
df.tail()
```

```
      RowNumber  CustomerId    Surname  CreditScore Geography  Gender  Age  \
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  \
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
9995         96270.64       0
9996        101699.77       0
9997         42085.58       1
9998         92888.52       1
9999         38190.78       0
```

```
df.describe()
```

```
         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
```

```
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
```

Question-2:

Perform Below Visualizations.

● Univariate Analysis

● Bi - Variate Analysis

● Multi - Variate Analysis

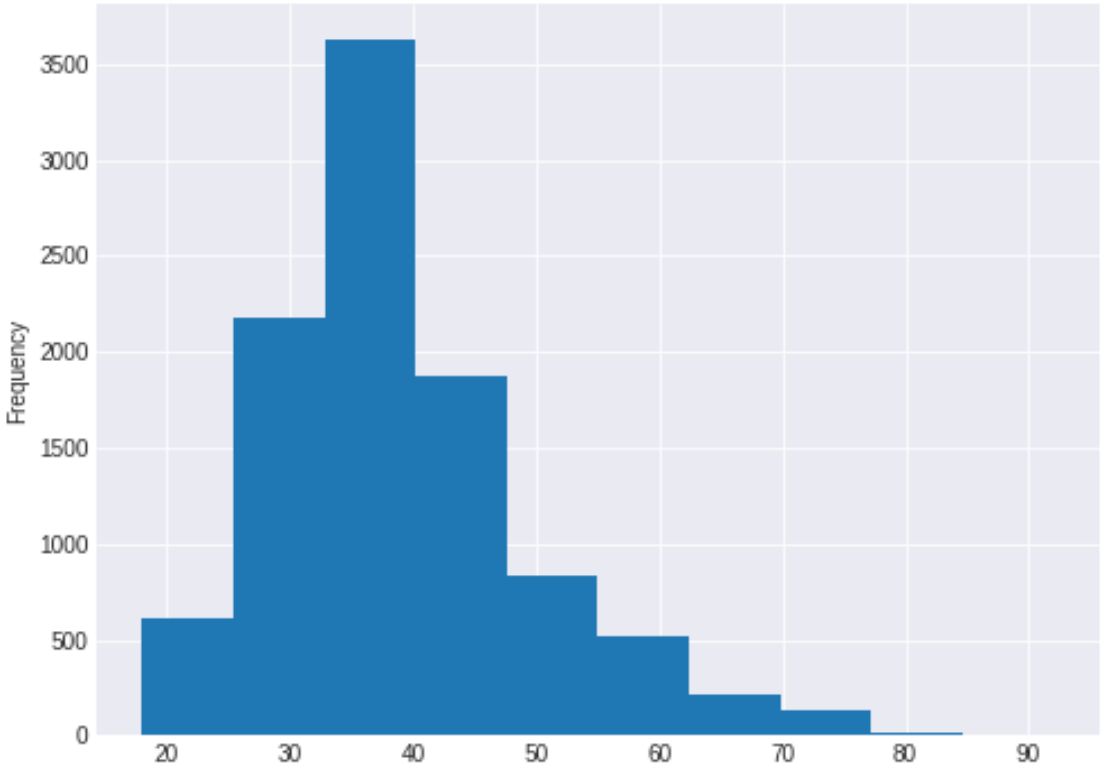
VISUALIZATION

1. UNI-VARIATE ANALYSIS

```
from matplotlib import pyplot as plt
plt.style.use('seaborn-darkgrid')
```

```
plt.figure(figsize=(8,6))
df.Age.plot(kind='hist')
```

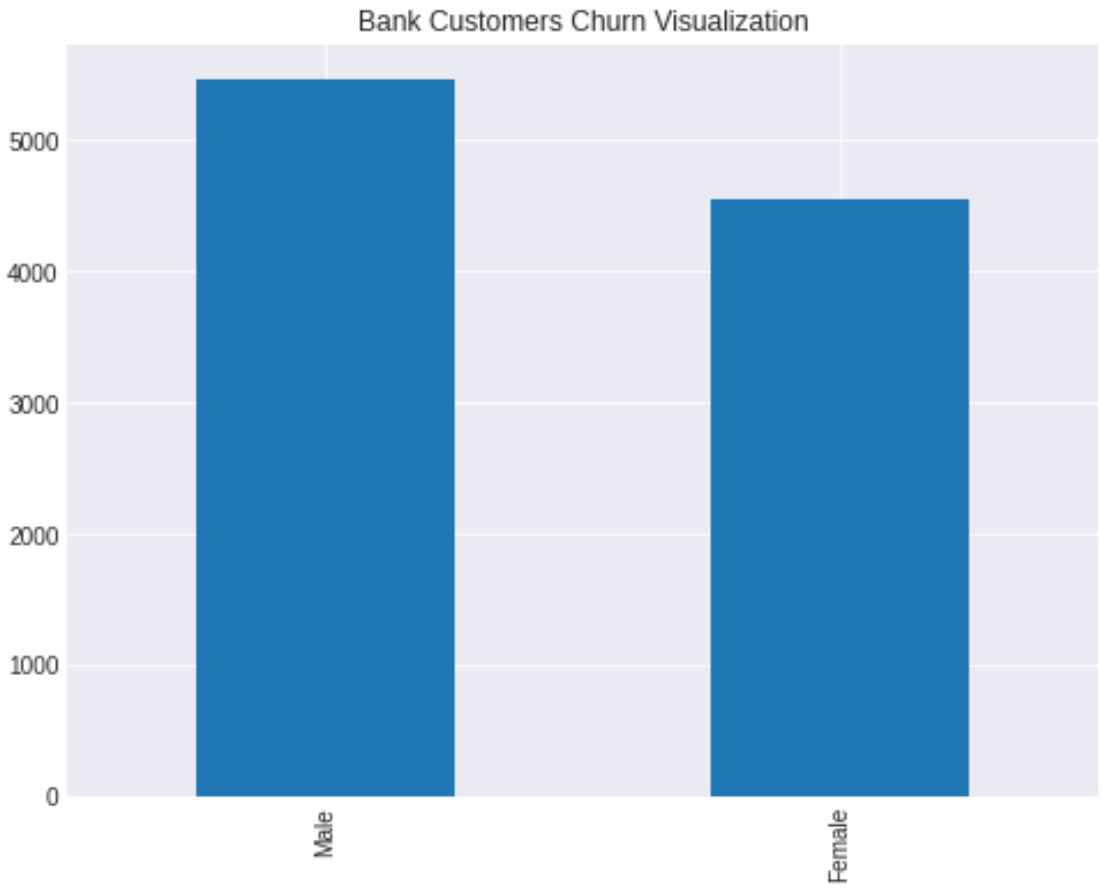
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f8acb57b9d0>
```




```
plt.figure(figsize=(8,6))
df.NumOfProducts.value_counts().plot(kind='bar')
```

