Milk Quality Prediction

April 5, 2023

0.1 Importing libraries

[1]:
```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score
import warnings
warnings.filterwarnings('ignore')
```

0.1.1 Milk Quality Prediction

0.2 Life cycle of Machine learning Project

- Understanding the problem statement
- Data Collection
- Exploratory Data Analysis
- Data Cleaning
- Data Pre-Processing
- Model Training

0.3 Discription of Dataset

About dataset : This dataset is manually collected from observations. It helps us to build machine learning models to predict the quality of milk. This dataset consists of 7 independent variables ie pH, Temperature, Taste, Odor, Fat, Turbidity, and Color. Generally, the Grade or Quality of the milk depends on these parameters. These parameters play a vital role in the predictive analysis of the milk.

Usage The target variable is nothing but the Grade of the milk. It can be

Target

Low (Bad)

Medium (Moderate)

High (Good)

If Taste, Odor, Fat, and Turbidity are satisfied with optimal conditions then they will assign 1 otherwise 0. Temperature and ph are given their actual values in the dataset.

We have to perform data preprocessing, and data augmentation techniques to build statistical and predictive models to predict the quality of the milk.

Inspiration To leverage the benefits of machine learning in the dairy industry.

0.3.1 Load the Dataset

[2]:
```
df = pd.read_csv('milk.csv')
```

0.3.2 EDA

0.3.3 Show the top 5 records

[3]:
```
df.head(5)
```

[3]:

	pH	Temprature	Taste	Odor	Fat	Turbidity	Colour	Grade
0	6.6	35	1	0	1	0	254	high
1	6.6	36	0	1	0	1	253	high
2	8.5	70	1	1	1	1	246	low
3	9.5	34	1	1	0	1	255	low
4	6.6	37	0	0	0	0	255	medium

0.3.4 show the last 5 records

[4]:
```
df.tail(5)
```

[4]:

	pH	Temprature	Taste	Odor	Fat	Turbidity	Colour	Grade
1054	6.7	45	1	1	0	0	247	medium
1055	6.7	38	1	0	1	0	255	high
1056	3.0	40	1	1	1	1	255	low
1057	6.8	43	1	0	1	0	250	high
1058	8.6	55	0	1	1	1	255	low

0.3.5 summary of dataset

[5]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1059 entries, 0 to 1058
Data columns (total 8 columns):
 #   Column       Non-Null Count  Dtype
---  ------       --------------  -----
 0   pH           1059 non-null   float64
 1   Temprature   1059 non-null   int64
 2   Taste        1059 non-null   int64
```

```
 3   Odor         1059 non-null   int64
 4   Fat          1059 non-null   int64
 5   Turbidity    1059 non-null   int64
 6   Colour       1059 non-null   int64
 7   Grade        1059 non-null   object
dtypes: float64(1), int64(6), object(1)
memory usage: 66.3+ KB
```

0.3.6 Check Numerical and Categorical Feature

[6]:
```
# define numerical & categorical columns
numeric_features=[feature for feature in df.columns if df[feature].dtype != 'O']
categorical_features=[feature for feature in df.columns if df[feature].dtype ==␣
↪'O']

#print columns
print(f'We have {len(numeric_features)} numerical features :{numeric_features}')
print(f'We have {len(categorical_features)} categorical features :
↪{categorical_features}')
```

```
We have 7 numerical features :['pH', 'Temprature', 'Taste', 'Odor', 'Fat ',
'Turbidity', 'Colour']
We have 1 categorical features :['Grade']
```

0.3.7 descriptive summary of the dataset

[7]:
```
df.describe()
```

[7]:
```
                pH   Temprature        Taste         Odor          Fat   \
count  1059.000000  1059.000000  1059.000000  1059.000000  1059.000000
mean      6.630123    44.226629     0.546742     0.432483     0.671388
std       1.399679    10.098364     0.498046     0.495655     0.469930
min       3.000000    34.000000     0.000000     0.000000     0.000000
25%       6.500000    38.000000     0.000000     0.000000     0.000000
50%       6.700000    41.000000     1.000000     0.000000     1.000000
75%       6.800000    45.000000     1.000000     1.000000     1.000000
max       9.500000    90.000000     1.000000     1.000000     1.000000

         Turbidity       Colour
count  1059.000000  1059.000000
mean      0.491029   251.840415
std       0.500156     4.307424
min       0.000000   240.000000
25%       0.000000   250.000000
50%       0.000000   255.000000
75%       1.000000   255.000000
max       1.000000   255.000000
```

0.3.8 shape of the dataset

[8]:
```
df.shape
```

[8]:
```
(1059, 8)
```

0.3.9 check the columns

[9]:
```
df.columns
```

[9]:
```
Index(['pH', 'Temprature', 'Taste', 'Odor', 'Fat ', 'Turbidity', 'Colour',
       'Grade'],
      dtype='object')
```

0.3.10 Unique values

[10]:
```
df['Grade'].unique()
```

[10]:
```
array(['high', 'low', 'medium'], dtype=object)
```

0.3.11 Total unique values

[11]:
```
df['Grade'].nunique()
```

[11]:
```
3
```

0.3.12 check the datatype of every columns

[12]:
```
df.dtypes
```

[12]:
```
pH             float64
Temprature       int64
Taste            int64
Odor             int64
Fat              int64
Turbidity        int64
Colour           int64
Grade           object
dtype: object
```

0.3.13 check the count of different values

[13]:
```
## it's a imbalanced data
df['Grade'].value_counts()
```

[13]:
```
low       429
medium    374
high      256
```

```
Name: Grade, dtype: int64
```

0.3.14 Check The Missing Values

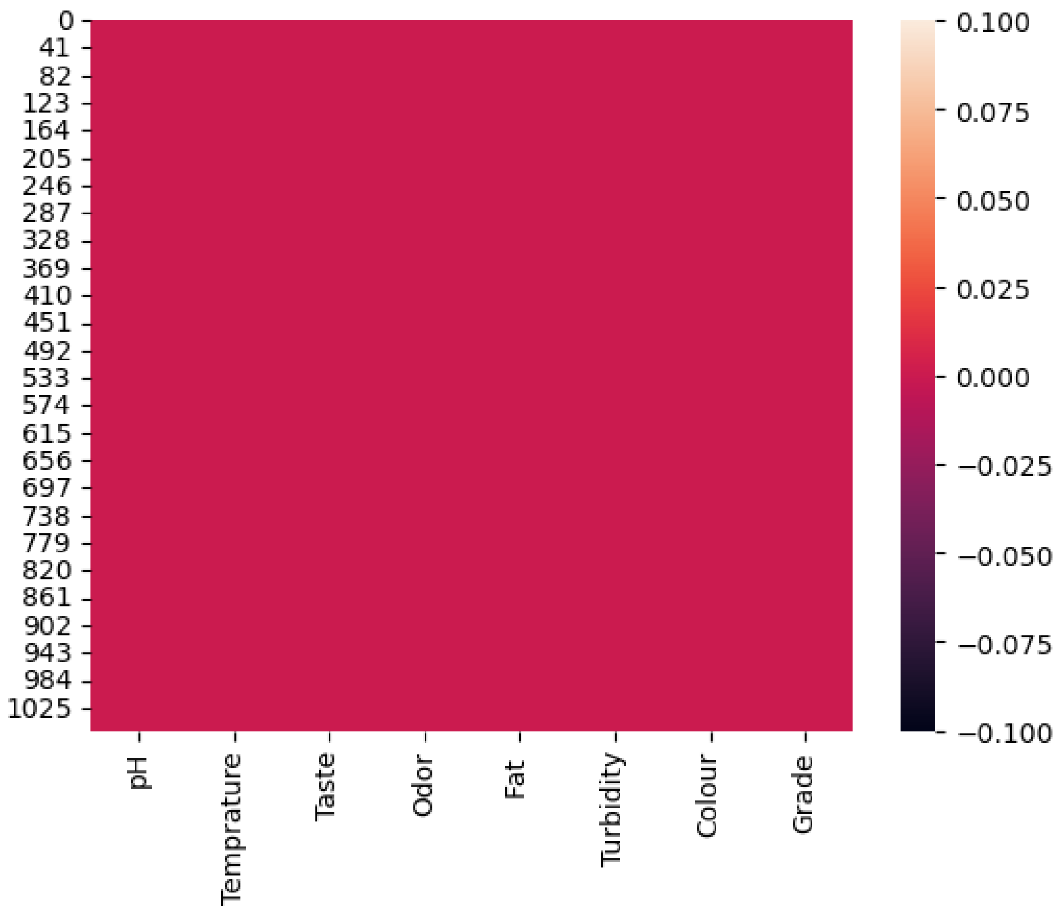
[14]:
```
df.isnull().sum()
```

[14]:
```
pH            0
Temprature    0
Taste         0
Odor          0
Fat           0
Turbidity     0
Colour        0
Grade         0
dtype: int64
```

0.3.15 From heatmap check missing values

[15]:
```
sns.heatmap(df.isnull())
```

[15]:
```
<AxesSubplot:>
```



0.3.16 To check dublicate records

[16]:
```python
## There are 240 rows are duplicated here
df[df.duplicated()]
```

[16]:

	pH	Temprature	Taste	Odor	Fat	Turbidity	Colour	Grade
35	6.8	45	0	1	1	1	255	high
48	9.5	34	1	1	0	1	255	low
50	6.6	37	1	1	1	1	255	high
51	5.5	45	1	0	1	1	250	low
52	4.5	60	0	1	1	1	250	low
…	…	…	…	…	…	…	…	…
1054	6.7	45	1	1	0	0	247	medium
1055	6.7	38	1	0	1	0	255	high
1056	3.0	40	1	1	1	1	255	low
1057	6.8	43	1	0	1	0	250	high
1058	8.6	55	0	1	1	1	255	low

[976 rows x 8 columns]

0.3.17 Checking the count of duplicate value

[17]:
```python
df.duplicated().sum()
```

[17]: 976

0.3.18 Check each columns unique values

[18]:
```python
for i in df.columns:
    print(i)
    print(df[i].unique())
    print('_______________________________________')
```

```
pH
[6.6 8.5 9.5 5.5 4.5 8.1 6.7 5.6 8.6 7.4 6.8 6.5 4.7 3.  9.  6.4]
_______________________________________
Temprature
[35 36 70 34 37 45 60 66 50 55 90 38 40 43 42 41 65]
_______________________________________
Taste
[1 0]
_______________________________________
Odor
[0 1]
_______________________________________
```

```
Fat
[1 0]
---------------------------------------
Turbidity
[0 1]
---------------------------------------
Colour
[254 253 246 255 250 247 245 240 248]
---------------------------------------
Grade
['high' 'low' 'medium']
---------------------------------------
```

0.3.19 Check Each column value Counts

[19]:
```
for i in df.columns:
    print(i)
    print(df[i].value_counts())
    print('__________________________________________')
```

```
pH
6.8    249
6.5    189
6.6    159
6.7     82
3.0     70
9.0     61
8.6     40
7.4     39
4.5     37
9.5     24
8.1     24
5.5     23
8.5     22
4.7     20
5.6     19
6.4      1
Name: pH, dtype: int64
__________________________________________
Temprature
45    219
38    179
40    132
37     83
43     77
36     66
50     58
55     48
```

```
34     40
41     30
66     24
35     23
70     22
65     22
60     18
90     17
42      1
Name: Temprature, dtype: int64
------------------------------------------
Taste
1    579
0    480
Name: Taste, dtype: int64
------------------------------------------
Odor
0    601
1    458
Name: Odor, dtype: int64
------------------------------------------
Fat
1    711
0    348
Name: Fat , dtype: int64
------------------------------------------
Turbidity
0    539
1    520
Name: Turbidity, dtype: int64
------------------------------------------
Colour
255    628
250    146
245    115
247     48
246     44
240     32
248     23
253     22
254      1
Name: Colour, dtype: int64
------------------------------------------
Grade
low       429
medium    374
high      256
Name: Grade, dtype: int64
```

0.3.20 Check the corelations

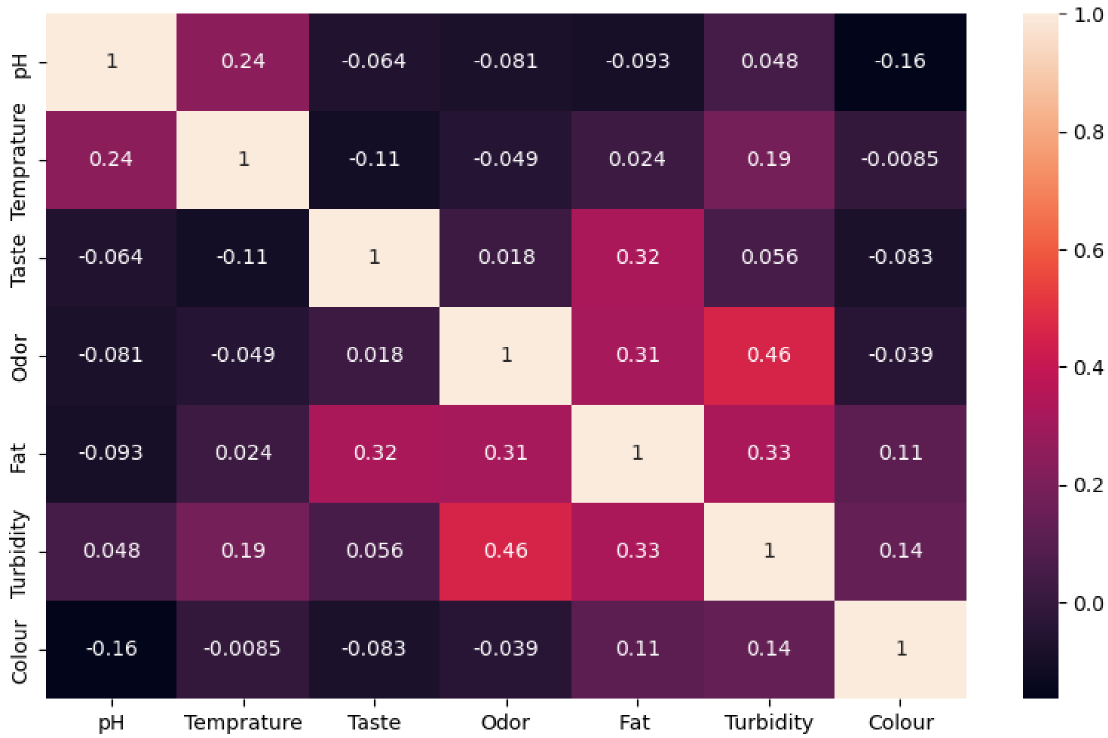
[20]:
```
df.corr()
```

[20]:
```
                  pH  Temprature     Taste      Odor       Fat  Turbidity  \
pH          1.000000    0.244684 -0.064053 -0.081331 -0.093429   0.048384
Temprature  0.244684    1.000000 -0.109792 -0.048870  0.024073   0.185106
Taste      -0.064053   -0.109792  1.000000  0.017582  0.324149   0.055755
Odor       -0.081331   -0.048870  0.017582  1.000000  0.314505   0.457935
Fat        -0.093429    0.024073  0.324149  0.314505  1.000000   0.329264
Turbidity   0.048384    0.185106  0.055755  0.457935  0.329264   1.000000
Colour     -0.164565   -0.008511 -0.082654 -0.039361  0.114151   0.136436

              Colour
pH         -0.164565
Temprature -0.008511
Taste      -0.082654
Odor       -0.039361
Fat         0.114151
Turbidity   0.136436
Colour      1.000000
```

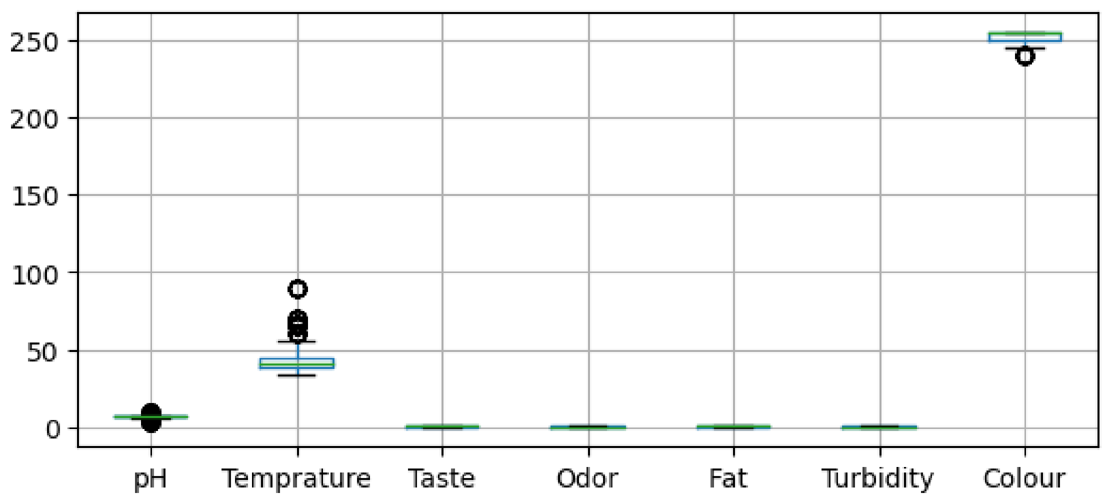
[21]:
```
plt.figure(figsize=(10,6))
sns.heatmap(df.corr(),annot=True)
```

[21]: <AxesSubplot:>

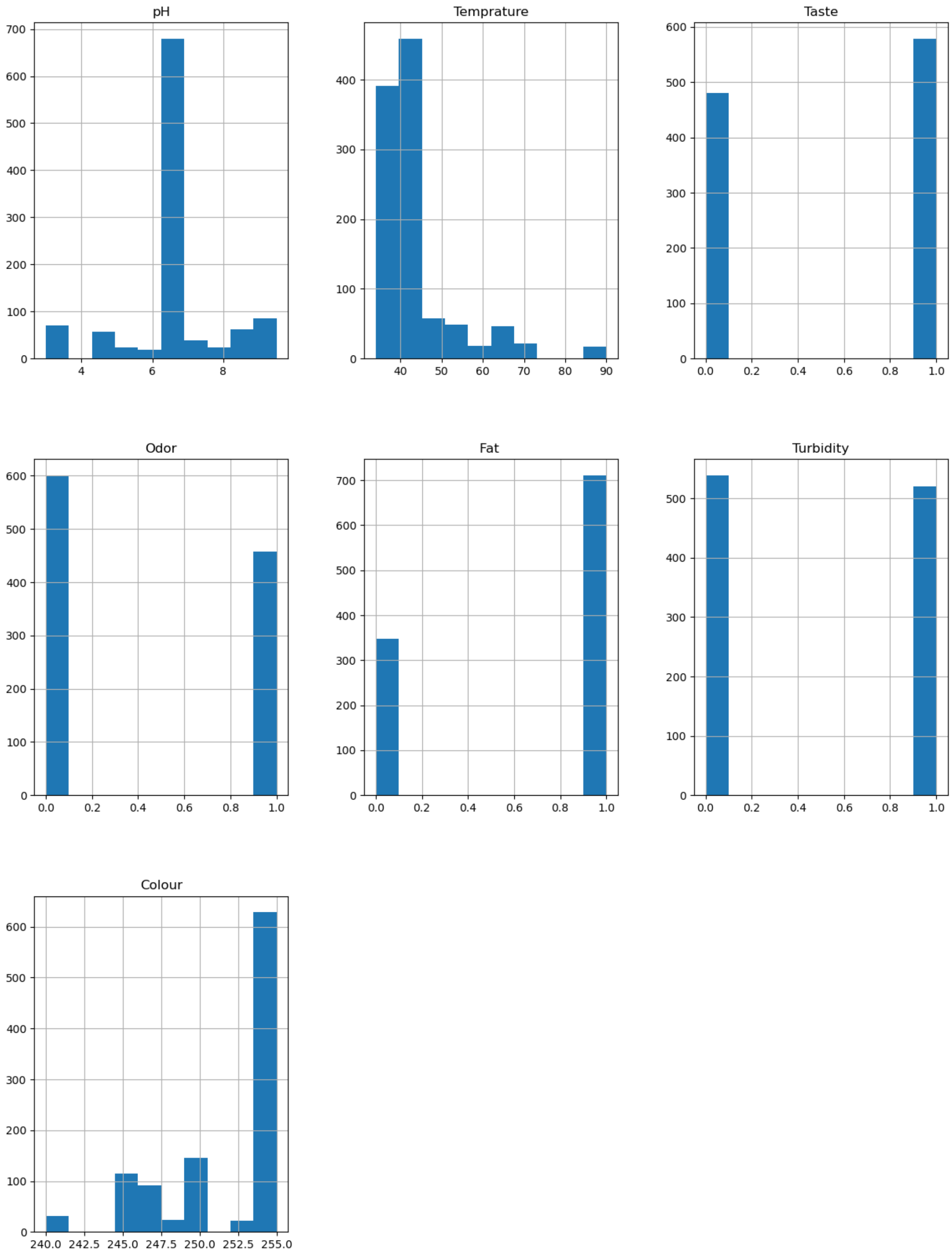


[22]:
```
plt.figure(figsize=(7,3))
df.boxplot()
```

[22]: <AxesSubplot:>



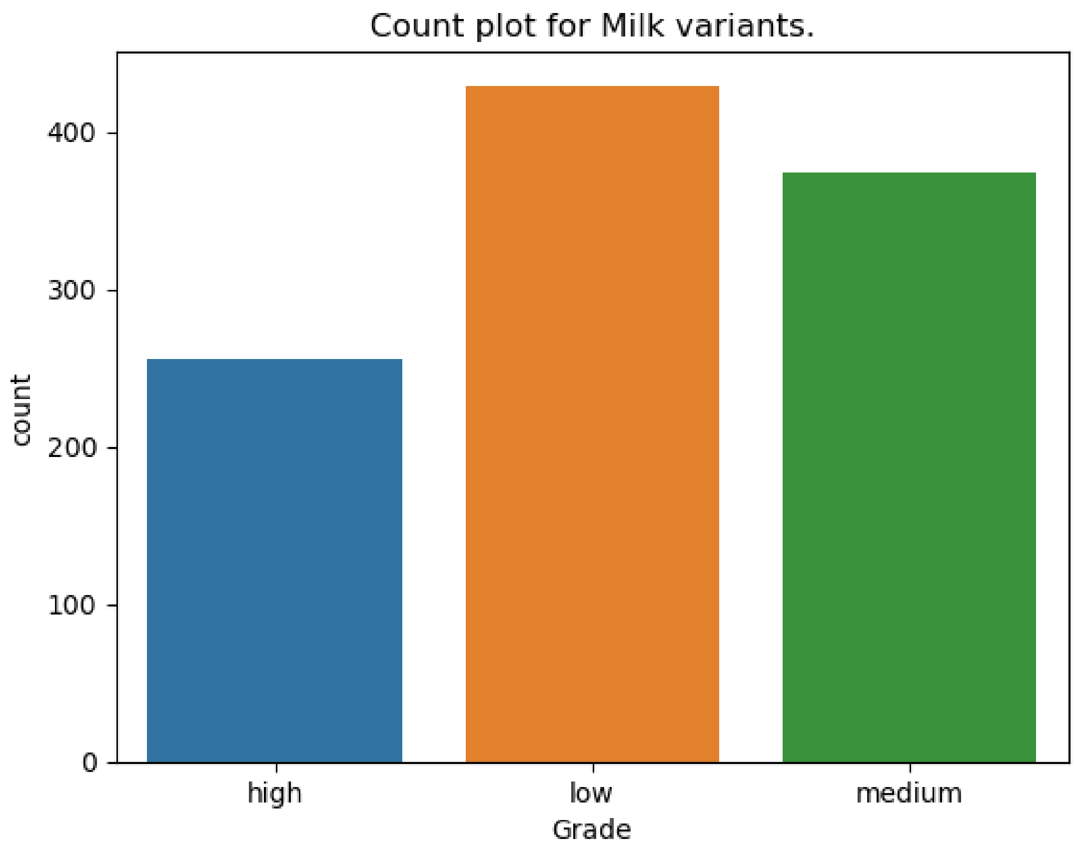
[23]:
```
df.hist(figsize=(15,20));
```



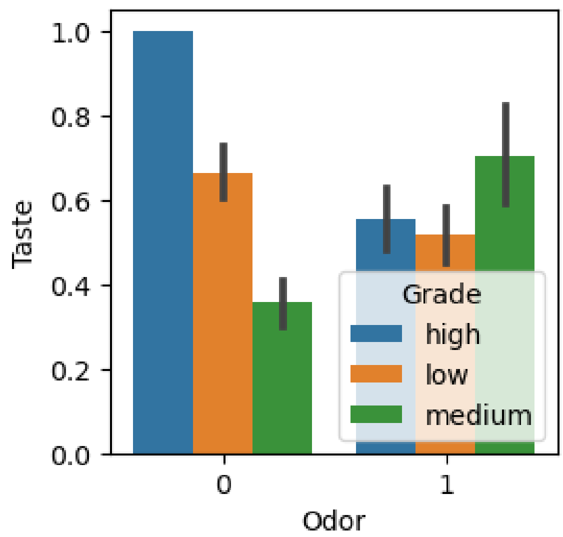
0.3.21 Countplot

[24]:
```
sns.countplot(x='Grade', data=df).set_title('Count plot for Milk variants.')
```

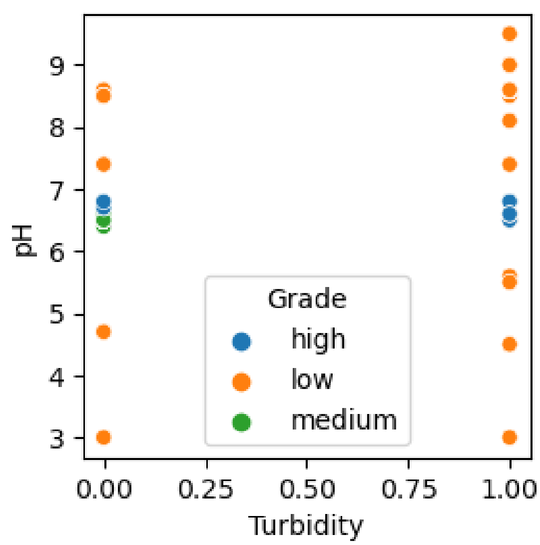
[24]: Text(0.5, 1.0, 'Count plot for Milk variants.')



[25]:
```
plt.figure(figsize=(3,3))
sns.barplot(x='Odor',y='Taste',hue='Grade',data=df)
plt.show()
```

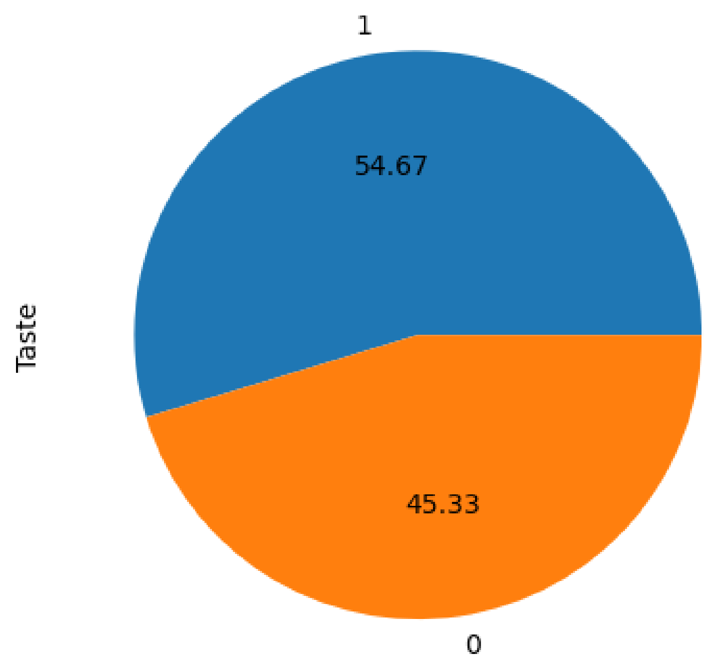


[26]:
```
plt.figure(figsize=(3,3))
sns.scatterplot(x='Turbidity',y='pH',hue='Grade',data=df)
plt.show()
```



[27]:
```
df['Taste'].value_counts().plot(kind='pie',autopct='%.2f')
```

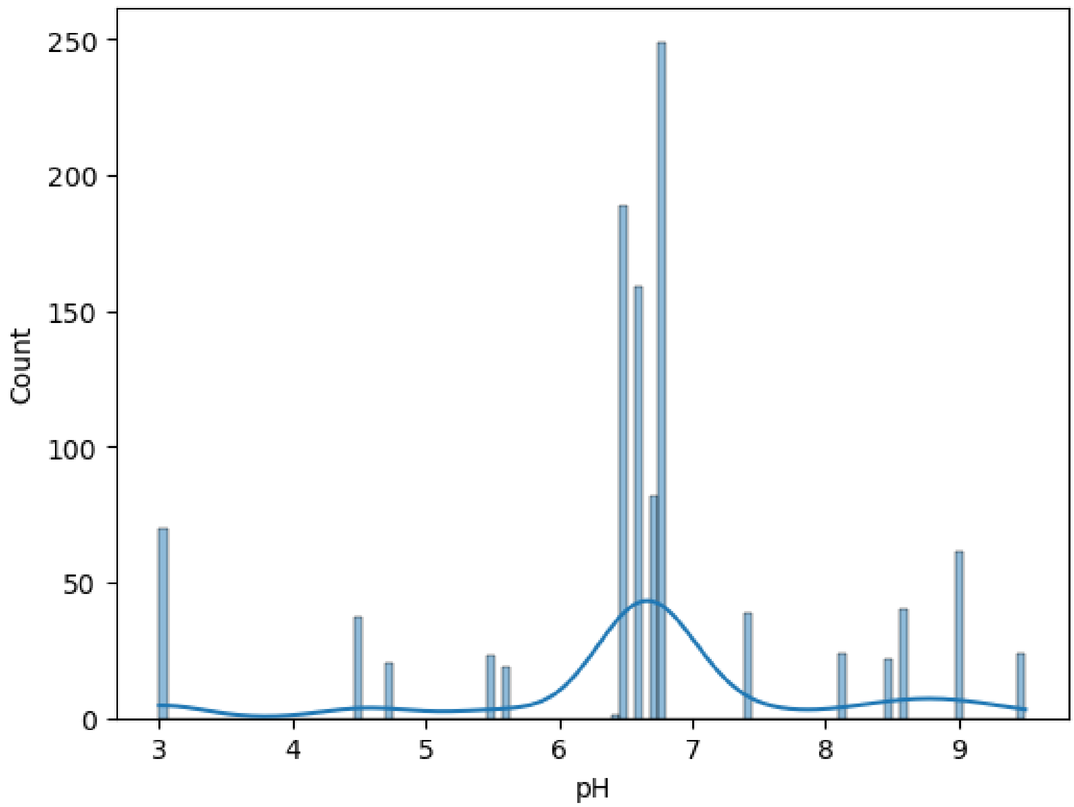
[27]: <AxesSubplot:ylabel='Taste'>



0.3.22 Histplot

[28]:
```
sns.histplot(df['pH'],kde=True)
```

[28]:
```
<AxesSubplot:xlabel='pH', ylabel='Count'>
```



0.4 Feature Engineering

0.4.1 Convert categorical feature to numerical feature of Grade

[29]:
```
from sklearn import preprocessing
```

[30]:
```
label_encoder = preprocessing.LabelEncoder()
```

[31]:
```
#transform Grade in numerical numbers using label encoder
df['Grade']= label_encoder.fit_transform(df['Grade'])
```

[32]:
```
df.head()
```

[32]:

	pH	Temprature	Taste	Odor	Fat	Turbidity	Colour	Grade
0	6.6	35	1	0	1	0	254	0
1	6.6	36	0	1	0	1	253	0
2	8.5	70	1	1	1	1	246	1
3	9.5	34	1	1	0	1	255	1
4	6.6	37	0	0	0	0	255	2

0.4.2 Building a Machine Learning Model

[33]:
```
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_absolute_error ,mean_squared_error,␣
 ↪median_absolute_error,confusion_matrix,accuracy_score,r2_score

from sklearn.tree import DecisionTreeRegressor
from sklearn.neighbors import KNeighborsRegressor
from sklearn.ensemble import RandomForestRegressor
from sklearn.linear_model import LinearRegression
from xgboost import XGBRegressor
```

[34]:
```
#splinting into train and test
x= df.drop(['Grade'],axis=1)
y= df['Grade']
```

[35]:
```
X_train,X_test,y_train,y_test = train_test_split(x,y,test_size=0.
 ↪2,random_state=43)
```

[36]:
```
print("X Train : ", X_train.shape)
print("X Test  : ", X_test.shape)
print("Y Train : ", y_train.shape)
print("Y Test  : ", y_test.shape)
```

```
X Train :  (847, 7)
X Test  :  (212, 7)
Y Train :  (847,)
Y Test  :  (212,)
```

[37]:
```
LR = LinearRegression()
DTR = DecisionTreeRegressor()
RFR = RandomForestRegressor()
KNR = KNeighborsRegressor()
XGB = XGBRegressor()
```

[38]:
```
li = [LR,DTR,RFR,KNR,XGB]
d = {}
for i in li:
    i.fit(X_train,y_train)
    ypred = i.predict(X_test)
    print(i,"",r2_score(y_test,ypred)*100)
    d.update({str(i):i.score(X_test,y_test)*100})
```

```
LinearRegression()  44.84265466163559
DecisionTreeRegressor()  99.20824619061847
RandomForestRegressor()  98.01855691664176
KNeighborsRegressor()  93.9193307439498
XGBRegressor(base_score=None, booster=None, callbacks=None,
             colsample_bylevel=None, colsample_bynode=None,
```

```
colsample_bytree=None, early_stopping_rounds=None,
enable_categorical=False, eval_metric=None, feature_types=None,
gamma=None, gpu_id=None, grow_policy=None, importance_type=None,
interaction_constraints=None, learning_rate=None, max_bin=None,
max_cat_threshold=None, max_cat_to_onehot=None,
max_delta_step=None, max_depth=None, max_leaves=None,
min_child_weight=None, missing=nan, monotone_constraints=None,
n_estimators=100, n_jobs=None, num_parallel_tree=None,
predictor=None, random_state=None, …)  98.61448086522984
```

[ ]: