```
import pandas as pd
import numpy as np
import pickle
import matplotlib.pyplot as plt
%matplotlib inline
import seaborn as sns
import sklearn
from sklearn.tree import DecisionTreeClassifier
from statsmodels.stats.outliers_influence import
variance_inflation_factor
from sklearn.ensemble import GradientBoostingClassifier,
RandomForestClassifier
from sklearn.neighbors import KNeighborsClassifier
from sklearn.model_selection import RandomizedSearchCV
from sklearn.linear_model import LogisticRegression
import imblearn
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import accuracy_score, classification_report,
confusion_matrix, f1_score

data = pd.read_csv('/content/test.csv')
data
```

```
      Loan_ID Gender Married Dependents     Education Self_Employed  \
0    LP001015   Male     Yes          0      Graduate            No
1    LP001022   Male     Yes          1      Graduate            No
2    LP001031   Male     Yes          2      Graduate            No
3    LP001035   Male     Yes          2      Graduate            No
4    LP001051   Male      No          0  Not Graduate            No
..        ...    ...     ...        ...          ...           ...
362  LP002971   Male     Yes         3+  Not Graduate           Yes
363  LP002975   Male     Yes          0      Graduate            No
364  LP002980   Male      No          0      Graduate            No
365  LP002986   Male     Yes          0      Graduate            No
366  LP002989   Male      No          0      Graduate           Yes

     ApplicantIncome  CoapplicantIncome  LoanAmount  Loan_Amount_Term
\
0               5720                  0       110.0             360.0

1               3076               1500       126.0             360.0

2               5000               1800       208.0             360.0

3               2340               2546       100.0             360.0

4               3276                  0        78.0             360.0

..               ...                ...         ...               ...
```

```
362              4009                1777       113.0              360.0

363              4158                 709       115.0              360.0

364              3250                1993       126.0              360.0

365              5000                2393       158.0              360.0

366              9200                   0        98.0              180.0


     Credit_History Property_Area
0               1.0         Urban
1               1.0         Urban
2               1.0         Urban
3               NaN         Urban
4               1.0         Urban
..              ...           ...
362             1.0         Urban
363             1.0         Urban
364             NaN     Semiurban
365             1.0         Rural
366             1.0         Rural

[367 rows x 12 columns]
```

```
data.drop(['Loan_ID'],axis=1,inplace=True)
```

```
data
```

```
    Gender Married Dependents     Education Self_Employed
ApplicantIncome  \
0     Male     Yes          0      Graduate            No
5720
1     Male     Yes          1      Graduate            No
3076
2     Male     Yes          2      Graduate            No
5000
3     Male     Yes          2      Graduate            No
2340
4     Male      No          0  Not Graduate            No
3276
..     ...     ...        ...           ...           ...
...
362   Male     Yes         3+  Not Graduate           Yes
4009
363   Male     Yes          0      Graduate            No
4158
364   Male      No          0      Graduate            No
3250
```

```
365   Male     Yes           0      Graduate             No
5000
366   Male      No           0      Graduate            Yes
9200

     CoapplicantIncome  LoanAmount  Loan_Amount_Term
Credit_History  \
0                    0       110.0             360.0             1.0

1                 1500       126.0             360.0             1.0

2                 1800       208.0             360.0             1.0

3                 2546       100.0             360.0             NaN

4                    0        78.0             360.0             1.0

..                 ...         ...               ...             ...

362               1777       113.0             360.0             1.0

