1.wine

January 17, 2021

[1]:
```
import seaborn as sns
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.ensemble import RandomForestClassifier
from sklearn.svm import SVC
from sklearn import svm
from sklearn.neural_network import MLPClassifier
from sklearn.metrics import confusion_matrix, classification_report
from sklearn.preprocessing import StandardScaler, LabelEncoder
from sklearn.model_selection import train_test_split
```

[2]:
```
wine = pd.read_csv('./datasets/winequality-red.csv',sep=';')
```

[3]:
```
wine.head()
```

[3]:
```
  fixed acidity,volatile acidity,citric acid,residual sugar,chlorides,free
sulfur dioxide,total sulfur dioxide,density,pH,sulphates,alcohol,quality
0  7.4,0.7,0.0,1.9,0.076,11.0,34.0,0.9978,3.51,0…
1  7.8,0.88,0.0,2.6,0.098,25.0,67.0,0.9968,3.2,0…
2  7.8,0.76,0.04,2.3,0.092,15.0,54.0,0.997,3.26,0…
3  11.2,0.28,0.56,1.9,0.075,17.0,60.0,0.998,3.16,…
4  7.4,0.7,0.0,1.9,0.076,11.0,34.0,0.9978,3.51,0…
```

[4]:
```
wine = pd.read_csv('./datasets/winequality-red.csv',sep=',')
```

[5]:
```
wine.head()
```

[5]:

	fixed acidity	volatile acidity	citric acid	residual sugar	chlorides	\
0	7.4	0.70	0.00	1.9	0.076	
1	7.8	0.88	0.00	2.6	0.098	
2	7.8	0.76	0.04	2.3	0.092	
3	11.2	0.28	0.56	1.9	0.075	
4	7.4	0.70	0.00	1.9	0.076	

	free sulfur dioxide	total sulfur dioxide	density	pH	sulphates	\
0	11.0	34.0	0.9978	3.51	0.56	
1	25.0	67.0	0.9968	3.20	0.68	

```
2                 15.0                 54.0   0.9970  3.26       0.65
3                 17.0                 60.0   0.9980  3.16       0.58
4                 11.0                 34.0   0.9978  3.51       0.56
```

```
   alcohol  quality
0      9.4        5
1      9.8        5
2      9.8        5
3      9.8        6
4      9.4        5
```

[6]:
```
wine.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1599 entries, 0 to 1598
Data columns (total 12 columns):
 #   Column                Non-Null Count  Dtype  
---  ------                --------------  -----  
 0   fixed acidity         1599 non-null   float64
 1   volatile acidity      1599 non-null   float64
 2   citric acid           1599 non-null   float64
 3   residual sugar        1599 non-null   float64
 4   chlorides             1599 non-null   float64
 5   free sulfur dioxide   1599 non-null   float64
 6   total sulfur dioxide  1599 non-null   float64
 7   density               1599 non-null   float64
 8   pH                    1599 non-null   float64
 9   sulphates             1599 non-null   float64
 10  alcohol               1599 non-null   float64
 11  quality               1599 non-null   int64  
dtypes: float64(11), int64(1)
memory usage: 150.0 KB
```

[7]:
```
wine.isnull().sum()
```

[7]:
```
fixed acidity           0
volatile acidity        0
citric acid             0
residual sugar          0
chlorides               0
free sulfur dioxide     0
total sulfur dioxide    0
density                 0
pH                      0
sulphates               0
alcohol                 0
quality                 0
```

```
dtype: int64
```

[8]:
```
#preprocessing Data
bins = (2,6.5,8)
group_names = ['bad', 'good']
wine['quality'] = pd.cut(wine['quality'], bins = bins, labels = group_names)
wine['quality'].unique()
```

[8]:
```
[bad, good]
Categories (2, object): [bad < good]
```

[9]:
```
label_quality = LabelEncoder()
```

[10]:
```
wine['quality'] = label_quality.fit_transform(wine['quality'])
```

[11]:
```
wine.head()
```

[11]:

	fixed acidity	volatile acidity	citric acid	residual sugar	chlorides	free sulfur dioxide	total sulfur dioxide	density	pH	sulphates	alcohol	quality
0	7.4	0.70	0.00	1.9	0.076	11.0	34.0	0.9978	3.51	0.56	9.4	0
1	7.8	0.88	0.00	2.6	0.098	25.0	67.0	0.9968	3.20	0.68	9.8	0
2	7.8	0.76	0.04	2.3	0.092	15.0	54.0	0.9970	3.26	0.65	9.8	0
3	11.2	0.28	0.56	1.9	0.075	17.0	60.0	0.9980	3.16	0.58	9.8	0
4	7.4	0.70	0.00	1.9	0.076	11.0	34.0	0.9978	3.51	0.56	9.4	0

[12]:
```
wine.head(10)
```

[12]:

	fixed acidity	volatile acidity	citric acid	residual sugar	chlorides
0	7.4	0.70	0.00	1.9	0.076
1	7.8	0.88	0.00	2.6	0.098
2	7.8	0.76	0.04	2.3	0.092
3	11.2	0.28	0.56	1.9	0.075
4	7.4	0.70	0.00	1.9	0.076
5	7.4	0.66	0.00	1.8	0.075

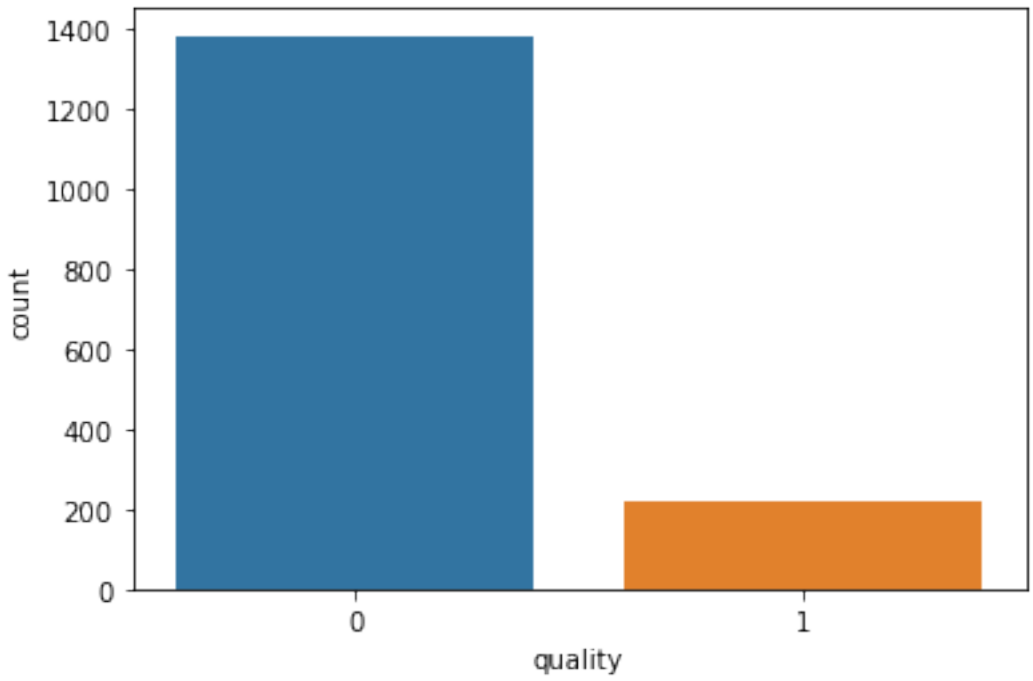
```
6            7.9              0.60         0.06             1.6      0.069
7            7.3              0.65         0.00             1.2      0.065
8            7.8              0.58         0.02             2.0      0.073
9            7.5              0.50         0.36             6.1      0.071

   free sulfur dioxide  total sulfur dioxide  density    pH  sulphates  \
0                 11.0                  34.0   0.9978  3.51       0.56
1                 25.0                  67.0   0.9968  3.20       0.68
2                 15.0                  54.0   0.9970  3.26       0.65
3                 17.0                  60.0   0.9980  3.16       0.58
4                 11.0                  34.0   0.9978  3.51       0.56
5                 13.0                  40.0   0.9978  3.51       0.56
6                 15.0                  59.0   0.9964  3.30       0.46
7                 15.0                  21.0   0.9946  3.39       0.47
8                  9.0                  18.0   0.9968  3.36       0.57
9                 17.0                 102.0   0.9978  3.35       0.80

   alcohol  quality
0      9.4        0
1      9.8        0
2      9.8        0
3      9.8        0
4      9.4        0
5      9.4        0
6      9.4        0
7     10.0        1
8      9.5        1
9     10.5        0
```

[13]:
```
wine['quality'].value_counts()
```

[13]:
```
0    1382
1     217
Name: quality, dtype: int64
```

[14]:
```
sns.countplot(wine['quality'])
```

[14]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fbebd436490>
```



[15]:
```
#separate the dataset as response variable and feature variables
X = wine.drop('quality', axis=1)
y = wine['quality']
```

[16]:
```
#Train and Test splitting of data
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)
```

[17]:
```
#Applying Standard scaling to get optimized result

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)
```

[18]:
```
X_train[:10]
```

[18]:
```
array([[ 0.21833164,  0.88971201,  0.19209222,  0.30972563, -0.04964208,
         0.69100692,  1.04293362,  1.84669643,  1.09349989,  0.45822284,
         1.12317723],
       [-1.29016623, -1.78878251,  0.65275338, -0.80507963, -0.45521361,
         2.38847304,  3.59387025, -3.00449133, -0.40043872, -0.40119696,
         1.40827174],
       [ 1.49475291, -0.78434707,  1.01104539, -0.52637831,  0.59927236,
        -0.95796016, -0.99174203,  0.76865471, -0.07566946,  0.51551749,
        -0.58738978],
```

```
[ 0.27635078,  0.86181102, -0.06383064, -0.66572897, -0.00908493,
  0.01202048, -0.71842739,  0.08948842,  0.05423824, -1.08873281,
 -0.96751578],
[ 0.04427419,  2.81487994, -0.62686095,  2.39998549, -0.31326357,
 -0.47296984,  0.2229897 ,  1.1998714 ,  0.37900751, -0.9741435 ,
 -0.49235828],
[-0.07176411, -0.78434707,  1.11341454, -0.17800167,  0.21397941,
  3.01896045,  2.62208486,  0.60694845,  0.44396136,  1.89058918,
 -0.58738978],
[-1.17412793,  0.10848444, -0.62686095, -0.52637831, -0.23214927,
  0.98200112, -0.35400787, -1.95879086,  0.05423824,  0.91658007,
  1.12317723],
[-0.1878024 , -0.17052541,  0.60156881,  0.03102432, -0.13075639,
 -0.37597178, -0.01995665,  0.93036097,  0.76873063, -0.229313  ,
  0.26789373],
[-0.07176411,  0.61070216, -0.01264607, -0.38702766,  0.13286511,
 -1.05495822,  0.92146044,  0.37516948, -1.17988496, -0.229313  ,
 -1.25261029],
[ 1.8428678 , -1.95618842,  1.21578369,  1.00647892,  0.31537229,
 -1.15195628, -0.71842739,  1.52328391, -0.20557717,  1.77599987,
 -0.30229528]])
```

1 Random Forest Classifier

[21]:
```
rfc = RandomForestClassifier(n_estimators=200)
rfc.fit(X_train, y_train)
pred_rfc = rfc.predict(X_test)
```

[22]:
```
pred_rfc[:20]
```

[22]:
```
array([0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0])
```

[24]:
```
#how our model performed
print(classification_report(y_test, pred_rfc))
print(confusion_matrix(y_test, pred_rfc))
```

```
              precision    recall  f1-score   support

           0       0.92      0.97      0.94       273
           1       0.73      0.51      0.60        47

    accuracy                           0.90       320
   macro avg       0.82      0.74      0.77       320
weighted avg       0.89      0.90      0.89       320

[[264   9]
```

```
 [ 23  24]]
```

2 SVM Classifier

[25]:
```
clf = svm.SVC()
clf.fit(X_train, y_train)
pred_clf = clf.predict(X_test)
```

[26]:
```
#how our model performed
print(classification_report(y_test, pred_clf))
print(confusion_matrix(y_test, pred_clf))
```

```
              precision    recall  f1-score   support

           0       0.88      0.98      0.93       273
           1       0.71      0.26      0.37        47

    accuracy                           0.88       320
   macro avg       0.80      0.62      0.65       320
weighted avg       0.86      0.88      0.85       320

[[268   5]
 [ 35  12]]
```

3 Neural Network

[39]:
```
mlpc = MLPClassifier(hidden_layer_sizes=(11,11,11), max_iter=1000)
mlpc.fit(X_train, y_train)
pred_mlpc = mlpc.predict(X_test)
```

[40]:
```
#how our model performed
print(classification_report(y_test, pred_mlpc))
print(confusion_matrix(y_test, pred_mlpc))
```

```
              precision    recall  f1-score   support

           0       0.92      0.92      0.92       273
           1       0.55      0.55      0.55        47

    accuracy                           0.87       320
   macro avg       0.74      0.74      0.74       320
weighted avg       0.87      0.87      0.87       320

[[252  21]
 [ 21  26]]
```

[41]:
```
from sklearn.metrics import accuracy_score
cm = accuracy_score(y_test,pred_rfc)
cm
```

[41]:
```
0.9
```

[42]:
```
wine.head(10)
```

[42]:

	fixed acidity	volatile acidity	citric acid	residual sugar	chlorides	free sulfur dioxide	total sulfur dioxide	density	pH	sulphates	alcohol	quality
0	7.4	0.70	0.00	1.9	0.076	11.0	34.0	0.9978	3.51	0.56	9.4	0
1	7.8	0.88	0.00	2.6	0.098	25.0	67.0	0.9968	3.20	0.68	9.8	0
2	7.8	0.76	0.04	2.3	0.092	15.0	54.0	0.9970	3.26	0.65	9.8	0
3	11.2	0.28	0.56	1.9	0.075	17.0	60.0	0.9980	3.16	0.58	9.8	0
4	7.4	0.70	0.00	1.9	0.076	11.0	34.0	0.9978	3.51	0.56	9.4	0
5	7.4	0.66	0.00	1.8	0.075	13.0	40.0	0.9978	3.51	0.56	9.4	0
6	7.9	0.60	0.06	1.6	0.069	15.0	59.0	0.9964	3.30	0.46	9.4	0
7	7.3	0.65	0.00	1.2	0.065	15.0	21.0	0.9946	3.39	0.47	10.0	1
8	7.8	0.58	0.02	2.0	0.073	9.0	18.0	0.9968	3.36	0.57	9.5	1
9	7.5	0.50	0.36	6.1	0.071	17.0	102.0	0.9978	3.35	0.80	10.5	0

[45]:
```
#check a new wine with new features to be a good or bad wine
Xnew = [[7.3,0.58,0.00,2.0,0.065,15.0,21.0,0.9946,3.36,0.47,10.0]]
Xnew = sc.transform(Xnew)
```

```
ynew = rfc.predict(Xnew)
ynew
```

[45]:
```
array([0])
```

[ ]:
```

```