In [1]:

```
import numpy as np
import pandas as pd
import os
os.chdir("C:\\Users\\kumar\\OneDrive\\Desktop\\Machine Learning")
dataset = pd.read_csv('Churn_Modelling.csv')
dataset.head()
```

Out[1]:

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

In [2]:

```
dataset.columns
```

Out[2]:

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

In [3]:

```
dataset['Geography'].value_counts()
```

Out[3]:

```
France     5014
Germany    2509
Spain      2477
Name: Geography, dtype: int64
```

In [4]:

```
print(dataset.groupby('Geography')['CreditScore'].mean())
```

```
Geography
France     649.668329
Germany    651.453567
Spain      651.333872
Name: CreditScore, dtype: float64
```

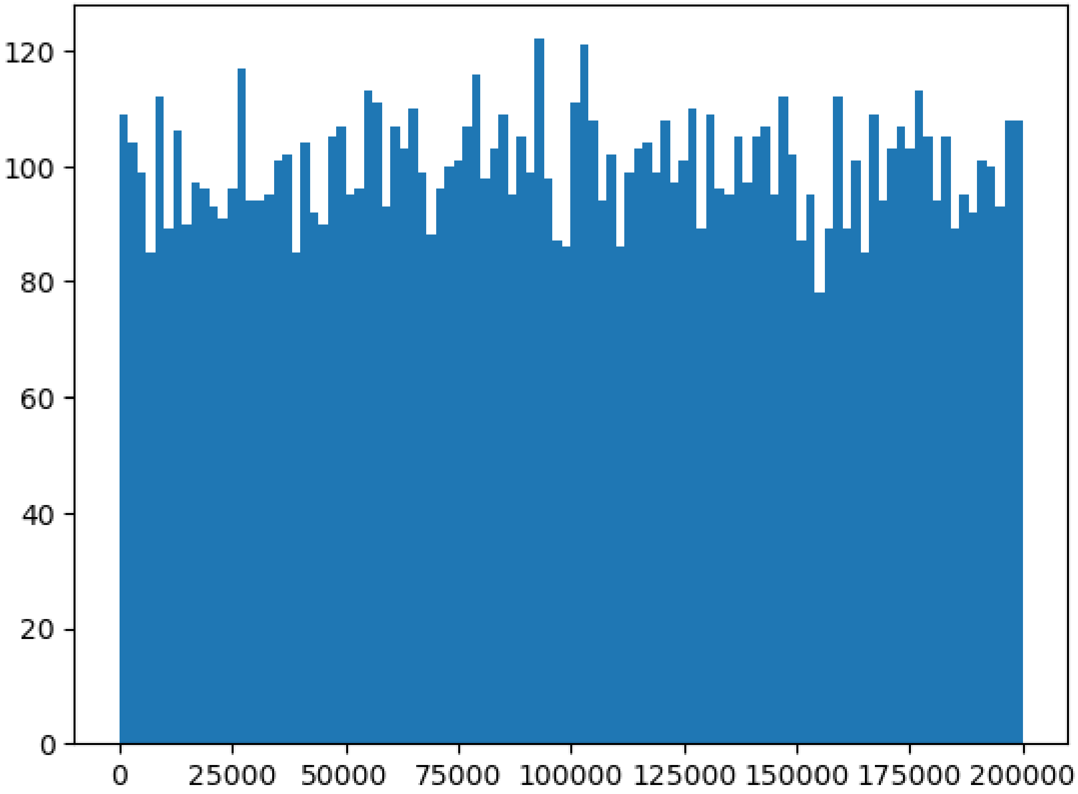
In [5]:

```
print(dataset.groupby('CustomerId')['Geography'].value_counts())
```

