Water Quality Index- EDA & Classification

April 20, 2022

[5]:
```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
import warnings
warnings.filterwarnings('ignore')
```

[8]:
```
water_data=pd.read_csv("/Users/jay/Desktop/Codes_Repo/Data Analysis/Water␣
↪Quality_EDA/water_quality.csv")
```

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

[11]:
```
         ph    Hardness        Solids  Chloramines     Sulfate  Conductivity  \
0       NaN  204.890456  20791.31898     7.300212  368.516441    564.308654
1  3.716080  129.422921  18630.05786     6.635246         NaN    592.885359
2  8.099124  224.236259  19909.54173     9.275884         NaN    418.606213
3  8.316766  214.373394  22018.41744     8.059332  356.886136    363.266516
4  9.092223  181.101509  17978.98634     6.546600  310.135738    398.410813

   Organic_carbon  Trihalomethanes  Turbidity  Potability
0       10.379783        86.990970   2.963135           0
1       15.180013        56.329076   4.500656           0
2       16.868637        66.420093   3.055934           0
3       18.436525       100.341674   4.628771           0
4       11.558279        31.997993   4.075075           0
```

[12]:
```
water_data.tail()
```

[12]:
```
            ph    Hardness        Solids  Chloramines     Sulfate  \
3271  4.668102  193.681736  47580.99160     7.166639  359.948574
3272  7.808856  193.553212  17329.80216     8.061362         NaN
3273  9.419510  175.762646  33155.57822     7.350233         NaN
3274  5.126763  230.603758  11983.86938     6.303357         NaN
3275  7.874671  195.102299  17404.17706     7.509306         NaN

      Conductivity  Organic_carbon  Trihalomethanes  Turbidity  Potability
3271    526.424171       13.894419        66.687695   4.435821           1
3272    392.449580       19.903225              NaN   2.798243           1
```

```
3273    432.044783      11.039070       69.845400   3.298875           1
3274    402.883113      11.168946       77.488213   4.708658           1
3275    327.459761      16.140368       78.698446   2.309149           1
```

[13]:
```
water_data.shape
```

[13]:
```
(3276, 10)
```

[14]:
```
water_data.columns
```

[14]:
```
Index(['ph', 'Hardness', 'Solids', 'Chloramines', 'Sulfate', 'Conductivity',
       'Organic_carbon', 'Trihalomethanes', 'Turbidity', 'Potability'],
      dtype='object')
```

[15]:
```
water_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 3276 entries, 0 to 3275
Data columns (total 10 columns):
 #   Column           Non-Null Count  Dtype
---  ------           --------------  -----
 0   ph               2785 non-null   float64
 1   Hardness         3276 non-null   float64
 2   Solids           3276 non-null   float64
 3   Chloramines      3276 non-null   float64
 4   Sulfate          2495 non-null   float64
 5   Conductivity     3276 non-null   float64
 6   Organic_carbon   3276 non-null   float64
 7   Trihalomethanes  3114 non-null   float64
 8   Turbidity        3276 non-null   float64
 9   Potability       3276 non-null   int64
dtypes: float64(9), int64(1)
memory usage: 256.1 KB
```

[16]:
```
water_data.describe()
```

[16]:
```
                ph     Hardness        Solids  Chloramines      Sulfate  \
count  2785.000000  3276.000000   3276.000000  3276.000000  2495.000000
mean      7.080795   196.369496  22014.092526     7.122277   333.775777
std       1.594320    32.879761   8768.570828     1.583085    41.416840
min       0.000000    47.432000    320.942611     0.352000   129.000000
25%       6.093092   176.850538  15666.690300     6.127421   307.699498
50%       7.036752   196.967627  20927.833605     7.130299   333.073546
75%       8.062066   216.667456  27332.762125     8.114887   359.950170
max      14.000000   323.124000  61227.196010    13.127000   481.030642

       Conductivity  Organic_carbon  Trihalomethanes    Turbidity  Potability
count   3276.000000     3276.000000      3114.000000  3276.000000  3276.000000
```

mean	426.205111	14.284970	66.396293	3.966786	0.390110
std	80.824064	3.308162	16.175008	0.780382	0.487849
min	181.483754	2.200000	0.738000	1.450000	0.000000
25%	365.734414	12.065801	55.844536	3.439711	0.000000
50%	421.884968	14.218338	66.622485	3.955028	0.000000
75%	481.792305	16.557652	77.337473	4.500320	1.000000
max	753.342620	28.300000	124.000000	6.739000	1.000000

[17]:
```
water_data.isnull().sum()
```

[17]:
```
ph                 491
Hardness             0
Solids               0
Chloramines          0
Sulfate            781
Conductivity         0
Organic_carbon       0
Trihalomethanes    162
Turbidity            0
Potability           0
dtype: int64
```

[18]:
```
water_data['ph'].fillna(water_data['ph'].mode(), inplace=True)
```

[20]:
```
water_data['Sulfate'].fillna(water_data['Sulfate'].mode(), inplace=True)
```

[22]:
```
water_data['Trihalomethanes'].fillna(water_data['Trihalomethanes'].mode(),␣
↪inplace=True)
```

[23]:
```
water_data.isnull().sum()
```

[23]:
```
ph                  65
Hardness             0
Solids               0
Chloramines          0
Sulfate            198
Conductivity         0
Organic_carbon       0
Trihalomethanes      7
Turbidity            0
Potability           0
dtype: int64
```

[24]:
```
water_data.dropna(inplace=True)
```

[25]:
```
water_data.corr()
```

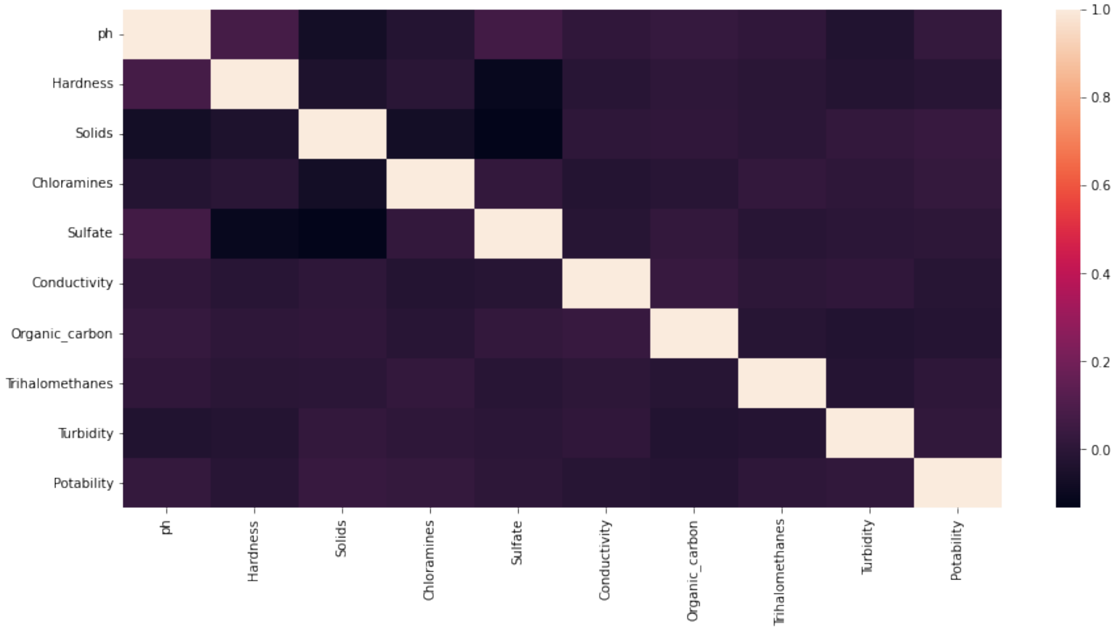
[25]:
```
                       ph  Hardness    Solids  Chloramines   Sulfate  \
ph               1.000000  0.073546 -0.072102    -0.026261  0.063919
Hardness         0.073546  1.000000 -0.043753    -0.007834 -0.107853
Solids          -0.072102 -0.043753  1.000000    -0.075168 -0.133952
Chloramines     -0.026261 -0.007834 -0.075168     1.000000  0.019461
Sulfate          0.063919 -0.107853 -0.133952     0.019461  1.000000
Conductivity     0.011440 -0.010009  0.007726    -0.026439 -0.017806
Organic_carbon   0.029681  0.004045  0.010430    -0.012763  0.017272
Trihalomethanes  0.008028 -0.009534 -0.003948     0.020067 -0.012869
Turbidity       -0.034639 -0.025290  0.017453     0.005258 -0.004721
Potability       0.021105 -0.013547  0.030630     0.022761  0.001577

                 Conductivity  Organic_carbon  Trihalomethanes  Turbidity  \
ph                   0.011440        0.029681         0.008028  -0.034639
Hardness            -0.010009        0.004045        -0.009534  -0.025290
Solids               0.007726        0.010430        -0.003948   0.017453
Chloramines         -0.026439       -0.012763         0.020067   0.005258
Sulfate             -0.017806        0.017272        -0.012869  -0.004721
Conductivity         1.000000        0.032167        -0.000832   0.010878
Organic_carbon       0.032167        1.000000        -0.014785  -0.029307
Trihalomethanes     -0.000832       -0.014785         1.000000  -0.020466
Turbidity            0.010878       -0.029307        -0.020466   1.000000
Potability          -0.016594       -0.019306         0.004839   0.012476

                 Potability
ph                 0.021105
Hardness          -0.013547
Solids             0.030630
Chloramines        0.022761
Sulfate            0.001577
Conductivity      -0.016594
Organic_carbon    -0.019306
Trihalomethanes    0.004839
Turbidity          0.012476
Potability         1.000000
```

[26]:
```
plt.figure(figsize=(15,7))
sns.heatmap(water_data.corr())
```

[26]: <AxesSubplot:>



[27]:
```
water_data.Potability.unique()
```

[27]:
```
array([0, 1])
```

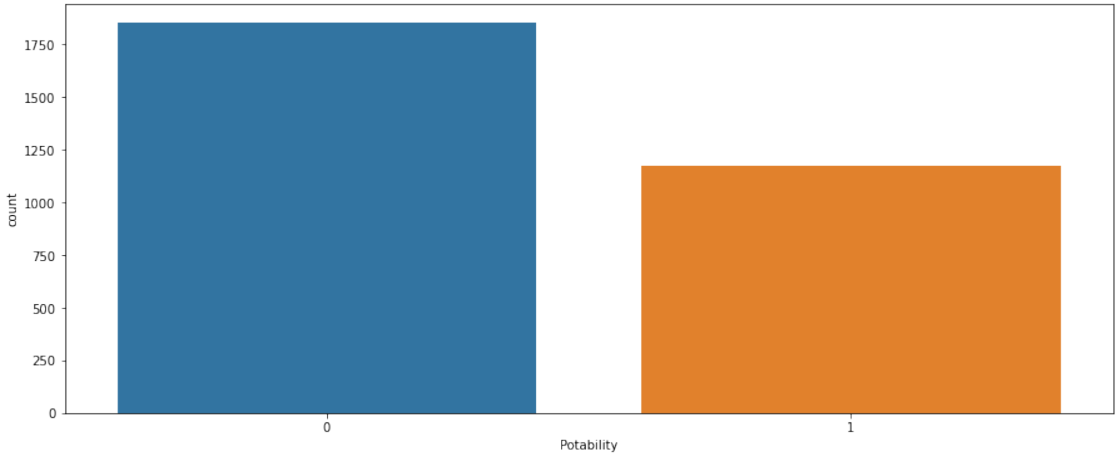
[28]:
```
water_data.Potability.value_counts()
```

[28]:
```
0    1853
1    1173
Name: Potability, dtype: int64
```

[33]:
```
plt.figure(figsize=(15,6))
sns.countplot('Potability', data=water_data)
plt.xsticks(rotation= 0)
plt.show()
```

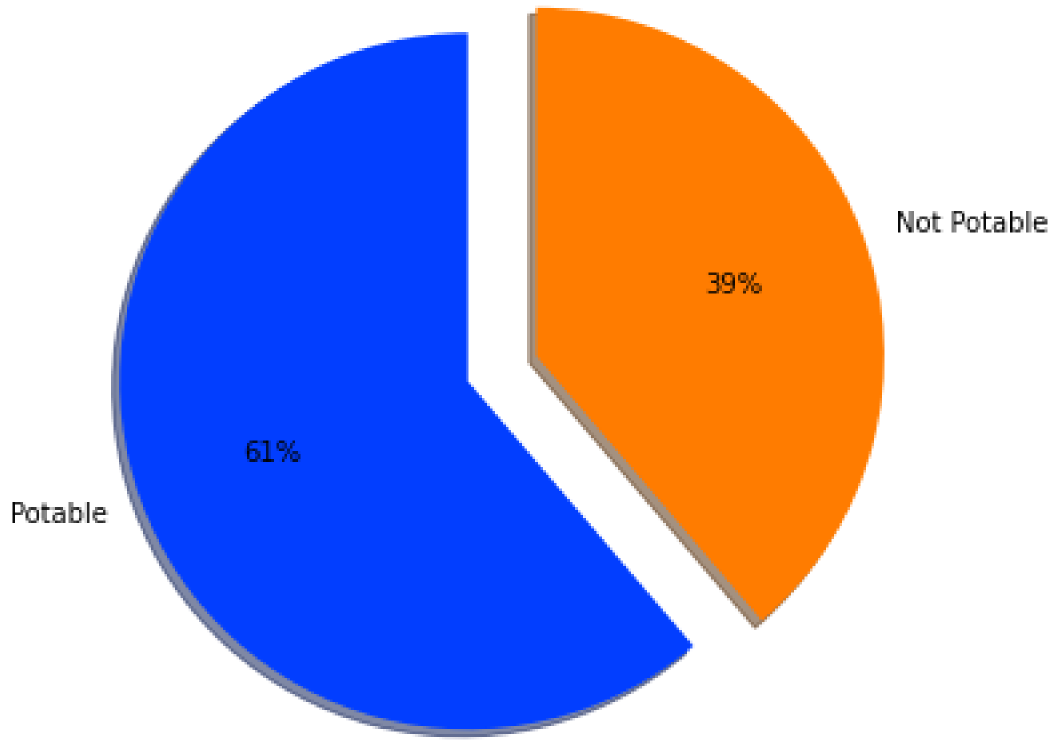
```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
/var/folders/0_/fvfpszc14j90zh4m8hmf_2yc0000gn/T/ipykernel_1433/211344869.py in
 ↪<module>
      1 plt.figure(figsize=(15,6))
      2 sns.countplot('Potability', data=water_data)
----> 3 plt.xsticks(rotation= 0)
      4 plt.show()

AttributeError: module 'matplotlib.pyplot' has no attribute 'xsticks'
```

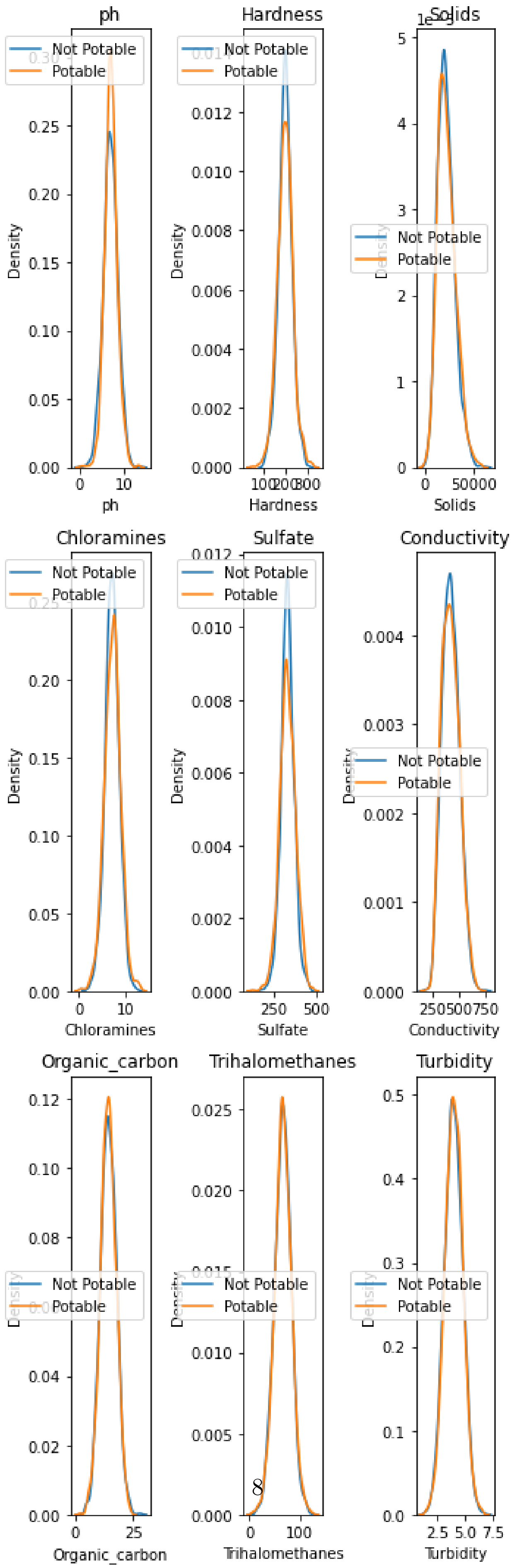


[36]:
```
plt.figure(figsize=(15,6))
explode=[0.2,0.01]
colors=sns.color_palette('bright')
plt.pie(water_data['Potability'].value_counts(), labels=['Potable','Not␣
↪Potable'],
        colors=colors, autopct='%0.0f%%', explode=explode, shadow='True',
       startangle=90)
plt.show
```

[36]:
```
<function matplotlib.pyplot.show(close=None, block=None)>
```



[38]:
```
not_potable= water_data.query('Potability==0')
potable= water_data.query('Potability==1')
plt.figure(figsize=(5,15))
for ax, col in enumerate(water_data.columns[:9]):
    plt.subplot(3,3,ax+1)
    plt.title(col)
    sns.kdeplot(x=not_potable[col], label='Not Potable')
    sns.kdeplot(x=potable[col], label='Potable')
    plt.legend()
plt.tight_layout()
```


ph
Hardness
Solids
Not Potable
Potable
Density
Chloramines
Sulfate
Conductivity
Organic_carbon
Trihalomethanes
Turbidity

[39]:
```
x=water_data.drop("Potability", axis=1).values
y=water_data["Potability"].values
```

[40]:
```
x.shape
```

[40]: (3026, 9)

[41]:
```
y.shape
```

[41]: (3026,)

[42]:
```
from sklearn.model_selection import train_test_split
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.20)
```

[44]:
```
from sklearn.tree import DecisionTreeClassifier
classifier= DecisionTreeClassifier(criterion='entropy',random_state=0)
```

[45]:
```
classifier.fit(x_train,y_train)
```

[45]: DecisionTreeClassifier(criterion='entropy', random_state=0)

[46]:
```
y_pred=classifier.predict(x_test)
```

[47]:
```
print("Training Accuracy:", classifier.score(x_train,y_train))
print("Testing Accuracy:", classifier.score(x_test,y_test))
```

```
Training Accuracy: 1.0
Testing Accuracy: 0.599009900990099
```

[48]:
```
from sklearn.metrics import confusion_matrix
cm=confusion_matrix(y_test,y_pred)
```

[49]:
```
cm
```

[49]:
```
array([[242, 119],
       [124, 121]])
```

[51]:
```
from sklearn.ensemble import RandomForestClassifier
classifier1= RandomForestClassifier(n_estimators= 10, criterion='entropy')
```

[52]:
```
classifier1.fit(x_train,y_train)
```

[52]: RandomForestClassifier(criterion='entropy', n_estimators=10)

[53]:
```
y_pred= classifier1.predict(x_test)
```

[54]:
```
print("Training Accuracy:", classifier1.score(x_train,y_train))
print("Testing Accuracy:", classifier1.score(x_test, y_test))
```

```
Training Accuracy: 0.9855371900826446
Testing Accuracy: 0.6254125412541254
```

[58]:
```
kt=confusion_matrix(y_test,y_pred)
```

[59]:
```
kt
```

[59]:
```
array([[242, 119],
       [124, 121]])
```