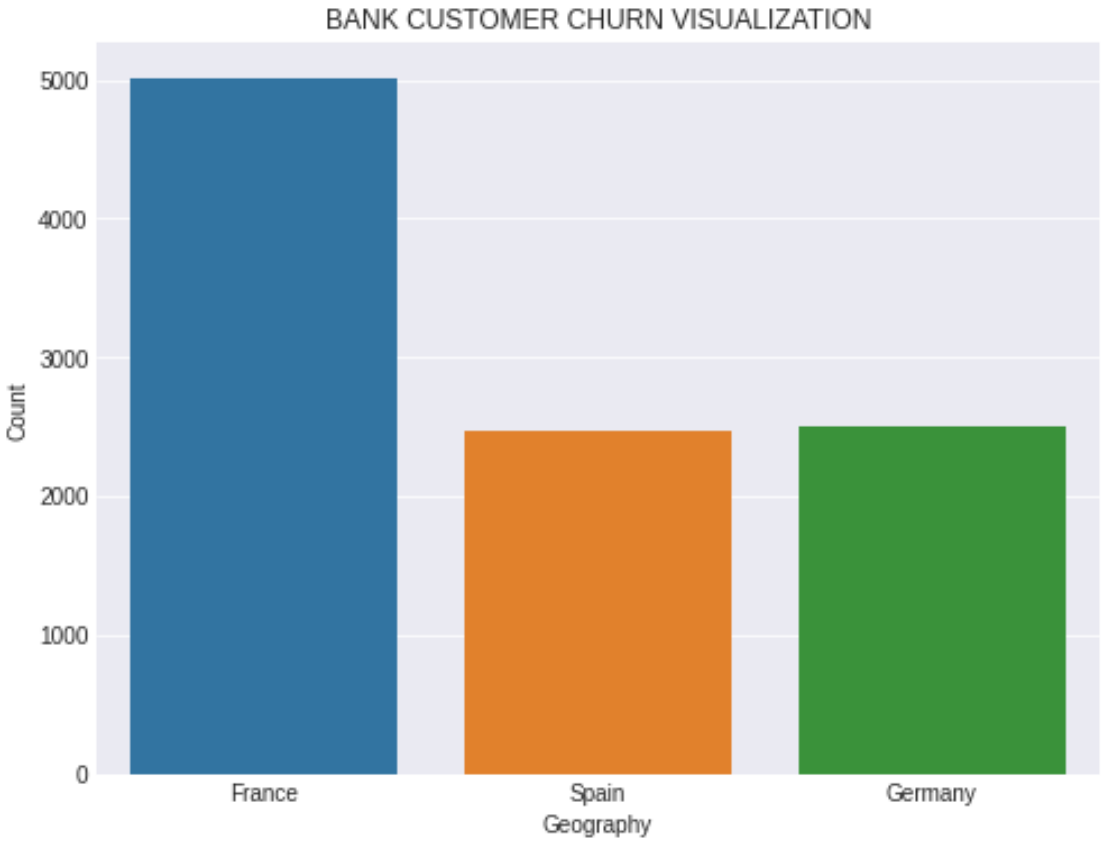
```
plt.figure(figsize=(8,6))
df.Gender.value_counts().plot(kind='bar')
plt.title('Bank Customers Churn Visualization')
```

```
Text(0.5, 1.0, 'Bank Customers Churn Visualization')
```



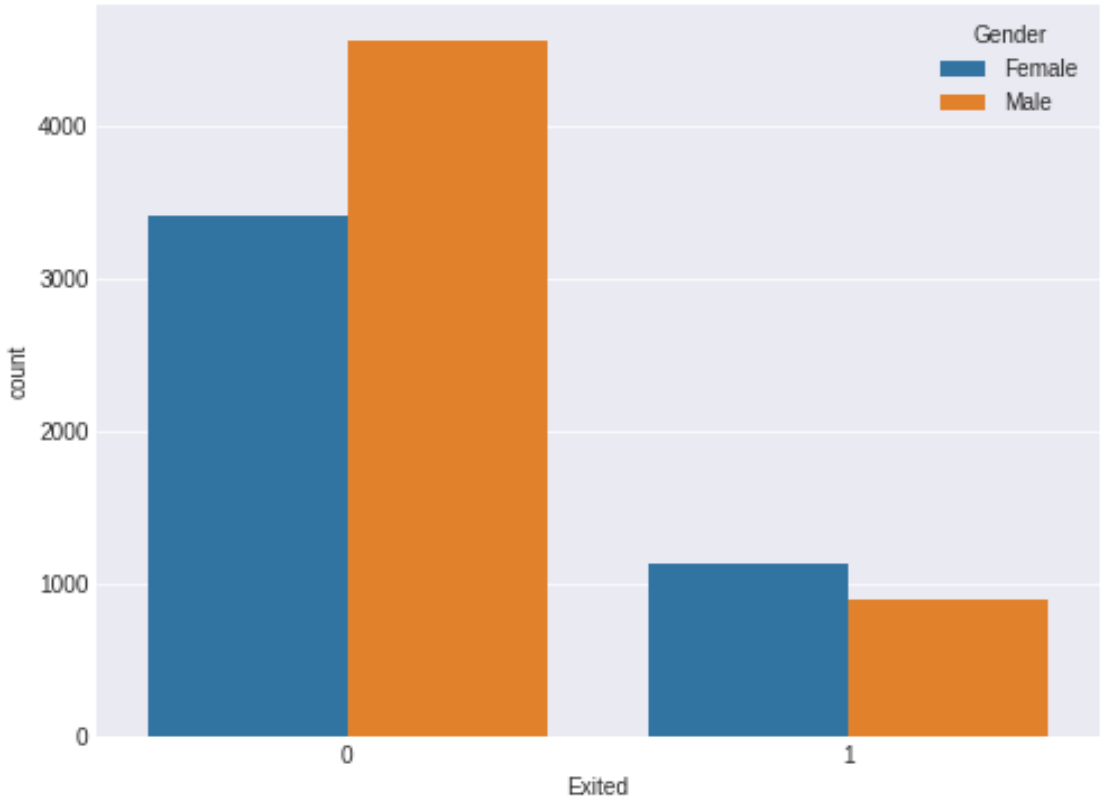

```
#COUNT PLOT
plt.figure(figsize=(8,6))
sns.countplot(x='Geography',data=df)
plt.xlabel('Geography')
plt.ylabel('Count')
plt.title('BANK CUSTOMER CHURN VISUALIZATION')
```

```
Text(0.5, 1.0, 'BANK CUSTOMER CHURN VISUALIZATION')
```



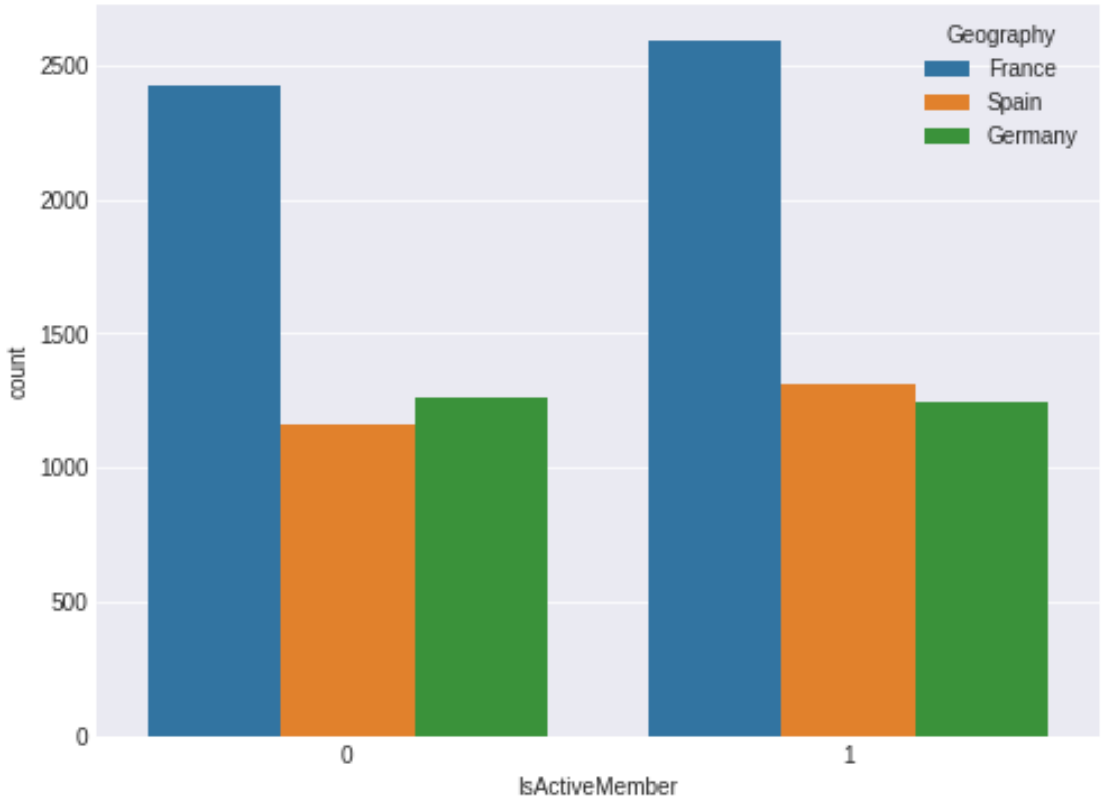

```
plt.figure(figsize=(8,6))
sns.countplot(x=df.Exited,hue=df.Gender)
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f8acadc8090>
```



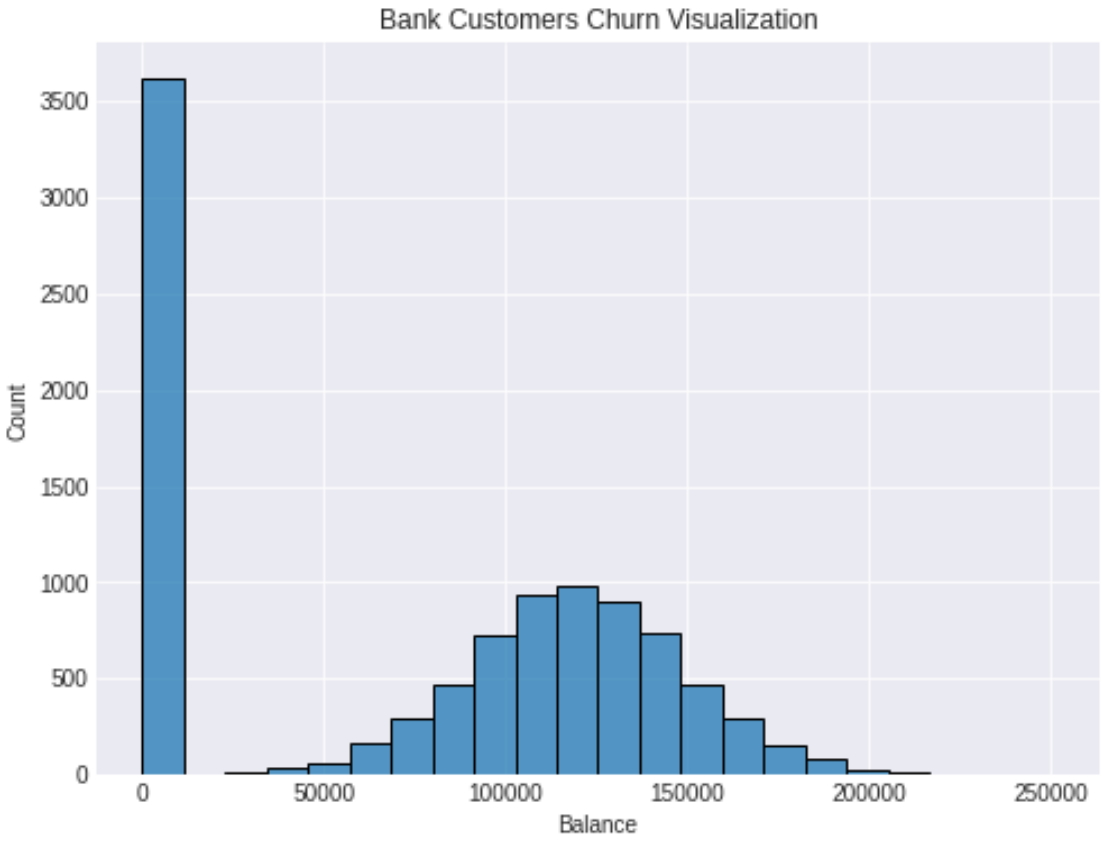

```
plt.figure(figsize=(8,6))
sns.countplot(x=df.IsActiveMember,hue=df.Geography)
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f8acadb8810>
```



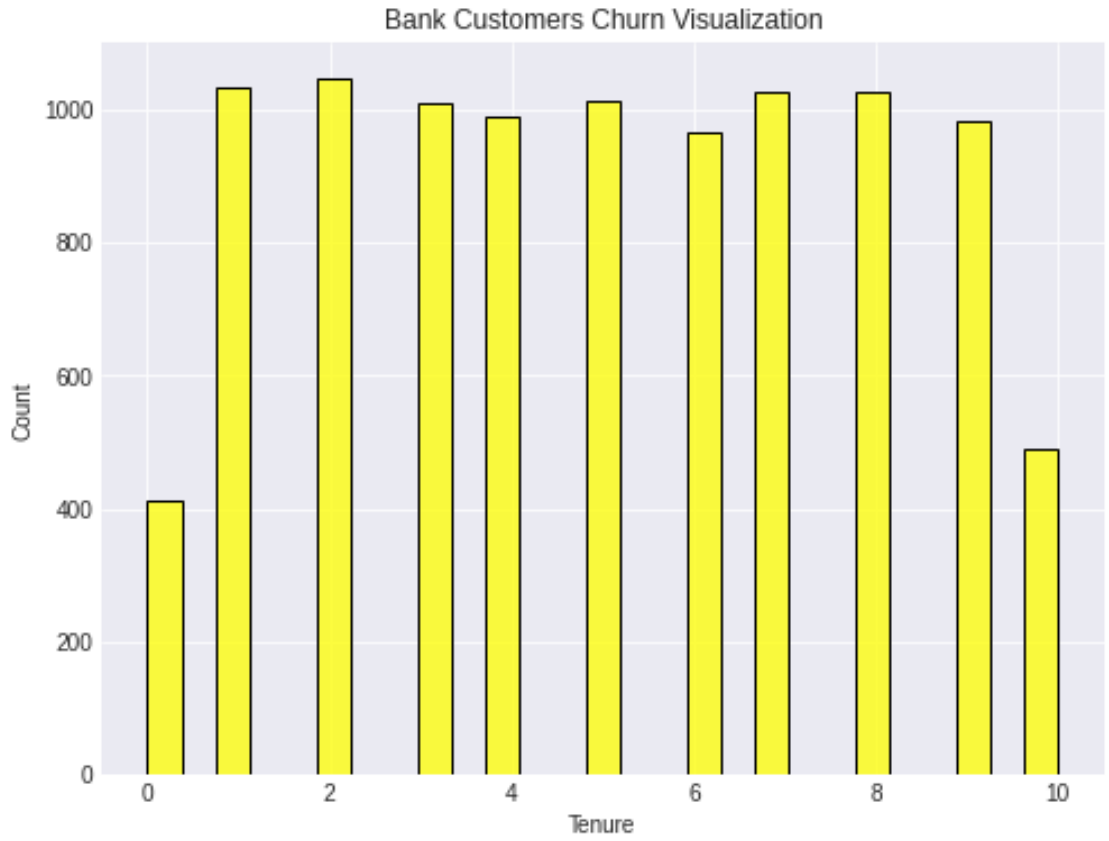

```
#HISTOGRAM
plt.figure(figsize=(8,6))
sns.histplot(df.Balance)
plt.xlabel('Balance')
plt.ylabel('Count')
plt.title('Bank Customers Churn Visualization')
```

```
Text(0.5, 1.0, 'Bank Customers Churn Visualization')
```



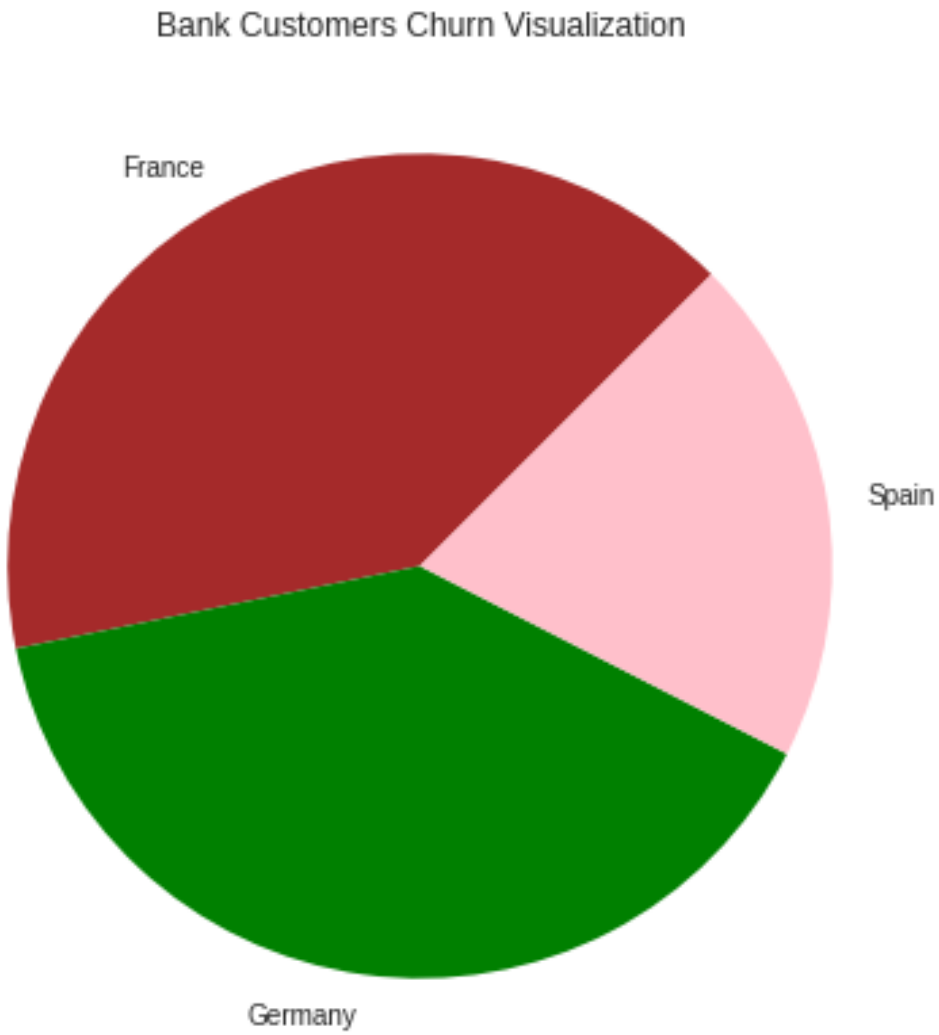

```
plt.figure(figsize=(8,6))
sns.histplot(df['Tenure'],kde=False,color='Yellow')
plt.xlabel('Tenure')
plt.ylabel('Count')
plt.title('Bank Customers Churn Visualization')
```

```
Text(0.5, 1.0, 'Bank Customers Churn Visualization')
```




```
labels = 'France', 'Germany', 'Spain'
colors = ['brown', 'green', 'pink']
area =  [311, 300, 153]
plt.figure(figsize =(8, 7))
plt.pie(area, colors = colors, labels = labels,startangle=45)
plt.title('Bank Customers Churn Visualization')
```