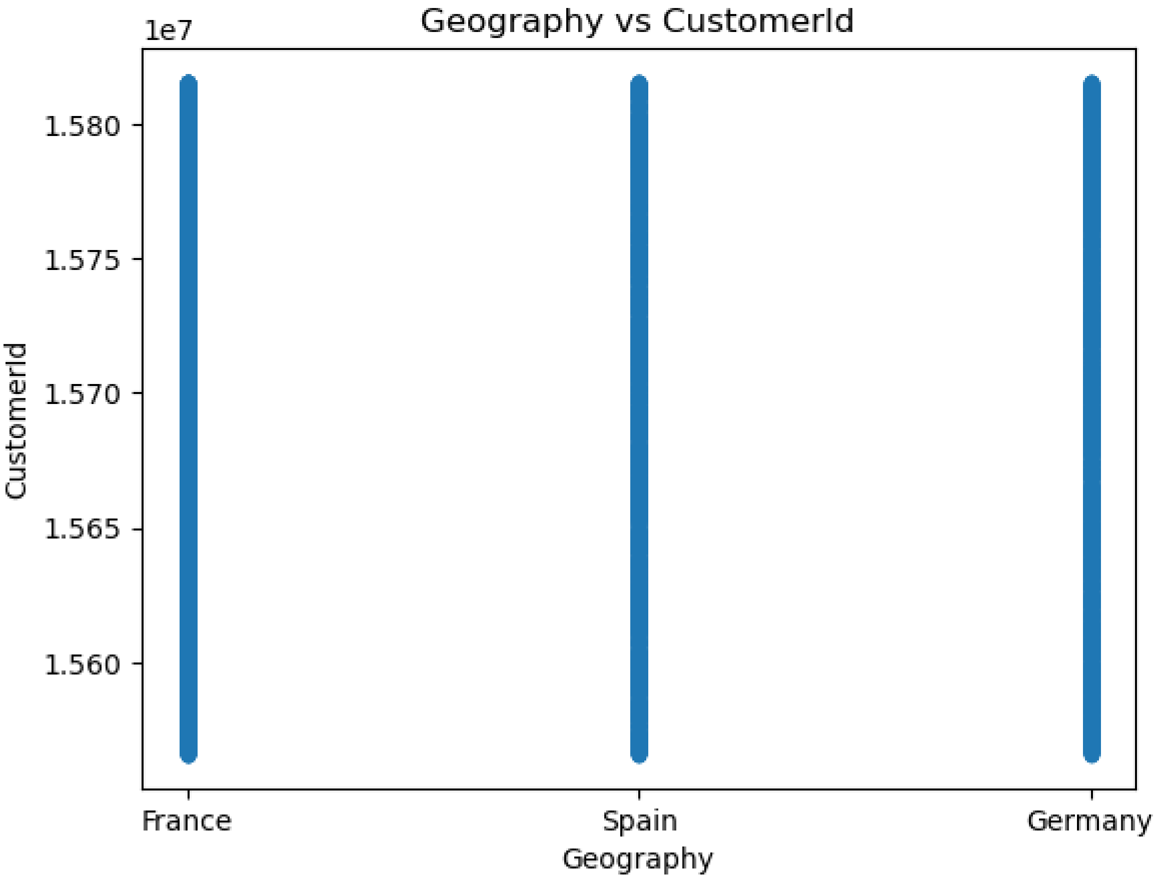
```
CustomerId  Geography
15565701    Spain        1
15565706    Spain        1
15565714    France       1
15565779    Germany      1
15565796    Germany      1
                        ..
15815628    France       1
15815645    France       1
15815656    Germany      1
15815660    France       1
15815690    Spain        1
Name: Geography, Length: 10000, dtype: int64
```

In [6]:

```
import matplotlib.pyplot as plt
import seaborn as sns
plt.hist(dataset['EstimatedSalary'], bins = 100)
plt.show()
```



In [7]:
```
dataset.plot.scatter(x="Geography",y="CustomerId")
plt.title("Geography vs CustomerId")
plt.xlabel("Geography")
plt.ylabel("CustomerId")
plt.show()
```

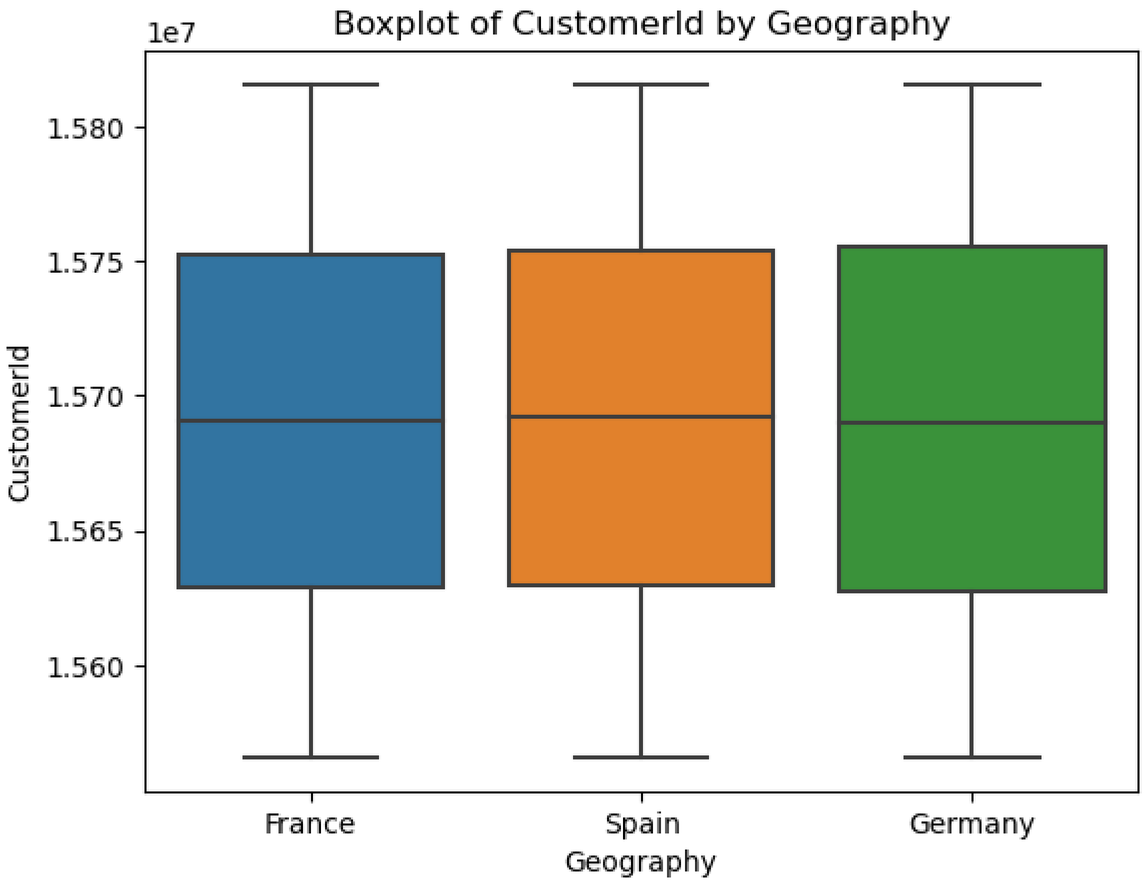


In [8]:
```
import seaborn as sns
import matplotlib.pyplot as plt
```

```
sns.boxplot(x='Geography', y='CustomerId', data=dataset)

plt.title('Boxplot of CustomerId by Geography')
plt.xlabel('Geography')
plt.ylabel('CustomerId')

plt.show()
```



In [9]:
```
print(dataset.shape)
```

```
(10000, 14)
```

In [10]:
```
X = dataset.iloc[:, 0:13].values  # Features (columns 0 to 12)
y = dataset.iloc[:, 13].values   # Target variable (column 13)
from sklearn.preprocessing import LabelEncoder
labelencoder_X_1 = LabelEncoder()
X[:, 3] = labelencoder_X_1.fit_transform(X[:, 3])
labelencoder_X_2 = LabelEncoder()
X[:, 4] = labelencoder_X_2.fit_transform(X[:, 4])
labelencoder_y = LabelEncoder()
y = labelencoder_y.fit_transform(y)
```

In [11]:
```
categorical_column = dataset.iloc[:, 0]
X_State = pd.get_dummies(categorical_column, drop_first=True)
X_State = X_State.astype(int)
dataset = dataset.drop(columns=[categorical_column.name])
X = pd.concat([X_State, dataset], axis=1)
```

In [12]:
```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y,test_size = 0.2,random_sta
```

In [13]:
```
from sklearn.preprocessing import StandardScaler
from sklearn.ensemble import RandomForestClassifier
from sklearn.model_selection import train_test_split
from sklearn.compose import ColumnTransformer
from sklearn.preprocessing import OneHotEncoder
```

```
In [14]: dataset = dataset.drop(['CustomerId', 'Surname'], axis=1)
         categorical_columns = ['Gender', 'Geography']
         ct = ColumnTransformer(
             transformers=[('encoder', OneHotEncoder(), categorical_columns)],
             remainder='passthrough'
         )
         X = ct.fit_transform(dataset.drop('Exited', axis=1))
         y = dataset['Exited']
```

```
In [15]: X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_sta
```

```
In [16]: sc = StandardScaler()
         X_train = sc.fit_transform(X_train)
         X_test = sc.transform(X_test)
```

```
In [17]: clf = RandomForestClassifier()
         clf.fit(X_train, y_train)

Out[17]: RandomForestClassifier()
```

```
In [18]: y_pred = clf.predict(X_test)
```

```
In [19]: from sklearn.metrics import accuracy_score
```

```
In [20]: accuracy_score(y_test, y_pred)

Out[20]: 0.8635
```

```
In [21]: from sklearn.metrics import confusion_matrix
         print(confusion_matrix(y_test, y_pred))

[[1544   63]
 [ 210  183]]
```

Result Observed

True Positives(TP) = 183

True Negatives(TN) = 1544

False Positives(FP) = 63

False Negatives(FN) = 210

Precision = TP/(TP+FP) = 183/(183+63)=183/246=0.744

Recall = TP/(TP+FN) = 183/(183+210)=183/393=0.4656

Accuracy = (TP+TN)/(TP+TN+FP+FN) = (183+1544)/(183+1544+63+210)=1727/2000=0.8635

In [ ]: