Assignment -2

Python Programming

Assignment Date	21 September 2022
Student Name	Mr. Gokulkannan V
Student Register Number	910619104021
Maximum Marks	

1.Importing necessary Libraries and Dataset

In [143]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline

import scipy.stats
import statsmodels.api as sm
#import statsmodels.stats.api as sms
import statsmodels.formula.api as smf
from statsmodels.stats.stattools import jarque_bera

sns.set_style('darkgrid')
sns.set(font_scale=1.3)

data = pd.read_csv('Churn_Modelling.csv')
data
```

Out[143]:

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

10000 rows × 14 columns

SHAPE AND SIZE OF THE DATASET

In [101]:
```
data.shape
```

Out[101]: (10000, 14)

DataTypes

In [103]:
```
data.describe(include='object')
```

Out[103]:

In [102…

```
data.dtypes
```

Out[102]:

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

	Surname	Geography	Gender
count	10000	10000	10000
unique	2932	3	2
top	Smith	France	Male
freq	32	5014	5457

```
data.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
```

Describe function to watch the Mean,Medium,etc

```
data.describe()
```

Out[105]:

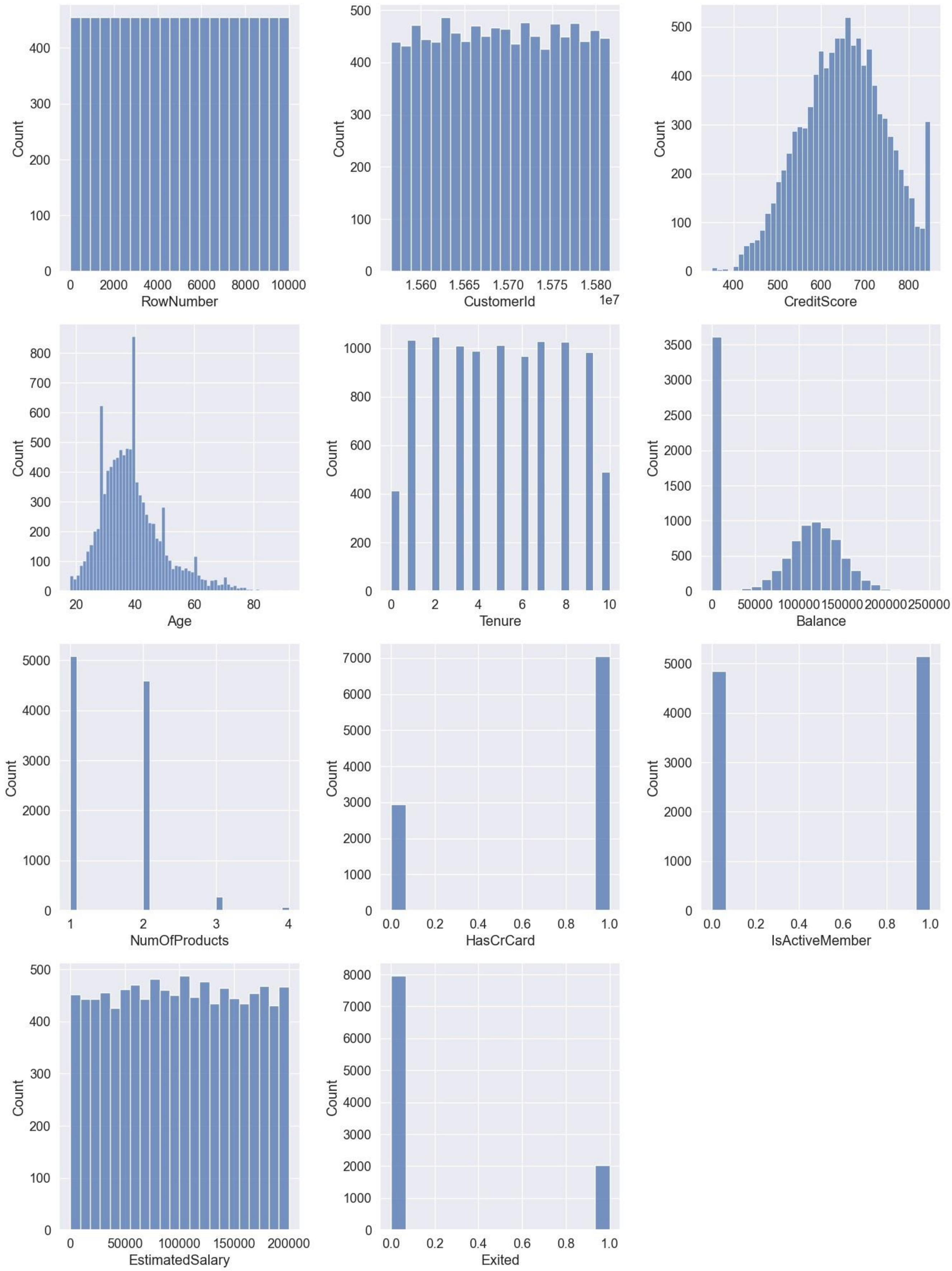
	RowNumber	CustomerId	CreditScore	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember
count	10000.00000	1.000000e+04	10000.000000	10000.000000	10000.000000	10000.000000	10000.000000	10000.00000	10000.000000
mean	5000.50000	1.569094e+07	650.528800	38.921800	5.012800	76485.889288	1.530200	0.70550	0.515100
std	2886.89568	7.193619e+04	96.653299	10.487806	2.892174	62397.405202	0.581654	0.45584	0.499797
min	1.00000	1.556570e+07	350.000000	18.000000	0.000000	0.000000	1.000000	0.00000	0.000000
25%	2500.75000	1.562853e+07	584.000000	32.000000	3.000000	0.000000	1.000000	0.00000	0.000000
50%	5000.50000	1.569074e+07	652.000000	37.000000	5.000000	97198.540000	1.000000	1.00000	1.000000
75%	7500.25000	1.575323e+07	718.000000	44.000000	7.000000	127644.240000	2.000000	1.00000	1.000000
max	10000.00000	1.581569e+07	850.000000	92.000000	10.000000	250898.090000	4.000000	1.00000	1.000000

2. Perform Visualizations

UNIVARIATE ANALYSIS

Histogram

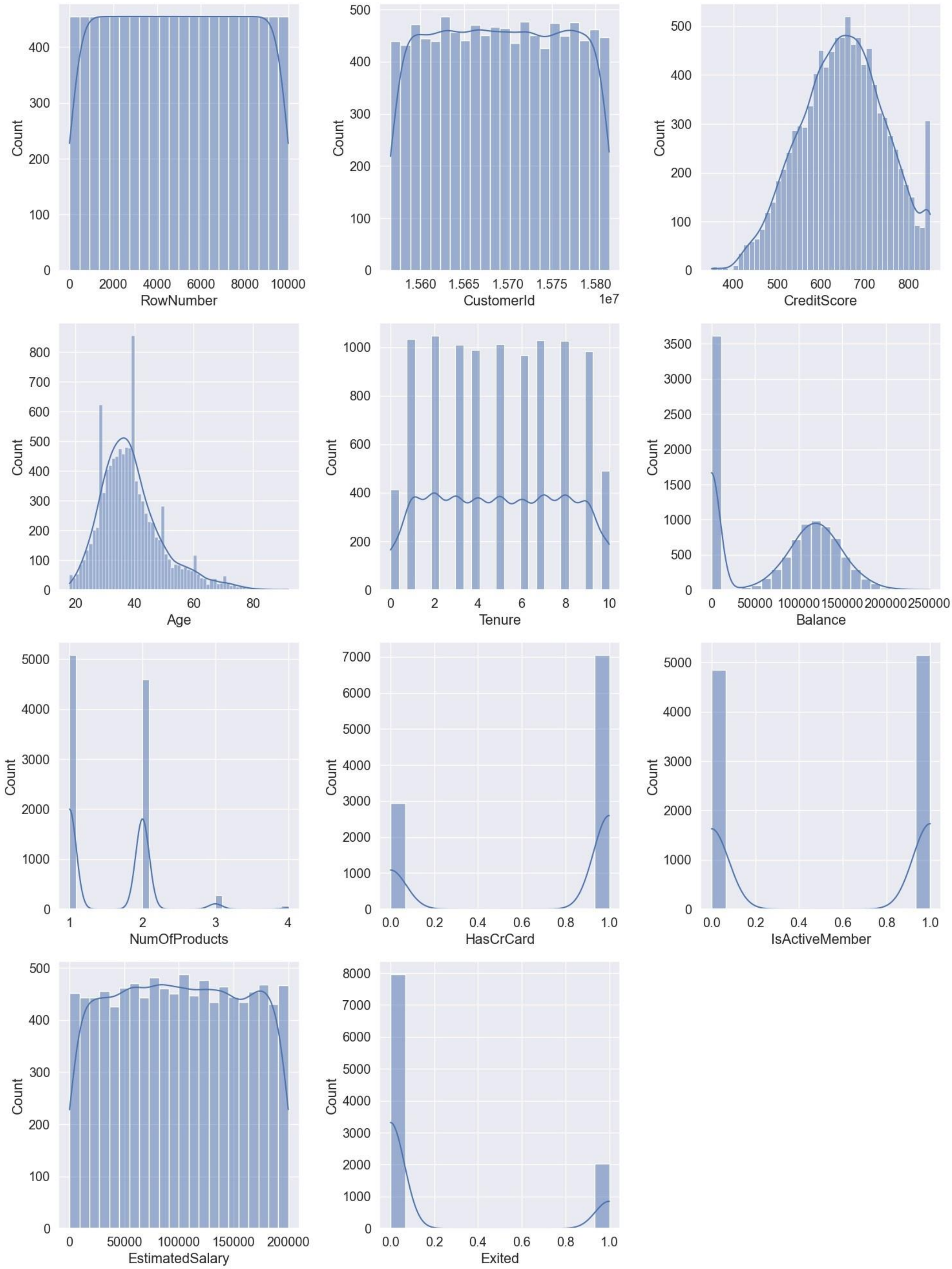
```
cols = 3
rows = 4
num_cols = data.select_dtypes(exclude='object').columns
fig = plt.figure( figsize=(cols*5, rows*5))
for i, col in enumerate(num_cols):

    ax=fig.add_subplot(rows,cols,i+1)

    sns.histplot(x = data[col], ax = ax)

fig.tight_layout()
plt.show()
```



Distplot

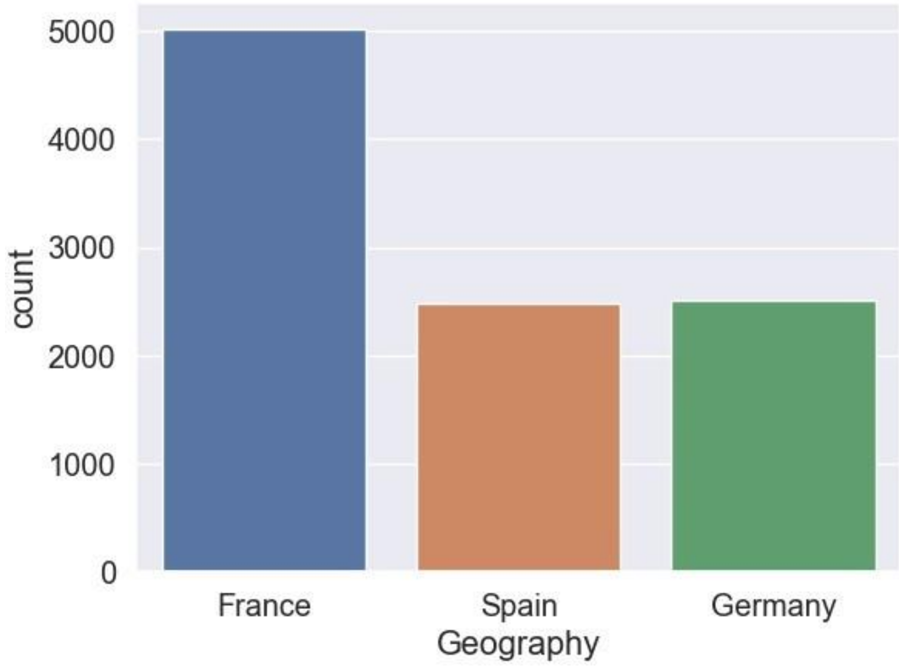
```
cols = 3
rows = 4
num_cols = data.select_dtypes(exclude='object').columns
fig = plt.figure( figsize=(cols*5, rows*5))
for i, col in enumerate(num_cols):

    ax=fig.add_subplot(rows,cols,i+1)

    sns.histplot(x = data[col], ax = ax, data=data, kde='True')

fig.tight_layout()
```

```
plt.show()
```



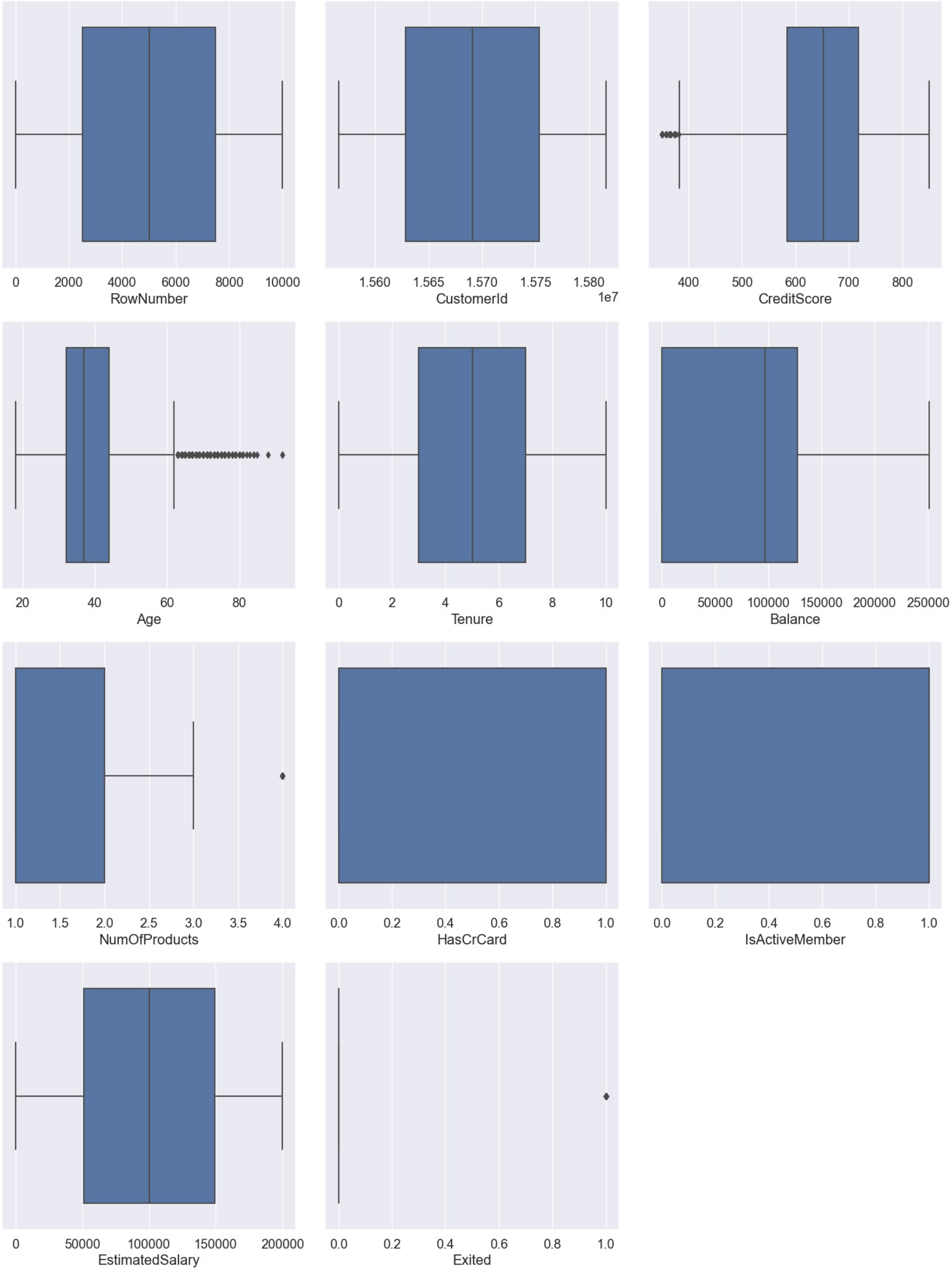
Countplot

```
sns.countplot(x = 'Geography', data=data)
plt.show()
```



Boxplot

```
cols = 3
rows = 4
num_cols = data.select_dtypes(exclude='object').columns
fig = plt.figure( figsize=(cols*5, rows*5))
for i, col in enumerate(num_cols):

    ax=fig.add_subplot(rows,cols,i+1)

    sns.boxplot(x = data[col], ax = ax)

fig.tight_layout()
plt.show()
```



Bivariate Analysis

```
data.head()
```

Out[110]:

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

In [111…

```
data.info()
```

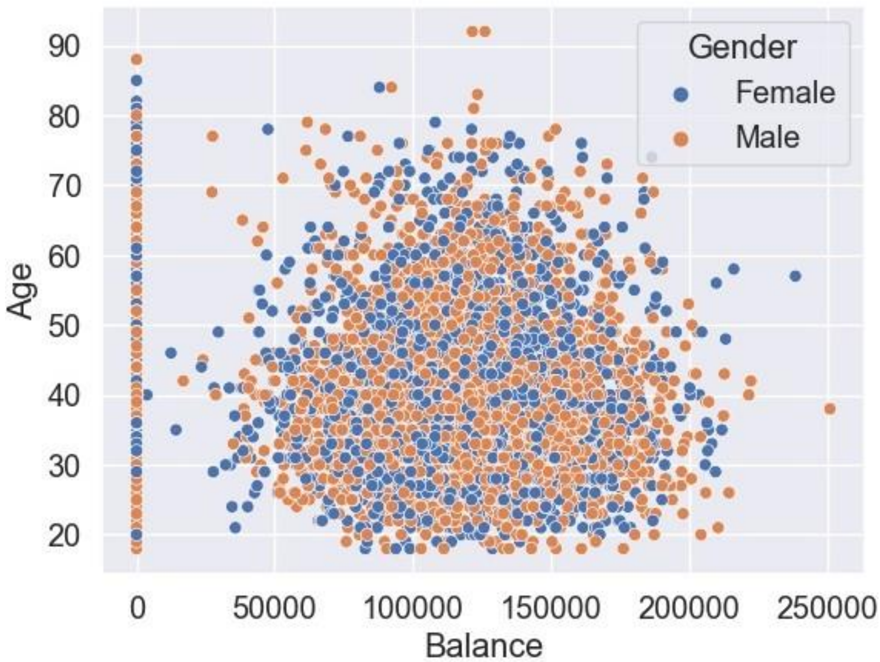
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10000 entries, 0 to 9999
Data columns (total 14 columns):
 #   Column           Non-Null Count  Dtype
---  ------           --------------  -----
 0   RowNumber        10000 non-null  int64
 1   CustomerId       10000 non-null  int64
 2   Surname          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
```

Numerical variable vs Numerical variable

Scatterplot

In [112…

```
sns.scatterplot(x='Balance', y='Age', data = data, hue='Gender')
plt.show()
```

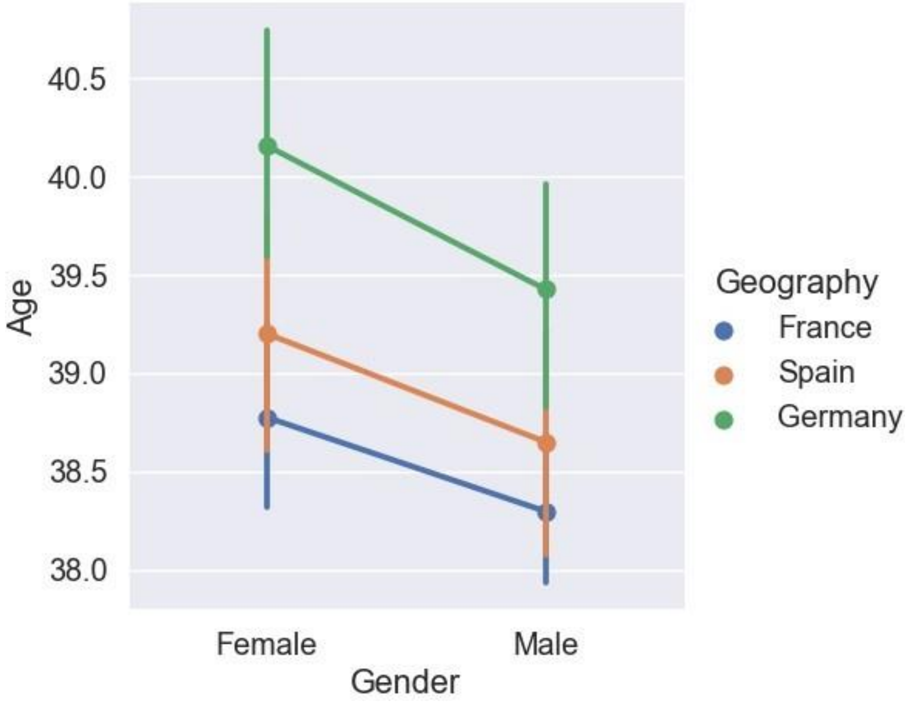


Categorical vs Categorical

Catplot

In [113…

```
sns.catplot(x='Gender', y='Age', data=data, kind='point', hue='Geography')
plt.show()
```

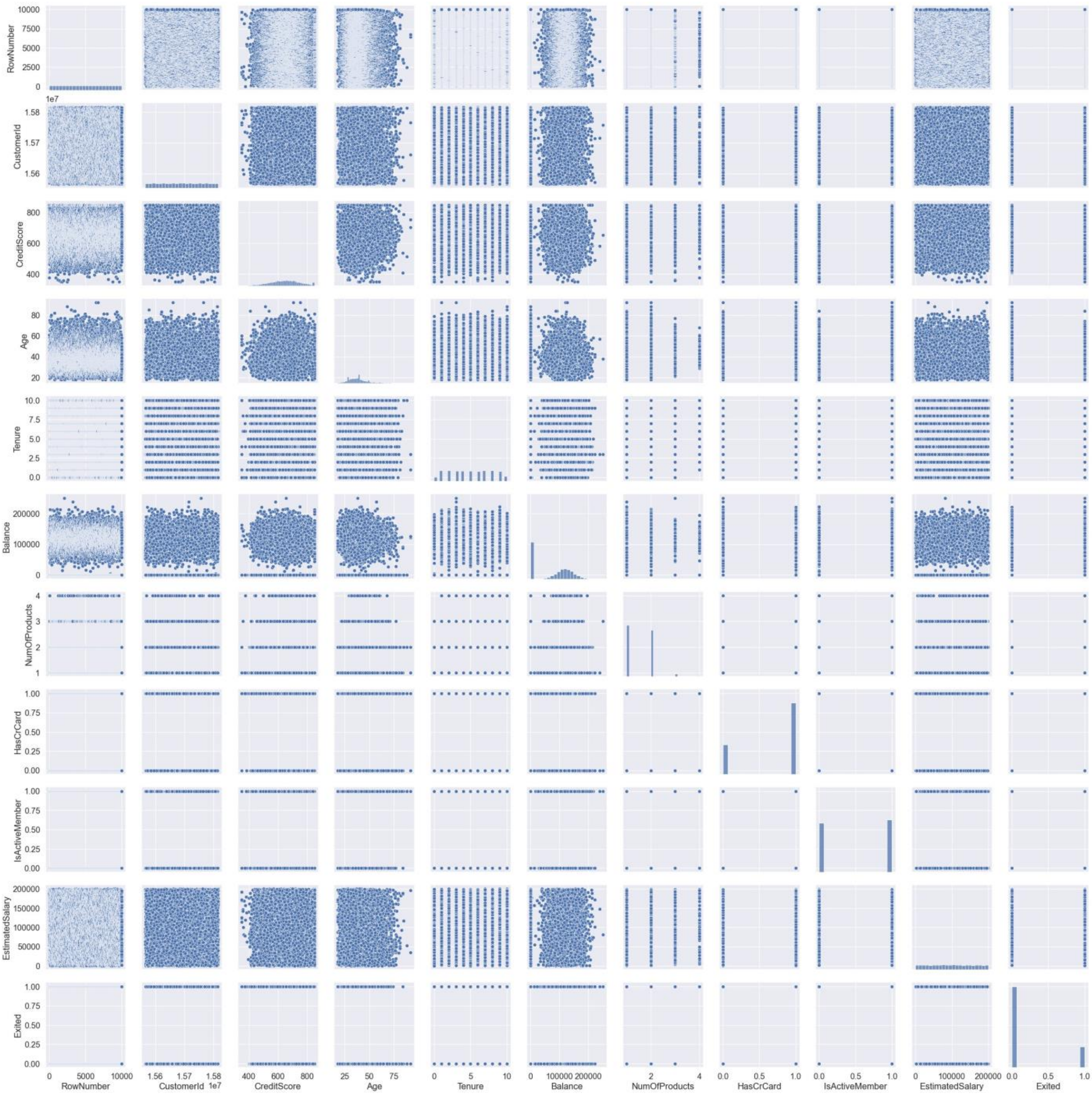


Multivariate Analysis

PairPlot

In [114]:
```
sns.pairplot(data)
```

Out[114]: <seaborn.axisgrid.PairGrid at 0x24161886980>



3. Perform descriptive statistics on the dataset.

```
data.describe(include='all')
```

Out[144]:

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProduct
count	10000.00000	1.000000e+04	10000	10000.000000	10000	10000	10000.000000	10000.000000	10000.000000	10000.00000
unique	NaN	NaN	2932	NaN	3	2	NaN	NaN	NaN	Na
top	NaN	NaN	Smith	NaN	France	Male	NaN	NaN	NaN	Na
freq	NaN	NaN	32	NaN	5014	5457	NaN	NaN	NaN	Na
mean	5000.50000	1.569094e+07	NaN	650.528800	NaN	NaN	38.921800	5.012800	76485.889288	1.53020
std	2886.89568	7.193619e+04	NaN	96.653299	NaN	NaN	10.487806	2.892174	62397.405202	0.58165
min	1.00000	1.556570e+07	NaN	350.000000	NaN	NaN	18.000000	0.000000	0.000000	1.00000
25%	2500.75000	1.562853e+07	NaN	584.000000	NaN	NaN	32.000000	3.000000	0.000000	1.00000
50%	5000.50000	1.569074e+07	NaN	652.000000	NaN	NaN	37.000000	5.000000	97198.540000	1.00000
75%	7500.25000	1.575323e+07	NaN	718.000000	NaN	NaN	44.000000	7.000000	127644.240000	2.00000
max	10000.00000	1.581569e+07	NaN	850.000000	NaN	NaN	92.000000	10.000000	250898.090000	4.00000

```
data.count()
```

Out[145]:
```
RowNumber          10000
CustomerId         10000
Surname            10000
CreditScore        10000
Geography          10000
Gender             10000
Age                10000
Tenure             10000
Balance            10000
NumOfProducts      10000
HasCrCard          10000
IsActiveMember     10000
EstimatedSalary    10000
Exited             10000
dtype: int64
```

4. Handle the Missing values.

Fill with Zeros for NAN values

In [146]:
```
a = data.fillna(0)
a
```

Out[146]:

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

10000 rows × 14 columns

5. Find the outliers and replace the outliers

In [147]:
```
a
```

Out[147]:

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

10000 rows × 14 columns

In [148]:
```
missing_values=data.isnull().sum()
missing_values[missing_values>0]/len(data)*100
```

Out[148]:
```
Series([], dtype: float64)
```

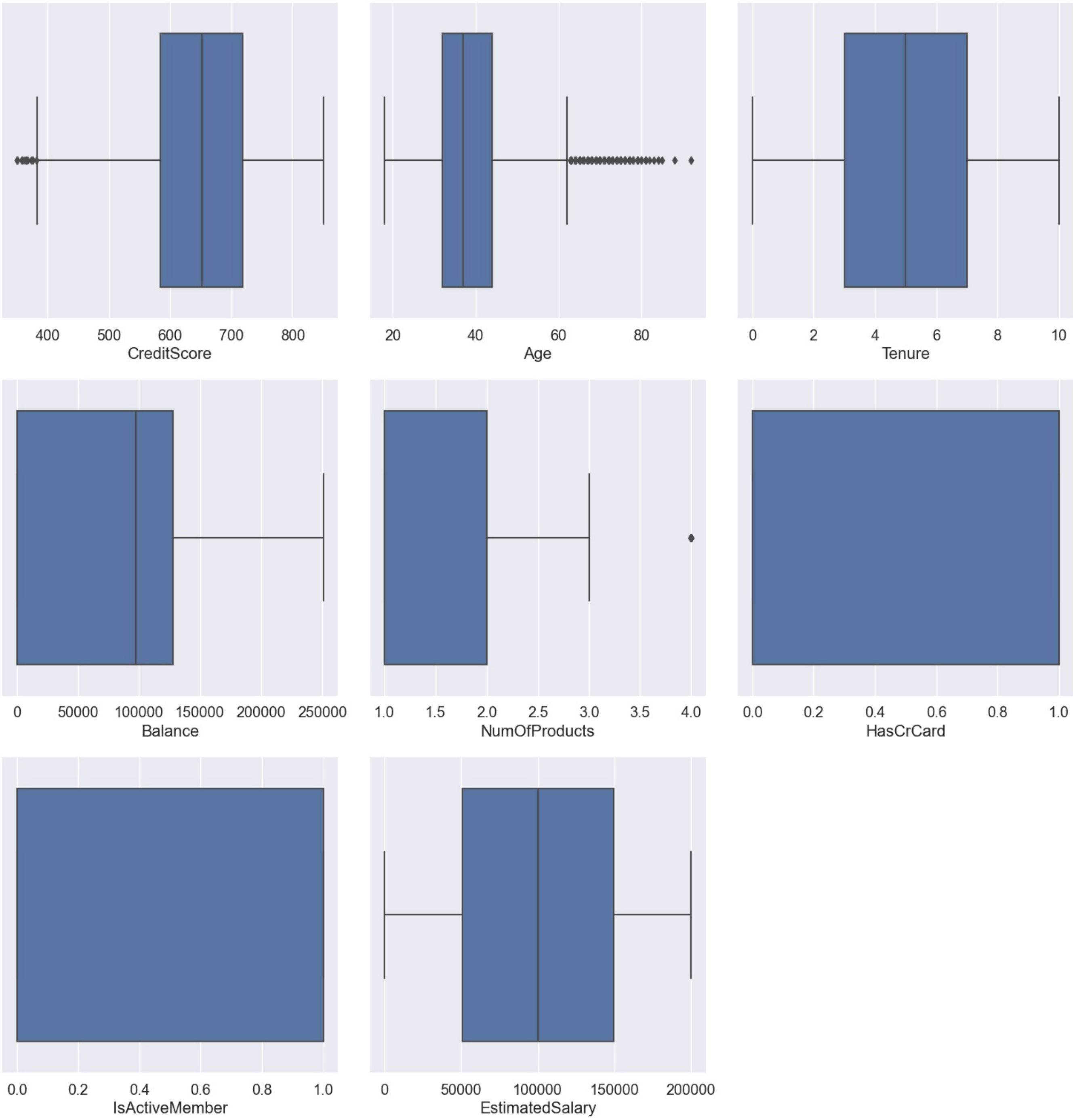
In [149]:
```
data.drop(['RowNumber','Exited','CustomerId','Surname','Geography','Gender'],axis=1,inplace=True)
data.head()
```

Out[149]:

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

In [150…

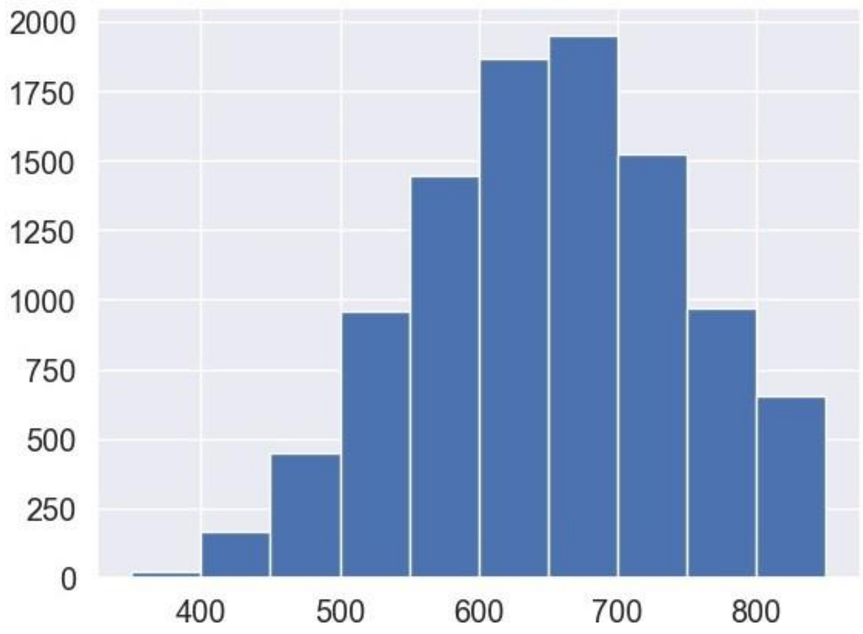
```python
cols = 3
rows = 4
num_cols = data.select_dtypes(exclude='object').columns
fig = plt.figure( figsize=(cols*5, rows*5))
for i, col in enumerate(num_cols):

    ax=fig.add_subplot(rows,cols,i+1)

    sns.boxplot(x = data[col], ax = ax)

fig.tight_layout()
plt.show()
```



In [123…

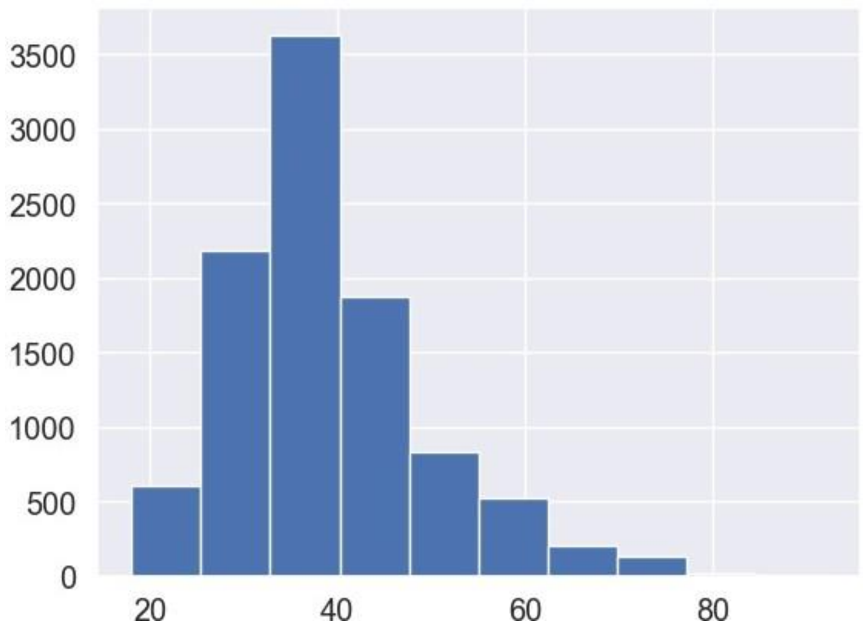
```python
data['CreditScore'].hist()
```

Out[123]: <AxesSubplot: >



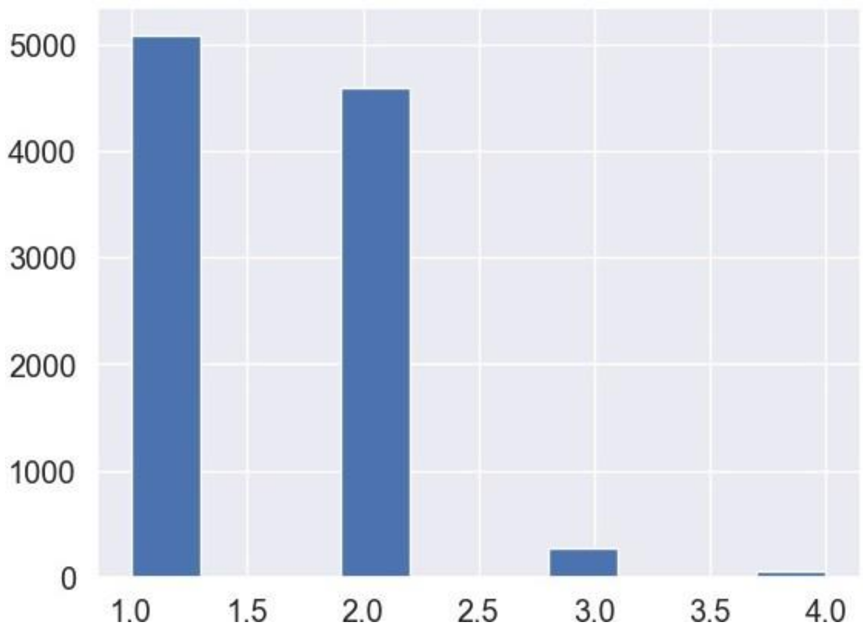
In [124]:
```
data['Age'].hist()
```

Out[124]: <AxesSubplot: >



In [125]:
```
data['NumOfProducts'].hist()
```

Out[125]: <AxesSubplot: >



In [151]:

```
print('Skewness value of Age: ',data['Age'].skew())
Age_mean = data['Age'].mean()
print('Mean of Age is: ',Age_mean)
Age_std = data['Age'].std()
print('Standard Deviation of Age is: ',Age_std)
low= Age_mean -(3 * Age_std)
high= Age_mean + (3 * Age_std)
Age_outliers = data[(data['Age'] < low) | (data['Age'] > high)]
#print('Outliers of Age is:\n',Age_outliers)
print('Outliers of Age is:')
Age_outliers.head()
```

```
Skewness value of Age: 1.0113202630234552
Mean of Age is:  38.9218
Standard Deviation of Age is: 10.487806451704609
Outliers of Age is:
```

Out[151]:

	CreditScore	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary
85	652	75	10	0.00	2	1	1	114675.75
158	646	73	6	97259.25	1	0	1	104719.66
230	673	72	1	0.00	2	0	1	111981.19
252	681	79	0	0.00	2	0	1	170968.99
310	652	80	4	0.00	2	1	1	188603.07

In [152]:

```
print('Skewness value of CreditScore: ',data['CreditScore'].skew())
CreditScore_mean = data['CreditScore'].mean()
print('Mean of CreditScore is: ',CreditScore_mean)
CreditScore_std = data['CreditScore'].std()
print('Standard Deviation of CreditScore is: ',CreditScore_std)
low= CreditScore_mean -(3 * CreditScore_std)
high= CreditScore_mean + (3 * CreditScore_std)
CreditScore_outliers = data[(data['CreditScore'] < low) | (data['CreditScore'] > high)]
#print('Outliers of Age is:\n',Age_outliers)
print('Outliers of CreditScore is:')
```

```
CreditScore_outliers.head()
```

```
Skewness value of CreditScore: -0.07160660820092675
Mean of CreditScore is:  650.5288
Standard Deviation of CreditScore is: 96.65329873613035
Outliers of CreditScore is:
```

Out[152]:

	CreditScore	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary
1405	359	44	6	128747.69	1	1	0	146955.71
1631	350	54	1	152677.48	1	1	1	191973.49
1838	350	39	0	109733.20	2	0	0	123602.11
1962	358	52	8	143542.36	3	1	0	141959.11
2473	351	57	4	163146.46	1	1	0	169621.69

In [153]:

```
print('Skewness value of NumOfProducts: ',data['NumOfProducts'].skew())
NumOfProducts_mean = data['NumOfProducts'].mean()
print('Mean of NumOfProducts is: ',NumOfProducts_mean)
NumOfProducts_std = data['NumOfProducts'].std()
print('Standard Deviation of NumOfProducts is: ',NumOfProducts_std)
low= NumOfProducts_mean -(3 * NumOfProducts_std)
high= NumOfProducts_mean + (3 * NumOfProducts_std)
NumOfProducts_outliers = data[(data['NumOfProducts'] < low) | (data['NumOfProducts'] > high)]
#print('Outliers of Age is:\n',Age_outliers)
print('Outliers of NumOfProducts is:')
NumOfProducts_outliers.head()
```

```
Skewness value of NumOfProducts: 0.7455678882823168
Mean of NumOfProducts is:  1.5302
Standard Deviation of NumOfProducts is: 0.5816543579989906
Outliers of NumOfProducts is:
```

Out[153]:

	CreditScore	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary
7	376	29	4	115046.74	4	1	0	119346.88
70	738	58	2	133745.44	4	1	0	28373.86
1254	628	46	1	46870.43	4	1	0	31272.14
1469	819	49	1	120656.86	4	0	0	166164.30
1488	596	30	6	121345.88	4	1	0	41921.75

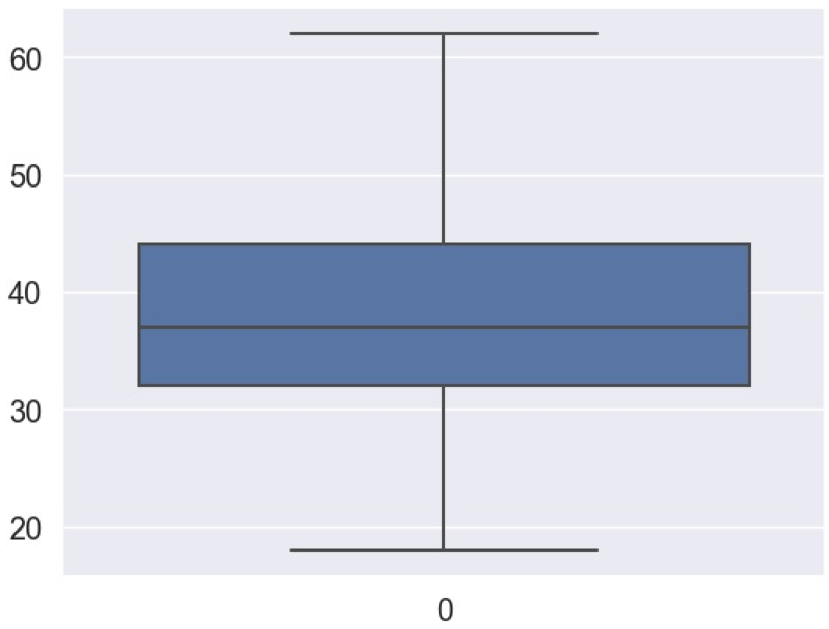
Outliers Eliminated

In [160]:

```
Q1 = data['Age'].quantile(0.25)
Q3 = data['Age'].quantile(0.75)
IQR = Q3 - Q1
whisker_width = 1.5
lower_whisker = Q1 -(whisker_width*IQR)
upper_whisker = Q3 + (whisker_width*IQR)
data['Age']=np.where(data['Age']>upper_whisker,upper_whisker,np.where(data['Age']<lower_whisker,lower_whisker,d
print('Outliers Removed in Age:')
sns.boxplot(data['Age'])
```

```
Outliers Removed in Age:
```

Out[160]: <AxesSubplot: >



In [161]:

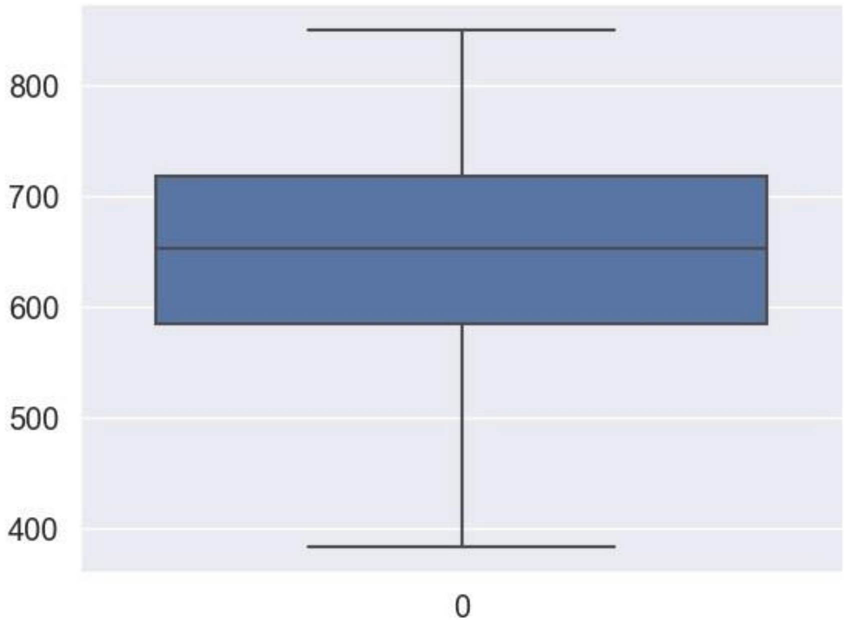
```
Q1 = data['CreditScore'].quantile(0.25)
```

```
Q3 = data['CreditScore'].quantile(0.75)
IQR = Q3 - Q1
whisker_width = 1.5
lower_whisker = Q1 -(whisker_width*IQR)
upper_whisker = Q3 + (whisker_width*IQR)
data['CreditScore']=np.where(data['CreditScore']>upper_whisker,upper_whisker,np.where(data['CreditScore']<lower
print('Outliers Removed in CreditScore:')
sns.boxplot(data['CreditScore'])
```

```
Outliers Removed in CreditScore:
```

Out[161]:

```
<AxesSubplot: >
```

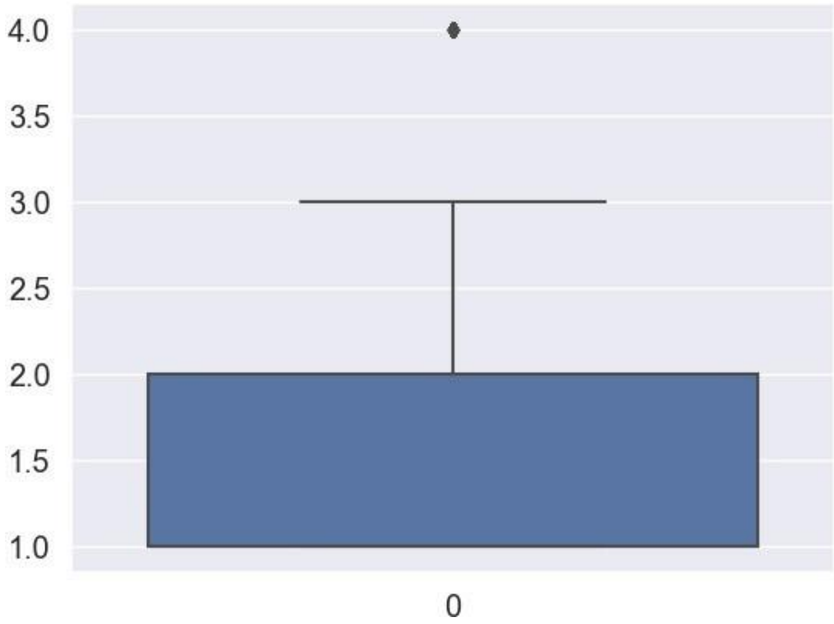



```
Q1 = data['NumOfProducts'].quantile(0.25)
Q3 = data['NumOfProducts'].quantile(0.75)
IQR = Q3 - Q1
whisker_width = 1.5
lower_whisker = Q1 -(whisker_width*IQR)
upper_whisker = Q3 + (whisker_width*IQR)
data['Age']=np.where(data['NumOfProducts']>upper_whisker,upper_whisker,np.where(data['NumOfProducts']<lower_whi
print('Outliers Removed in NumOfProducts:')
sns.boxplot(data['NumOfProducts'])
```

```
Outliers Removed in NumOfProducts:
```

Out[162]:

```
<AxesSubplot: >
```



6. Check for Categorical columns and perform encoding.

```
#data1 = pd.read_csv('Churn_Modelling.csv')
#data1.head()
```

```
import numpy as np #for numpy operations
import pandas as pd #for creating DataFrame using Pandas
```

```python
# to split the dataset using sklearn
from sklearn.preprocessing import LabelEncoder,OneHotEncoder
# load titanic dataset
data1 = pd.read_csv('Churn_Modelling.csv')
data1.head(10)
```

Out[2]:

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMemb
0	1	15634602	Hargrave	619	France	Female	42	2	0.00	1	1	
1	2	15647311	Hill	608	Spain	Female	41	1	83807.86	1	0	
2	3	15619304	Onio	502	France	Female	42	8	159660.80	3	1	
3	4	15701354	Boni	699	France	Female	39	1	0.00	2	0	
4	5	15737888	Mitchell	850	Spain	Female	43	2	125510.82	1	1	
5	6	15574012	Chu	645	Spain	Male	44	8	113755.78	2	1	
6	7	15592531	Bartlett	822	France	Male	50	7	0.00	2	1	
7	8	15656148	Obinna	376	Germany	Female	29	4	115046.74	4	1	
8	9	15792365	He	501	France	Male	44	4	142051.07	2	0	
9	10	15592389	H?	684	France	Male	27	2	134603.88	1	1	

In [3]:

```python
data1.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
```

In [4]:

```python
# label_encoder object
label_encoder =LabelEncoder()
# Encode labels in column.
data1['Surname']= label_encoder.fit_transform(data1['Surname'])
data1.head(10)
```

Out[4]:

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMemb
0	1	15634602	1115	619	France	Female	42	2	0.00	1	1	
1	2	15647311	1177	608	Spain	Female	41	1	83807.86	1	0	
2	3	15619304	2040	502	France	Female	42	8	159660.80	3	1	
3	4	15701354	289	699	France	Female	39	1	0.00	2	0	
4	5	15737888	1822	850	Spain	Female	43	2	125510.82	1	1	
5	6	15574012	537	645	Spain	Male	44	8	113755.78	2	1	
6	7	15592531	177	822	France	Male	50	7	0.00	2	1	
7	8	15656148	2000	376	Germany	Female	29	4	115046.74	4	1	
8	9	15792365	1146	501	France	Male	44	4	142051.07	2	0	
9	10	15592389	1081	684	France	Male	27	2	134603.88	1	1	

In [7]:

```python
data1['Gender']= label_encoder.fit_transform(data1['Gender'])
data1.head(10)
```

Out[7]:

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMemb
0	1	15634602	1115	619	France	0	42	2	0.00	1	1	
1	2	15647311	1177	608	Spain	0	41	1	83807.86	1	0	
2	3	15619304	2040	502	France	0	42	8	159660.80	3	1	
3	4	15701354	289	699	France	0	39	1	0.00	2	0	
4	5	15737888	1822	850	Spain	0	43	2	125510.82	1	1	
5	6	15574012	537	645	Spain	1	44	8	113755.78	2	1	
6	7	15592531	177	822	France	1	50	7	0.00	2	1	
7	8	15656148	2000	376	Germany	0	29	4	115046.74	4	1	
8	9	15792365	1146	501	France	1	44	4	142051.07	2	0	
9	10	15592389	1081	684	France	1	27	2	134603.88	1	1	

In [8]:

```
data1['Geography']= label_encoder.fit_transform(data1['Geography'])
data1.head(10)
```

Out[8]:

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMemb
0	1	15634602	1115	619	0	0	42	2	0.00	1	1	
1	2	15647311	1177	608	2	0	41	1	83807.86	1	0	
2	3	15619304	2040	502	0	0	42	8	159660.80	3	1	
3	4	15701354	289	699	0	0	39	1	0.00	2	0	
4	5	15737888	1822	850	2	0	43	2	125510.82	1	1	
5	6	15574012	537	645	2	1	44	8	113755.78	2	1	
6	7	15592531	177	822	0	1	50	7	0.00	2	1	
7	8	15656148	2000	376	1	0	29	4	115046.74	4	1	
8	9	15792365	1146	501	0	1	44	4	142051.07	2	0	
9	10	15592389	1081	684	0	1	27	2	134603.88	1	1	

7. Split the data into dependent and independent variables.

#

Dependent Variable : A dependent variable is a variable w hose value depends on another variable.

#

Independent Variable : An Independent variable is a variable w hose value never depends on another variable.

#

In [42]:

```
print("The Minimum value of Dataset:\n",data1.min(numeric_only=True))
print("\n")
print("The Maximum value of Dataset:\n",data1.max(numeric_only=True))
print("\n")
print("The Mean value of Dataset:\n",data1.mean(numeric_only=True))
print("\n")


print(data1.count(0))
print(data1.shape)
print(data1.size)
```

```
The Minimum value of Dataset:
 RowNumber                 1.00
CustomerId         15565701.00
Surname                   0.00
CreditScore             350.00
Geography                 0.00
Gender                    0.00
Age                      18.00
Tenure                    0.00
Balance                   0.00
NumOfProducts             1.00
HasCrCard                 0.00
IsActiveMember            0.00
EstimatedSalary          11.58
Exited                    0.00
dtype: float64


The Maximum value of Dataset:
 RowNumber             10000.00
CustomerId         15815690.00
Surname                2931.00
CreditScore             850.00
Geography                 2.00
Gender                    1.00
Age                      92.00
Tenure                   10.00
Balance              250898.09
NumOfProducts             4.00
HasCrCard                 1.00
IsActiveMember            1.00
EstimatedSalary      199992.48
Exited                    1.00
dtype: float64


The Mean value of Dataset:
 RowNumber            5.000500e+03
CustomerId         1.569094e+07
Surname            1.507774e+03
CreditScore        6.505288e+02
Geography          7.463000e-01
Gender             5.457000e-01
Age                3.892180e+01
Tenure             5.012800e+00
Balance            7.648589e+04
NumOfProducts      1.530200e+00
HasCrCard          7.055000e-01
IsActiveMember     5.151000e-01
EstimatedSalary    1.000902e+05
Exited             2.037000e-01
dtype: float64


RowNumber          10000
CustomerId         10000
Surname            10000
CreditScore        10000
Geography          10000
Gender             10000
Age                10000
Tenure             10000
Balance            10000
NumOfProducts      10000
HasCrCard          10000
IsActiveMember     10000
EstimatedSalary    10000
Exited             10000
dtype: int64
(10000, 14)
140000
```

In [31]:

```
y = data1["Surname"]
x=data1.drop(columns=["Surname"],axis=1)
x.head()
```

Out[31]:

	RowNumber	CustomerId	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	Estimat
0	1	15634602	619	0	0	42	2	0.00	1	1	1	1
1	2	15647311	608	2	0	41	1	83807.86	1	0	1	1
2	3	15619304	502	0	0	42	8	159660.80	3	1	0	1
3	4	15701354	699	0	0	39	1	0.00	2	0	0	
4	5	15737888	850	2	0	43	2	125510.82	1	1	1	

9. Scale the independent variables

In [33]:
```
names=x.columns
names
```

Out[33]:
```
Index(['RowNumber', 'CustomerId', 'CreditScore', 'Geography', 'Gender', 'Age',
       'Tenure', 'Balance', 'NumOfProducts', 'HasCrCard', 'IsActiveMember',
       'EstimatedSalary', 'Exited'],
      dtype='object')
```

In [34]:
```
from sklearn.preprocessing import scale
```

In [35]:
```
X=scale(x)
```

In [36]:
```
X
```

Out[36]:
```
array([[-1.73187761, -0.78321342, -0.32622142, ...,  0.97024255,
         0.02188649,  1.97716468],
       [-1.7315312 , -0.60653412, -0.44003595, ...,  0.97024255,
         0.21653375, -0.50577476],
       [-1.73118479, -0.99588476, -1.53679418, ..., -1.03067011,
         0.2406869 ,  1.97716468],
       ...,
       [ 1.73118479, -1.47928179, 0.60498839, ...,  0.97024255,
        -1.00864308,  1.97716468],
       [ 1.7315312 , -0.11935577, 1.25683526, ..., -1.03067011,
        -0.12523071,  1.97716468],
       [ 1.73187761, -0.87055909, 1.46377078, ..., -1.03067011,
        -1.07636976, -0.50577476]])
```

In [37]:
```
x = pd.DataFrame(X,columns = names )
x
```

Out[37]:

	RowNumber	CustomerId	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMem
0	-1.731878	-0.783213	-0.326221	-0.901886	-1.095988	0.293517	-1.041760	-1.225848	-0.911583	0.646092	0.970
1	-1.731531	-0.606534	-0.440036	1.515067	-1.095988	0.198164	-1.387538	0.117350	-0.911583	-1.547768	0.970
2	-1.731185	-0.995885	-1.536794	-0.901886	-1.095988	0.293517	1.032908	1.333053	2.527057	0.646092	-1.030
3	-1.730838	0.144767	0.501521	-0.901886	-1.095988	0.007457	-1.387538	-1.225848	0.807737	-1.547768	-1.030
4	-1.730492	0.652659	2.063884	1.515067	-1.095988	0.388871	-1.041760	0.785728	-0.911583	0.646092	0.970
...	...	...	...	...	...	...	...	...	...	...	
9995	1.730492	-1.177652	1.246488	-0.901886	0.912419	0.007457	-0.004426	-1.225848	0.807737	0.646092	-1.030
9996	1.730838	-1.682806	-1.391939	-0.901886	0.912419	-0.373958	1.724464	-0.306379	-0.911583	0.646092	0.970
9997	1.731185	-1.479282	0.604988	-0.901886	-1.095988	-0.278604	0.687130	-1.225848	-0.911583	-1.547768	0.970
9998	1.731531	-0.119356	1.256835	0.306591	0.912419	0.293517	-0.695982	-0.022608	0.807737	0.646092	-1.030
9999	1.731878	-0.870559	1.463771	-0.901886	-1.095988	-1.041433	-0.350204	0.859965	-0.911583	0.646092	-1.030

10000 rows × 13 columns

10.Split the data into training and testing

#

The train-test split is used to estimate the performance of machine learning algorithms that are applicable for prediction-based Algorithms/Applications. By default, the Test set is split into 30 % of actual data and the training set is split into 70% of the actual data.

#

In [38]:
```
from sklearn.model_selection import train_test_split
```

In [39]:
```
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.2,random_state=0)
```

In [40]:
```
x_train.head()
```

Out[40]:

	RowNumber	CustomerId	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMem
7389	0.827747	-0.195066	0.170424	1.515067	-1.095988	-0.469311	-0.004426	-1.225848	0.807737	0.646092	-1.030
9275	1.481077	0.810821	-2.312802	0.306591	0.912419	0.293517	-1.387538	-0.012892	-0.911583	0.646092	0.970
2995	-0.694379	-1.507642	-1.195351	-0.901886	-1.095988	-0.946079	-1.041760	0.575076	-0.911583	0.646092	-1.030
5316	0.109639	1.243462	0.035916	1.515067	0.912419	0.102810	-0.004426	0.467955	-0.911583	0.646092	-1.030
356	-1.608556	-1.100775	2.063884	1.515067	-1.095988	1.723821	1.032908	0.806010	0.807737	0.646092	0.970

In [41]:

```
x_train.shape,y_train.shape,x_test.shape,y_test.shape
```

Out[41]:

```
((8000, 13), (8000,), (2000, 13), (2000,))
```