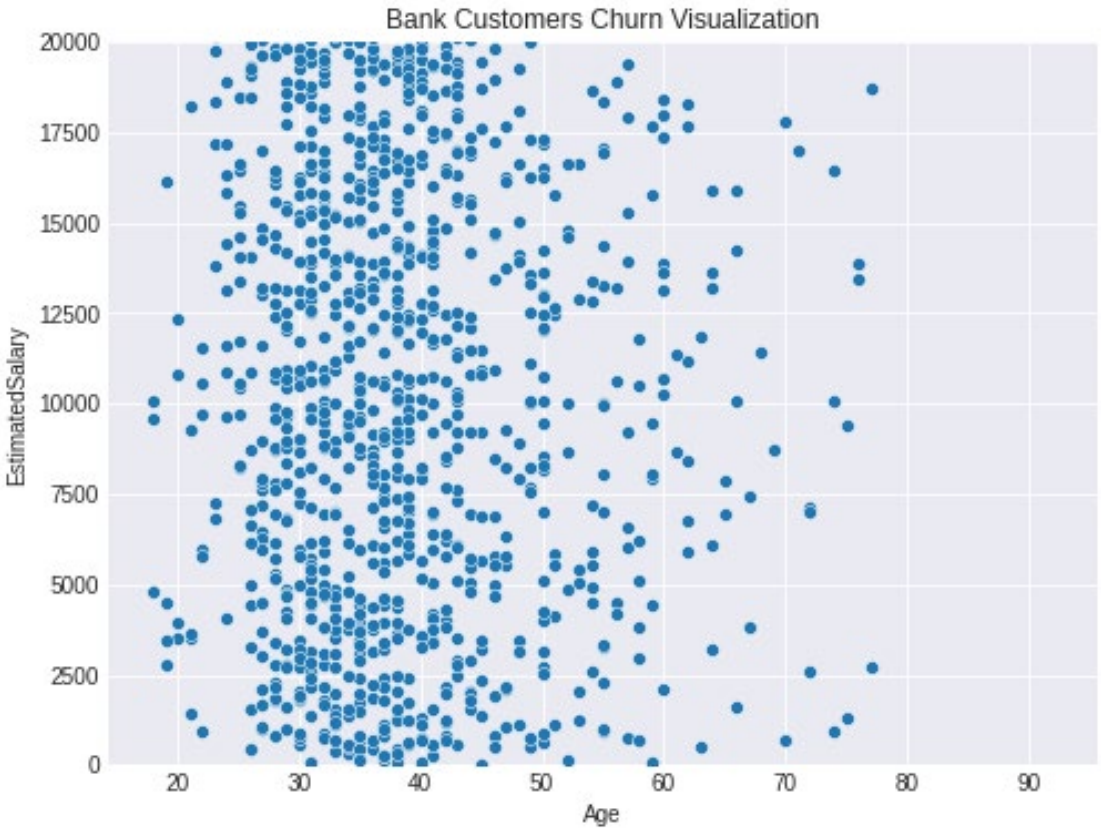
```
Text(0.5, 1.0, 'Bank Customers Churn Visualization')
```



2.BI-VARIATE ANLYSIS

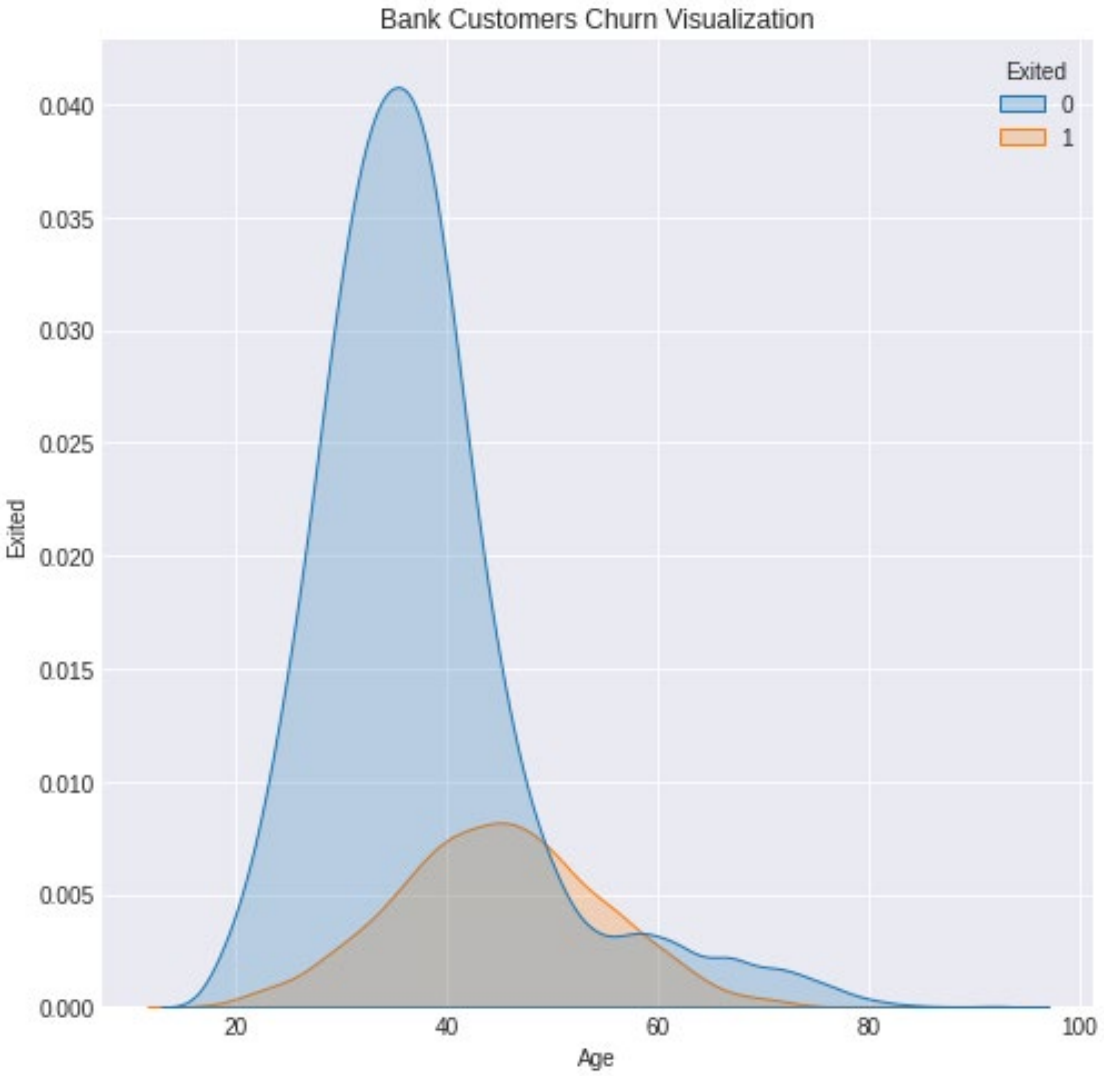
```
plt.figure(figsize=(8,6))
sns.scatterplot(x=df.Age,y=df.EstimatedSalary)
plt.ylim(0,20000)
plt.title('Bank Customers Churn Visualization')
```

```
Text(0.5, 1.0, 'Bank Customers Churn Visualization')
```




```
plt.figure(figsize=(8,8))
sns.kdeplot(data=df,x='Age',hue='Exited',fill=True)
plt.xlabel('Age')
plt.ylabel('Exited')
plt.title('Bank Customers Churn Visualization')
```

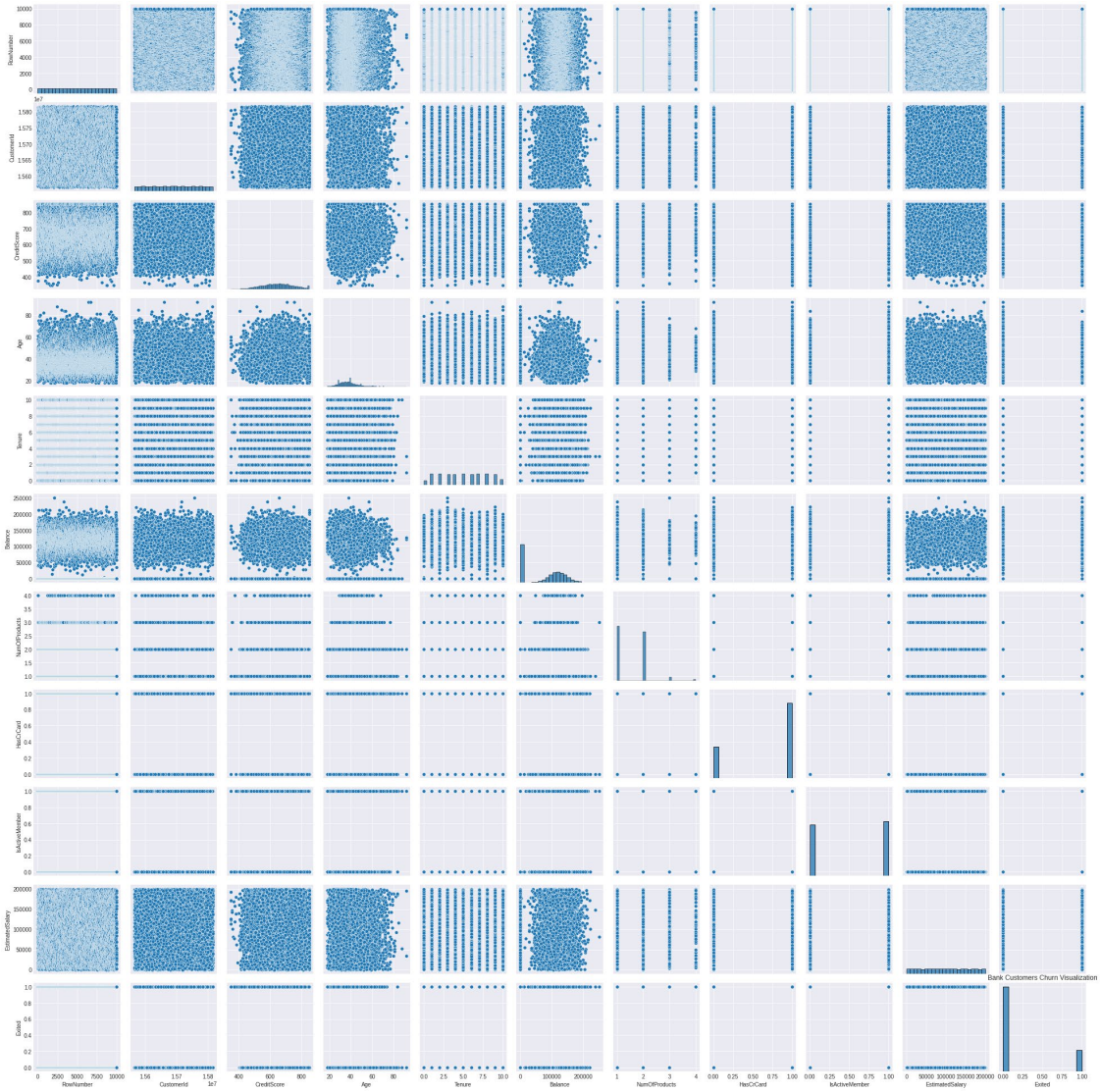
```
Text(0.5, 1.0, 'Bank Customers Churn Visualization')
```



3.MULTI-VARITE ANALYSIS

```
sns.pairplot(df)
plt.title('Bank Customers Churn Visualization')
```

```
Text(0.5, 1.0, 'Bank Customers Churn Visualization')
```



Question-3:

Perform descriptive statistics on the dataset

DESCRIPTIVE STATISTICS

```
import statistics as sts
sts.mean(df.EstimatedSalary)
```

```
100090.239881
```

```
sts.median(df.CreditScore)
```

```
652.0
```

```
sts.mode(df.Geography)
```

```
{"type":"string"}
```

```
sts.variance(df.Age)
```

```
109.99408416841685
```

```
sts.stdev(df.Tenure)
```

```
2.8921743770496837
```

```
#RANGE
max(df.Balance)-min(df.Balance)
```

```
250898.09
```

Question-4:

HANDLING THE MISSING VALUES

```
print(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
```

```
df.columns
```

```
Index(['RowNumber', 'CustomerId', 'Surname', 'CreditScore', 'Geography',
       'Gender', 'Age', 'Tenure', 'Balance', 'NumOfProducts', 'HasCrCard',
       'IsActiveMember', 'EstimatedSalary', 'Exited'],
      dtype='object')
```

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

```
df.columns
```

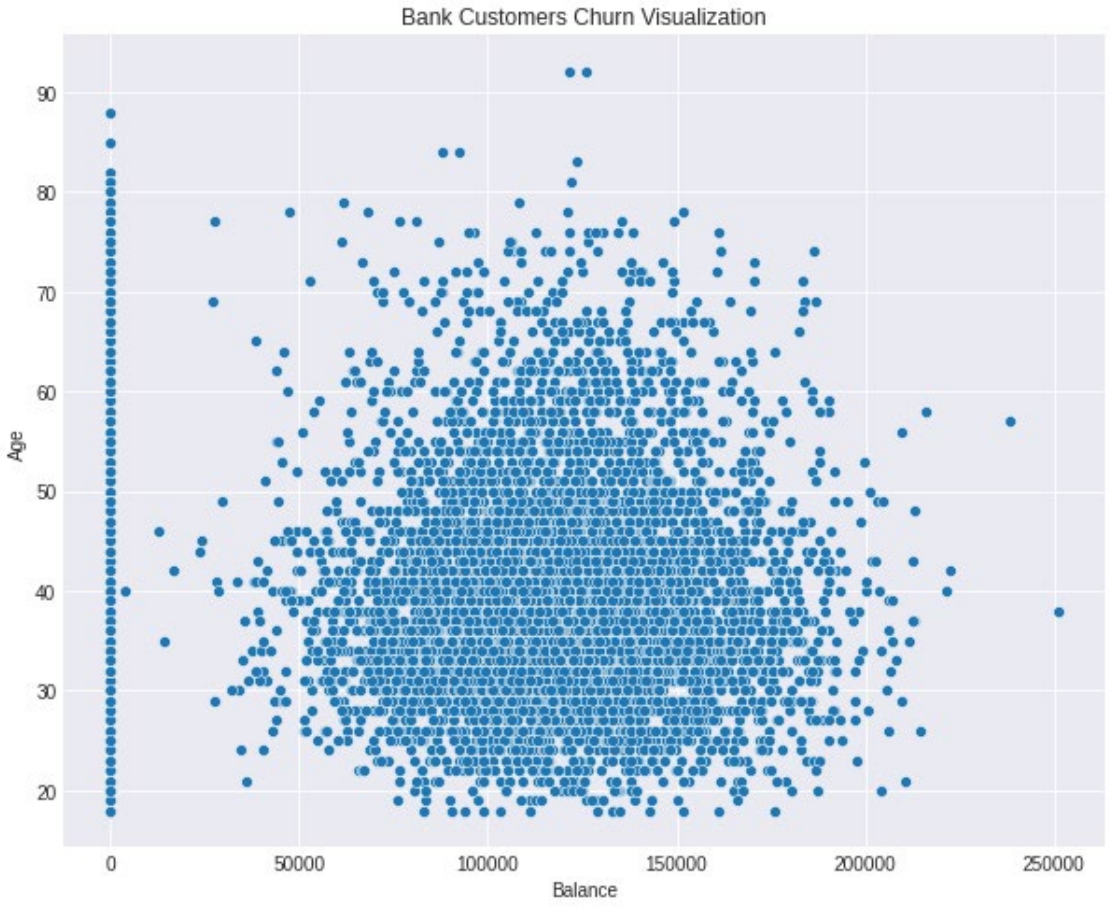
```
Index(['CreditScore', 'Geography', 'Gender', 'Age', 'Tenure', 'Balance',
       'NumOfProducts', 'HasCrCard', 'IsActiveMember', 'EstimatedSalary',
       'Exited'],
      dtype='object')
```

Question-5:

FIND THE OUTLIERS & REPLACE THE OUTLIERS

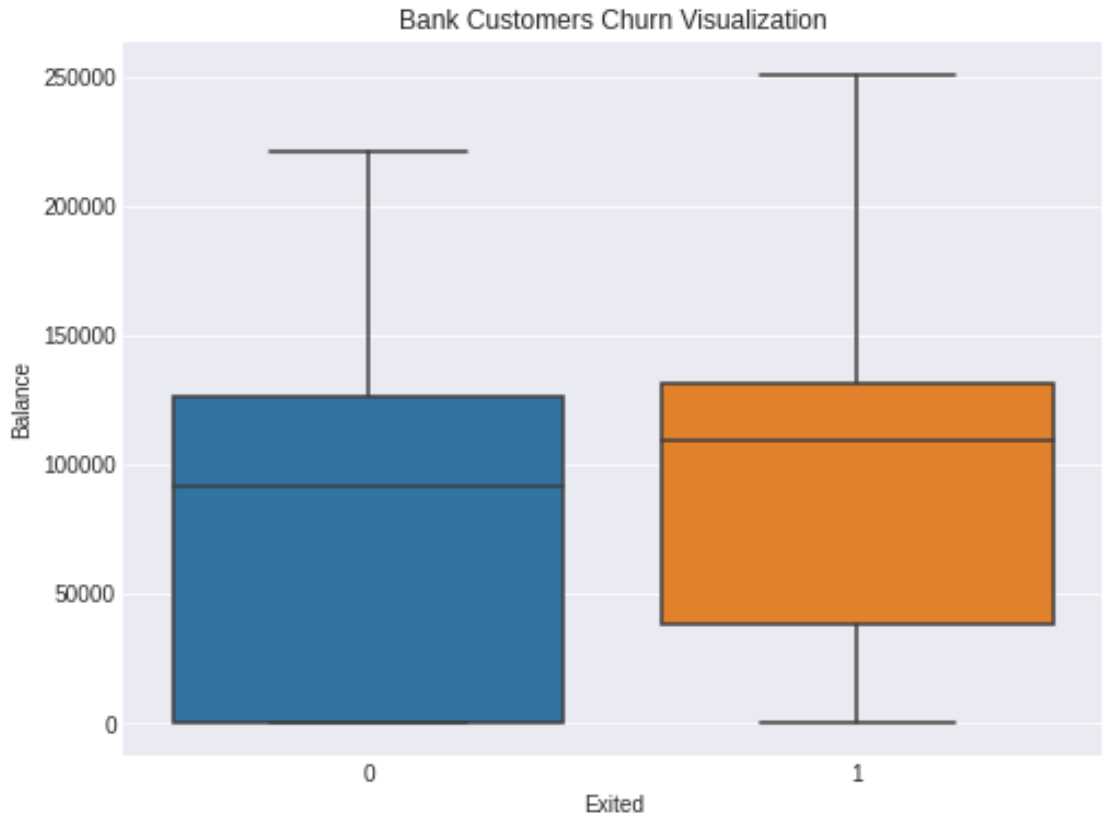
```
plt.figure(figsize=(10,8))
sns.scatterplot(x=df.Balance,y=df.Age)
plt.title('Bank Customers Churn Visualization')
```

```
Text(0.5, 1.0, 'Bank Customers Churn Visualization')
```




```
plt.figure(figsize=(8,6))
sns.boxplot(x=df.Exited,y=df.Balance)
plt.title('Bank Customers Churn Visualization')
```

```
Text(0.5, 1.0, 'Bank Customers Churn Visualization')
```




```
df.Age.describe()
```

```
count    10000.000000
mean        38.921800
std         10.487806
min         18.000000
25%         32.000000
50%         37.000000
75%         44.000000
max         92.000000
Name: Age, dtype: float64
```

```
median = df.loc[df['Age']<50, 'Age'].median()
df.loc[df.Age > 50, 'Age'] = np.nan
df.fillna(median,inplace=True)
df.Age.describe()
```

```
count    10000.000000
mean        35.948900
std          6.454739
min         18.000000
25%         32.000000
50%         36.000000
75%         40.000000
```

```
max         50.000000
Name: Age, dtype: float64
```

Question-6:

CHECK FOR CATEGORICAL COLUMNS & PERFORM ENCODING

```
df.columns
```

```
Index(['CreditScore', 'Geography', 'Gender', 'Age', 'Tenure', 'Balance',
       'NumOfProducts', 'HasCrCard', 'IsActiveMember', 'EstimatedSalary',
       'Exited'],
      dtype='object')
```

```
#LABEL ENCODING
from sklearn.preprocessing import LabelEncoder
from collections import Counter as count
le=LabelEncoder()
print('Before label Encoding: ',count(df['Geography']))
df['Geography']=le.fit_transform(df["Geography"])
print('After label Encoding: ',count(df["Geography"]))
```

```
Before label Encoding:  Counter({'France': 5014, 'Germany': 2509, 'Spain':
2477})
After label Encoding:  Counter({0: 5014, 1: 2509, 2: 2477})
```

```
print('Before Replace: ',count(df["Exited"]))
df['Exited']=df['Exited'].replace([0,1],['No','Yes'])
print('After Replace: ',count(df['Exited']))
```

```
Before Replace:  Counter({0: 7963, 1: 2037})
After Replace:  Counter({'No': 7963, 'Yes': 2037})
```

```
df.shape
```

```
(10000, 11)
```

```
#One Hot Encoder
from sklearn.preprocessing import OneHotEncoder
df1=OneHotEncoder()
df2=df1.fit_transform(df[['Gender','Tenure']])
```

```
df2.shape
```

```
(10000, 13)
```

Question-7:

SPLIT THE DATA INTO DEPENDENT & INDEPENDENT VARIABLES

```
#INDEPENDENT VARIABLES
x=df.iloc[:,0:10]
print(x)
```

```
      CreditScore  Geography  Gender   Age  Tenure    Balance  NumOfProducts
\
0             619          0  Female  42.0       2       0.00              1
1             608          2  Female  41.0       1   83807.86              1
2             502          0  Female  42.0       8  159660.80              3
3             699          0  Female  39.0       1       0.00              2
4             850          2  Female  43.0       2  125510.82              1
...           ...        ...     ...   ...     ...        ...            ...
9995          771          0    Male  39.0       5       0.00              2
9996          516          0    Male  35.0      10   57369.61              1
9997          709          0  Female  36.0       7       0.00              1
9998          772          1    Male  42.0       3   75075.31              2
9999          792          0  Female  28.0       4  130142.79              1

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

[10000 rows x 10 columns]
```

```
#DEPENDENT VARIABLES
y=df.iloc[:,10]
print(y)
```

```
0       Yes
1        No
2       Yes
3        No
4        No
       ...
9995     No
9996     No
9997    Yes
9998    Yes
9999     No
Name: Exited, Length: 10000, dtype: object
```

Question-8:

SCALE THE INDEPENDENT VARIABLES

```
x = pd.get_dummies(x)
x.head()
```

```
   CreditScore  Geography   Age  Tenure    Balance  NumOfProducts  HasCrCard
\
0          619          0  42.0       2       0.00              1          1
1          608          2  41.0       1   83807.86              1          0
2          502          0  42.0       8  159660.80              3          1
3          699          0  39.0       1       0.00              2          0
4          850          2  43.0       2  125510.82              1          1

   IsActiveMember  EstimatedSalary  Gender_Female  Gender_Male
0               1        101348.88              1            0
1               1        112542.58              1            0
2               0        113931.57              1            0
3               0         93826.63              1            0
4               1         79084.10              1            0
```

```
x.shape
```

```
(10000, 11)
```

```
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
x_train = sc.fit_transform(x_train)
x_test = sc.fit_transform(x_test)

x_train = pd.DataFrame(x_train)
x_train.head()
```

```
         0         1         2         3         4         5         6   \
0 -0.735507  0.312661  0.480615  0.008860  0.673160  2.535034 -1.553624
1  1.024427 -0.892353 -0.600877  0.008860 -1.207724  0.804242  0.643657
2  0.808295  1.517675 -0.291879  1.393293 -0.356937  0.804242  0.643657
3  0.396614  1.517675  0.326116  0.008860 -0.009356 -0.926551  0.643657
4 -0.467915 -0.892353  0.017118  0.701077 -1.207724  0.804242  0.643657

         7         8         9         10
0 -1.034460 -1.640810  1.087261 -1.087261
1 -1.034460 -0.079272  1.087261 -1.087261
2  0.966688 -0.996840  1.087261 -1.087261
3  0.966688 -1.591746 -0.919743  0.919743
4  0.966688  1.283302 -0.919743  0.919743
```

Question-9:

SPLIT THE DATA INTO TRAINING & TESTING

```
from sklearn.model_selection import train_test_split
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size = 0.25,
random_state = 0)

print('x_train size: {}'.format(x_train.shape))
print('y_train size: {}'.format(y_train.shape))
print('x_test size: {}'.format(x_test.shape))
print('y_test size: {}'.format(y_test.shape))
```

```
x_train size: (7500, 11)
y_train size: (7500,)
x_test size: (2500, 11)
y_test size: (2500,)
```