```
import seaborn as sns
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from time import time
%matplotlib inline
from sklearn import preprocessing
from sklearn import preprocessing
from sklearn.preprocessing import StandardScaler,normalize, MinMaxScaler
from sklearn.metrics import mean_squared_error
from sklearn.model_selection import StratifiedKFold
import plotly.express as px

from datetime import datetime,date
# importing machine learning models for prediction
from sklearn.linear_model import LogisticRegression
from sklearn.svm import SVC
from sklearn.ensemble import RandomForestClassifier,AdaBoostClassifier,GradientBoostingClassifie
from sklearn.neighbors import KNeighborsClassifier
from sklearn.svm import SVC
from sklearn.tree import DecisionTreeClassifier
import lightgbm as lgb
import xgboost as xgb
from sklearn.metrics import confusion_matrix
from sklearn.neural_network import MLPClassifier
from sklearn.metrics import roc_auc_score,confusion_matrix,f1_score,accuracy_score
from collections import Counter
from imblearn.under_sampling import NearMiss
```

```
data = pd.read_csv("/content/Churn_Modelling[1].csv",na_values=' ')
data.head()
```

	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

```
data.describe()
```

	RowNumber	CustomerId	CreditScore	Age	Tenure	Balance	Nu
count	10000.00000	1.000000e+04	10000.000000	10000.000000	10000.000000	10000.000000	1
mean	5000.50000	1.569094e+07	650.528800	38.921800	5.012800	76485.889288	
std	2886.89568	7.193619e+04	96.653299	10.487806	2.892174	62397.405202	
min	1.00000	1.556570e+07	350.000000	18.000000	0.000000	0.000000	
25%	2500.75000	1.562853e+07	584.000000	32.000000	3.000000	0.000000	
50%	5000.50000	1.569074e+07	652.000000	37.000000	5.000000	97198.540000	
75%	7500.25000	1.575323e+07	718.000000	44.000000	7.000000	127644.240000	
max	10000.00000	1.581569e+07	850.000000	92.000000	10.000000	250898.090000	

```
#import pandas_profiling as pandas_pf
#pandas_pf.ProfileReport(df)
```

```
# df['Tenure/Age'] = df.Tenure / df.Age
#df['CreditScore'] = pd.qcut(df['CreditScore'], 6, labels=[1,2,3,4,5,6])
#df['Age'] = pd.qcut(df['Age'], 8, labels=[1,2,3,4,5,6,7,8])
#df["Balance"] = pd.qcut(df['Balance'].rank(method="first"), 5, labels = [1, 2, 3, 4,5])
#df["EstimatedSalary"] = pd.qcut(df['EstimatedSalary'], 10, labels = [1, 2, 3, 4, 5, 6, 7, 8, 9,
```

```
sns.distplot(df["Tenure"], hist=False)
```

```
<ipython-input-6-508b74f8f997>:1: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.
```

```
plt.figure(figsize=(12,5))
plt.subplot(1,2,1)
sns.displot(df["Tenure"])
plt.subplot(1,2,2)
sns.distplot(df["CreditScore"])
```

```
<ipython-input-7-82dcc05b6990>:4: MatplotlibDeprecationWarning: Auto-removal of overlappin
  plt.subplot(1,2,2)
<ipython-input-7-82dcc05b6990>:5: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

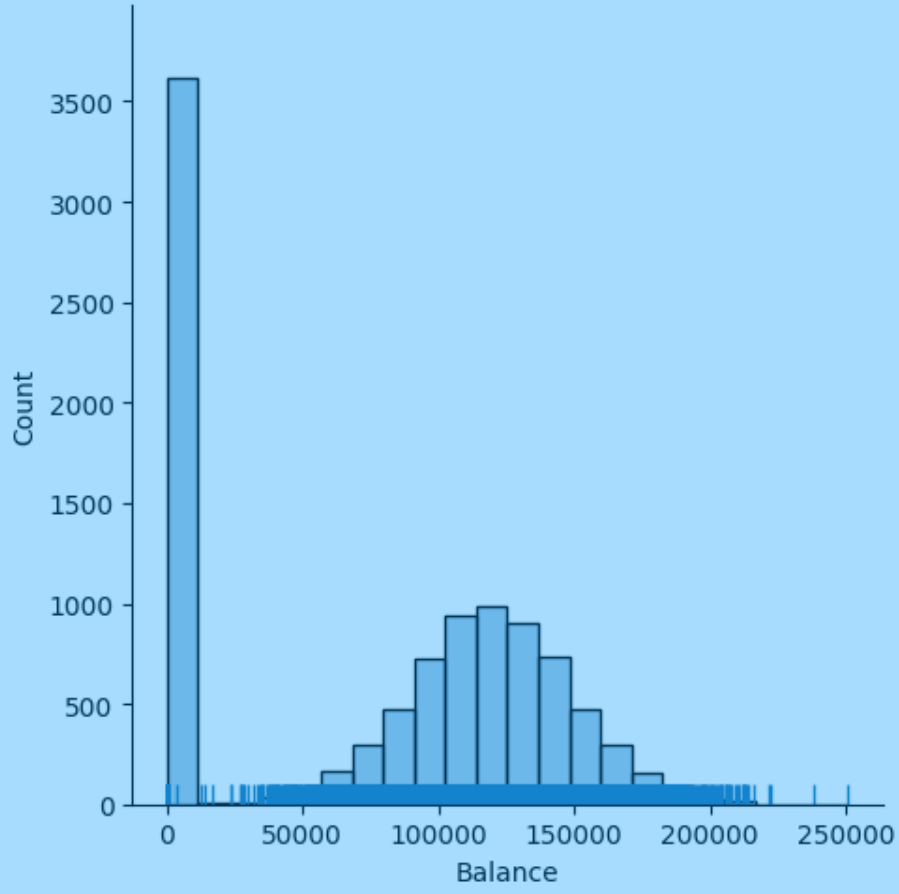
Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(df["CreditScore"])
<Axes: xlabel='CreditScore', ylabel='Density'>
```

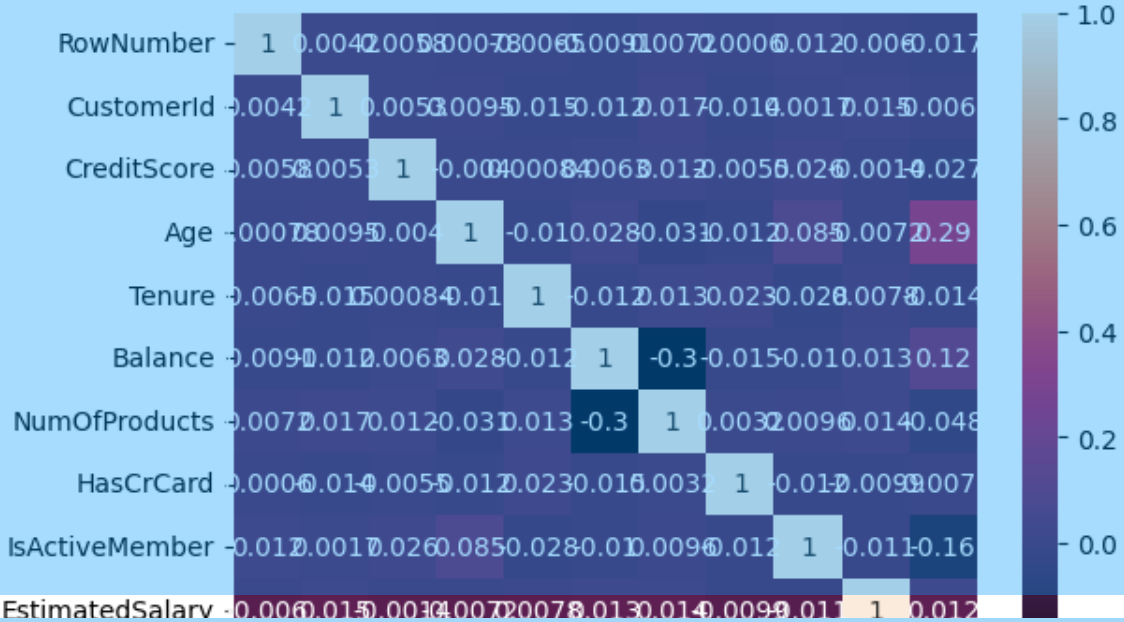

```
sns.displot(df, x="Balance", alpha=.4, rug=True)
```

```
<seaborn.axisgrid.FacetGrid at 0x7f08e2a0b550>
```




```
sns.heatmap(df.corr(), annot=True)
```

```
<Axes: >
```




```
sns.pairplot(df=df, markers=["^","v"], palette="inferno")
```

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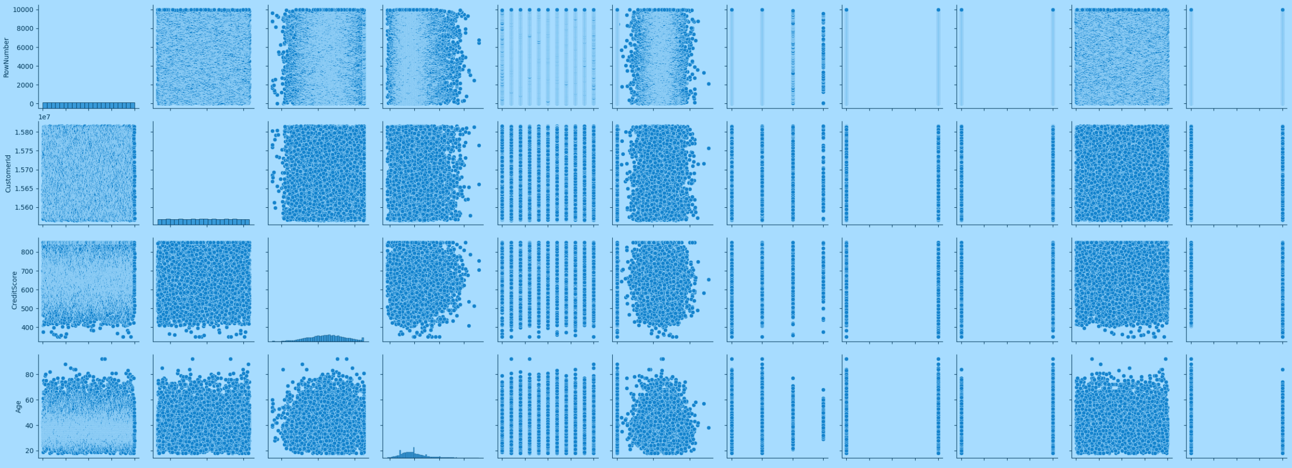
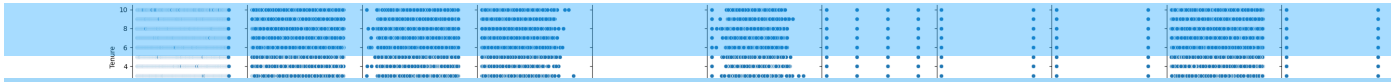
/usr/local/lib/python3.9/dist-packages/seaborn/axisgrid.py:1609: UserWarning: Ignoring `pal
  func(x=x, y=y, **kwargs)
/usr/local/lib/python3.9/dist-packages/seaborn/axisgrid.py:1609: UserWarning: Ignoring `pal
  func(x=x, y=y, **kwargs)
<seaborn.axisgrid.PairGrid at 0x7f08e4802250>
```





```
x= df.iloc[:,0:19].values
y= df.iloc[:,19:20].values
```

```
x
```

```
array([[1, 15634602, 'Hargrave', ..., 1, 101348.88, 1],
       [2, 15647311, 'Hill', ..., 1, 112542.58, 0],
       [3, 15619304, 'Onio', ..., 0, 113931.57, 1],
       ...,
       [9998, 15584532, 'Liu', ..., 1, 42085.58, 1],
       [9999, 15682355, 'Sabbatini', ..., 0, 92888.52, 1],
       [10000, 15628319, 'Walker', ..., 0, 38190.78, 0]], dtype=object)
```

```
y
```

```
array([], shape=(10000, 0), dtype=float64)
```

```
x=df.iloc[:,3:-1].values
y=df.Exited.values
```

```
from sklearn.preprocessing import LabelEncoder
le= LabelEncoder()
x[:,2]=le.fit_transform(x[:,2])
```

```
x
```

```
array([[619, 'France', 0, ..., 1, 1, 101348.88],
       [608, 'Spain', 0, ..., 0, 1, 112542.58],
       [502, 'France', 0, ..., 1, 0, 113931.57],
       ...,
       [709, 'France', 0, ..., 0, 1, 42085.58],
       [772, 'Germany', 1, ..., 1, 0, 92888.52],
       [792, 'France', 0, ..., 1, 0, 38190.78]], dtype=object)
```

```
y
```

```
array([1, 0, 1, ..., 1, 1, 0])
```

```
from sklearn.preprocessing import LabelEncoder
le= LabelEncoder()
x[:,2]=le.fit_transform(x[:,2])
```

```
x
```

```
array([[619, 'France', 0, ..., 1, 1, 101348.88],
       [608, 'Spain', 0, ..., 0, 1, 112542.58],
       [502, 'France', 0, ..., 1, 0, 113931.57],
       ...,
       [709, 'France', 0, ..., 0, 1, 42085.58],
       [772, 'Germany', 1, ..., 1, 0, 92888.52],
       [792, 'France', 0, ..., 1, 0, 38190.78]], dtype=object)
```

```
from sklearn.compose import ColumnTransformer
from sklearn.preprocessing import OneHotEncoder
ct=ColumnTransformer(transformers=[("encoder",OneHotEncoder(),[1])],remainder="passthrough")
x=np.array(ct.fit_transform(x))
```

```
x
```

```
array([[1.0, 0.0, 0.0, ..., 1, 1, 101348.88],
       [0.0, 0.0, 1.0, ..., 0, 1, 112542.58],
       [1.0, 0.0, 0.0, ..., 1, 0, 113931.57],
       ...,
       [1.0, 0.0, 0.0, ..., 0, 1, 42085.58],
       [0.0, 1.0, 0.0, ..., 1, 0, 92888.52],
       [1.0, 0.0, 0.0, ..., 1, 0, 38190.78]], dtype=object)
```

```
from sklearn.model_selection import train_test_split
xtrain,xtest,ytrain,ytest=train_test_split(x,y,test_size=0.2,random_state=43)
```

```
from sklearn.preprocessing import StandardScaler
sc=StandardScaler()
xtrain1=sc.fit_transform(xtrain)
xtest1=sc.transform(xtest)
```

```
xtrain.shape
```

```
(8000, 10)
```