In [1]:
```python
import numpy as np
import pandas as pd
```

In [2]:
```python
train_data = pd.read_csv('Churn_Modelling.csv')
```

In [3]:
```python
train_data.shape
```

Out[3]:
```
(10000, 14)
```

In [4]:
```python
train_data
```

Out[4]:

	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
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
9995	9996	15606229	Obijiaku	771	France	Male	39	5	0.00	2	1	0	96270.64	0
9996	9997	15569892	Johnstone	516	France	Male	35	10	57369.61	1	1	1	101699.77	0
9997	9998	15584532	Liu	709	France	Female	36	7	0.00	1	0	1	42085.58	1
9998	9999	15682355	Sabbatini	772	Germany	Male	42	3	75075.31	2	1	0	92888.52	1
9999	10000	15628319	Walker	792	France	Female	28	4	130142.79	1	1	0	38190.78	0

10000 rows × 14 columns

In [5]:
```python
train_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
```

In [6]:
```python
train_data.describe()
```

Out[6]:

	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

In [7]:
```python
train_data.describe(include = 'object')
```

Out[7]:

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

In [8]:
```python
train_data.isnull().sum()
```

Out[8]:
```
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
```

In [9]:
```python
train_data.dropna(ignore_index=True,inplace=True)
```

In [10]:
```python
data = train_data.drop(columns=['RowNumber','CustomerId','Surname'])
```

In [11]:
```python
data
```

Out[11]:

	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
0	619	France	Female	42	2	0.00	1	1	1	101348.88	1
1	608	Spain	Female	41	1	83807.86	1	0	1	112542.58	0
2	502	France	Female	42	8	159660.80	3	1	0	113931.57	1
3	699	France	Female	39	1	0.00	2	0	0	93826.63	0
4	850	Spain	Female	43	2	125510.82	1	1	1	79084.10	0
...	...	...	...	...	...	...	...	...	...	...	...
9995	771	France	Male	39	5	0.00	2	1	0	96270.64	0
9996	516	France	Male	35	10	57369.61	1	1	1	101699.77	0
9997	709	France	Female	36	7	0.00	1	0	1	42085.58	1
9998	772	Germany	Male	42	3	75075.31	2	1	0	92888.52	1
9999	792	France	Female	28	4	130142.79	1	1	0	38190.78	0

10000 rows × 11 columns

In [12]:
```python
data.info()
```

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

In [13]:
```python
data
```

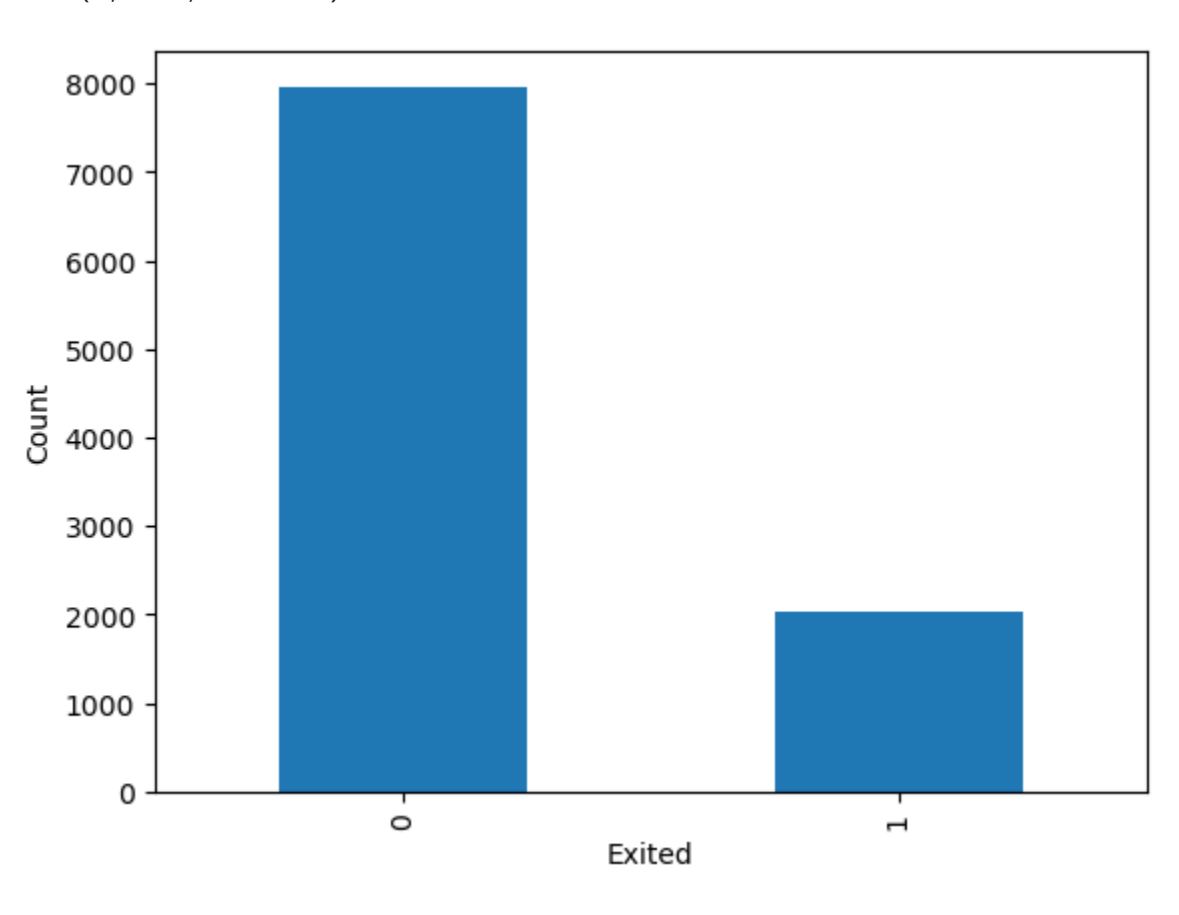
Out[13]:

	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
0	619	France	Female	42	2	0.00	1	1	1	101348.88	1
1	608	Spain	Female	41	1	83807.86	1	0	1	112542.58	0
2	502	France	Female	42	8	159660.80	3	1	0	113931.57	1
3	699	France	Female	39	1	0.00	2	0	0	93826.63	0
4	850	Spain	Female	43	2	125510.82	1	1	1	79084.10	0
...	...	...	...	...	...	...	...	...	...	...	...
9995	771	France	Male	39	5	0.00	2	1	0	96270.64	0
9996	516	France	Male	35	10	57369.61	1	1	1	101699.77	0
9997	709	France	Female	36	7	0.00	1	0	1	42085.58	1
9998	772	Germany	Male	42	3	75075.31	2	1	0	92888.52	1
9999	792	France	Female	28	4	130142.79	1	1	0	38190.78	0

10000 rows × 11 columns

In [14]:
```python
ax = data['Exited'].value_counts().to_frame().plot(kind='bar',legend=False)
ax.set_xlabel('Exited')
ax.set_ylabel('Count')
```

Out[14]:
```
Text(0, 0.5, 'Count')
```



In [15]:
```python
import seaborn as sns
c = data['Geography'].value_counts().to_frame()
c.reset_index()
```

Out[15]:

	Geography	count
0	France	5014
1	Germany	2509
2	Spain	2477

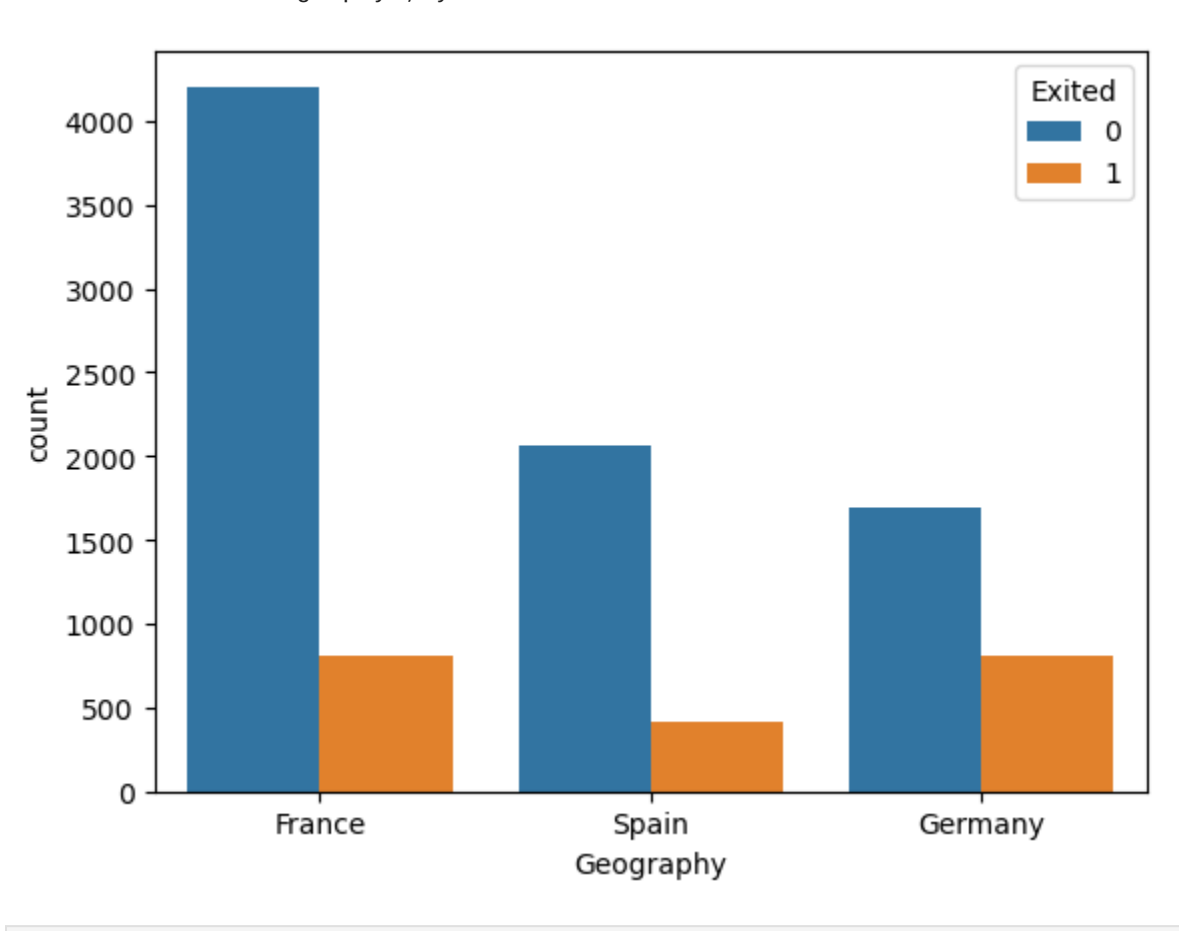
In [18]:
```python
c = data.groupby(['Exited'])['Geography'].value_counts().to_frame().reset_index()
c
```

Out[18]:

	Exited	Geography	count
0	0	France	4204
1	0	Spain	2064
2	0	Germany	1695
3	1	Germany	814
4	1	France	810
5	1	Spain	413

