ASSIGNMENT 4

Importing the necessary libraries

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

LOADING THE DATASET

```
df = pd.read_csv("/content/sample_data/abalone.csv")
```

```
df
```

	Sex	Length	Diameter	Height	Whole weight	Shucked weight	Viscera weight	Shell weight	Rings
0	M	0.455	0.365	0.095	0.5140	0.2245	0.1010	0.1500	15
1	M	0.350	0.265	0.090	0.2255	0.0995	0.0485	0.0700	7
2	F	0.530	0.420	0.135	0.6770	0.2565	0.1415	0.2100	9
3	M	0.440	0.365	0.125	0.5160	0.2155	0.1140	0.1550	10
4	I	0.330	0.255	0.080	0.2050	0.0895	0.0395	0.0550	7
...	...	...	...	...	...	...	...	...	...
4172	F	0.565	0.450	0.165	0.8870	0.3700	0.2390	0.2490	11
4173	M	0.590	0.440	0.135	0.9660	0.4390	0.2145	0.2605	10
4174	M	0.600	0.475	0.205	1.1760	0.5255	0.2875	0.3080	9
4175	F	0.625	0.485	0.150	1.0945	0.5310	0.2610	0.2960	10
4176	M	0.710	0.555	0.195	1.9485	0.9455	0.3765	0.4950	12

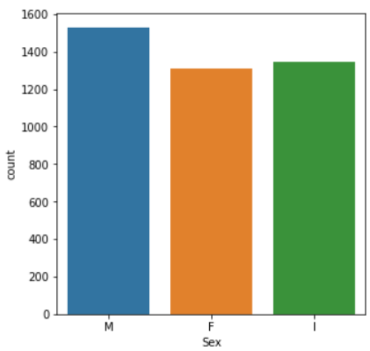
4177 rows × 9 columns

VISUALIZATIONS ON THE DATASET

UNIVARIATE ANALYSIS

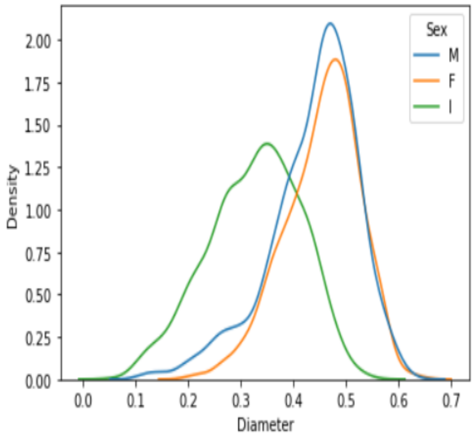
```
#Count plot with respect to Sex
plt.figure(figsize=(5,5))
sns.countplot(df.Sex)
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pass the following variable as a keyword arg: x. From version 0.12, th
e only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretation.
  FutureWarning
```

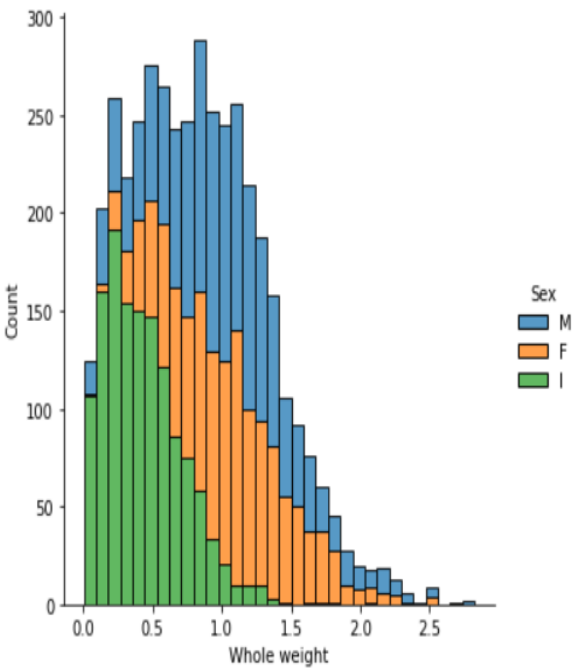



```
#Density plot for Diameter
colors = sns.color_palette()
sns.kdeplot(data=df, x="Diameter", hue="Sex")
```

```
#Density plot for Diameter
colors = sns.color_palette()
sns.kdeplot(data=df, x="Diameter", hue="Sex")
```



