In [1]:
```
import numpy as np
import pandas as pd
import seaborn as sns
```

In [24]:
```
wine = pd.read_csv('E://Data Science//Sapient//Case_Onsite_Modeling_Wine//wine_dataset.csv')
```

Finding missing values in dataset

In [3]:
```
wine.isna().sum()
```

Out[3]:
```
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
style                   0
dtype: int64
```

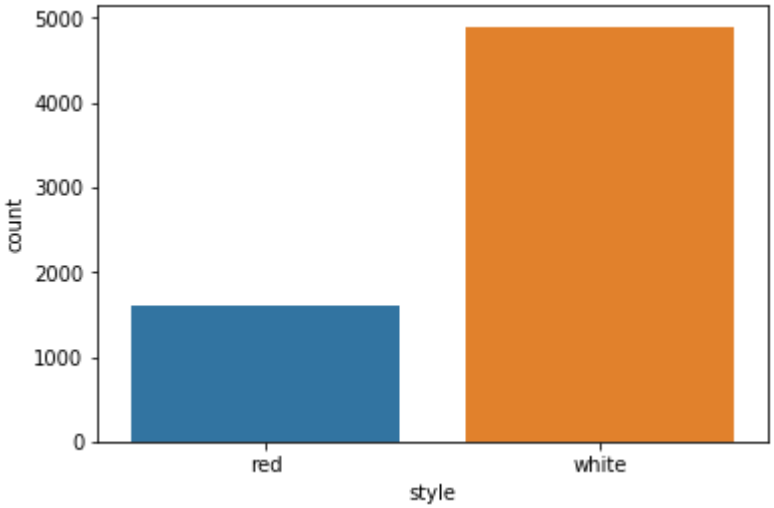
In [4]:
```
wine.dtypes
```

Out[4]:
```
fixed_acidity           float64
volatile_acidity        float64
citric_acid             float64
residual_sugar          float64
chlorides               float64
free_sulfur_dioxide     float64
total_sulfur_dioxide    float64
density                 float64
pH                      float64
sulphates               float64
alcohol                 float64
quality                   int64
style                    object
dtype: object
```

EDA

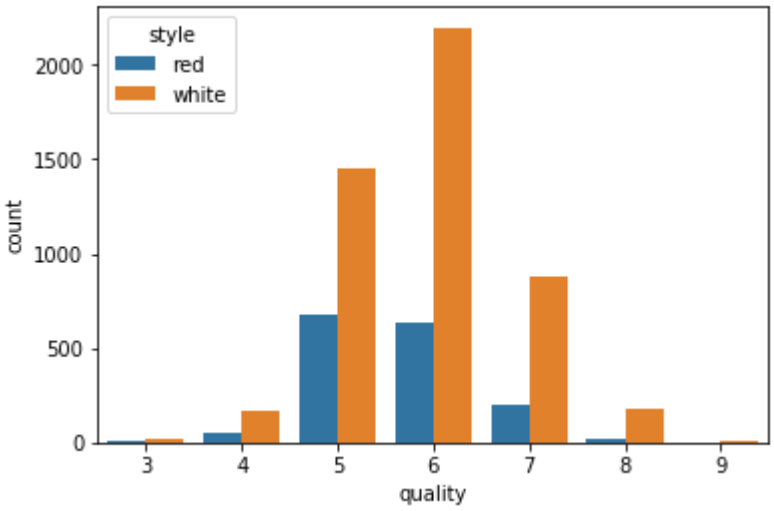
In [6]:
```
sns.countplot(wine['style'])
```

Out[6]: <matplotlib.axes._subplots.AxesSubplot at 0x249389808d0>



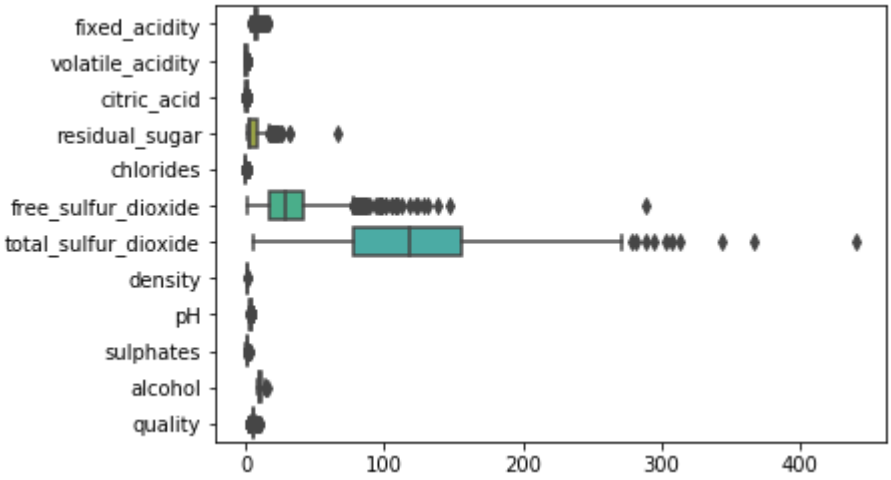
In [7]:
```
sns.countplot(wine['quality'],hue = wine['style'])
```

Out[7]: <matplotlib.axes._subplots.AxesSubplot at 0x249389b1cc0>



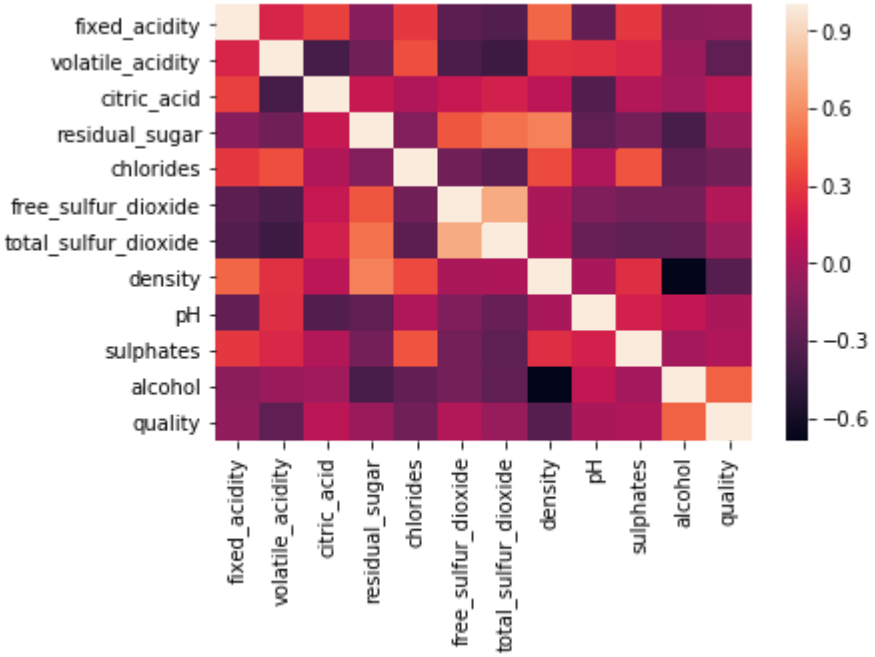
In [12]:
```
temp = [x for x in wine.columns if x not in ['style']]
sns.boxplot(data = wine[temp], orient="h")
```

Out[12]: <matplotlib.axes._subplots.AxesSubplot at 0x2493a0cc668>



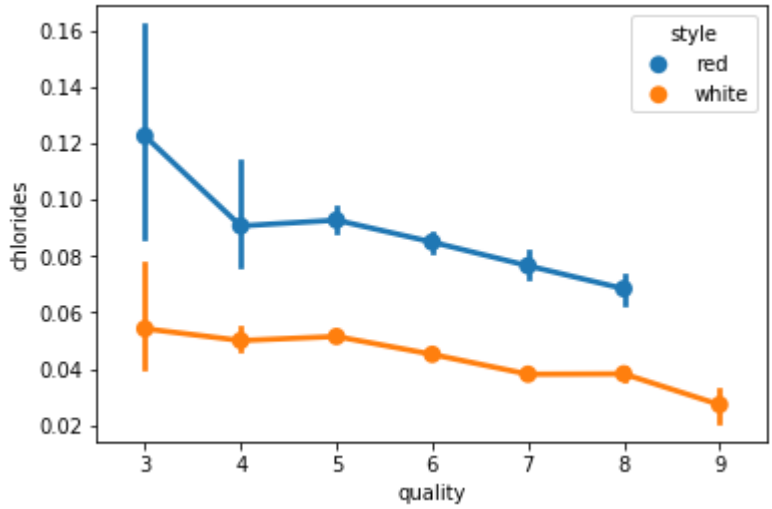
In [14]:
```
corr = wine[temp].corr()
sns.heatmap(corr)
```

Out[14]: <matplotlib.axes._subplots.AxesSubplot at 0x2493a285198>



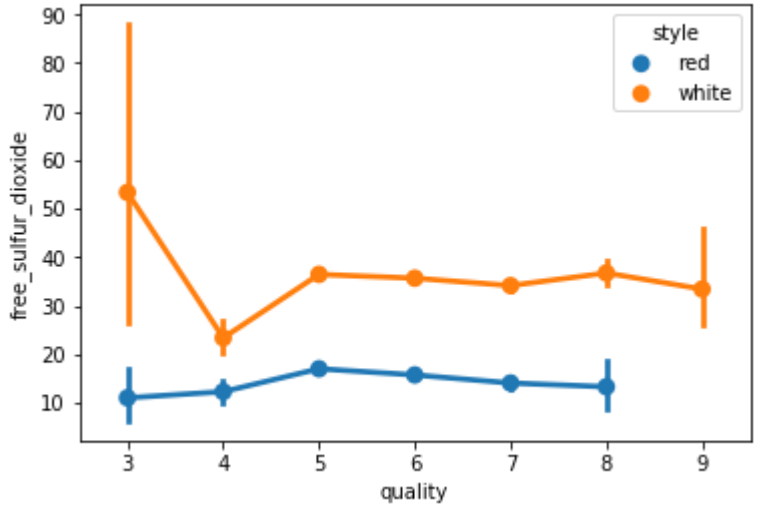
In [15]:
```
sns.pointplot(x="quality",y="chlorides",hue="style",data = wine)
```

Out[15]: <matplotlib.axes._subplots.AxesSubplot at 0x2493a3399b0>



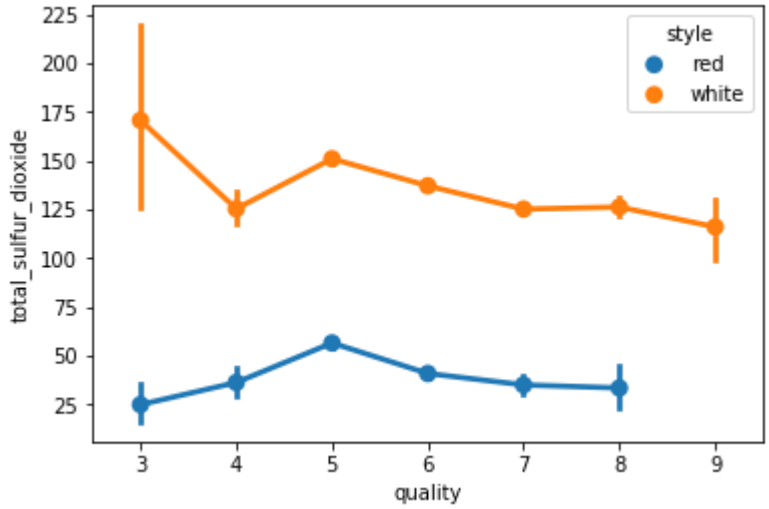
In [16]:
```
sns.pointplot(x="quality",y="free_sulfur_dioxide",hue="style",data = wine)
```

Out[16]: <matplotlib.axes._subplots.AxesSubplot at 0x2493a370278>



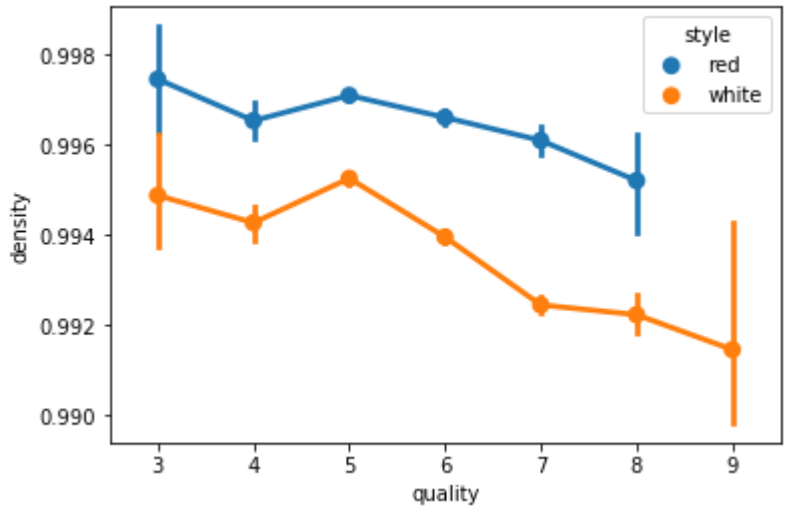
In [17]:
```
sns.pointplot(x="quality",y="total_sulfur_dioxide",hue="style",data = wine)
```

Out[17]: <matplotlib.axes._subplots.AxesSubplot at 0x2493a464320>



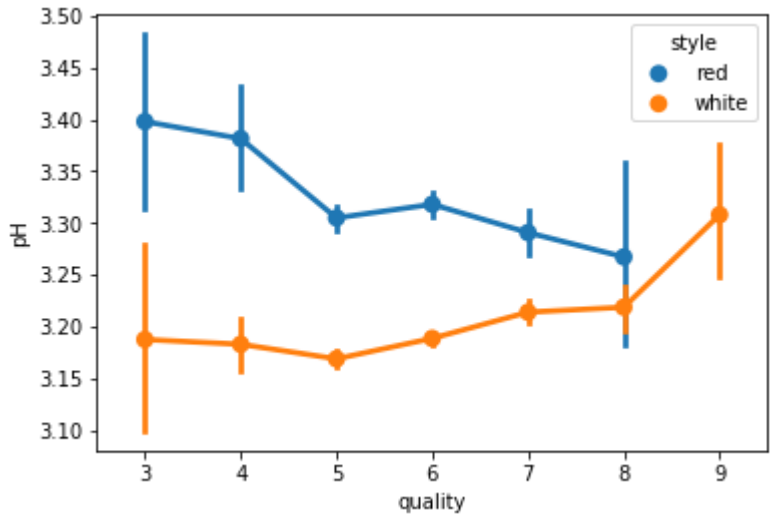
In [18]:
```
sns.pointplot(x="quality",y="density",hue="style",data = wine)
```

Out[18]: <matplotlib.axes._subplots.AxesSubplot at 0x2493a500208>



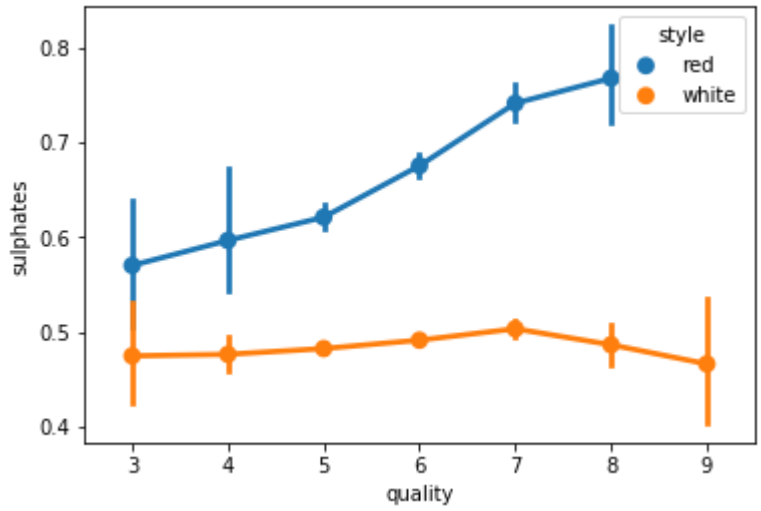
In [19]:
```
sns.pointplot(x="quality",y="pH",hue="style",data = wine)
```

Out[19]: <matplotlib.axes._subplots.AxesSubplot at 0x2493a51cb00>



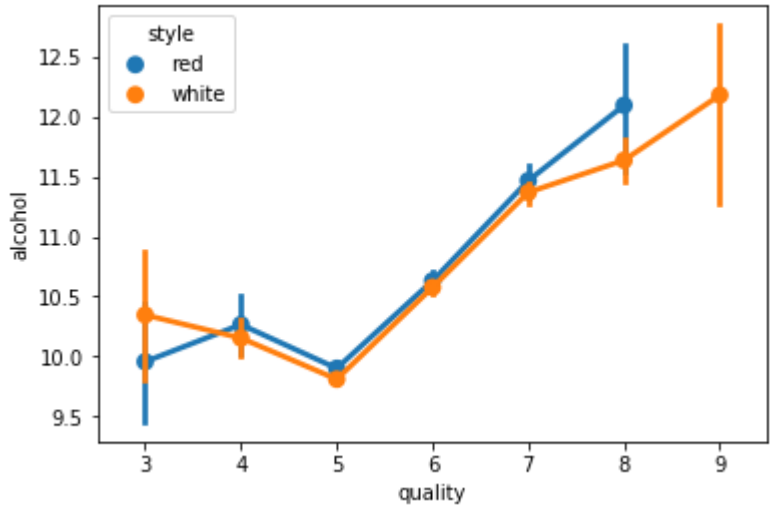
In [20]:
```
sns.pointplot(x="quality",y="sulphates",hue="style",data = wine)
```

Out[20]: <matplotlib.axes._subplots.AxesSubplot at 0x2493a5ab400>



In [21]:
```
sns.pointplot(x="quality",y="alcohol",hue="style",data = wine)
```

Out[21]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x2493a6ac470>
```



converting style datatype to int

In [38]:
```
from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()
wine['style'] = le.fit_transform(wine['style'])
```

checking the imbalance of dataset

In [25]:
```
wine['style'].value_counts(normalize = True)
```

Out[25]:
```
white    0.753886
red      0.246114
Name: style, dtype: float64
```

Modeling

In [32]:
```
from sklearn.model_selection import train_test_split
from sklearn.model_selection import cross_val_score
from sklearn.metrics import f1_score
from sklearn.tree import DecisionTreeClassifier
from sklearn.linear_model import LogisticRegression
from sklearn.ensemble import RandomForestClassifier
from xgboost import XGBClassifier
from imblearn.over_sampling import SMOTE
```

In [27]:
```
def data_sampling(X, y, method = 'smote', kind = 'regular', seed = 0):
    if method == 'smote':
        sm = SMOTE(kind = kind)
        X_res, y_res = sm.fit_sample(X, y)

    return {'X' : X_res, 'y' : y_res}
```

In [39]:
```
feature_names = [x for x in wine.columns if x not in ['style']]
target = wine['style']
```

In [40]:
```
X = wine[feature_names].values
y = wine['style'].values
```

In [41]:
```
X_train, X_valid, y_train, y_valid=  train_test_split(X,y,train_size = 0.7,str
atify = y,random_state = 0)
```

```
C:\Users\AA\Anaconda3\lib\site-packages\sklearn\model_selection\_split.py:202
6: FutureWarning: From version 0.21, test_size will always complement train_s
ize unless both are specified.
  FutureWarning)
```

applying smote on data

In [42]:
```
smote = data_sampling(X_train, y_train, method = 'smote')
X_SMOTE_train = smote['X']
y_SMOTE_train = smote['y']
```

In [43]:
```
pd.DataFrame({'target' : y_SMOTE_train})['target'].value_counts(normalize=True
)
```

Out[43]:
```
1    0.5
0    0.5
Name: target, dtype: float64
```

Logistic Regression

In [44]:
```
lr = LogisticRegression(random_state = 0)
lr.fit(X_SMOTE_train, y_SMOTE_train)
```

Out[44]:
```
LogisticRegression(C=1.0, class_weight=None, dual=False, fit_intercept=True,
          intercept_scaling=1, max_iter=100, multi_class='ovr', n_jobs=1,
          penalty='l2', random_state=0, solver='liblinear', tol=0.0001,
          verbose=0, warm_start=False)
```

In [45]:
```
f1_score(y_valid, lr.predict(X_valid))
```

Out[45]:
```
0.9866209262435678
```

kfold cross validation

In [47]:
```
f1 = cross_val_score(lr,X_SMOTE_train, y_SMOTE_train, cv=3, scoring='f1')
```

In [48]:
```
f1
```

Out[48]:
```
array([0.97150373, 0.98601399, 0.98030635])
```

Decission Tree

In [92]:
```
clf = DecisionTreeClassifier(random_state = 0)
clf.fit(X_SMOTE_train, y_SMOTE_train)
```

Out[92]:
```
DecisionTreeClassifier(class_weight=None, criterion='gini', max_depth=None,
            max_features=None, max_leaf_nodes=None,
            min_impurity_decrease=0.0, min_impurity_split=None,
            min_samples_leaf=1, min_samples_split=2,
            min_weight_fraction_leaf=0.0, presort=False, random_state=0,
            splitter='best')
```

In [93]:
```
f1_score(y_valid, clf.predict(X_valid))
```

Out[93]:
```
0.9877467665078286
```

grid search with cross validation

In [51]:
```
from sklearn.model_selection import GridSearchCV
parameters = [{'max_depth' :[5,10,15,20]}]
grid_search = GridSearchCV(clf,param_grid = parameters,scoring = 'f1',cv = 3,n
_jobs = -1)
```

In [52]:
```
grid_search = grid_search.fit(X_SMOTE_train, y_SMOTE_train)
```

In [53]:
```
grid_search.best_score_
```

Out[53]:
```
0.9887692782409007
```

In [54]:
```
grid_search.best_params_
```

Out[54]:
```
{'max_depth': 10}
```

Random Forest

In [94]:
```
rf = RandomForestClassifier(random_state = 0)
rf.fit(X_SMOTE_train, y_SMOTE_train)
```

Out[94]:
```
RandomForestClassifier(bootstrap=True, class_weight=None, criterion='gini',
            max_depth=None, max_features='auto', max_leaf_nodes=None,
            min_impurity_decrease=0.0, min_impurity_split=None,
            min_samples_leaf=1, min_samples_split=2,
            min_weight_fraction_leaf=0.0, n_estimators=10, n_jobs=1,
            oob_score=False, random_state=0, verbose=0, warm_start=False)
```

In [95]:
```
f1_score(y_valid, rf.predict(X_valid))
```

Out[95]:
```
0.9942196531791907
```

grid search with cross validation

In [56]:
```
parameters = [{'max_depth' :[5,10,15,20] , 'max_features':[3,4,5,6]}]
grid_search = GridSearchCV(rf,param_grid = parameters,scoring = 'f1',cv = 3,n_
jobs = -1)
```

In [57]:
```
grid_search = grid_search.fit(X_SMOTE_train, y_SMOTE_train)
```

In [69]:
```
grid_search.best_score_
```

Out[69]:
```
0.9951893099026833
```

In [59]:
```
grid_search.best_params_
```

Out[59]:
```
{'max_depth': 10, 'max_features': 4}
```

xgboost

In [96]:
```
xgb = XGBClassifier(random_state = 0, n_estimators=50)
xgb.fit(X_SMOTE_train, y_SMOTE_train)
```

Out[96]:
```
XGBClassifier(base_score=0.5, booster='gbtree', colsample_bylevel=1,
       colsample_bytree=1, gamma=0, learning_rate=0.1, max_delta_step=0,
       max_depth=3, min_child_weight=1, missing=None, n_estimators=50,
       n_jobs=1, nthread=None, objective='binary:logistic', random_state=0,
       reg_alpha=0, reg_lambda=1, scale_pos_weight=1, seed=None,
       silent=True, subsample=1)
```

In [97]:
```
from sklearn.metrics import confusion_matrix
confusion_matrix(y_valid,xgb.predict(X_valid))
```

```
C:\Users\AA\Anaconda3\lib\site-packages\sklearn\preprocessing\label.py:151: D
eprecationWarning: The truth value of an empty array is ambiguous. Returning
False, but in future this will result in an error. Use `array.size > 0` to ch
eck that an array is not empty.
  if diff:
```

Out[97]:
```
array([[ 472,    8],
       [   8, 1462]], dtype=int64)
```

In [98]:
```
f1_score(y_valid, xgb.predict(X_valid))
```

```
C:\Users\AA\Anaconda3\lib\site-packages\sklearn\preprocessing\label.py:151: D
eprecationWarning: The truth value of an empty array is ambiguous. Returning
False, but in future this will result in an error. Use `array.size > 0` to ch
eck that an array is not empty.
  if diff:
```

Out[98]:
```
0.9945578231292517
```

grid search with cross validation

In [112]:
```
parameters = [{'max_depth' :[5,10,15,20] , 'n_estimators':[50,100,200,500]}]
grid_search = GridSearchCV(xgb,param_grid = parameters,scoring = 'f1',cv = 3,n
_jobs = -1)
```

In [113]:
```
grid_search = grid_search.fit(X_SMOTE_train, y_SMOTE_train)
```

In [114]:
```
grid_search.best_score_
```

Out[114]:
```
0.9962130517425446
```

In [115]:
```
grid_search.best_params_
```

Out[115]:
```
{'max_depth': 5, 'n_estimators': 500}
```

In [104]:
```
xgb.feature_importances_
```

Out[104]:
```
array([0.0545977 , 0.11781609, 0.00574713, 0.0316092 , 0.1724138 ,
       0.00574713, 0.25574714, 0.08045977, 0.10632184, 0.12068965,
       0.04885057, 0.        ], dtype=float32)
```

In [105]:
```
pd.DataFrame()
pd.DataFrame({'colname' : wine[temp].columns,'importance' : xgb.feature_import
ances_})
```

Out[105]:

	colname	importance
0	fixed_acidity	0.054598
1	volatile_acidity	0.117816
2	citric_acid	0.005747
3	residual_sugar	0.031609
4	chlorides	0.172414
5	free_sulfur_dioxide	0.005747
6	total_sulfur_dioxide	0.255747
7	density	0.080460
8	pH	0.106322
9	sulphates	0.120690
10	alcohol	0.048851
11	quality	0.000000

applying parameters obtained form gridsearch to model

In [116]:
```
xgb = XGBClassifier(random_state = 0, max_depth = 5,n_estimators=500)
xgb.fit(X_SMOTE_train, y_SMOTE_train)
```

Out[116]:
```
XGBClassifier(base_score=0.5, booster='gbtree', colsample_bylevel=1,
       colsample_bytree=1, gamma=0, learning_rate=0.1, max_delta_step=0,
       max_depth=5, min_child_weight=1, missing=None, n_estimators=500,
       n_jobs=1, nthread=None, objective='binary:logistic', random_state=0,
       reg_alpha=0, reg_lambda=1, scale_pos_weight=1, seed=None,
       silent=True, subsample=1)
```

In [117]:
```
f1_score(y_valid, xgb.predict(X_valid))
```

```
C:\Users\AA\Anaconda3\lib\site-packages\sklearn\preprocessing\label.py:151: D
eprecationWarning: The truth value of an empty array is ambiguous. Returning
False, but in future this will result in an error. Use `array.size > 0` to ch
eck that an array is not empty.
  if diff:
```

Out[117]:
```
0.9959211420802174
```