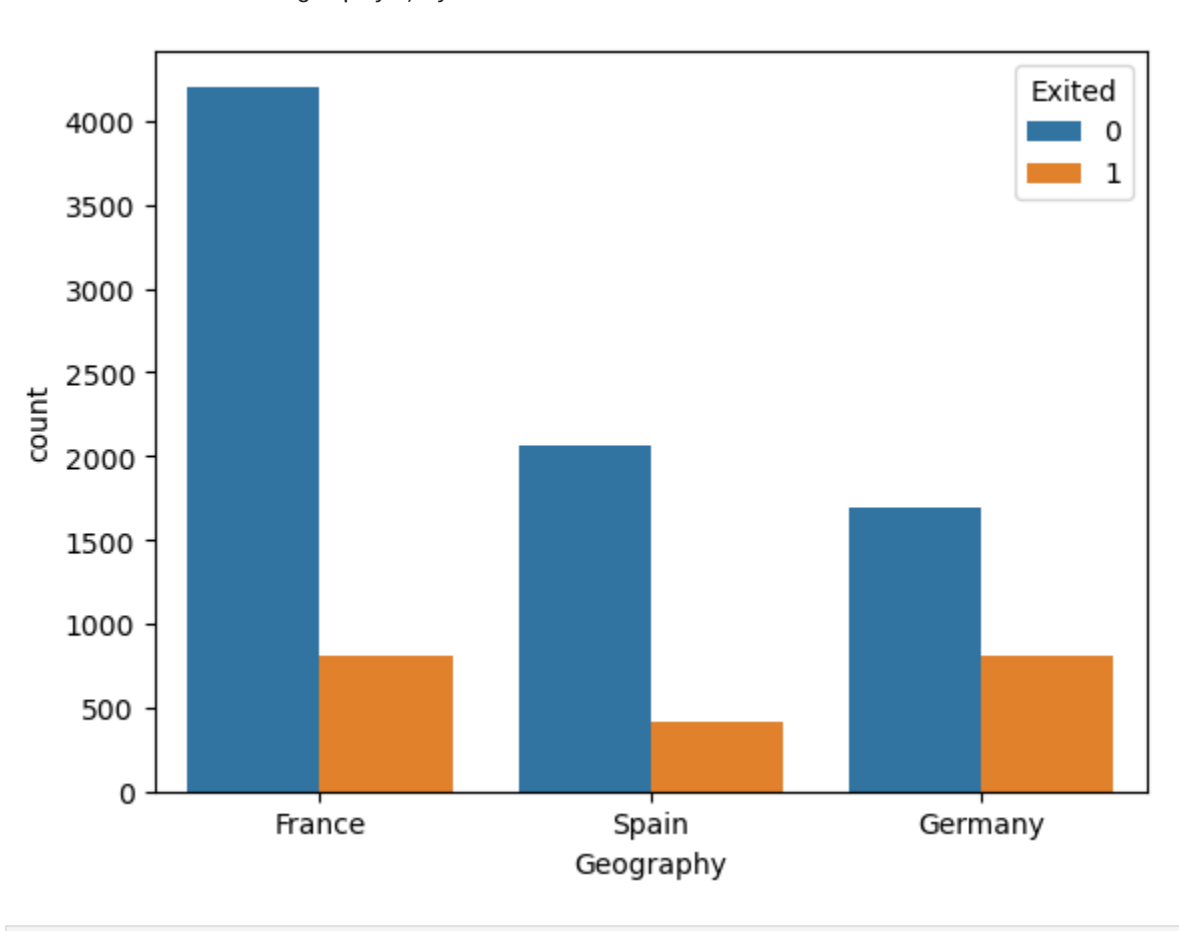
In [19]:
```python
import seaborn as sns
sns.countplot(x='Geography',data=data,hue='Exited')
```

Out[19]:
```
<Axes: xlabel='Geography', ylabel='count'>
```



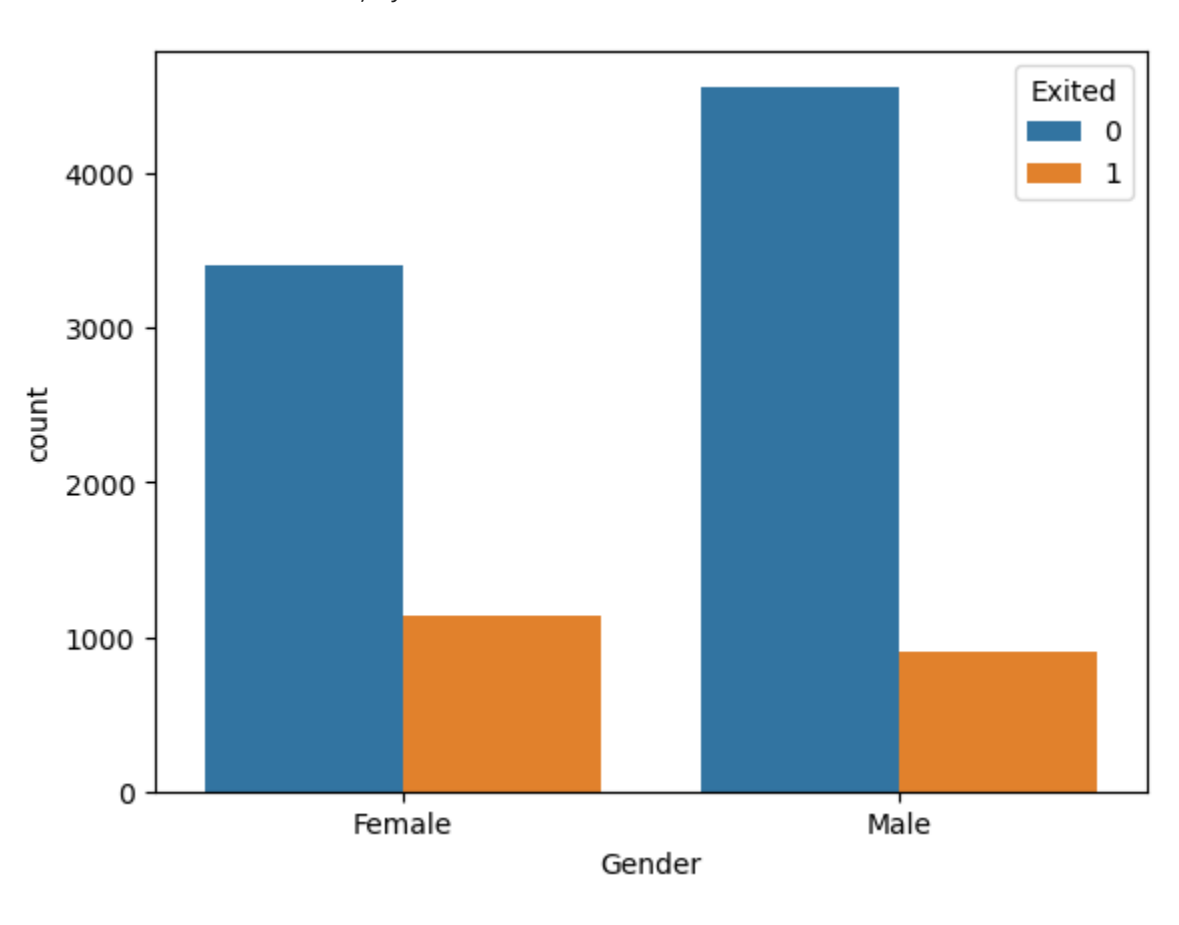
In [20]:
```python
sns.barplot(x='Geography',y='count',data=c,hue='Exited')
```