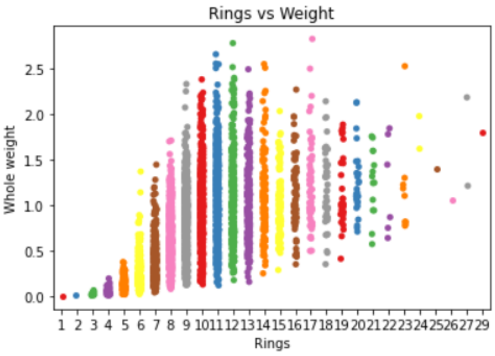

```
#Whole weight count - univariate distplot
sns.displot(data=df, x="Whole weight", hue="Sex", multiple="stack")
```



BIVARIATE ANALYSIS

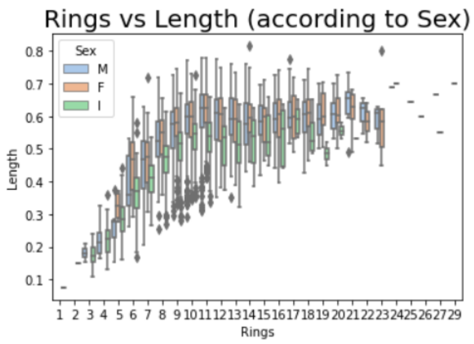
```python
#Rings vs Weight
#plt.rcParams['figure.figsize'] = (12, 7)
#sns.swarmplot(df['Rings'], df['Whole weight'])
sns.stripplot(data=df, x="Rings", y="Whole weight", palette="Set1")
plt.title('Rings vs Weight')
```

```
Text(0.5, 1.0, 'Rings vs Weight')
```

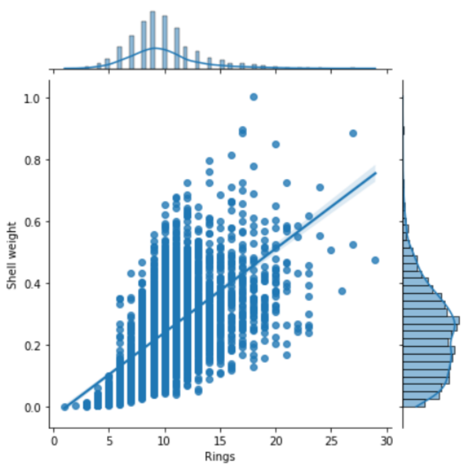



```python
#Rings vs Length acc to Sex
sns.boxplot(data=df, x='Rings', y='Length', hue = df['Sex'], palette = 'pastel')
plt.title('Rings vs Length (according to Sex)', fontsize = 20)
```

```
Text(0.5, 1.0, 'Rings vs Length (according to Sex)')
```

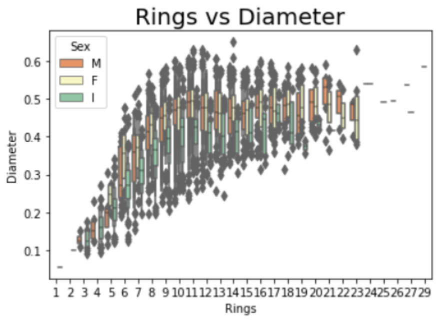



```python
#Jointplot for Rings vs Shell Weight
plt.figure(figsize=(20, 5))
sns.jointplot(data=df, x='Rings', y='Shell weight', kind='reg')
```



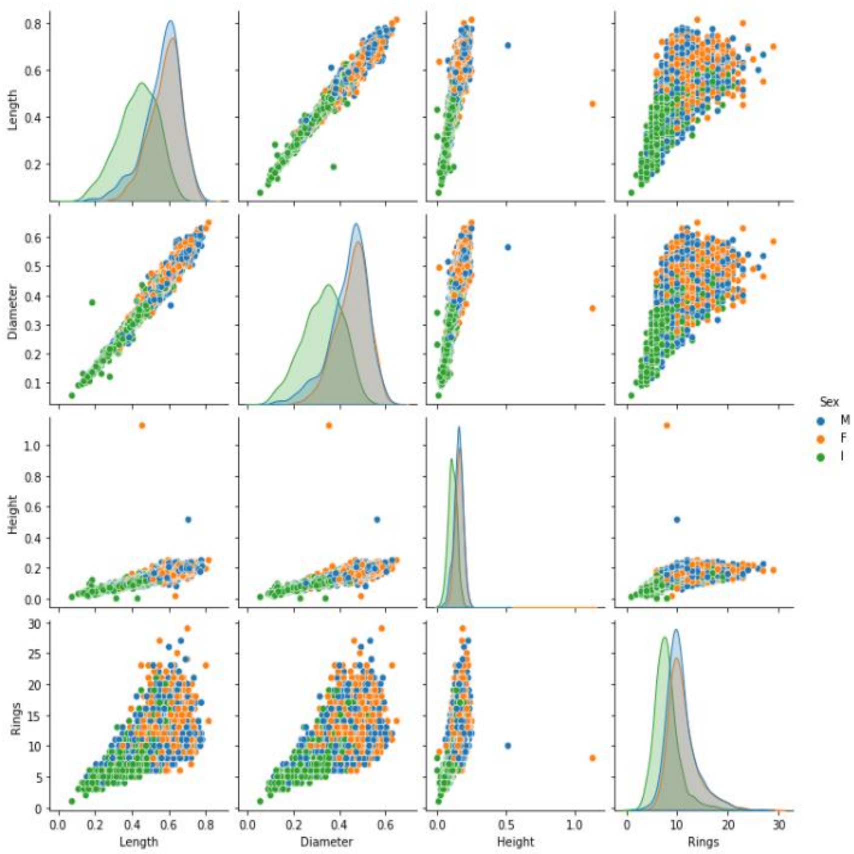
```
#Rings vs Diameter
sns.boxenplot(data=df, x='Rings', y='Diameter', hue="Sex", palette = 'Spectral')
plt.title('Rings vs Diameter', fontsize = 20)
```

```
Text(0.5, 1.0, 'Rings vs Diameter')
```



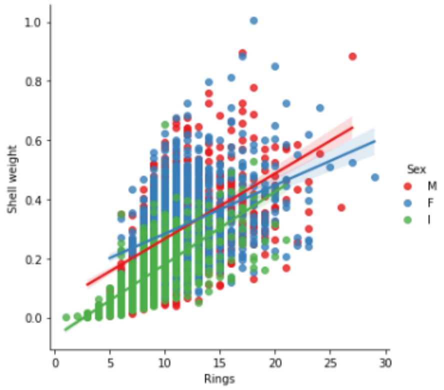
MULTI-VARIATE ANALYSIS

```
#Pairplot - Multivariate analysis
plt.rcParams['figure.figsize']=10,10
sns.pairplot(df, x_vars=["Length", "Diameter", "Height", "Rings"], y_vars=["Length", "Diameter", "Height", "Rings"],hue="Sex")
```

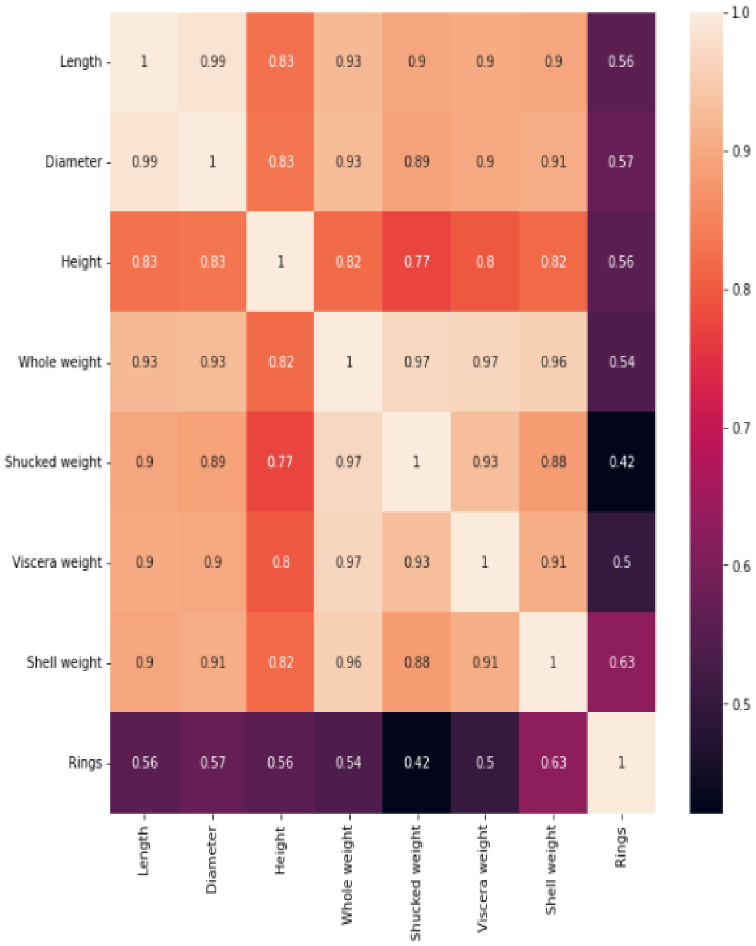


```
plt.figure(figsize=(20, 5))

sns.lmplot(data=df, x='Rings', y='Shell weight', hue='Sex', fit_reg=True, palette="Set1")
```




```
plt.figure(figsize=(10, 10))
corr = df.corr()
sns.heatmap(corr, annot=True)
```



Performing Descriptive Statistics on the dataset

```
df.head()
```

	Sex	Length	Diameter	Height	Whole weight	Shucked weight	Viscera weight	Shell weight	Rings
0	M	0.455	0.365	0.095	0.5140	0.2245	0.1010	0.150	15
1	M	0.350	0.265	0.090	0.2255	0.0995	0.0485	0.070	7
2	F	0.530	0.420	0.135	0.6770	0.2565	0.1415	0.210	9
3	M	0.440	0.365	0.125	0.5160	0.2155	0.1140	0.155	10
4	I	0.330	0.255	0.080	0.2050	0.0895	0.0395	0.055	7

```
df.describe()
```

	Length	Diameter	Height	Whole weight	Shucked weight	Viscera weight	Shell weight	Rings
count	4177.000000	4177.000000	4177.000000	4177.000000	4177.000000	4177.000000	4177.000000	4177.000000
mean	0.523992	0.407881	0.139516	0.828742	0.359367	0.180594	0.238831	9.933684
std	0.120093	0.099240	0.041827	0.490389	0.221963	0.109614	0.139203	3.224169
min	0.075000	0.055000	0.000000	0.002000	0.001000	0.000500	0.001500	1.000000
25%	0.450000	0.350000	0.115000	0.441500	0.186000	0.093500	0.130000	8.000000
50%	0.545000	0.425000	0.140000	0.799500	0.336000	0.171000	0.234000	9.000000
75%	0.615000	0.480000	0.165000	1.153000	0.502000	0.253000	0.329000	11.000000
max	0.815000	0.650000	1.130000	2.825500	1.488000	0.760000	1.005000	29.000000

```
df.info()
```

```
RangeIndex: 4177 entries, 0 to 4176
Data columns (total 9 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   Sex             4177 non-null   object
 1   Length          4177 non-null   float64
 2   Diameter        4177 non-null   float64
 3   Height          4177 non-null   float64
 4   Whole weight    4177 non-null   float64
 5   Shucked weight  4177 non-null   float64
 6   Viscera weight  4177 non-null   float64
 7   Shell weight    4177 non-null   float64
 8   Rings           4177 non-null   int64
dtypes: float64(7), int64(1), object(1)
memory usage: 293.8+ KB
```

Check for Missing values and deal with them

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

```
Sex               0
Length            0
Diameter          0
Height            0
Whole weight      0
Shucked weight    0
Viscera weight    0
Shell weight      0
Rings             0
dtype: int64
```

There are no missing values. Thus it is handled implicitly.

Find the outliers and replace them outliers

```
def find_outliers_IQR(df):

   q1=df.quantile(0.25)

   q3=df.quantile(0.75)

   IQR=q3-q1

   outliers = df[((df<(q1-1.5*IQR)) | (df>(q3+1.5*IQR)))]

   return outliers
```

```
outliers = find_outliers_IQR(df["Shucked weight"])

print("number of outliers: " + str(len(outliers)))

print("max outlier value: " + str(outliers.max()))
print("min outlier value: " + str(outliers.min()))

outliers
```

```
number of outliers: 48
max outlier value: 1.488
min outlier value: 0.9815
```

```
165     1.0705
891     1.1465
1048    1.0120
1051    1.1335
1052    1.0070
1193    1.0950
1197    1.0465
1199    1.0265
1202    1.0260
1206    1.1090
1207    1.1965
1209    1.4880
1417    1.1075
1418    1.0465
1426    1.1565
1427    1.2320
1527    1.0170
1528    1.3510
1749    0.9895
1750    0.9925
1754    1.1455
1756    1.0300
1761    1.0830
1762    1.1155
1763    1.3485
1821    1.0715
1982    1.0815
2544    1.0685
2623    0.9915
2624    1.1280
2625    1.0515
2675    1.0050
2710    1.0615
2810    1.1055
2811    1.2530
2862    1.1705
2863    1.1495
2970    0.9815
2972    0.9955
3007    1.2395
3082    1.0135
3427    1.1455
3599    1.2395
3713    1.2455
3715    1.1945
3961    1.1330
3962    1.0745
3993    0.9840
Name: Shucked weight, dtype: float64
```

```
median = df.loc[df['Shucked weight']<0.9815, 'Shucked weight'].median()
```

```
median
```

```
0.3325
```

```
df.loc[df["Shucked weight"] >= 0.9815, 'Shucked weight'] = np.nan
```

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

```
Sex                0
Length             0
Diameter           0
Height             0
Whole weight       0
Shucked weight    48
Viscera weight     0
Shell weight       0
Rings              0
dtype: int64
```

```
df.fillna(median,inplace=True)
```

These steps (above) are repeated for each feature to remove outliers and replace them with the median of their values

```
#shell weight
outliers = find_outliers_IQR(df["Shell weight"])

print("number of outliers: " + str(len(outliers)))

print("max outlier value: " + str(outliers.max()))
print("min outlier value: " + str(outliers.min()))

outliers
```

```
number of outliers: 35
max outlier value: 1.005
min outlier value: 0.63
```

```
81      0.6750
129     0.7800
157     0.6350
163     1.0050
164     0.8150
165     0.7250
166     0.8500
167     0.6500
168     0.7600
277     0.6900
334     0.7100
358     0.7000
891     0.8970
1193    0.6380
1207    0.6785
1428    0.7975
1761    0.6300
1762    0.6420
1823    0.6430
1985    0.6460
2090    0.6585
2108    0.8850
2157    0.7250
2161    0.8850
2208    0.6650
2274    0.6850
2368    0.6600
3008    0.7260
3148    0.6855
3149    0.7100
3151    0.7250
3188    0.6650
3715    0.6745
3928    0.6550
4145    0.6570
Name: Shell weight, dtype: float64
```

```python
median = df.loc[df['Shell weight']<0.63, 'Shell weight'].median()
```

```python
median
```

```
0.23
```

```python
df.loc[df["Shell weight"] >= 0.63, 'Shell weight'] = np.nan
```

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

```
Sex                0
Length             0
Diameter           0
Height             0
Whole weight       0
Shucked weight     0
Viscera weight     0
Shell weight      35
Rings              0
dtype: int64
```

```python
df.fillna(median,inplace=True)
```

```python
outliers = find_outliers_IQR(df["Viscera weight"])

print("number of outliers: " + str(len(outliers)))

print("max outlier value: " + str(outliers.max()))
print("min outlier value: " + str(outliers.min()))

outliers
```

```
number of outliers: 26
max outlier value: 0.76
min outlier value: 0.4925
```

```
170     0.5410
1048    0.5225
1052    0.5090
1204    0.5500
1206    0.5195
1207    0.5130
1209    0.4985
1422    0.5640
1427    0.5190
1750    0.4925
1757    0.5195
1759    0.5185
1762    0.6415
1763    0.7600
2334    0.5900
2623    0.5005
2624    0.5120
2709    0.5265
2710    0.5235
2810    0.5250
2811    0.5410
2863    0.5115
3427    0.5750
3628    0.5145
3715    0.5745
4148    0.5260
Name: Viscera weight, dtype: float64
```

```python
median = df.loc[df['Viscera weight']<0.4925, 'Viscera weight'].median()
df.loc[df["Viscera weight"] >= 0.4925, 'Viscera weight'] = np.nan
df.fillna(median,inplace=True)
```

Check for Categorical columns and perform encoding.

```
#Sex - Categorical Feature. Thus it is encoded (one-hot encoding) considering each Sex with binary values
df = pd.get_dummies(df)
```

```
df.head()
```

	Length	Diameter	Height	Whole weight	Shucked weight	Viscera weight	Shell weight	Rings	Sex_F	Sex_I	Sex_M
0	0.455	0.365	0.095	0.5140	0.2245	0.1010	0.150	15	0	0	1
1	0.350	0.265	0.090	0.2255	0.0995	0.0485	0.070	7	0	0	1
2	0.530	0.420	0.135	0.6770	0.2565	0.1415	0.210	9	1	0	0
3	0.440	0.365	0.125	0.5160	0.2155	0.1140	0.155	10	0	0	1
4	0.330	0.255	0.080	0.2050	0.0895	0.0395	0.055	7	0	1	0

Split the data into dependent and independent variables

```
y = df['Rings']
df = df.drop(['Rings'], axis = 1)
X = df

print("Shape of X:", X.shape)
print("Shape of y:", y.shape)
```

```
Shape of X: (4177, 10)
Shape of y: (4177,)
```

Scale the independent variables

```
from sklearn.preprocessing import StandardScaler
float_columns = [x for x in df.columns if x not in ['Sex', 'Rings']]
sc = StandardScaler()
df2 = df.copy()
df[float_columns] = sc.fit_transform(df[float_columns])
df.head()
```

	Length	Diameter	Height	Whole weight	Shucked weight	Viscera weight	Shell weight	Sex_F	Sex_I	Sex_M
0	-0.574558	-0.432149	-1.064424	-0.641898	-0.610419	-0.730937	-0.643304	-0.674834	-0.688018	1.316677
1	-1.448986	-1.439929	-1.183978	-1.230277	-1.216404	-1.227524	-1.250780	-0.674834	-0.688018	1.316677
2	0.050033	0.122130	-0.107991	-0.309469	-0.455287	-0.347855	-0.187697	1.481846	-0.688018	-0.759488
3	-0.699476	-0.432149	-0.347099	-0.637819	-0.654050	-0.607972	-0.605337	-0.674834	-0.688018	1.316677
4	-1.615544	-1.540707	-1.423087	-1.272086	-1.264883	-1.312654	-1.364682	-0.674834	1.453451	-0.759488

```
X
```

	Length	Diameter	Height	Whole weight	Shucked weight	Viscera weight	Shell weight	Sex_F	Sex_I	Sex_M
0	-0.574558	-0.432149	-1.064424	-0.641898	-0.610419	-0.730937	-0.643304	-0.674834	-0.688018	1.316677
1	-1.448986	-1.439929	-1.183978	-1.230277	-1.216404	-1.227524	-1.250780	-0.674834	-0.688018	1.316677
2	0.050033	0.122130	-0.107991	-0.309469	-0.455287	-0.347855	-0.187697	1.481846	-0.688018	-0.759488
3	-0.699476	-0.432149	-0.347099	-0.637819	-0.654050	-0.607972	-0.605337	-0.674834	-0.688018	1.316677
4	-1.615544	-1.540707	-1.423087	-1.272086	-1.264883	-1.312654	-1.364682	-0.674834	1.453451	-0.759488
...	...	...	...	...	...	...	...	...	...	...
4172	0.341509	0.424464	0.609334	0.118813	0.094947	0.574379	0.108448	1.481846	-0.688018	-0.759488
4173	0.549706	0.323686	-0.107991	0.279929	0.429451	0.342638	0.195773	-0.674834	-0.688018	1.316677
4174	0.632985	0.676409	1.565767	0.708212	0.848793	1.033131	0.556462	-0.674834	-0.688018	1.316677
4175	0.841182	0.777187	0.250672	0.541998	0.875456	0.782472	0.465340	1.481846	-0.688018	-0.759488
4176	1.549052	1.482634	1.326659	2.283681	2.884903	1.874965	1.976438	-0.674834	-0.688018	1.316677

4177 rows × 10 columns

```
y
```

```
0       15
1        7
2        9
3       10
4        7
        ..
4172    11
4173    10
4174     9
4175    10
4176    12
Name: Rings, Length: 4177, dtype: int64
```

Split the data into training and testing data

```
from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.25, random_state = 0)
```

Building the model

```
from sklearn.ensemble import RandomForestClassifier

model = RandomForestClassifier()
```

Training the model

```
model.fit(X_train, y_train)
```

```
RandomForestClassifier()
```

Testing the model

```
y_pred = model.predict(X_test)
```

Measuring the performance using metrics

```
from sklearn.metrics import mean_squared_error
from sklearn.metrics import r2_score
from sklearn.metrics import accuracy_score

mse = mean_squared_error(y_test, y_pred)
rmse = np.sqrt(mse)
print("RMSE :", rmse)

r2 = r2_score(y_test, y_pred)
print("R2 Score :", r2)

print("Accuracy Score : ", accuracy_score(y_test, y_pred))
```

```
RMSE : 2.564759331910503
R2 Score : 0.37400316130002664
Accuracy Score :  0.22870813397129186
```

Similarly, trying the same set of steps for Support Vector Machines algorithm..

```
from sklearn import svm
smodel = svm.SVC()
model.fit(X_train, y_train)
y_pred = model.predict(X_test)
mse = mean_squared_error(y_test, y_pred)
rmse = np.sqrt(mse)
print("RMSE :", rmse)

r2 = r2_score(y_test, y_pred)
print("R2 Score :", r2)

print("Accuracy Score : ", accuracy_score(y_test, y_pred))
```

```
RMSE : 2.5161678160386876
R2 Score : 0.3974985329009276
Accuracy Score :  0.2430622009569378
```