363                709       115.0             360.0             1.0

364               1993       126.0             360.0             NaN

365               2393       158.0             360.0             1.0

366                  0        98.0             180.0             1.0


    Property_Area
0           Urban
1           Urban
2           Urban
3           Urban
4           Urban
..            ...
362         Urban
363         Urban
364     Semiurban
365         Rural
366         Rural

[367 rows x 11 columns]

#data['Gender'].unique()

data['Gender']=data['Gender'].map({'Female':1,'Male':0})
data.head()
```

```
   Gender Married Dependents     Education Self_Employed
ApplicantIncome  \
0     0.0     Yes          0      Graduate            No
5720
1     0.0     Yes          1      Graduate            No
3076
2     0.0     Yes          2      Graduate            No
5000
3     0.0     Yes          2      Graduate            No
2340
4     0.0      No          0  Not Graduate            No
3276

   CoapplicantIncome  LoanAmount  Loan_Amount_Term  Credit_History  \
0                  0       110.0             360.0             1.0
1               1500       126.0             360.0             1.0
2               1800       208.0             360.0             1.0
3               2546       100.0             360.0             NaN
4                  0        78.0             360.0             1.0

  Property_Area
0         Urban
1         Urban
2         Urban
3         Urban
4         Urban
```

```
data['Property_Area']=data['Property_Area'].map({'Urban':2,
'Semiurban': 1, 'Rural':0})
data.head()
```

```
   Gender Married Dependents     Education Self_Employed
ApplicantIncome  \
0     0.0     Yes          0      Graduate            No
5720
1     0.0     Yes          1      Graduate            No
3076
2     0.0     Yes          2      Graduate            No
5000
3     0.0     Yes          2      Graduate            No
2340
4     0.0      No          0  Not Graduate            No
3276

   CoapplicantIncome  LoanAmount  Loan_Amount_Term  Credit_History  \
0                  0       110.0             360.0             1.0
1               1500       126.0             360.0             1.0
2               1800       208.0             360.0             1.0
3               2546       100.0             360.0             NaN
4                  0        78.0             360.0             1.0
```

```
   Property_Area
0              2
1              2
2              2
3              2
4              2
```

```
data['Married']=data['Married'].map({'Yes':1,'No':0})
data.head()
```

```
   Gender  Married Dependents     Education Self_Employed
ApplicantIncome  \
0     0.0        1          0      Graduate            No
5720
1     0.0        1          1      Graduate            No
3076
2     0.0        1          2      Graduate            No
5000
3     0.0        1          2      Graduate            No
2340
4     0.0        0          0  Not Graduate            No
3276

   CoapplicantIncome  LoanAmount  Loan_Amount_Term  Credit_History  \
0                  0       110.0             360.0             1.0
1               1500       126.0             360.0             1.0
2               1800       208.0             360.0             1.0
3               2546       100.0             360.0             NaN
4                  0        78.0             360.0             1.0

   Property_Area
0              2
1              2
2              2
3              2
4              2
```

```
data['Education']=data['Education'].map({'Graduate':1, 'Not
Graduate':0})
data.head()
```

```
   Gender  Married Dependents  Education Self_Employed
ApplicantIncome  \
0     0.0        1          0          1            No
5720
1     0.0        1          1          1            No
3076
2     0.0        1          2          1            No
5000
```

```
3     0.0         1           2           1             No
2340
4     0.0         0           0           0             No
3276

   CoapplicantIncome  LoanAmount  Loan_Amount_Term  Credit_History  \
0                  0       110.0             360.0             1.0
1               1500       126.0             360.0             1.0
2               1800       208.0             360.0             1.0
3               2546       100.0             360.0             NaN
4                  0        78.0             360.0             1.0

   Property_Area
0              2
1              2
2              2
3              2
4              2
```

```
data['Self_Employed']=data['Self_Employed'].map({'Yes':1, 'No':0})
data.head()
```

```
   Gender  Married Dependents  Education  Self_Employed
ApplicantIncome  \
0     0.0         1           0           1             0.0
5720
1     0.0         1           1           1             0.0
3076
2     0.0         1           2           1             0.0
5000
3     0.0         1           2           1             0.0
2340
4     0.0         0           0           0             0.0
3276

   CoapplicantIncome  LoanAmount  Loan_Amount_Term  Credit_History  \
0                  0       110.0             360.0             1.0
1               1500       126.0             360.0             1.0
2               1800       208.0             360.0             1.0
3               2546       100.0             360.0             NaN
4                  0        78.0             360.0             1.0

   Property_Area
0              2
1              2
2              2
3              2
4              2
```

```
data.isnull().sum()
```

```
Gender                11
Married                0
Dependents            10
Education              0
Self_Employed         23
ApplicantIncome        0
CoapplicantIncome      0
LoanAmount             5
Loan_Amount_Term       6
Credit_History        29
Property_Area          0
dtype: int64
```

```
data['Gender'] = data['Gender'].fillna(data['Gender'].mode()[0])
```

```
data['Married'] = data['Married'].fillna(data['Married'].mode()[0])
```

```
data['Dependents']=data['Dependents'].str.replace('+','') #0 1 2 3+
---- 3
```

```
<ipython-input-16-2accd703ef08>:1: FutureWarning: The default value of
regex will change from True to False in a future version. In addition,
single character regular expressions will *not* be treated as literal
strings when regex=True.
  data['Dependents']=data['Dependents'].str.replace('+','') #0 1 2 3+
---- 3
```

```
data['Dependents'] =
data['Dependents'].fillna(data['Dependents'].mode()[0])
```

```
data['Self_Employed'] =
data['Self_Employed'].fillna(data['Self_Employed'].mode()[0])
```

```
data['LoanAmount'] =
data['LoanAmount'].fillna(data['LoanAmount'].mode()[0])
```

```
data['Loan_Amount_Term'] =
data['Loan_Amount_Term'].fillna(data['Loan_Amount_Term'].mode()[0])
```

```
data['Credit_History'] =
data['Credit_History'].fillna(data['Credit_History'].mode()[0])
```

```
data.isnull().sum()
```

```
Gender                0
Married               0
Dependents            0
Education             0
Self_Employed         0
ApplicantIncome       0
CoapplicantIncome     0
LoanAmount            0
```

```
Loan_Amount_Term     0
Credit_History       0
Property_Area        0
dtype: int64
```

```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 367 entries, 0 to 366
Data columns (total 11 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   Gender             367 non-null    float64
 1   Married            367 non-null    int64  
 2   Dependents         367 non-null    object 
 3   Education          367 non-null    int64  
 4   Self_Employed      367 non-null    float64
 5   ApplicantIncome    367 non-null    int64  
 6   CoapplicantIncome  367 non-null    int64  
 7   LoanAmount         367 non-null    float64
 8   Loan_Amount_Term   367 non-null    float64
 9   Credit_History     367 non-null    float64
 10  Property_Area      367 non-null    int64  
dtypes: float64(5), int64(5), object(1)
memory usage: 31.7+ KB
```

```
data['Gender']=data['Gender'].astype('int64')
data['Married']=data['Married'].astype('int64')
data['Dependents']=data['Dependents'].astype("Int64")
data['Self Employed']=data['Self_Employed'].astype('int64')
data['CoapplicantIncome']=data['CoapplicantIncome'].astype('int64')
data['LoanAmount']=data['LoanAmount'].astype('int64')
data ['Loan_Amount_Term']=data['Loan_Amount_Term'].astype('int64')
data['Credit_History']=data['Credit_History'].astype('int64')
```

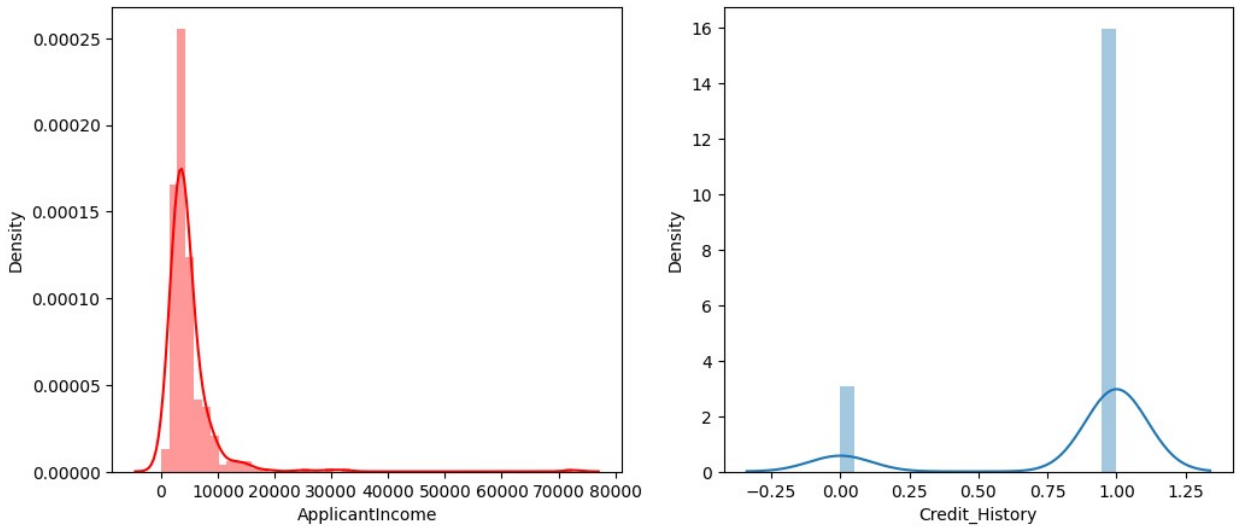
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 367 entries, 0 to 366
Data columns (total 12 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   Gender             367 non-null    int64  
 1   Married            367 non-null    int64  
 2   Dependents         367 non-null    Int64  
 3   Education          367 non-null    int64  
 4   Self_Employed      367 non-null    float64
 5   ApplicantIncome    367 non-null    int64  
 6   CoapplicantIncome  367 non-null    int64  
 7   LoanAmount         367 non-null    int64
```

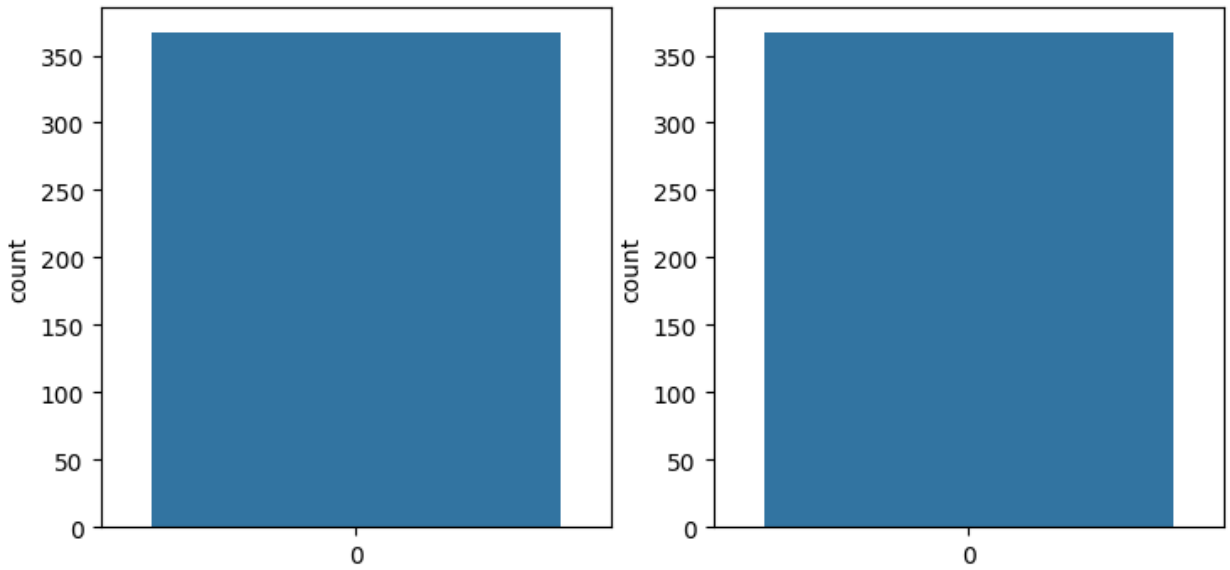
```
 8   Loan_Amount_Term   367 non-null    int64
 9   Credit_History     367 non-null    int64
 10  Property_Area      367 non-null    int64
 11  Self Employed      367 non-null    int64
dtypes: Int64(1), float64(1), int64(10)
memory usage: 34.9 KB
```