Out[20]:
```
<Axes: xlabel='Geography', ylabel='count'>
```



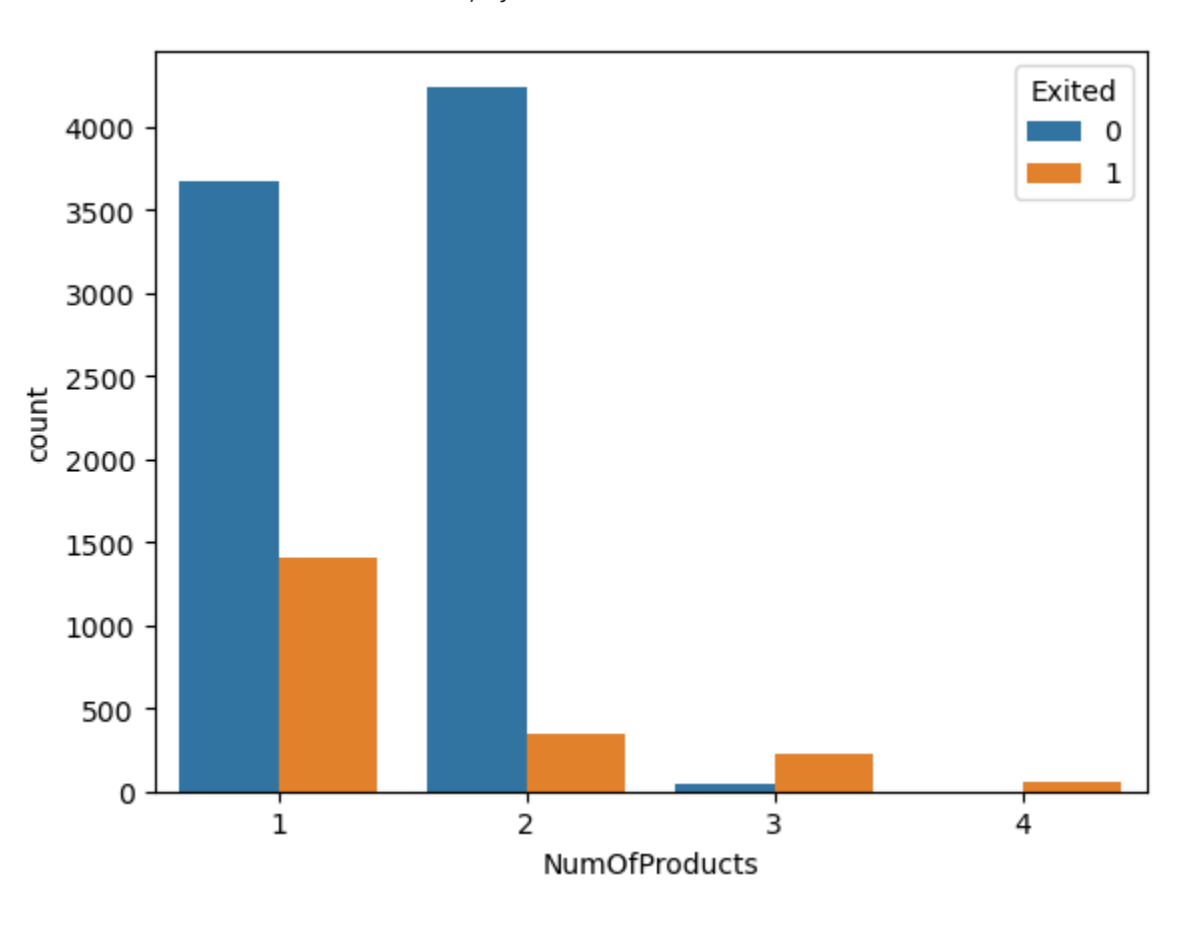
In [21]:
```python
sns.countplot(x='Gender',data=data,hue='Exited')
```

Out[21]:
```
<Axes: xlabel='Gender', ylabel='count'>
```



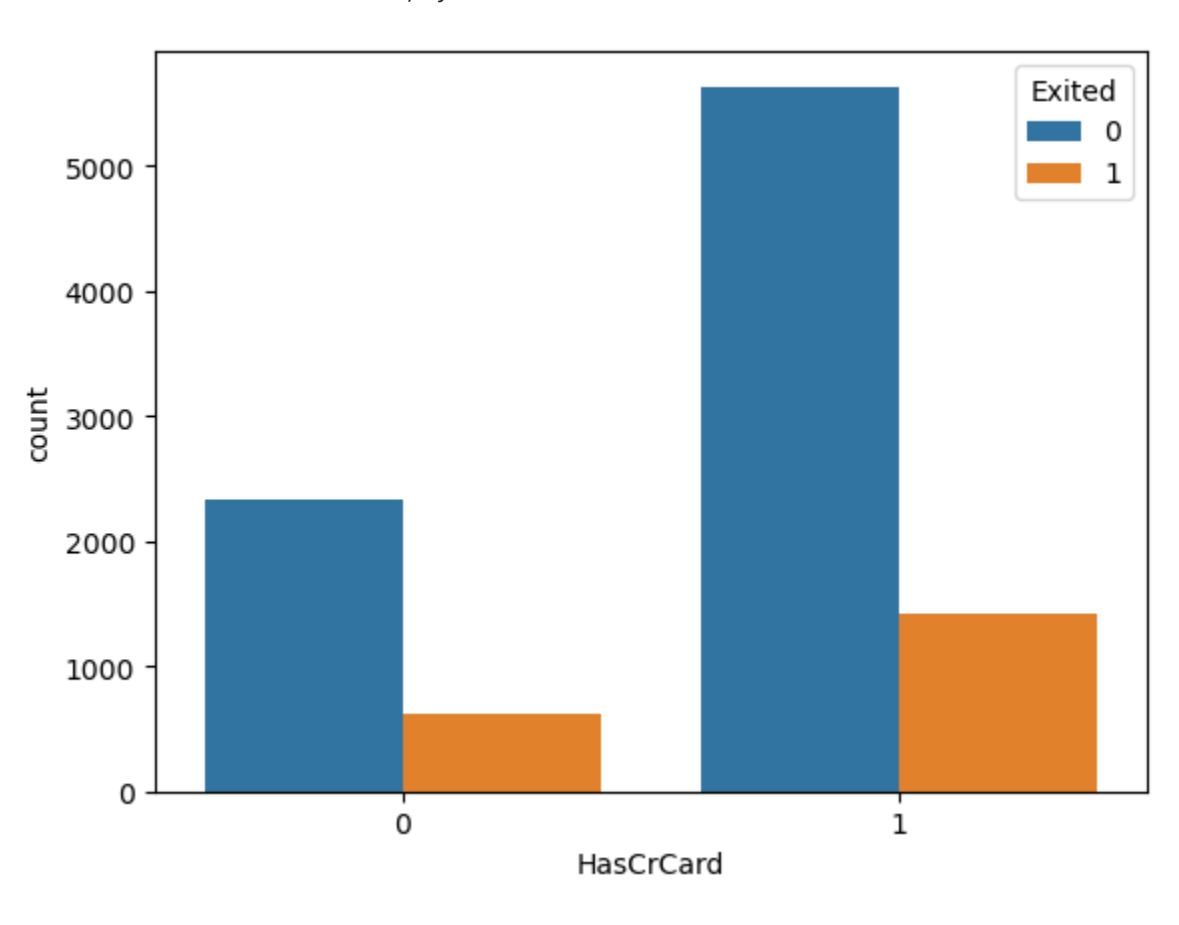
In [22]:
```python
sns.countplot(x='NumOfProducts',data=data,hue='Exited')
```

Out[22]:
```
<Axes: xlabel='NumOfProducts', ylabel='count'>
```



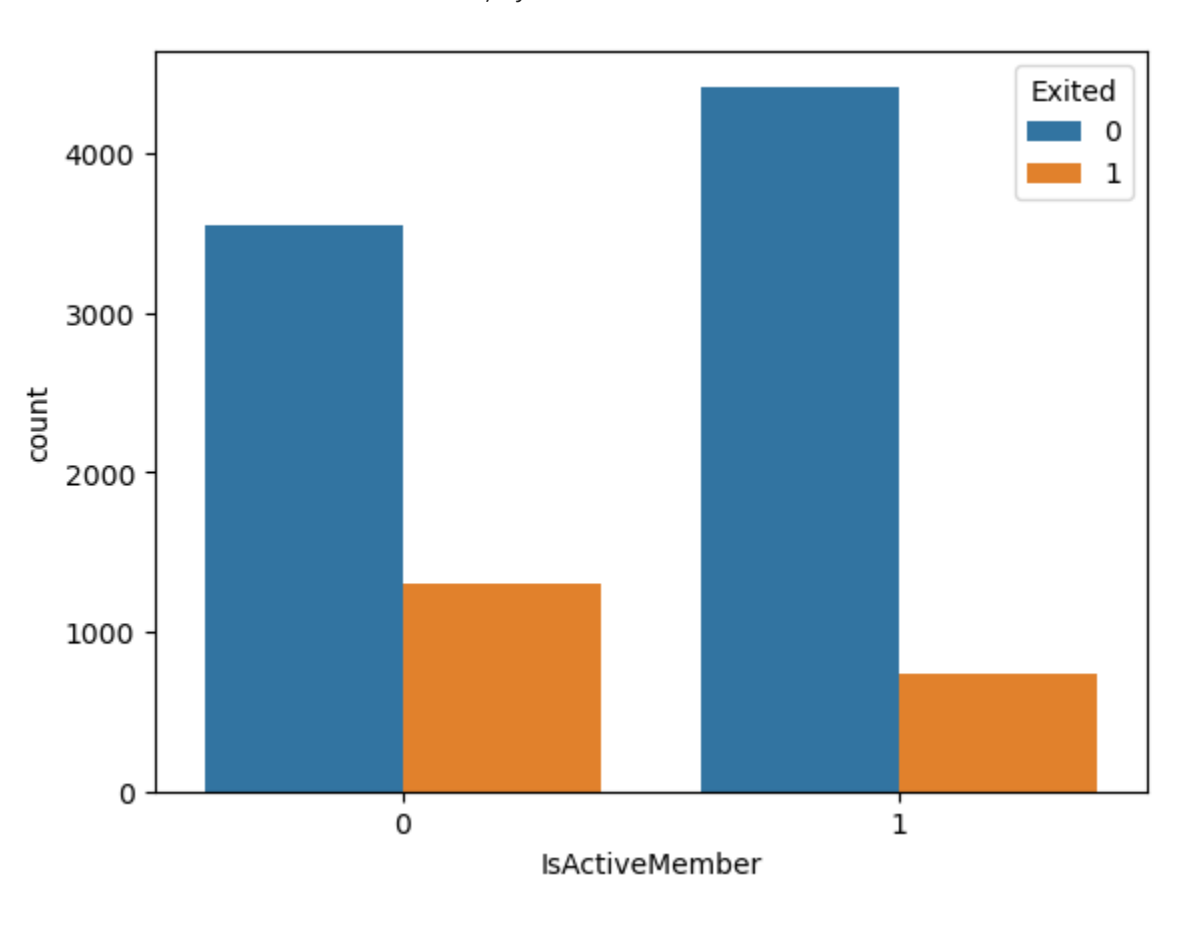
In [23]:
```python
sns.countplot(x='HasCrCard',data=data,hue='Exited')
```

Out[23]:
```
<Axes: xlabel='HasCrCard', ylabel='count'>
```



In [24]:
```python
sns.countplot(x='IsActiveMember',data=data,hue='Exited')
```

Out[24]:
```
<Axes: xlabel='IsActiveMember', ylabel='count'>
```

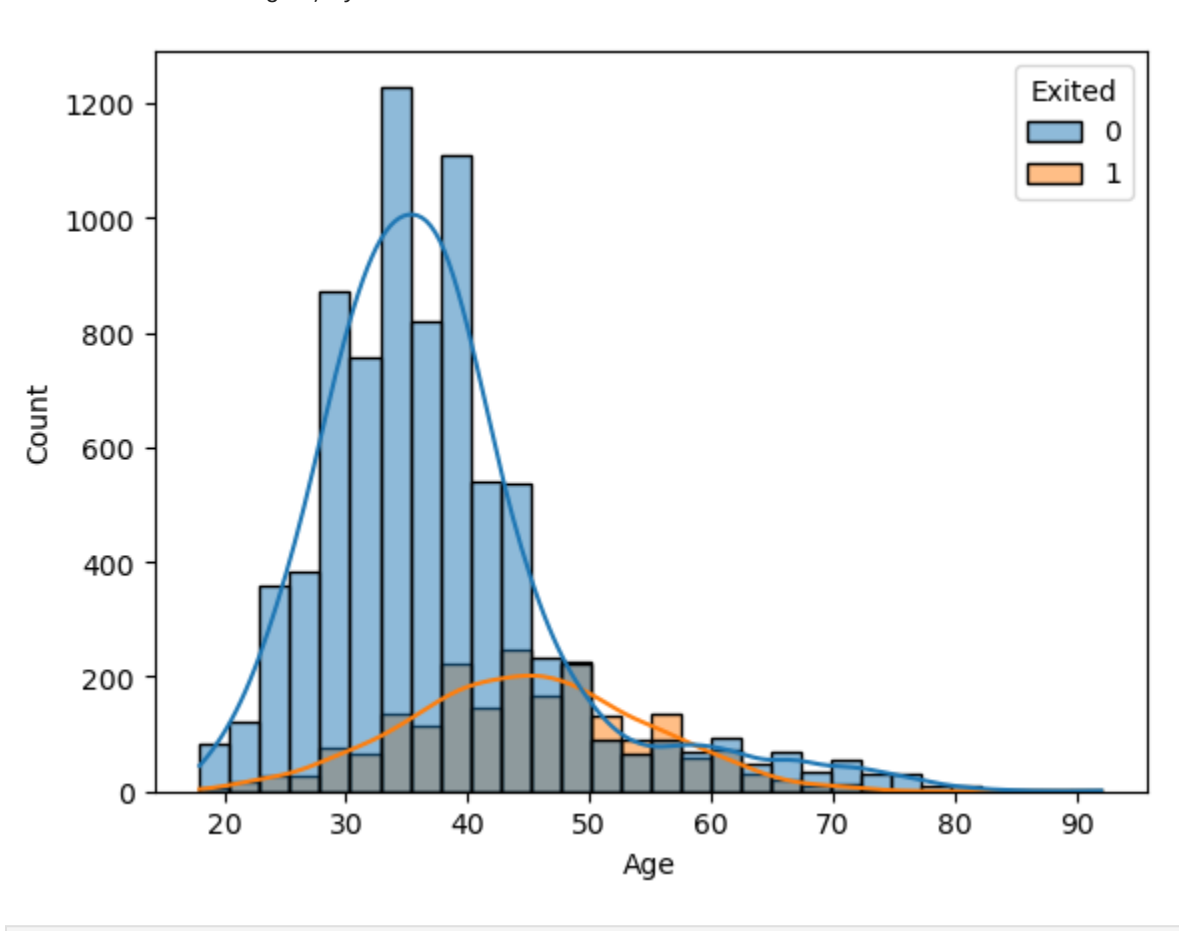


In [25]:
```python
data['Age'].value_counts()
```

Out[25]:
```
Age
37    478
38    477
35    474
36    456
34    447
     ...
92      2
82      1
88      1
85      1
83      1
Name: count, Length: 70, dtype: int64
```

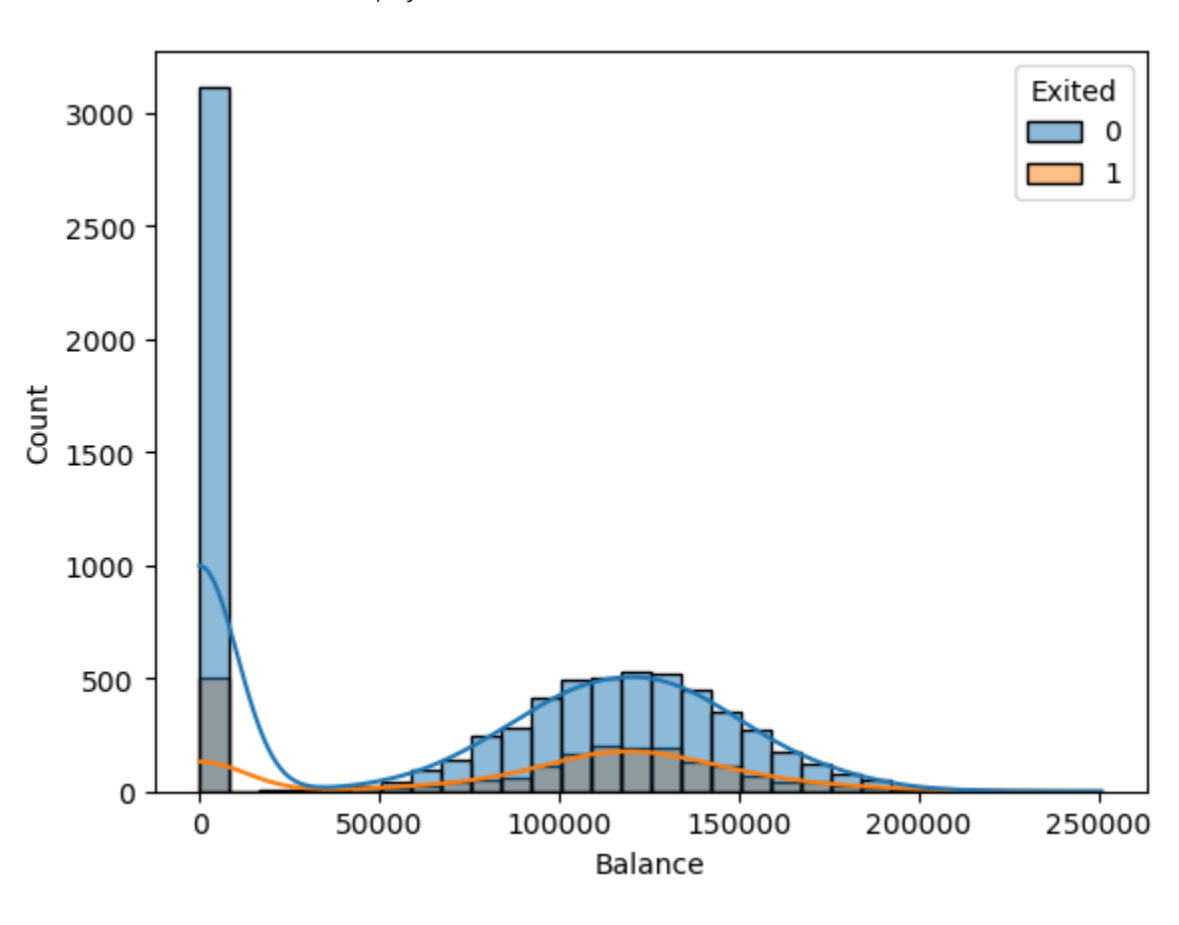
In [26]:
```python
sns.histplot(x=data['Age'], bins=30,data=data, kde=True,hue='Exited')
```

Out[26]:
```
<Axes: xlabel='Age', ylabel='Count'>
```



In [27]:
```python
sns.histplot(x=data['Balance'], bins=30,data=data, kde=True,hue='Exited')
```

Out[27]:
```
<Axes: xlabel='Balance', ylabel='Count'>
```

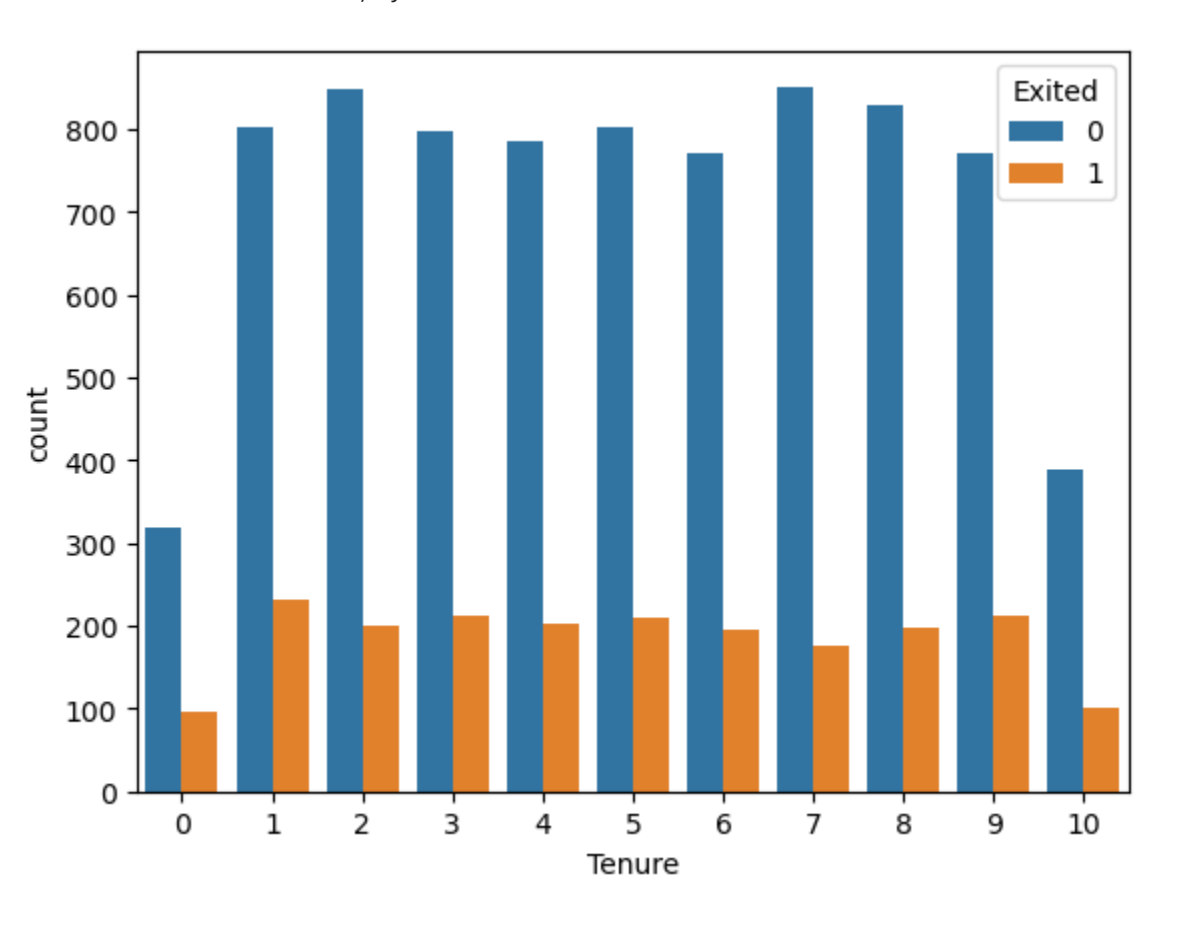


In [28]:
```python
data['Tenure'].value_counts()
```

Out[28]:
```
Tenure
2     1048
1     1035
7     1028
8     1025
5     1012
3     1009
4      989
9      984
6      967
10     490
0      413
Name: count, dtype: int64
```

In [29]:
```python
sns.countplot(x='Tenure',data=data,hue='Exited')
```

Out[29]:
```
<Axes: xlabel='Tenure', ylabel='count'>
```



In [30]:
```python
data.dtypes
```

Out[30]:
```
CreditScore          int64
Geography           object
Gender              object
Age                  int64
Tenure               int64
Balance            float64
NumOfProducts        int64
HasCrCard            int64
IsActiveMember       int64
EstimatedSalary    float64
Exited               int64
dtype: object
```

In [31]:
```python
data['HasCrCard'] = data['HasCrCard'].astype('object')
```

In [32]:
```python
data['IsActiveMember'] = data['IsActiveMember'].astype('object')
data.dtypes
```

Out[32]:
```
CreditScore          int64
Geography           object
Gender              object
Age                  int64
Tenure               int64
Balance            float64
NumOfProducts        int64
HasCrCard           object
IsActiveMember      object
EstimatedSalary    float64
Exited               int64
dtype: object
```

In [33]:
```python
data['Exited'] = data['Exited'].astype('object')
data.dtypes
```

Out[33]:
```
CreditScore          int64
Geography           object
Gender              object
Age                  int64
Tenure               int64
Balance            float64
NumOfProducts        int64
HasCrCard           object
IsActiveMember      object
EstimatedSalary    float64
Exited              object
dtype: object
```

In [34]:
```python
from sklearn.preprocessing import StandardScaler
sc = StandardScaler()
data[['CreditScore', 'Age', 'Balance', 'EstimatedSalary']] = sc.fit_transform(data[['CreditScore', 'Age', 'Balance', 'EstimatedSalary']])
data
```

Out[34]:

	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
0	-0.326221	France	Female	0.293517	2	-1.225848	1	1	1	0.021886	1
1	-0.440036	Spain	Female	0.198164	1	0.117350	1	0	1	0.216534	0
2	-1.536794	France	Female	0.293517	8	1.333053	3	1	0	0.240687	1
3	0.501521	France	Female	0.007457	1	-1.225848	2	0	0	-0.108918	0
4	2.063884	Spain	Female	0.388871	2	0.785728	1	1	1	-0.365276	0
...	...	...	...	...	...	...	...	...	...	...	...
9995	1.246488	France	Male	0.007457	5	-1.225848	2	1	0	-0.066419	0
9996	-1.391939	France	Male	-0.373958	10	-0.306379	1	1	1	0.027988	0
9997	0.604988	France	Female	-0.278604	7	-1.225848	1	0	1	-1.008643	1
9998	1.256835	Germany	Male	0.293517	3	-0.022608	2	1	0	-0.125231	1
9999	1.463771	France	Female	-1.041433	4	0.859965	1	1	0	-1.076370	0

10000 rows × 11 columns

In [35]:
```python
data = pd.get_dummies(data, columns=['Geography', 'Gender'], drop_first=True)
data
```

Out[35]:

	CreditScore	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited	Geography_Germany	Geography_Spain	Gender_Male
0	-0.326221	0.293517	2	-1.225848	1	1	1	0.021886	1	False	False	False
1	-0.440036	0.198164	1	0.117350	1	0	1	0.216534	0	False	True	False
2	-1.536794	0.293517	8	1.333053	3	1	0	0.240687	1	False	False	False
3	0.501521	0.007457	1	-1.225848	2	0	0	-0.108918	0	False	False	False
4	2.063884	0.388871	2	0.785728	1	1	1	-0.365276	0	False	True	False
...	...	...	...	...	...	...	...	...	...	...	...	...
9995	1.246488	0.007457	5	-1.225848	2	1	0	-0.066419	0	False	False	True
9996	-1.391939	-0.373958	10	-0.306379	1	1	1	0.027988	0	False	False	True
9997	0.604988	-0.278604	7	-1.225848	1	0	1	-1.008643	1	False	False	False
9998	1.256835	0.293517	3	-0.022608	2	1	0	-0.125231	1	True	False	True
9999	1.463771	-1.041433	4	0.859965	1	1	0	-1.076370	0	False	False	False

10000 rows × 12 columns

In [36]:
```python
from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()
data['Geography_Germany'] = le.fit_transform(data['Geography_Germany'])
data['Geography_Spain']  = le.fit_transform(data['Geography_Spain'])
data['Gender_Male'] = le.fit_transform(data['Gender_Male'])
data
```

Out[36]:

	CreditScore	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited	Geography_Germany	Geography_Spain	Gender_Male
0	-0.326221	0.293517	2	-1.225848	1	1	1	0.021886	1	0	0	0
1	-0.440036	0.198164	1	0.117350	1	0	1	0.216534	0	0	1	0
2	-1.536794	0.293517	8	1.333053	3	1	0	0.240687	1	0	0	0
3	0.501521	0.007457	1	-1.225848	2	0	0	-0.108918	0	0	0	0
4	2.063884	0.388871	2	0.785728	1	1	1	-0.365276	0	0	1	0
...	...	...	...	...	...	...	...	...	...	...	...	...
9995	1.246488	0.007457	5	-1.225848	2	1	0	-0.066419	0	0	0	1
9996	-1.391939	-0.373958	10	-0.306379	1	1	1	0.027988	0	0	0	1
9997	0.604988	-0.278604	7	-1.225848	1	0	1	-1.008643	1	0	0	0
9998	1.256835	0.293517	3	-0.022608	2	1	0	-0.125231	1	1	0	1
9999	1.463771	-1.041433	4	0.859965	1	1	0	-1.076370	0	0	0	0

10000 rows × 12 columns

In [37]:
```python
data.columns
```

Out[37]:
```
Index(['CreditScore', 'Age', 'Tenure', 'Balance', 'NumOfProducts', 'HasCrCard',
       'IsActiveMember', 'EstimatedSalary', 'Exited', 'Geography_Germany',
       'Geography_Spain', 'Gender_Male'],
      dtype='object')
```

In [38]:
```python
data['HasCrCard'] = data['HasCrCard'].astype('int')
data['IsActiveMember'] = data['IsActiveMember'].astype('int')
data['Exited'] = data['Exited'].astype('int')
```

In [39]:
```python
from sklearn.model_selection import train_test_split
X = data.drop(columns=['Exited'])
y= data['Exited']
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
```

In [40]:
```python
from sklearn.linear_model import LogisticRegression
from sklearn.ensemble import RandomForestClassifier
```

In [41]:
```python
Lr = LogisticRegression(random_state=42)
Lr.fit(X_train,y_train)
y_pred_train = Lr.predict(X_train)
y_pred_train
```

Out[41]:
```
array([0, 0, 0, ..., 0, 0, 0])
```

In [42]:
```python
y_pred_test = Lr.predict(X_test)
y_pred_test
```

Out[42]:
```
array([0, 0, 0, ..., 0, 0, 0])
```

In [43]:
```python
from sklearn.metrics import accuracy_score

acc_train = accuracy_score(y_train,y_pred_train)
acc_train
```

Out[43]:
```
0.811
```

In [44]:
```python
acc_test = accuracy_score(y_test,y_pred_test)
acc_test
```

Out[44]:
```
0.8115
```

In [45]:
```python
clf1 = RandomForestClassifier(random_state=42)
clf1.fit(X_train,y_train)
y_pred_train1 = clf1.predict(X_train)
y_pred_train1
```

Out[45]:
```
array([0, 0, 1, ..., 1, 1, 0])
```

In [46]:
```python
y_pred_test1 = clf1.predict(X_test)
y_pred_test1
```

Out[46]:
```
array([0, 0, 0, ..., 1, 0, 0])
```

In [47]:
```python
acc_train1 = accuracy_score(y_train,y_pred_train1)
acc_train1
```

Out[47]:
```
1.0
```

In [48]:
```python
acc_test1 = accuracy_score(y_test,y_pred_test1)
acc_test1
```

Out[48]:
```
0.867
```

In [ ]: