Loan Approval Prediction

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn import svm

df = pd.read_csv("Copy of loan - loan.csv")

df.head()
```

```
    Loan_ID Gender Married Dependents     Education Self_Employed  \
0  LP001002   Male      No          0      Graduate            No   
1  LP001003   Male     Yes          1      Graduate            No   
2  LP001005   Male     Yes          0      Graduate           Yes   
3  LP001006   Male     Yes          0  Not Graduate            No   
4  LP001008   Male      No          0      Graduate            No   

   ApplicantIncome  CoapplicantIncome  LoanAmount  Loan_Amount_Term  \
0             5849                0.0         NaN             360.0   
1             4583             1508.0       128.0             360.0   
2             3000                0.0        66.0             360.0   
3             2583             2358.0       120.0             360.0   
4             6000                0.0       141.0             360.0   

   Credit_History Property_Area Loan_Status  
0             1.0         Urban           Y  
1             1.0         Rural           N  
2             1.0         Urban           Y  
3             1.0         Urban           Y  
4             1.0         Urban           Y  
```

```
df.info()
```

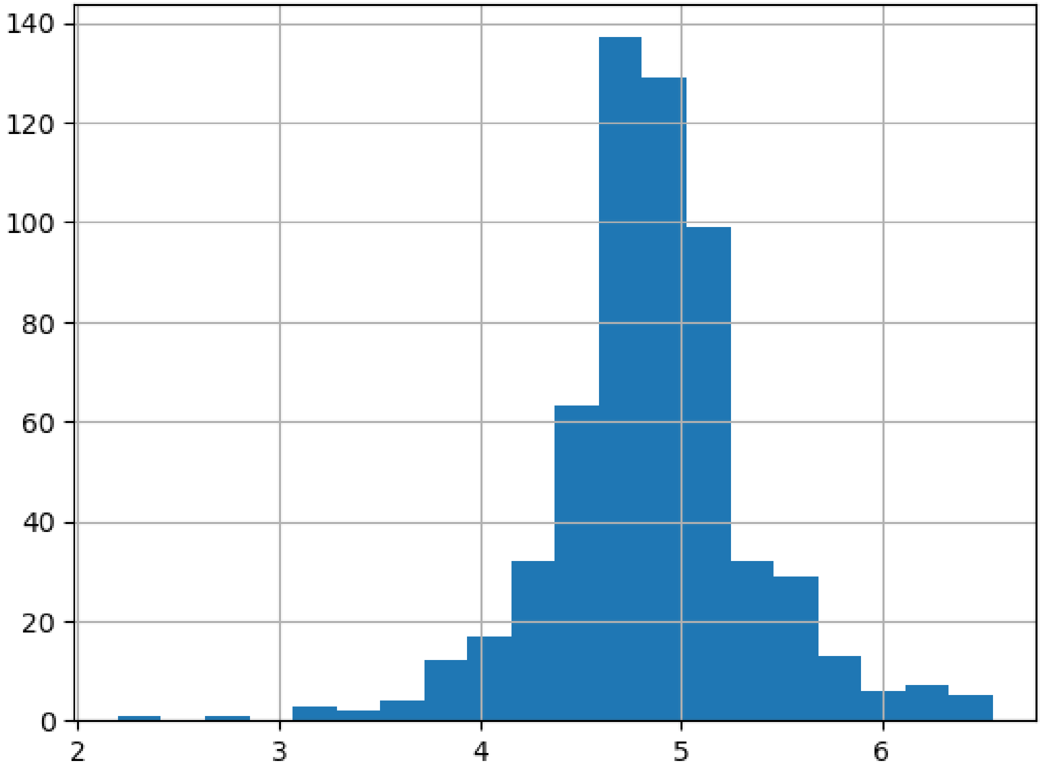
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 614 entries, 0 to 613
Data columns (total 13 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   Loan_ID            614 non-null    object 
 1   Gender             601 non-null    object 
 2   Married            611 non-null    object 
 3   Dependents         599 non-null    object 
 4   Education          614 non-null    object 
 5   Self_Employed      582 non-null    object 
 6   ApplicantIncome    614 non-null    int64  
 7   CoapplicantIncome  614 non-null    float64
 8   LoanAmount         592 non-null    float64
 9   Loan_Amount_Term   600 non-null    float64
 10  Credit_History     564 non-null    float64
 11  Property_Area      614 non-null    object
 12  Loan_Status        614 non-null    object
dtypes: float64(4), int64(1), object(8)
memory usage: 62.5+ KB
```

```
df.isnull().sum()
```

```
Loan_ID               0
Gender               13
Married               3
Dependents           15
Education             0
Self_Employed        32
ApplicantIncome       0
CoapplicantIncome     0
LoanAmount           22
Loan_Amount_Term     14
Credit_History       50
Property_Area         0
Loan_Status           0
dtype: int64
```

```
df['loanAmount_log']=np.log(df['LoanAmount'])
df['loanAmount_log'].hist(bins=20)
```

```
<Axes: >
```

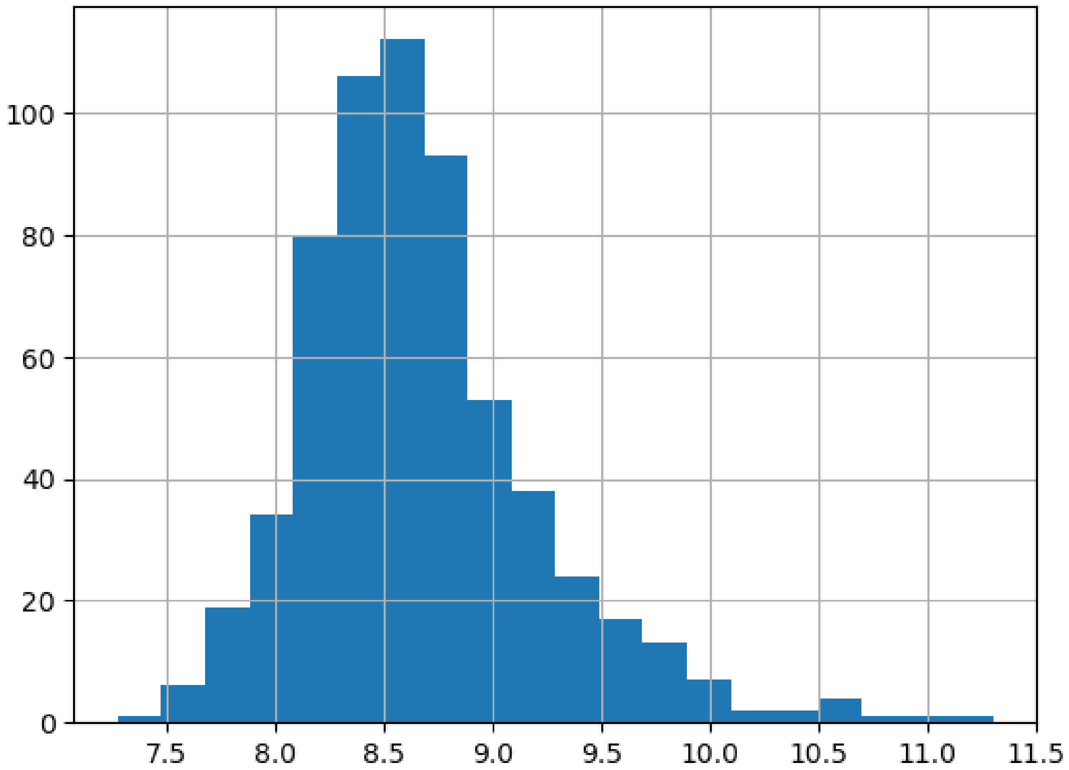


```
df.isnull().sum()
```

```
Loan_ID               0
Gender               13
Married               3
Dependents           15
Education             0
Self_Employed        32
ApplicantIncome       0
CoapplicantIncome     0
LoanAmount           22
Loan_Amount_Term     14
Credit_History       50
Property_Area         0
Loan_Status           0
loanAmount_log       22
dtype: int64
```

```
df['TotalIncome']=df['ApplicantIncome']+df['CoapplicantIncome']
df['TotalIncome_log']=np.log(df['TotalIncome'])
df['TotalIncome_log'].hist(bins=20)
```

```
<Axes: >
```



```
df['Gender'].fillna(df['Gender'].mode()[0], inplace = True)
df['Married'].fillna(df['Married'].mode()[0], inplace = True)
df['Self_Employed'].fillna(df['Self_Employed'].mode()[0], inplace =
True)
df['Dependents'].fillna(df['Dependents'].mode()[0], inplace = True)

df.LoanAmount = df.LoanAmount.fillna(df.LoanAmount.mean())
df.loanAmount_log = df.loanAmount_log.fillna(df.loanAmount_log.mean())

df['Loan_Amount_Term'].fillna(df['Loan_Amount_Term'].mode()[0],
inplace = True)
df['Credit_History'].fillna(df['Credit_History'].mode()[0], inplace =
True)

df.isnull().sum()
```

```
/var/folders/6n/g6lnxsn534d_1smlgjknm7880000gn/T/
ipykernel_2332/2627185228.py:1: FutureWarning: A value is trying to be
set on a copy of a DataFrame or Series through chained assignment
using an inplace method.
The behavior will change in pandas 3.0. This inplace method will never
work because the intermediate object on which we are setting values
always behaves as a copy.

For example, when doing 'df[col].method(value, inplace=True)', try
using 'df.method({col: value}, inplace=True)' or df[col] =
df[col].method(value) instead, to perform the operation inplace on the
original object.


  df['Gender'].fillna(df['Gender'].mode()[0], inplace = True)
/var/folders/6n/g6lnxsn534d_1smlgjknm7880000gn/T/ipykernel_2332/262718
5228.py:2: FutureWarning: A value is trying to be set on a copy of a
DataFrame or Series through chained assignment using an inplace
method.
The behavior will change in pandas 3.0. This inplace method will never
work because the intermediate object on which we are setting values
always behaves as a copy.

For example, when doing 'df[col].method(value, inplace=True)', try
using 'df.method({col: value}, inplace=True)' or df[col] =
df[col].method(value) instead, to perform the operation inplace on the
original object.


  df['Married'].fillna(df['Married'].mode()[0], inplace = True)
/var/folders/6n/g6lnxsn534d_1smlgjknm7880000gn/T/ipykernel_2332/262718
5228.py:3: FutureWarning: A value is trying to be set on a copy of a
DataFrame or Series through chained assignment using an inplace
method.
The behavior will change in pandas 3.0. This inplace method will never
work because the intermediate object on which we are setting values
always behaves as a copy.

For example, when doing 'df[col].method(value, inplace=True)', try
using 'df.method({col: value}, inplace=True)' or df[col] =
df[col].method(value) instead, to perform the operation inplace on the
original object.


  df['Self_Employed'].fillna(df['Self_Employed'].mode()[0], inplace =
True)
/var/folders/6n/g6lnxsn534d_1smlgjknm7880000gn/T/ipykernel_2332/262718
5228.py:4: FutureWarning: A value is trying to be set on a copy of a
DataFrame or Series through chained assignment using an inplace
method.
The behavior will change in pandas 3.0. This inplace method will never
work because the intermediate object on which we are setting values
always behaves as a copy.

For example, when doing 'df[col].method(value, inplace=True)', try
using 'df.method({col: value}, inplace=True)' or df[col] =
df[col].method(value) instead, to perform the operation inplace on the
original object.
```

```
  df['Dependents'].fillna(df['Dependents'].mode()[0], inplace = True)
/var/folders/6n/g6lnxsn534d_1smlgjknm7880000gn/T/ipykernel_2332/262718
5228.py:9: FutureWarning: A value is trying to be set on a copy of a
DataFrame or Series through chained assignment using an inplace
method.
The behavior will change in pandas 3.0. This inplace method will never
work because the intermediate object on which we are setting values
always behaves as a copy.

For example, when doing 'df[col].method(value, inplace=True)', try
using 'df.method({col: value}, inplace=True)' or df[col] =
df[col].method(value) instead, to perform the operation inplace on the
original object.


  df['Loan_Amount_Term'].fillna(df['Loan_Amount_Term'].mode()[0],
inplace = True)
/var/folders/6n/g6lnxsn534d_1smlgjknm7880000gn/T/ipykernel_2332/262718
5228.py:10: FutureWarning: A value is trying to be set on a copy of a
DataFrame or Series through chained assignment using an inplace
method.
The behavior will change in pandas 3.0. This inplace method will never
work because the intermediate object on which we are setting values
always behaves as a copy.

For example, when doing 'df[col].method(value, inplace=True)', try
using 'df.method({col: value}, inplace=True)' or df[col] =
df[col].method(value) instead, to perform the operation inplace on the
original object.


  df['Credit_History'].fillna(df['Credit_History'].mode()[0], inplace
= True)

Loan_ID              0
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
Loan_Status          0
loanAmount_log       0
TotalIncome          0
```

```
TotalIncome_log      0
dtype: int64
```

```
x = df.iloc[:,np.r_[1:5,9:11,13:15]].values
y = df.iloc[:,12].values
```

```
x
```

```
array([['Male', 'No', '0', ..., 1.0, 4.857444178729352, 5849.0],
       ['Male', 'Yes', '1', ..., 1.0, 4.852030263919617, 6091.0],
       ['Male', 'Yes', '0', ..., 1.0, 4.189654742026425, 3000.0],
       ...,
       ['Male', 'Yes', '1', ..., 1.0, 5.53338948872752, 8312.0],
       ['Male', 'Yes', '2', ..., 1.0, 5.231108616854587, 7583.0],
       ['Female', 'No', '0', ..., 0.0, 4.890349128221754, 4583.0]],
      dtype=object)
```

```
y
```

```
array(['Y', 'N', 'Y', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'N', 'Y', 'Y',
'Y',
       'N', 'Y', 'Y', 'Y', 'N', 'N', 'Y', 'N', 'Y', 'N', 'N', 'N',
'Y',
       'Y', 'Y', 'N', 'Y', 'N', 'N', 'N', 'Y', 'N', 'Y', 'N', 'Y',
'Y',
       'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'Y',
'Y',
       'N', 'N', 'N', 'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'N', 'N',
'N',
       'N', 'N', 'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'N', 'Y', 'N', 'N',
'N',
       'N', 'Y', 'Y', 'Y', 'N', 'N', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y',
'Y',
       'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y',
'Y',
       'Y', 'Y', 'Y', 'N', 'N', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'Y',
'Y',
       'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'N',
'N',
       'Y', 'Y', 'Y', 'Y', 'Y', 'N', 'N', 'Y', 'N', 'N', 'N', 'Y',
'Y',
       'Y', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'N', 'Y', 'N', 'N', 'Y',
'Y',
       'Y', 'Y', 'Y', 'Y', 'Y', 'N', 'N', 'Y', 'Y', 'Y', 'N', 'Y',
'N',
       'Y', 'Y', 'Y', 'N', 'Y', 'N', 'Y', 'Y', 'N', 'Y', 'N', 'N',
'N',
       'Y', 'N', 'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'N', 'N', 'Y',
'Y',
       'N', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'Y',
'Y',
        'Y', 'N', 'N', 'N', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'N', 'Y',
'N',
        'Y', 'Y', 'Y', 'Y', 'N', 'N', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y',
'Y',
        'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'N',
'Y',
        'Y', 'Y', 'Y', 'N', 'N', 'Y', 'Y', 'N', 'Y', 'N', 'N', 'N',
'N',
        'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'Y',
'Y',
        'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'N',
'Y',
        'N', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'N', 'Y', 'Y', 'Y', 'Y',
'N',
        'N', 'N', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'N', 'N', 'Y', 'Y',
'Y',
        'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'Y',
'Y',
        'N', 'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y',
'Y',
        'N', 'Y', 'N', 'N', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'Y',
'Y',
        'N', 'Y', 'N', 'Y', 'Y', 'Y', 'N', 'N', 'Y', 'N', 'Y', 'Y',
'Y',
        'Y', 'N', 'N', 'N', 'Y', 'N', 'Y', 'Y', 'Y', 'N', 'Y', 'Y',
'Y',
        'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'N', 'Y',
'Y',
        'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'N', 'N', 'N',
'Y',
        'Y', 'N', 'Y', 'Y', 'Y', 'N', 'N', 'N', 'Y', 'N', 'Y', 'N',
'Y',
        'N', 'N', 'Y', 'Y', 'Y', 'N', 'Y', 'N', 'Y', 'Y', 'N', 'Y',
'Y',
        'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'Y',
'Y',
        'Y', 'Y', 'Y', 'Y', 'Y', 'N', 'N', 'N', 'N', 'Y', 'N', 'Y',
'Y',
        'Y', 'Y', 'N', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'N',
'Y',
        'Y', 'N', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'N',
'Y',
        'Y', 'Y', 'Y', 'Y', 'Y', 'N', 'N', 'Y', 'N', 'Y', 'Y', 'Y',
'Y',
        'N', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'N', 'Y', 'Y',
'Y',
        'N', 'Y', 'Y', 'N', 'Y', 'Y', 'N', 'N', 'Y', 'Y', 'N', 'N',
'N',
       'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y',
'N',
       'N', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'N', 'Y', 'Y', 'Y',
'Y',
       'N', 'Y', 'N', 'Y', 'N', 'Y', 'Y', 'N', 'N', 'Y', 'Y', 'Y',
'Y',
       'Y', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'N', 'N', 'N', 'Y',
'N',
       'Y', 'N', 'N', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'N',
'N',
       'N', 'Y', 'Y', 'Y', 'N', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'N',
'N',
       'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'Y',
'Y',
       'Y', 'Y', 'N'], dtype=object)
```

```
print("per of missing gender is %2f%%" %
((df['Gender'].isnull().sum()/df.shape[0])*100))
```

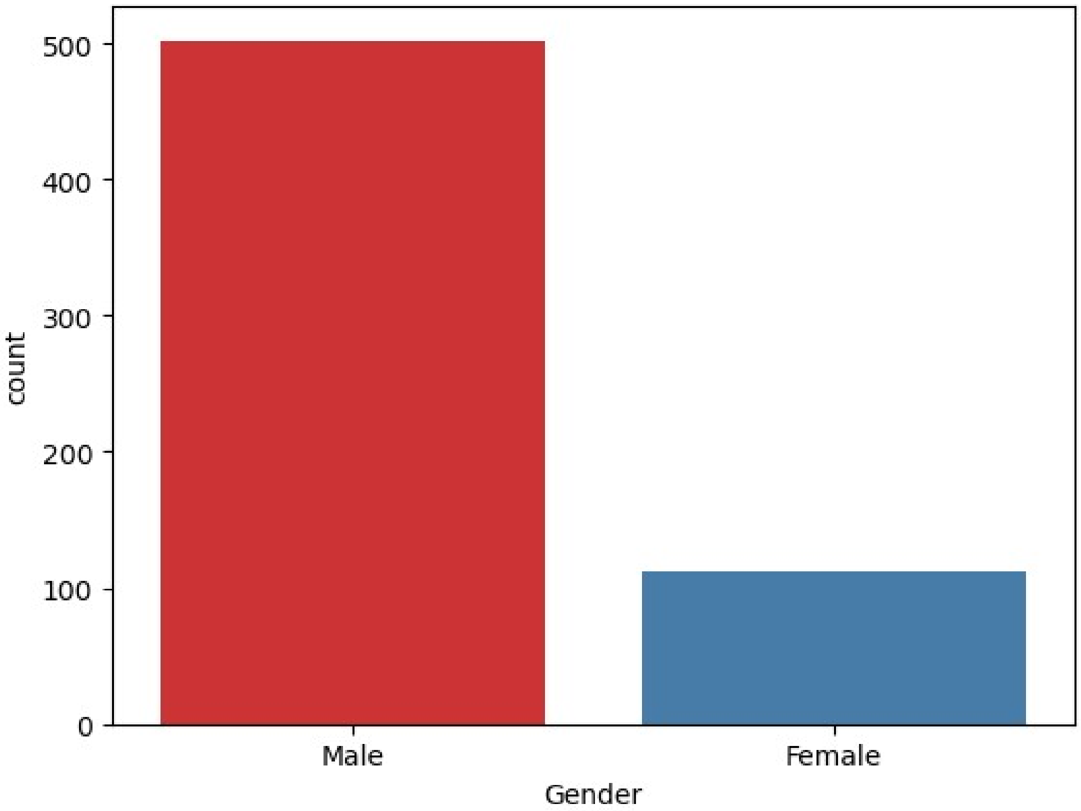
```
per of missing gender is 0.000000%
```

```
print("number of people who take loan as group by gender:")
print(df['Gender'].value_counts())
sns.countplot(x='Gender',data=df, palette = 'Set1')
```

```
number of people who take loan as group by gender:
Gender
Male      502
Female    112
Name: count, dtype: int64
```

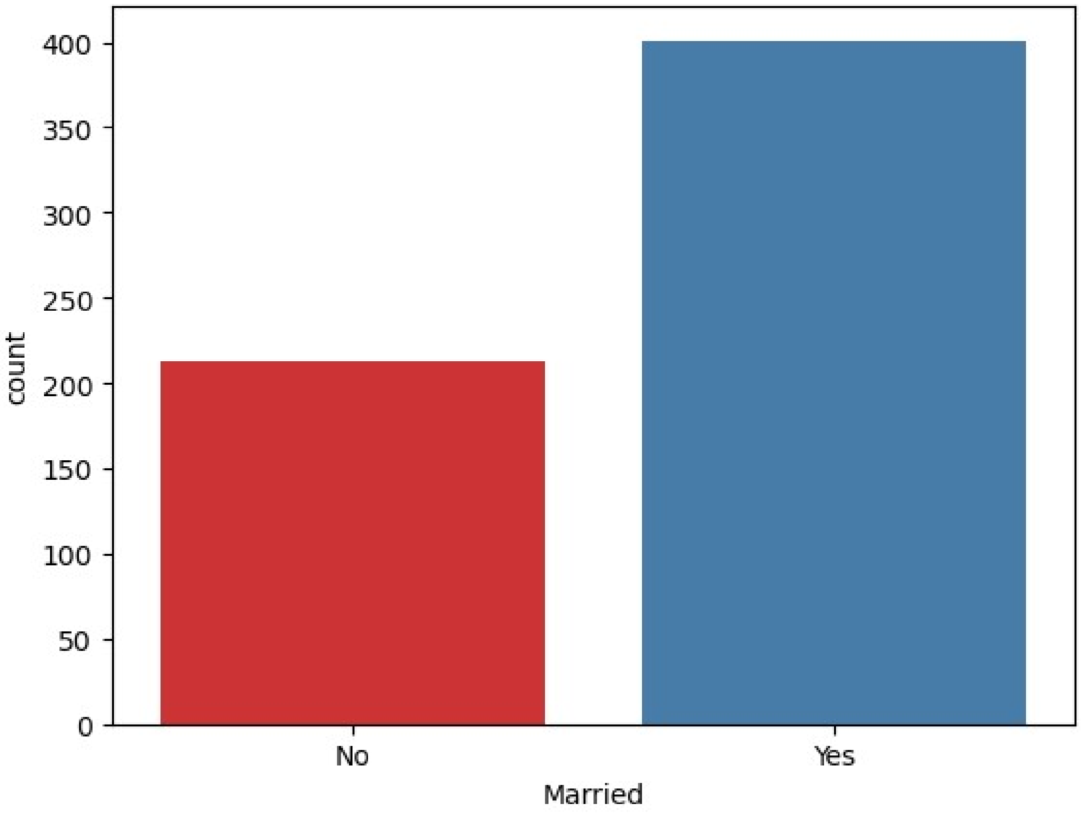
```
/var/folders/6n/g6lnxsn534d_1smlgjknm7880000gn/T/
ipykernel_2332/3749721744.py:3: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be
removed in v0.14.0. Assign the `x` variable to `hue` and set
`legend=False` for the same effect.

  sns.countplot(x='Gender',data=df, palette = 'Set1')
```

```
<Axes: xlabel='Gender', ylabel='count'>
```



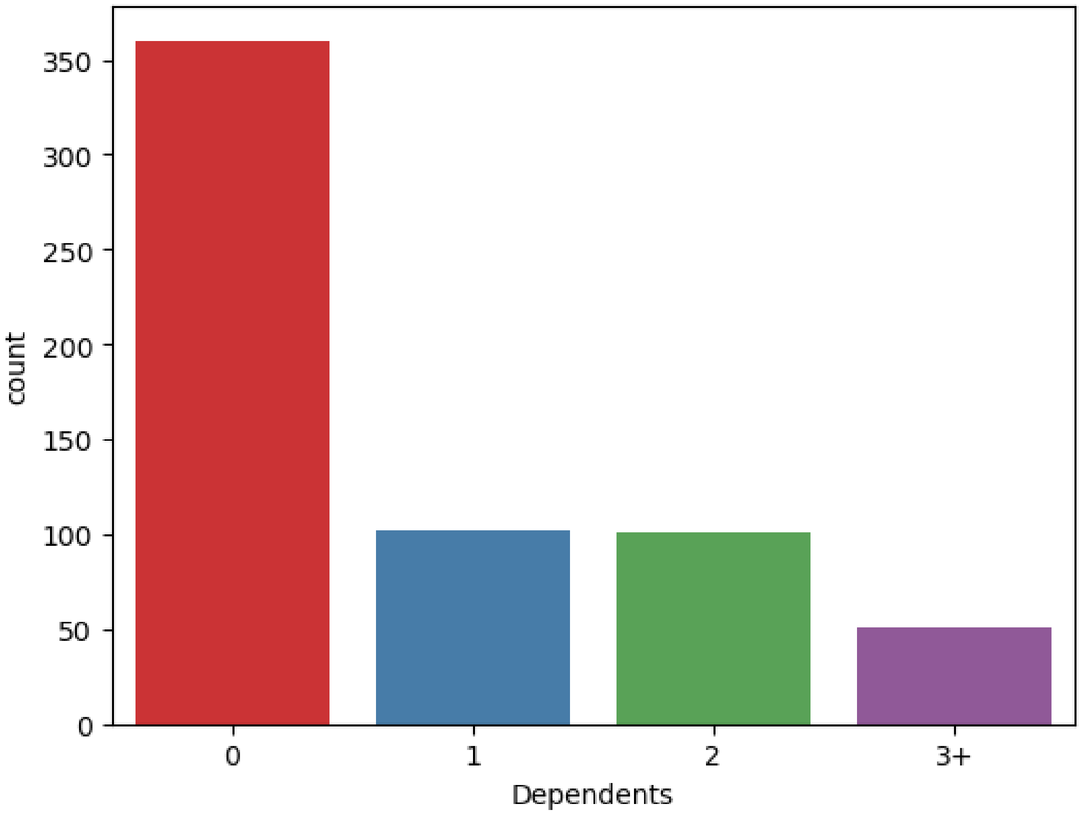
```
print("number of people who take loan as group by marital status:")
print(df['Married'].value_counts())
sns.countplot(x='Married',data=df, palette = 'Set1')
```

```
number of people who take loan as group by marital status:
Married
Yes    401
No     213
Name: count, dtype: int64

/var/folders/6n/g6lnxsn534d_1smlgjknm7880000gn/T/
ipykernel_2332/1749401279.py:3: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be
removed in v0.14.0. Assign the `x` variable to `hue` and set
`legend=False` for the same effect.

  sns.countplot(x='Married',data=df, palette = 'Set1')

<Axes: xlabel='Married', ylabel='count'>
```



```
print("numberof people who take loan as group by dependents:")
print(df['Dependents'].value_counts())
sns.countplot(x='Dependents',data=df, palette = 'Set1')
```

```
numberof people who take loan as group by dependents:
Dependents
0     360
1     102
2     101
3+     51
Name: count, dtype: int64

/var/folders/6n/g6lnxsn534d_1smlgjknm7880000gn/T/
ipykernel_2332/3879772451.py:3: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be
removed in v0.14.0. Assign the `x` variable to `hue` and set
`legend=False` for the same effect.

  sns.countplot(x='Dependents',data=df, palette = 'Set1')

<Axes: xlabel='Dependents', ylabel='count'>
```

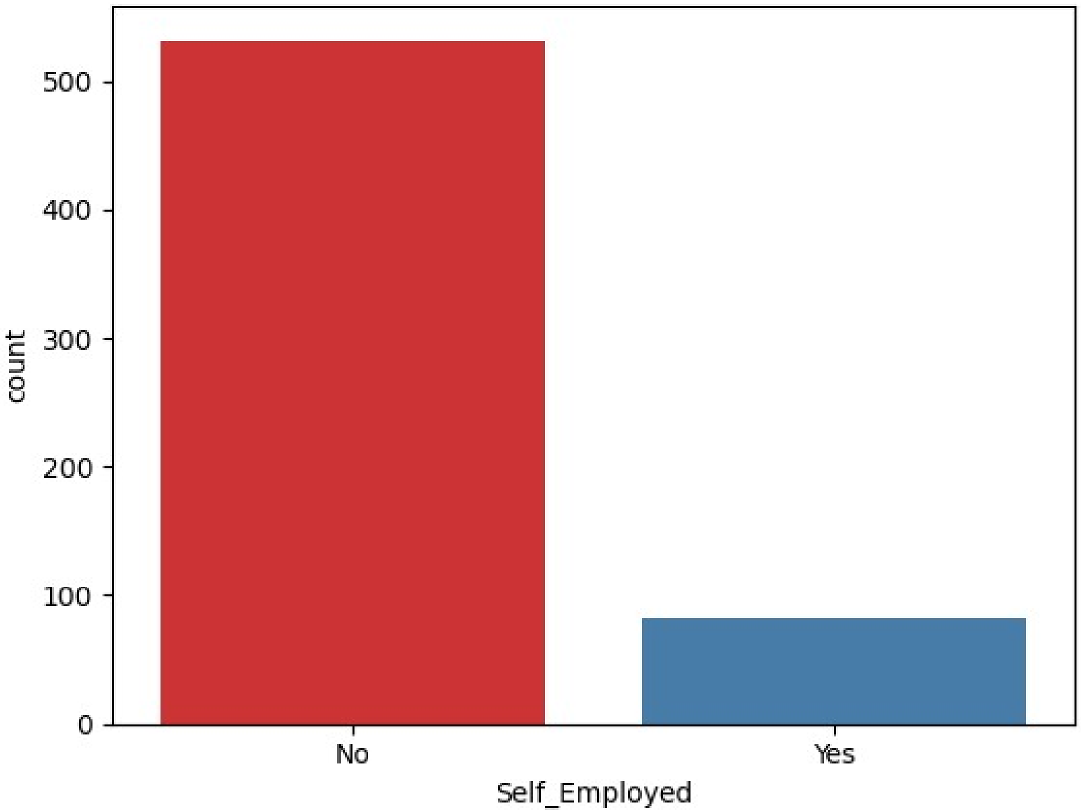


```
print("numberof people who take loan as group by employed:")
print(df['Self_Employed'].value_counts())
sns.countplot(x='Self_Employed',data=df, palette = 'Set1')
```

```
numberof people who take loan as group by employed:
Self_Employed
No     532
Yes     82
Name: count, dtype: int64
```

```
/var/folders/6n/g6lnxsn534d_1smlgjknm7880000gn/T/
ipykernel_2332/1972013330.py:3: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be
removed in v0.14.0. Assign the `x` variable to `hue` and set
`legend=False` for the same effect.

  sns.countplot(x='Self_Employed',data=df, palette = 'Set1')
```

```
<Axes: xlabel='Self_Employed', ylabel='count'>
```

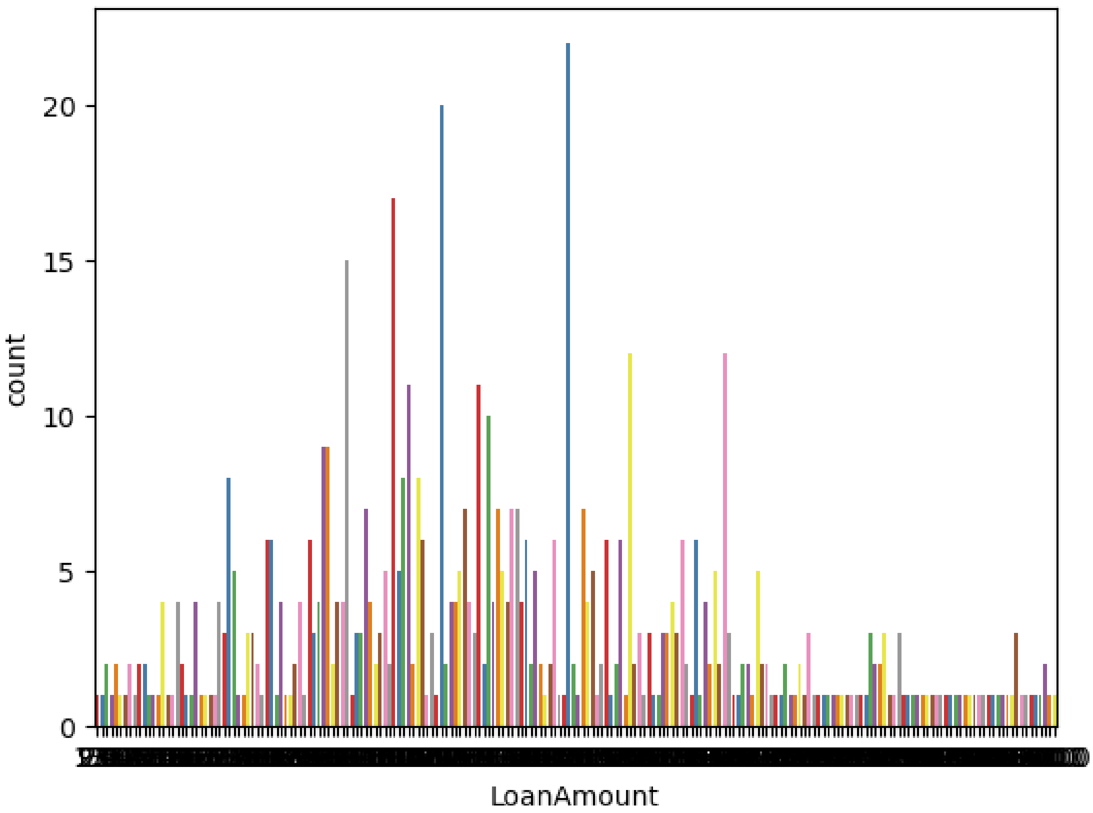


```
print("numberof people who take loan as group by loanammount:")
print(df['LoanAmount'].value_counts())
sns.countplot(x='LoanAmount',data=df, palette = 'Set1')
```

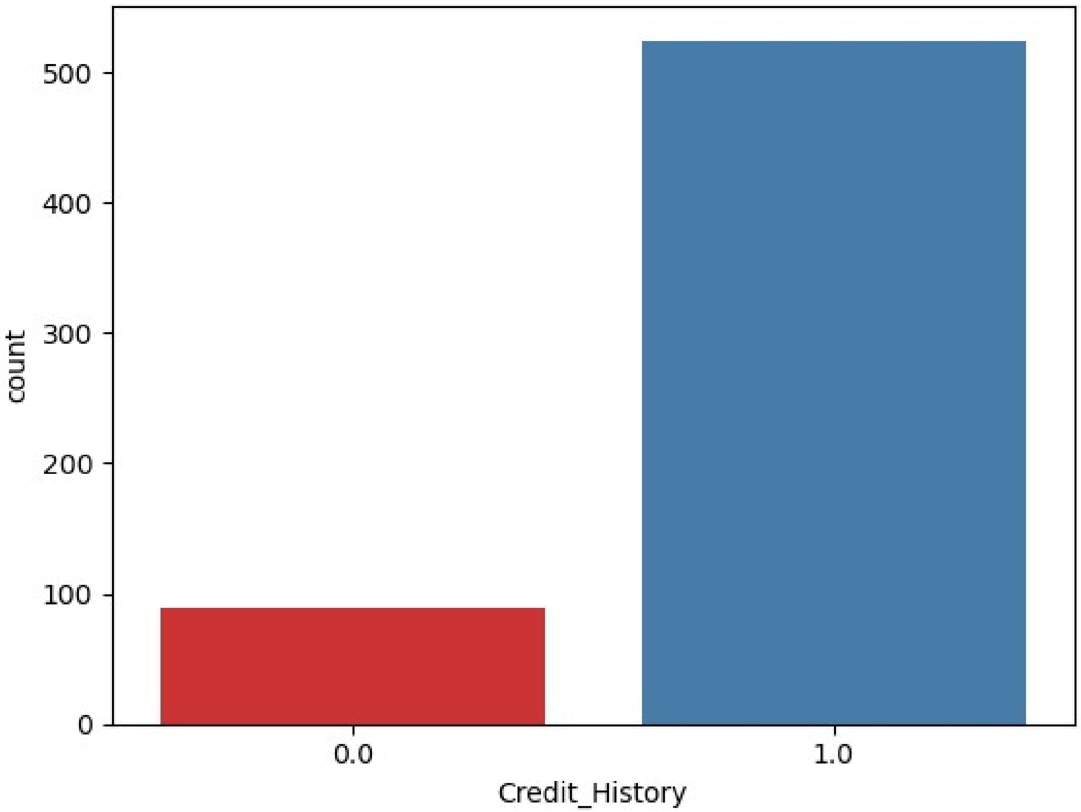
```
numberof people who take loan as group by loanammount:
LoanAmount
146.412162    22
120.000000    20
110.000000    17
100.000000    15
160.000000    12
              ..
240.000000     1
214.000000     1
59.000000      1
166.000000     1
253.000000     1
Name: count, Length: 204, dtype: int64
```

```
/var/folders/6n/g6lnxsn534d_1smlgjknm7880000gn/T/
ipykernel_2332/4258793160.py:3: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be
removed in v0.14.0. Assign the `x` variable to `hue` and set
`legend=False` for the same effect.
```

```
  sns.countplot(x='LoanAmount',data=df, palette = 'Set1')

<Axes: xlabel='LoanAmount', ylabel='count'>
```



```
print("numberof people who take loan as group by Credit history:")
print(df['Credit_History'].value_counts())
sns.countplot(x='Credit_History',data=df, palette = 'Set1')

numberof people who take loan as group by Credit history:
Credit_History
1.0    525
0.0     89
Name: count, dtype: int64

/var/folders/6n/g6lnxsn534d_1smlgjknm7880000gn/T/
ipykernel_2332/440312157.py:3: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be
removed in v0.14.0. Assign the `x` variable to `hue` and set
`legend=False` for the same effect.

  sns.countplot(x='Credit_History',data=df, palette = 'Set1')

<Axes: xlabel='Credit_History', ylabel='count'>
```



```
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_state = 0)

from sklearn.preprocessing import LabelEncoder
Labelencoder_x = LabelEncoder()

for i in range(0, 5):
    X_train[:,i]= Labelencoder_x.fit_transform(X_train[:,i])
    X_train[:,7]= Labelencoder_x.fit_transform(X_train[:,7])

X_train

array([[1, 1, 0, ..., 1.0, 4.875197323201151, 267],
       [1, 0, 1, ..., 1.0, 5.278114659230517, 407],
       [1, 1, 0, ..., 0.0, 5.003946305945459, 249],
       ...,
       [1, 1, 3, ..., 1.0, 5.298317366548036, 363],
       [1, 1, 0, ..., 1.0, 5.075173815233827, 273],
       [0, 1, 0, ..., 1.0, 5.204006687076795, 301]], dtype=object)

Labelencoder_y = LabelEncoder()
y_train = Labelencoder_y.fit_transform(y_train)

y_train
```

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

```
for i in range(0,5):
    X_test[:,i] = Labelencoder_x.fit_transform(X_test[:,i])
    X_test[:,7] = Labelencoder_x.fit_transform(X_test[:,7])
```

```
X_test
```

```
array([[1, 0, 0, 0, 5, 1.0, 4.430816798843313, 85],
       [0, 0, 0, 0, 5, 1.0, 4.718498871295094, 28],
       [1, 1, 0, 0, 5, 1.0, 5.780743515792329, 104],
       [1, 1, 0, 0, 5, 1.0, 4.700480365792417, 80],
       [1, 1, 2, 0, 5, 1.0, 4.574710978503383, 22],
       [1, 1, 0, 1, 3, 0.0, 5.10594547390058, 70],
       [1, 1, 3, 0, 3, 1.0, 5.056245805348308, 77],
       [1, 0, 0, 0, 5, 1.0, 6.003887067106539, 114],
       [1, 0, 0, 0, 5, 0.0, 4.820281565605037, 53],
       [1, 1, 0, 0, 5, 1.0, 4.852030263919617, 55],
       [0, 0, 0, 0, 5, 1.0, 4.430816798843313, 4],
       [1, 1, 1, 0, 5, 1.0, 4.553876891600541, 2],
       [0, 0, 0, 0, 5, 1.0, 5.634789603169249, 96],
       [1, 1, 2, 0, 5, 1.0, 5.4638318050256105, 97],
       [1, 1, 0, 0, 5, 1.0, 4.564348191467836, 117],
       [1, 1, 1, 0, 5, 1.0, 4.204692619390966, 22],
       [1, 0, 1, 1, 5, 1.0, 5.247024072160486, 32],
       [1, 0, 0, 1, 5, 1.0, 4.882801922586371, 25],
       [0, 0, 0, 0, 5, 1.0, 4.532599493153256, 1],
       [1, 1, 0, 1, 5, 0.0, 5.198497031265826, 44],
       [0, 1, 0, 0, 5, 0.0, 4.787491742782046, 71],
       [1, 1, 0, 0, 5, 1.0, 4.962844630259907, 43],
       [1, 1, 2, 0, 5, 1.0, 4.68213122712422, 91],
       [1, 1, 2, 0, 5, 1.0, 5.10594547390058, 111],
       [1, 1, 0, 0, 5, 1.0, 4.060443010546419, 35],
       [1, 1, 1, 0, 5, 1.0, 5.521460917862246, 94],
       [1, 0, 0, 0, 5, 1.0, 5.231108616854587, 98],
       [1, 1, 0, 0, 5, 1.0, 5.231108616854587, 110],
       [1, 1, 3, 0, 5, 0.0, 4.852030263919617, 41],
       [0, 0, 0, 0, 5, 0.0, 4.634728988229636, 50],
       [1, 1, 0, 0, 5, 1.0, 5.429345628954441, 99],
       [1, 0, 0, 1, 5, 1.0, 3.871201010907891, 46],
       [1, 1, 1, 1, 5, 1.0, 4.499809670330265, 52],
       [1, 1, 0, 0, 5, 1.0, 5.19295685089021, 102],
       [1, 1, 0, 0, 5, 1.0, 4.857444178729352, 95],
       [0, 1, 0, 1, 5, 0.0, 5.181783550292085, 57],
       [1, 1, 0, 0, 5, 1.0, 5.147494476813453, 65],
       [1, 0, 0, 1, 5, 1.0, 4.836281906951478, 39],
       [1, 1, 0, 0, 5, 1.0, 4.852030263919617, 75],
       [1, 1, 2, 1, 5, 1.0, 4.68213122712422, 24],
       [0, 0, 0, 0, 5, 1.0, 4.382026634673881, 9],
       [1, 1, 3, 0, 5, 0.0, 4.812184355372417, 68],
       [1, 1, 2, 0, 2, 1.0, 2.833213344056216, 0],
       [1, 1, 1, 1, 5, 1.0, 5.062595033026967, 67],
       [1, 0, 0, 0, 5, 1.0, 4.330733340286331, 21],
       [1, 0, 0, 0, 5, 1.0, 5.231108616854587, 113],
       [1, 1, 1, 0, 5, 1.0, 4.7535901911063645, 18],
       [0, 0, 0, 0, 5, 1.0, 4.74493212836325, 37],
       [1, 1, 1, 0, 5, 1.0, 4.852030263919617, 72],
       [1, 0, 0, 0, 5, 1.0, 4.941642422609304, 78],
       [1, 1, 3, 1, 5, 1.0, 4.30406509320417, 8],
       [1, 1, 0, 0, 5, 1.0, 4.867534450455582, 84],
       [1, 1, 0, 1, 5, 1.0, 4.672828834461906, 31],
       [1, 0, 0, 0, 5, 1.0, 4.857444178729352, 61],
       [1, 1, 0, 0, 5, 1.0, 4.718498871295094, 19],
       [1, 1, 0, 0, 5, 1.0, 5.556828061699537, 107],
       [1, 1, 0, 0, 5, 1.0, 4.553876891600541, 34],
       [1, 0, 0, 1, 5, 1.0, 4.890349128221754, 74],
       [1, 1, 2, 0, 5, 1.0, 5.123963979403259, 62],
       [1, 0, 0, 0, 5, 1.0, 4.787491742782046, 27],
       [0, 0, 0, 0, 5, 0.0, 4.919980925828125, 108],
       [0, 0, 0, 0, 5, 1.0, 5.365976015021851, 103],
       [1, 1, 0, 1, 5, 1.0, 4.74493212836325, 38],
       [0, 0, 0, 0, 5, 0.0, 4.330733340286331, 13],
       [1, 1, 2, 0, 5, 1.0, 4.890349128221754, 69],
       [1, 1, 1, 0, 5, 1.0, 5.752572638825633, 112],
       [1, 1, 0, 0, 5, 1.0, 5.075173815233827, 73],
       [1, 0, 0, 0, 5, 1.0, 4.912654885736052, 47],
       [1, 1, 0, 0, 5, 1.0, 5.204006687076795, 81],
       [1, 0, 0, 1, 5, 1.0, 4.564348191467836, 60],
       [1, 0, 0, 0, 5, 1.0, 4.204692619390966, 83],
       [0, 1, 0, 0, 5, 1.0, 4.867534450455582, 5],
       [1, 1, 2, 1, 5, 1.0, 5.056245805348308, 58],
       [1, 1, 1, 1, 3, 1.0, 4.919980925828125, 79],
       [0, 1, 0, 0, 5, 1.0, 4.969813299576001, 54],
       [1, 1, 0, 1, 4, 1.0, 4.820281565605037, 56],
       [1, 0, 0, 0, 5, 1.0, 4.499809670330265, 120],
       [1, 0, 3, 0, 5, 1.0, 5.768320995793772, 118],
       [1, 1, 2, 0, 5, 1.0, 4.718498871295094, 101],
       [0, 0, 0, 0, 5, 0.0, 4.7535901911063645, 26],
       [0, 0, 0, 0, 6, 1.0, 4.727387818712341, 33],
       [1, 1, 1, 0, 5, 1.0, 6.214608098422191, 119],
       [0, 0, 0, 0, 5, 1.0, 5.267858159063328, 89],
       [1, 1, 2, 0, 5, 1.0, 5.231108616854587, 92],
       [1, 0, 0, 0, 6, 1.0, 4.2626798770413155, 6],
       [1, 1, 0, 0, 0, 1.0, 4.709530201312334, 90],
       [1, 1, 0, 0, 5, 1.0, 4.700480365792417, 45],
       [1, 1, 2, 0, 5, 1.0, 5.298317366548036, 109],
       [1, 0, 1, 0, 3, 1.0, 4.727387818712341, 17],
       [1, 1, 1, 0, 5, 1.0, 4.6443908991413725, 36],
       [0, 1, 0, 1, 5, 1.0, 4.605170185988092, 16],
       [1, 0, 0, 0, 5, 1.0, 4.30406509320417, 7],
       [1, 1, 1, 0, 1, 1.0, 5.147494476813453, 88],
       [1, 1, 3, 0, 4, 0.0, 5.19295685089021, 87],
       [0, 0, 0, 0, 5, 1.0, 4.2626798770413155, 3],
       [1, 0, 0, 1, 3, 0.0, 4.836281906951478, 59],
       [1, 0, 0, 0, 3, 1.0, 5.1647859739235145, 82],
       [1, 0, 0, 0, 5, 1.0, 4.969813299576001, 66],
       [1, 1, 2, 1, 5, 1.0, 4.394449154672439, 51],
       [1, 1, 1, 0, 5, 1.0, 5.231108616854587, 100],
       [1, 1, 0, 0, 5, 1.0, 5.351858133476067, 93],
       [1, 1, 0, 0, 5, 1.0, 4.605170185988092, 15],
       [1, 1, 2, 0, 5, 1.0, 4.787491742782046, 106],
       [1, 0, 0, 0, 3, 1.0, 4.787491742782046, 105],
       [1, 1, 3, 0, 5, 1.0, 4.852030263919617, 64],
       [1, 0, 0, 0, 5, 1.0, 4.8283137373023015, 49],
       [1, 0, 0, 1, 5, 1.0, 4.6443908991413725, 42],
       [0, 0, 0, 0, 5, 1.0, 4.477336814478207, 10],
       [1, 1, 0, 1, 5, 1.0, 4.553876891600541, 20],
       [1, 1, 3, 1, 3, 1.0, 4.394449154672439, 14],
       [1, 0, 0, 0, 5, 1.0, 5.298317366548036, 76],
       [0, 0, 0, 0, 5, 1.0, 4.90527477843843, 11],
       [1, 0, 0, 0, 6, 1.0, 4.727387818712341, 18],
       [1, 1, 2, 0, 5, 1.0, 4.248495242049359, 23],
       [1, 1, 0, 1, 5, 0.0, 5.303304908059076, 63],
       [1, 1, 0, 0, 3, 0.0, 4.499809670330265, 48],
       [0, 0, 0, 0, 5, 1.0, 4.430816798843313, 30],
       [1, 0, 0, 0, 5, 1.0, 4.897839799950911, 29],
       [1, 1, 2, 0, 5, 1.0, 5.170483995038151, 86],
       [1, 1, 3, 0, 5, 1.0, 4.867534450455582, 115],
       [1, 1, 0, 0, 5, 1.0, 6.077642243349034, 116],
       [1, 1, 3, 1, 3, 0.0, 4.248495242049359, 40],
       [1, 1, 1, 0, 5, 1.0, 4.564348191467836, 12]], dtype=object)
```

```
Labelencoder_y = LabelEncoder()
```

```
y_test = Labelencoder_y.fit_transform(y_test)
```

```
y_test
```

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

```
from sklearn.preprocessing import StandardScaler
```

```
ss = StandardScaler()
```

```
X_train = ss.fit_transform(X_train)
x_test = ss.fit_transform(X_test)
```

```
from sklearn.ensemble import RandomForestClassifier
```

```
rf_clf = RandomForestClassifier()
rf_clf.fit(X_train, y_train)
```

```
RandomForestClassifier()
```

```
from sklearn import metrics
y_pred = rf_clf.predict(x_test)
```

```
print("acc of random forest clf is",metrics.accuracy_score(y_pred,
y_test))
```

```
y_pred
```

```
acc of random forest clf is 0.7804878048780488
```

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

```
from sklearn.naive_bayes import GaussianNB
nb_clf = GaussianNB()
nb_clf.fit(X_train, y_train)
```

```
GaussianNB()
```

```
y_pred = nb_clf.predict(X_test)
print('acc of naive bayes is ',metrics.accuracy_score(y_pred, y_test))
```

```
acc of naive bayes is  0.2764227642276423
```

```
y_pred
```

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

```
from sklearn.tree import DecisionTreeClassifier
dt_clf = DecisionTreeClassifier()
dt_clf.fit(X_train, y_train)
```

```
DecisionTreeClassifier()
```

```
y_pred = dt_clf.predict(X_test)
print("acc of DT is",metrics.accuracy_score(y_pred, y_test))
```

```
acc of DT is 0.7154471544715447
```

```
y_pred
```

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

```
from sklearn.neighbors import KNeighborsClassifier
kn_clf = KNeighborsClassifier()
kn_clf.fit(X_train,y_train)
```

```
KNeighborsClassifier()
```

```
y_pred = kn_clf.predict(X_test)
print("acc of KN is", metrics.accuracy_score(y_pred, y_test))
```

```
acc of KN is 0.5528455284552846
```