```
## Data visualization

plt.figure(figsize=(12,5))
plt.subplot(121)
sns.distplot(data['ApplicantIncome'], color='r')
plt.subplot(122)
sns.distplot(data['Credit_History'])
plt.show()
```

```
<ipython-input-43-4b78f43a4171>:3: 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(data['ApplicantIncome'], color='r')
<ipython-input-43-4b78f43a4171>: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(data['Credit_History'])
```




```
plt.figure(figsize=(18,4))
plt.subplot(1,4,1)
sns.countplot(data['Gender'])
plt.subplot(1,4,2)
sns.countplot(data['Education'])
plt.show()
```




```
pd.crosstab(data['Gender'],[data['Self_Employed']])
```

Self_Employed	0.0	1.0
Gender		
0	264	33
1	66	4

```
from imblearn.combine import SMOTETomek
```

```
smote = SMOTETomek()

sc=StandardScaler()
x_bal=sc.fit_transform

x_bal
```

```
<bound method TransformerMixin.fit_transform of StandardScaler()>
```

```
def RandomForest(X_tarin,x_test,y_train,y_test):
    model = RandomForestClassifier()
    model.fit(X_train,y_train)
    y_tr = model.predict(X_train)
    print(accuracy_score(y_tr,y_train))
    yPred = model.predict(X_test)
    print(accuracy_score(yPred,y_test))

def decisionTree(X_train,x_test,y_train,y_test):
    model = DecisionTreeClassifier()
    model.fit(X_train,y_train)
    y_tr = model.predict(X_train)
    print(accuracy_score(y_tr,y_train))
    yPred = model.predict(X_test)
    print(accuracy_score(yPred,y_test))

def KNN(X_train,X_test,y_train,y_test):
    model = KNeighborsClassifier()
    model.fit(X_train,y_train)
    y_tr = model.predict(X_train)
    print(accuracy_score (y_tr,y_train))
    yPred = model.predict(x_test)
    print(accuracy_score(yPred,y_test))

def XGB(X_train,X_test,y_train,y_test):
    model = GradientBoostingClassifier()
    model.fit(x_train,y_train)
    y_tr = model.predict(x_train)
    print(accuracy_score(y_tr,y_train))
    yPred = model.predict(X_test)
    print(accuracy_score(yPred,y_test))

from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense

classifier = Sequential()
classifier.add(Dense(units=100, activation='relu', input_dim=11))

classifier.add(Dense(units=50, activation='relu'))

classifier.add(Dense(units=1, activation='sigmoid'))
```

```
classifier.compile(optimizer="adam", loss="binary_crossentropy",
metrics=['accuracy'])

rf = RandomForestClassifier()

parameters = {
               'n_estimators' : [1,20,30,55,68,74,90,120,115],
                'criterion':['gini','entropy'],
                'max_features' : ["auto", "sqrt", "log2"],
        'max_depth' : [2,5,8,10], 'verbose' : [1,2,3,4,6,8,9,10]

}

RCV = RandomizedSearchCV(estimator=rf, param_distributions=parameters,
cv=10,n_iter=4)

def RandomForest(X_tarin,X_test,y_train,y_test):
    model = RandomForestClassifier(verbose= 9, n_estimators= 120,
max_features= 'log2',max_depth=8, criterion= 'entropy')
    model.fit(X_train,y_train)
    y_tr = model.predict(X_train)
    print("Training Accuracy")
    print(accuracy_score (y_tr,y_train))
    yPred = model.predict(X_test)
    print('Testing Accuracy')
    print(accuracy_score(yPred,y_test))

pickle.dump(model,open('rdf.pkl','wb'))

---------------------------------------------------------------------------
-----
NameError                                 Traceback (most recent call
last)
<ipython-input-243-bcc86464d947> in <cell line: 1>()
----> 1 pickle.dump(model,open('rdf.pkl','wb'))

NameError: name 'model' is not defined
```