Assignment-4

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TASK 1

```
import pandas as pd
```

```
df=pd.read_csv('/content/winequality-red.csv')
df.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
```

```
df.shape
```

```
(1599, 12)
```

TASK 2

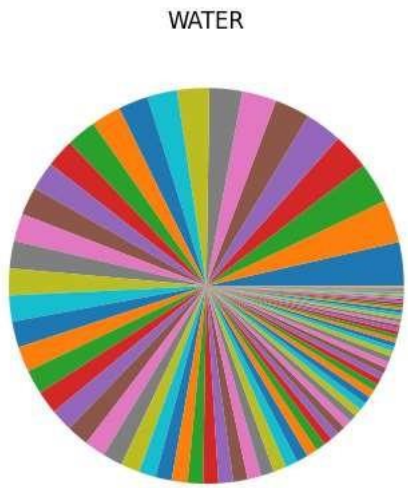
Univariate

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

```
sns.displot(df.pH)
```

```
<seaborn.axisgrid.FacetGrid at 0x7df31745cc40>
```

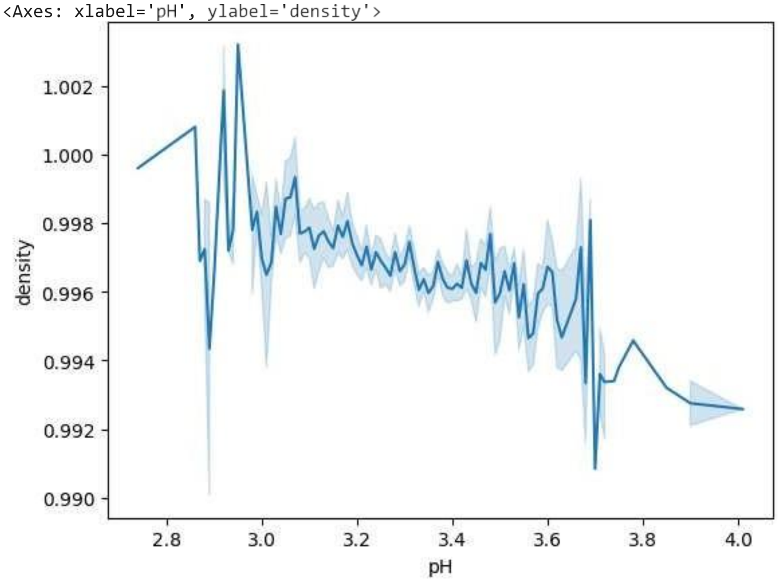

```
plt.pie(df.pH.value_counts())
plt.title('WATER')
plt.show()
```



Bivariate

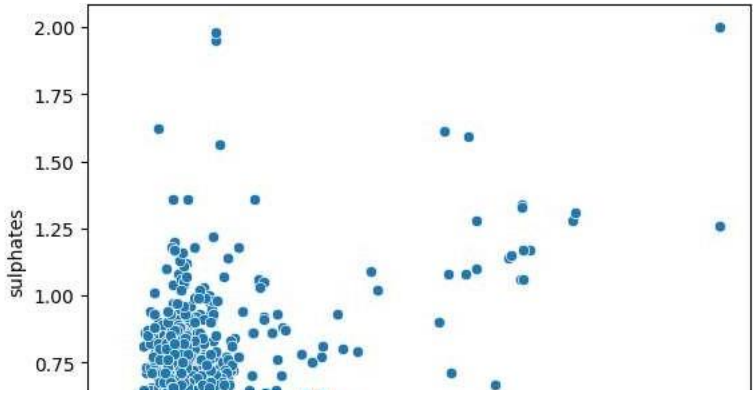
```
sns.lineplot(x = df.pH,y=df.density)
```

```
<Axes: xlabel='pH', ylabel='density'>
```




```
sns.scatterplot(x = df.chlorides,y=df.sulphates)
```

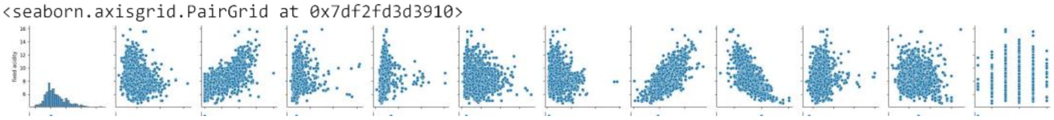
```
<Axes: xlabel='chlorides', ylabel='sulphates'>
```



Multivariate

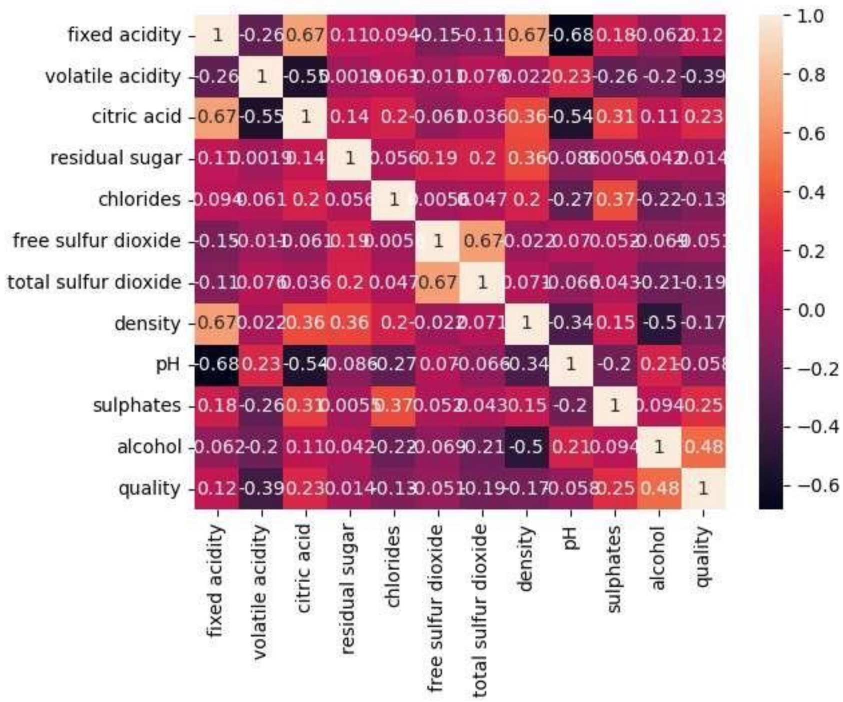
```
sns.pairplot(df)
```

```
<seaborn.axisgrid.PairGrid at 0x7df2fd3d3910>
```



```
sns.heatmap(df.corr(),annot=True)
```

```
<Axes: >
```



TASK 3

```
from sklearn.linear_model import LinearRegression
```

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

```
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
```

```
df.value_counts()
```

```
fixed acidity  volatile acidity  citric acid  residual sugar  chlorides  free sulfur dioxide  total sulfur dioxide  density  pH
sulphates  alcohol  quality
7.5            0.510             0.02         1.7             0.084      13.0                 31.0                  0.99538  3.36
0.54       10.5     6           4
6.7            0.460             0.24         1.7             0.077      18.0                 34.0                  0.99480  3.39
0.60       10.6     6           4
7.2            0.360             0.46         2.1             0.074      24.0                 44.0                  0.99534  3.40
0.85       11.0     7           4
               0.695             0.13         2.0             0.076      12.0                 20.0                  0.99546  3.29
0.54       10.1     5           4
8.3            0.650             0.10         2.9             0.089      17.0                 40.0                  0.99803  3.29
0.55       9.5      5           3

..
7.5            0.430             0.30         2.2             0.062      6.0                  12.0                  0.99495  3.44
           11.5     7           1
0.72
               0.420             0.32         2.7             0.067      7.0                  25.0                  0.99628  3.24
```

```
0.44      10.4     5         1
                             0.31        1.6             0.080      15.0               42.0                 0.99780  3.31
0.64      9.0      5         1
                0.410        0.15        3.7             0.104      29.0               94.0                 0.99786  3.14
0.58      9.1      5         1
15.9            0.360        0.65        7.5             0.096      22.0               71.0                 0.99760  2.98
0.84      14.9     5         1
Length: 1359, dtype: int64
```

```
df.nunique()
```

```
fixed acidity            96
volatile acidity        143
citric acid              80
residual sugar           91
chlorides               153
free sulfur dioxide      60
total sulfur dioxide    144
density                 436
pH                       89
sulphates                96
alcohol                  65
quality                   6
dtype: int64
```

```
y = df['pH']
y.head()
```

```
0    3.51
1    3.20
2    3.26
3    3.16
4    3.51
Name: pH, dtype: float64
```

```
X= df.drop(columns = ['quality'],axis =1)
X.head()
```

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

```
from sklearn.preprocessing import StandardScaler
scale =StandardScaler()
```

```
X_scaled =pd.DataFrame(scale.fit_transform(X),columns = X.columns)
X_scaled.head()
```

	fixed acidity	volatile acidity	citric acid	residual sugar	chlorides	free sulfur dioxide	total sulfur dioxide	density	pH	sulphate
0	-0.528360	0.961877	-1.391472	-0.453218	-0.243707	-0.466193	-0.379133	0.558274	1.288643	-0.57920
1	-0.298547	1.967442	-1.391472	0.043416	0.223875	0.872638	0.624363	0.028261	-0.719933	0.12895
2	-0.298547	1.297065	-1.186070	-0.169427	0.096353	-0.083669	0.229047	0.134264	-0.331177	-0.04808
3	1.654856	-1.384443	1.484154	-0.453218	-0.264960	0.107592	0.411500	0.664277	-0.979104	-0.46118
4	-0.528360	0.961877	-1.391472	-0.453218	-0.243707	-0.466193	-0.379133	0.558274	1.288643	-0.57920

```
from sklearn.model_selection import train_test_split
x_train,x_test,y_train,y_test = train_test_split(X_scaled,y,test_size =0.2,random_state =0)
```

```
x_train.shape
```

```
(1279, 11)
```

```
x_test.shape
```

```
(320, 11)
```

```
x_test.head()
```

	fixed acidity	volatile acidity	citric acid	residual sugar	chlorides	free sulfur dioxide	total sulfur dioxide	density	pH	sulph
1109	1.425044	-0.323013	0.816598	-0.311323	1.775397	1.063900	0.593954	0.770280	-0.914312	0.60
1032	-0.126188	1.632254	-1.391472	1.107633	0.160114	-1.039977	-0.987312	0.950485	0.316751	-0.75
1002	0.448342	-1.328579	0.303093	-0.346797	-0.520005	-0.274931	-0.591995	-0.840962	-0.331177	1.07
487	1.080326	0.654620	0.457144	-0.524166	-0.732542	-1.039977	-0.987312	0.770280	-0.914312	-1.40
979	2.229387	-0.434742	1.124700	-0.807957	-0.264960	-1.231239	-1.230584	0.081262	-1.173483	-0.16

```
y_test
```

```
1109    3.17
1032    3.36
1002    3.26
487     3.17
979     3.13
        ...
794     3.17
813     3.44
1322    3.18
704     3.29
1023    3.27
Name: pH, Length: 320, dtype: float64
```

```
from sklearn.linear_model import LinearRegression
lr = LinearRegression()
```

```
lr.fit(x_train,y_train)
```

```
▾ LinearRegression
LinearRegression()
```

```
y_predict = lr.predict(x_test)
y_predict
```

```
array([3.17, 3.36, 3.26, 3.17, 3.13, 3.13, 3.12, 3.47, 3.3 , 3.27, 3.2 ,
       3.14, 3.29, 3.74, 3.5 , 3.34, 3.33, 3.15, 3.55, 3.38, 3.35, 3.27,
       3.36, 3.3 , 3.57, 3.27, 3.23, 3.35, 3.2 , 3.9 , 3.14, 3.31, 3.53,
       3.5 , 3.52, 3.26, 3.46, 3.69, 3.62, 3.35, 3.33, 3.37, 3.49, 3.02,
       3.3 , 3.19, 3.16, 3.3 , 3.58, 3.36, 3.41, 3.38, 3.38, 3.3 , 3.32,
       3.35, 3.3 , 3.09, 3.23, 3.27, 3.68, 3.32, 3.32, 3.56, 3.51, 3.42,
       3.29, 2.92, 3.19, 3.07, 3.3 , 3.04, 3.38, 3.17, 3.34, 3.58, 3.46,
       3.45, 3.35, 3.3 , 3.1 , 3.39, 3.51, 3.14, 3.36, 3.4 , 3.44, 3.25,
       3.42, 3.44, 3.26, 3.22, 3.62, 3.35, 3.4 , 3.3 , 3.15, 3.19, 3.26,
       3.04, 3.23, 3.38, 3.29, 3.34, 3.46, 3.39, 3.46, 3.41, 3.42, 3.23,
       3.56, 3.1 , 3.23, 3.29, 3.33, 3.37, 3.25, 3.27, 3.45, 3.36, 3.23,
       2.92, 3.03, 3.36, 3.27, 3.3 , 3.23, 3.13, 3.36, 3.06, 3.4 , 3.35,
       3.32, 3.22, 3.28, 3.29, 3.06, 3.  , 2.88, 3.36, 3.39, 3.19, 3.16,
       3.67, 3.17, 3.3 , 3.23, 3.33, 3.18, 3.34, 3.42, 3.39, 3.41, 3.29,
       3.61, 3.46, 3.25, 3.28, 3.44, 3.38, 3.48, 3.42, 3.32, 3.5 , 3.14,
       3.25, 3.54, 3.41, 3.18, 3.27, 3.1 , 3.35, 3.48, 3.15, 3.52, 3.21,
       3.18, 3.34, 3.71, 3.16, 3.32, 3.38, 3.41, 3.2 , 3.39, 3.2 , 3.26,
       3.29, 3.25, 3.42, 3.33, 2.94, 3.18, 3.29, 3.46, 3.28, 3.2 , 3.39,
       3.28, 3.16, 3.19, 3.41, 3.26, 3.31, 3.26, 3.59, 3.24, 3.38, 3.36,
       3.42, 3.29, 3.25, 3.11, 3.18, 3.49, 3.47, 3.04, 3.39, 3.38, 3.28,
       3.51, 3.16, 3.2 , 3.03, 3.36, 3.12, 3.22, 3.56, 3.16, 3.39, 3.53,
       3.57, 3.35, 3.23, 3.13, 3.42, 3.07, 3.33, 3.36, 3.22, 3.48, 3.4 ,
       3.36, 3.39, 3.24, 3.26, 3.29, 3.29, 3.  , 3.39, 3.19, 3.44, 3.23,
       3.26, 3.4 , 3.36, 3.21, 3.11, 3.48, 3.07, 3.44, 3.68, 3.14, 3.08,
       3.34, 3.36, 3.6 , 3.28, 3.28, 3.33, 3.14, 3.17, 3.24, 3.9 , 3.22,
       3.39, 3.14, 3.21, 3.39, 3.05, 3.14, 3.27, 3.17, 3.26, 3.26, 3.55,
       3.36, 3.27, 3.34, 3.15, 3.49, 3.5 , 3.41, 3.19, 3.26, 3.38, 3.4 ,
       3.29, 3.35, 3.15, 3.44, 3.56, 3.12, 3.31, 3.35, 3.61, 3.45, 3.48,
       3.37, 3.39, 3.36, 3.42, 3.66, 3.19, 3.2 , 3.17, 3.44, 3.18, 3.29,
       3.27])
```

```
y_predict1 =lr.predict(x_train)
y_predict1
```

```
array([3.39, 3.13, 3.26, ..., 3.29, 3.3 , 3.25])
```

```
profit =pd.DataFrame({'Actual_pH':y_test,'Predicted_pH':y_predict})
profit
```

	Actual_pH	Predicted_pH
1109	3.17	3.17
1032	3.36	3.36
1002	3.26	3.26
487	3.17	3.17
979	3.13	3.13
...	...	...
794	3.17	3.17
813	3.44	3.44
1322	3.18	3.18
704	3.29	3.29
1023	3.27	3.27

320 rows × 2 columns

Task 4

```
from sklearn import metrics
```

```
print(metrics.r2_score(y_test,y_predict))
```

```
1.0
```

```
print(metrics.r2_score(y_train,y_predict1))
```

```
1.0
```

```
print(metrics.mean_squared_error(y_test,y_predict))
```

```
3.457429436163966e-31
```

```
print(np.sqrt(metrics.mean_squared_error(y_test,y_predict)))
```

```
5.879991017139368e-16
```

+ Code + Text

TASK 5

```
df.head()
```

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

```
lr.predict([[7.4, 0.70, 0.00, 1.9,  0.076,  11.0, 34.0, 0.9978, 3.51, 0.56, 9.4]])/100000
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/base.py:439:  UserWarning: X does not have valid feature names, but LinearRegression was
  warnings.warn(
```

```
array([3.85284021e-05])
```

```
lr.predict([[7.8, 0.88, 0.00, 2.6,  0.098,  25.0, 67.0, 0.9968, 3.20, 0.68, 9.8]])/100000
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/base.py:439: UserWarning: X does not have valid feature names, but LinearRegression was
  warnings.warn(
array([3.80499538e-05])
```

```
lr.predict([[7.4, 0.70, 0.00, 1.9,  0.076,  11.0, 34.0, 0.9978, 3.51, 0.56, 9.4]])/100000
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/base.py:439: UserWarning: X does not have valid feature names, but LinearRegression was
  warnings.warn(
array([3.85284021e-05])
```