

**Assignment -3**  
**Python Programming**

Assignment Date	30 September 2022
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Maximum Marks	2 Marks

**Building a Regression Model**

**1. Perform Below Visualizations.**

**Univariate Analysis**

**1. Summary Statistics**

```
In [1]: import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import statsmodels.api as sm
```

```
In [2]: file_data = pd.read_csv('C:/KavinKumar/abalone.csv')
file_data
```

```
Out[2]:
```

	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 x 9 columns

## Add a Age column in a dataset

```
In [3]: file_data['Age']=''  
file_data.head()
```

```
Out[3]:
```

	Sex	Length	Diameter	Height	Whole weight	Shucked weight	Viscera weight	Shell weight	Rings	Age
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	

```
In [4]: file_data['Age']=file_data['Rings']+1.5  
file_data.head()
```

```
Out[4]:
```

	Sex	Length	Diameter	Height	Whole weight	Shucked weight	Viscera weight	Shell weight	Rings	Age
0	M	0.455	0.365	0.095	0.5140	0.2245	0.1010	0.150	15	16.5
1	M	0.350	0.265	0.090	0.2255	0.0995	0.0485	0.070	7	8.5
2	F	0.530	0.420	0.135	0.6770	0.2565	0.1415	0.210	9	10.5
3	M	0.440	0.365	0.125	0.5160	0.2155	0.1140	0.155	10	11.5
4	I	0.330	0.255	0.080	0.2050	0.0895	0.0395	0.055	7	8.5

## Drop the Rings Column

```
In [5]: file_data = file_data.drop(columns=['Rings'],axis=1)  
file_data
```

```
Out[5]:
```

	Sex	Length	Diameter	Height	Whole weight	Shucked weight	Viscera weight	Shell weight	Age
0	M	0.455	0.365	0.095	0.5140	0.2245	0.1010	0.1500	16.5
1	M	0.350	0.265	0.090	0.2255	0.0995	0.0485	0.0700	8.5
2	F	0.530	0.420	0.135	0.6770	0.2565	0.1415	0.2100	10.5
3	M	0.440	0.365	0.125	0.5160	0.2155	0.1140	0.1550	11.5
4	I	0.330	0.255	0.080	0.2050	0.0895	0.0395	0.0550	8.5
...	...	...	...	...	...	...	...	...	...
4172	F	0.565	0.450	0.165	0.8870	0.3700	0.2390	0.2490	12.5
4173	M	0.590	0.440	0.135	0.9660	0.4390	0.2145	0.2605	11.5
4174	M	0.600	0.475	0.205	1.1760	0.5255	0.2875	0.3080	10.5
4175	F	0.625	0.485	0.150	1.0945	0.5310	0.2610	0.2960	11.5
4176	M	0.710	0.555	0.195	1.9485	0.9455	0.3765	0.4950	13.5

4177 rows x 9 columns

```
In [6]: file_data['Height'].mean()
```

```
Out[6]: 0.1395163993296614
```

```
In [7]: file_data['Height'].median()
```

```
Out[7]: 0.14
```

```
In [8]: file_data['Height'].std()
```

```
Out[8]: 0.04182705660725703
```

## 2. Frequency Table

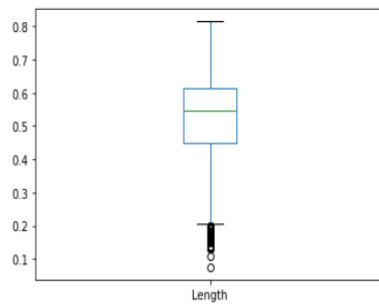
```
In [9]: file_data['Sex'].value_counts()
```

```
Out[9]: M    1528  
I    1342  
F    1307  
Name: Sex, dtype: int64
```

## 3. Create Charts

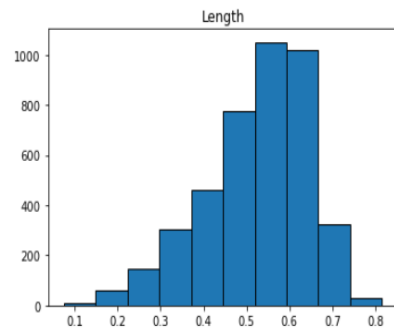
```
In [10]: file_data.boxplot(column=['Length'], grid=False)
```

```
Out[10]: <AxesSubplot:>
```



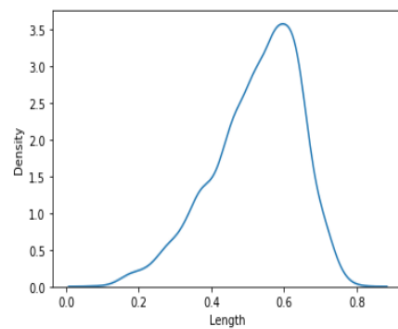
```
In [11]: file_data.hist(column='Length', grid=False, edgecolor='black')
```

```
Out[11]: array([[<AxesSubplot:title={'center':'Length'}>]], dtype=object)
```



```
In [12]: sns.kdeplot(file_data['Length'])
```

```
Out[12]: <AxesSubplot:xlabel='Length', ylabel='Density'>
```

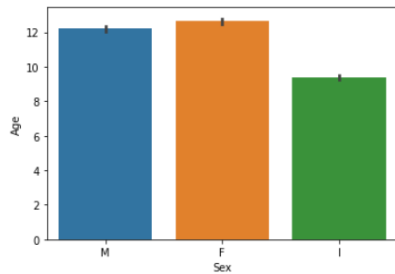


## Bi - Variate Analysis

### 1. Barplot

```
In [13]: data = sns.barplot(x = file_data["Sex"], y = file_data["Age"])
data
```

```
Out[13]: <AxesSubplot:xlabel='Sex', ylabel='Age'>
```



### 2. Correlation Coefficients

```
In [14]: file_data.corr()
```

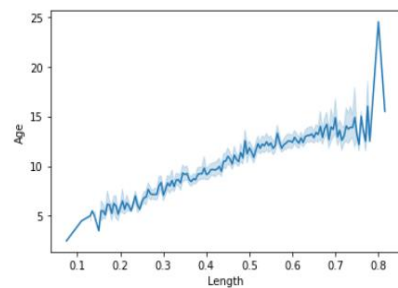
```
Out[14]:
```

	Length	Diameter	Height	Whole weight	Shucked weight	Viscera weight	Shell weight	Age
Length	1.000000	0.986812	0.827554	0.925261	0.897914	0.903018	0.897706	0.556720
Diameter	0.986812	1.000000	0.833684	0.925452	0.893162	0.899724	0.905330	0.574660
Height	0.827554	0.833684	1.000000	0.819221	0.774972	0.798319	0.817338	0.557467
Whole weight	0.925261	0.925452	0.819221	1.000000	0.969405	0.966375	0.955355	0.540390
Shucked weight	0.897914	0.893162	0.774972	0.969405	1.000000	0.931961	0.882617	0.420884
Viscera weight	0.903018	0.899724	0.798319	0.966375	0.931961	1.000000	0.907656	0.503819
Shell weight	0.897706	0.905330	0.817338	0.955355	0.882617	0.907656	1.000000	0.627574
Age	0.556720	0.574660	0.557467	0.540390	0.420884	0.503819	0.627574	1.000000

### 3. Linear Plot

```
In [15]: data = sns.lineplot(x = file_data["Length"], y = file_data["Age"])
data
```

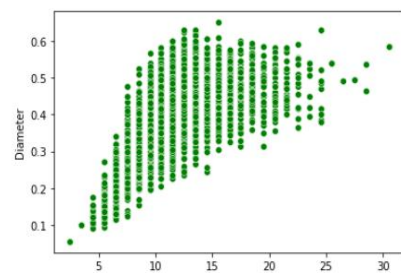
```
Out[15]: <AxesSubplot:xlabel='Length', ylabel='Age'>
```



### 4. Scatter Plot

```
In [16]: data = sns.scatterplot(x = file_data["Age"], y = file_data["Diameter"], color="green")
data
```

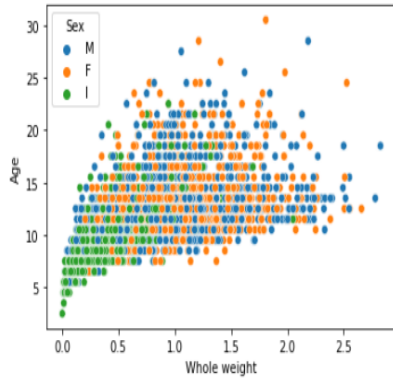
```
Out[16]: <AxesSubplot:xlabel='Age', ylabel='Diameter'>
```



## Multi - Variate Analysis

```
In [17]: x = sns.scatterplot(x=file_data['Whole weight'],y=file_data['Age'],hue=file_data["Sex"])
x
```

```
Out[17]: <AxesSubplot:xlabel='Whole weight', ylabel='Age'>
```



## 4. Perform descriptive statistics on the dataset.

```
In [18]: file_data.shape
```

```
Out[18]: (4177, 9)
```

```
In [19]: file_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
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   Age              4177 non-null   float64 
dtypes: float64(8), object(1)
memory usage: 293.8+ KB
```

```
In [20]: file_data.describe()
```

```
Out[20]:
```

	Length	Diameter	Height	Whole weight	Shucked weight	Viscera weight	Shell weight	Age
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	11.433684
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	2.500000
25%	0.450000	0.350000	0.115000	0.441500	0.186000	0.093500	0.130000	9.500000
50%	0.545000	0.425000	0.140000	0.799500	0.336000	0.171000	0.234000	10.500000
75%	0.615000	0.480000	0.165000	1.153000	0.502000	0.253000	0.329000	12.500000
max	0.815000	0.650000	1.130000	2.825500	1.488000	0.760000	1.005000	30.500000

In [21]:

```
file_data.head()
```

Out[21]:

	Sex	Length	Diameter	Height	Whole weight	Shucked weight	Viscera weight	Shell weight	Age
0	M	0.455	0.365	0.095	0.5140	0.2245	0.1010	0.150	16.5
1	M	0.350	0.265	0.090	0.2255	0.0995	0.0485	0.070	8.5
2	F	0.530	0.420	0.135	0.6770	0.2565	0.1415	0.210	10.5
3	M	0.440	0.365	0.125	0.5160	0.2155	0.1140	0.155	11.5
4	I	0.330	0.255	0.080	0.2050	0.0895	0.0395	0.055	8.5

In [22]:

```
file_data.tail()
```

Out[22]:

	Sex	Length	Diameter	Height	Whole weight	Shucked weight	Viscera weight	Shell weight	Age
4172	F	0.565	0.450	0.165	0.8870	0.3700	0.2390	0.2490	12.5
4173	M	0.590	0.440	0.135	0.9660	0.4390	0.2145	0.2605	11.5
4174	M	0.600	0.475	0.205	1.1760	0.5255	0.2875	0.3080	10.5
4175	F	0.625	0.485	0.150	1.0945	0.5310	0.2610	0.2960	11.5
4176	M	0.710	0.555	0.195	1.9485	0.9455	0.3765	0.4950	13.5

In [23]:

```
file_data.mean(numeric_only=True)
```

Out[23]:

```
Length      0.523992
Diameter    0.407881
Height      0.139516
Whole weight 0.828742
Shucked weight 0.359367
Viscera weight 0.180594
Shell weight 0.238831
Age         11.433684
dtype: float64
```

In [24]:

```
file_data.median(numeric_only=True)
```

Out[24]:

```
Length      0.5450
Diameter    0.4250
Height      0.1400
Whole weight 0.7995
Shucked weight 0.3360
Viscera weight 0.1710
Shell weight 0.2340
Age         10.5000
dtype: float64
```

In [25]:

```
file_data.mode()
```

Out[25]:

	Sex	Length	Diameter	Height	Whole weight	Shucked weight	Viscera weight	Shell weight	Age
0	M	0.550	0.45	0.15	0.2225	0.175	0.1715	0.275	10.5
1	NaN	0.625	NaN	NaN	NaN	NaN	NaN	NaN	NaN

In [26]:

```
file_data.var(numeric_only=True)
```

Out[26]:

```
Length      0.014422
Diameter    0.009849
Height      0.001750
Whole weight 0.240481
Shucked weight 0.049268
Viscera weight 0.012015
Shell weight 0.019377
Age         10.395266
dtype: float64
```

In [27]:

```
file_data.std(numeric_only=True)
```

Out[27]:

```
Length      0.120093
Diameter    0.099240
Height      0.041827
Whole weight 0.490389
Shucked weight 0.221963
Viscera weight 0.109614
Shell weight 0.139203
Age         3.224169
dtype: float64
```

```
In [28]: file_data.skew(numeric_only=True)
```

```
Out[28]: Length      -0.639873  
Diameter    -0.609198  
Height       3.128817  
Whole weight  0.530959  
Shucked weight 0.719098  
Viscera weight 0.591852  
Shell weight  0.620927  
Age          1.114102  
dtype: float64
```

```
In [29]: file_data.kurt(numeric_only=True)
```

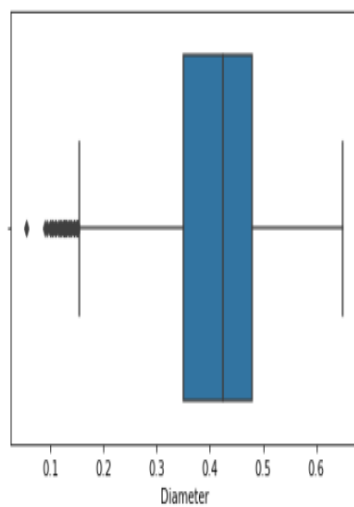
```
Out[29]: Length      0.064621  
Diameter    -0.045476  
Height      76.025509  
Whole weight -0.023644  
Shucked weight 0.595124  
Viscera weight 0.084012  
Shell weight  0.531926  
Age          2.330687  
dtype: float64
```

```
In [30]: quantile = file_data['Whole weight'].quantile(q=[0.75, 0.25])  
quantile
```

```
Out[30]: 0.75    1.1530  
0.25     0.4415  
Name: Whole weight, dtype: float64
```

```
In [31]: x = file_data.Diameter  
sns.boxplot(x=x)
```

```
Out[31]:
```



## 5. Handle the Missing values.

In [32]:

```
print(file_data.isnull())
```

	Sex	Length	Diameter	Height	Whole weight	Shucked weight	\
0	False	False	False	False	False	False	
1	False	False	False	False	False	False	
2	False	False	False	False	False	False	
3	False	False	False	False	False	False	
4	False	False	False	False	False	False	
...	...	...	...	...	...	...	
4172	False	False	False	False	False	False	
4173	False	False	False	False	False	False	
4174	False	False	False	False	False	False	
4175	False	False	False	False	False	False	
4176	False	False	False	False	False	False	

	Viscera weight	Shell weight	Age
0	False	False	False
1	False	False	False
2	False	False	False
3	False	False	False
4	False	False	False
...	...	...	...
4172	False	False	False
4173	False	False	False
4174	False	False	False
4175	False	False	False
4176	False	False	False

[4177 rows x 9 columns]

In [33]:

```
print(file_data.isnull().sum())
```

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



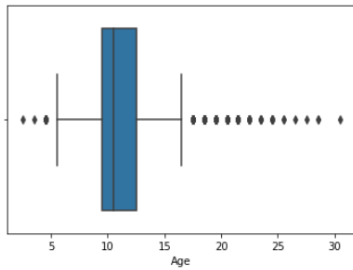
```
In [34]: file_data.isna().any()
```

```
Out[34]: Sex           False
Length        False
Diameter      False
Height        False
Whole weight  False
Shucked weight False
Viscera weight False
Shell weight  False
Age           False
dtype: bool
```

## 6. Find the outliers and replace the outliers

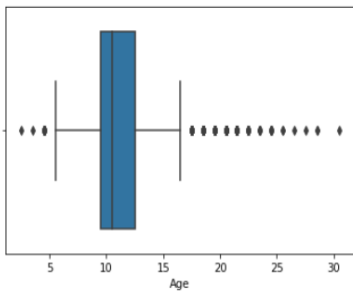
```
In [35]: x = sns.boxplot(x=file_data["Age"])
x
```

Out[35]:



```
In [36]: x = file_data.Age
sns.boxplot(x=x)
```

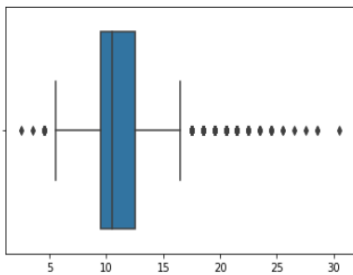
Out[36]:



```
In [37]: x = np.where(file_data['Age']>57,39, file_data['Age'])
```

```
In [38]: sns.boxplot(x=x)
```

Out[38]:



## 7. Check for Categorical columns and perform encoding.

```
In [39]: import warnings
warnings.filterwarnings('ignore')
x = pd.Categorical(file_data["Whole weight"])
x
```

```
Out[39]: [0.5140, 0.2255, 0.6770, 0.5160, 0.2050, ..., 0.8870, 0.9660, 1.1760, 1.0945, 1.9485]
Length: 4177
Categories (2429, float64): [0.0020, 0.0080, 0.0105, 0.0130, ..., 2.5550, 2.6570, 2.7795, 2.8255]
```

```
In [40]: # One Hot Encoding

pd.get_dummies(file_data["Height"]).head(10)
```

```
Out[40]:
```

	0.000	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050	...	0.210	0.215	0.220	0.225	0.230	0.235	0.240	0.250	0.515	1.130
0	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0	0

10 rows × 51 columns

```
In [41]: pd.get_dummies(file_data).head(10)
```

```
Out[41]:
```

	Length	Diameter	Height	Whole weight	Shucked weight	Viscera weight	Shell weight	Age	Sex_F	Sex_I	Sex_M
0	0.455	0.365	0.095	0.5140	0.2245	0.1010	0.150	16.5	0	0	1
1	0.350	0.265	0.090	0.2255	0.0995	0.0485	0.070	8.5	0	0	1
2	0.530	0.420	0.135	0.6770	0.2565	0.1415	0.210	10.5	1	0	0
3	0.440	0.365	0.125	0.5160	0.2155	0.1140	0.155	11.5	0	0	1
4	0.330	0.255	0.080	0.2050	0.0895	0.0395	0.055	8.5	0	1	0
5	0.425	0.300	0.095	0.3515	0.1410	0.0775	0.120	9.5	0	1	0
6	0.530	0.415	0.150	0.7775	0.2370	0.1415	0.330	21.5	1	0	0
7	0.545	0.425	0.125	0.7680	0.2940	0.1495	0.260	17.5	1	0	0
8	0.475	0.370	0.125	0.5095	0.2165	0.1125	0.165	10.5	0	0	1
9	0.550	0.440	0.150	0.8945	0.3145	0.1510	0.320	20.5	1	0	0

## 8. Split the data into dependent and independent variables.

In [42]: *# Splitting the Dataset into the Independent*

```
X = file_data.iloc[:, :-1].values
print(X)

[['M' 0.455 0.365 ... 0.2245 0.101 0.15]
 ['M' 0.35 0.265 ... 0.0995 0.0485 0.07]
 ['F' 0.53 0.42 ... 0.2565 0.1415 0.21]
 ...
 ['M' 0.6 0.475 ... 0.5255 0.2875 0.308]
 ['F' 0.625 0.485 ... 0.531 0.261 0.296]
 ['M' 0.71 0.555 ... 0.9455 0.3765 0.495]]
```

In [43]: *# Extracting the Dataset to Get the Dependent*

```
Y = file_data.iloc[:, -1].values
print(Y)
```

```
[16.5  8.5 10.5 ... 10.5 11.5 13.5]
```

## 9. Scale the independent variables

In [44]: *from sklearn.preprocessing import scale*

In [45]: *x = scale(file\_data["Viscera weight"])*  
x

Out[45]: array([-0.72621157, -1.20522124, -0.35668983, ..., 0.97541324,  
 0.73362741, 1.78744868])

## 10. Split the data into training and testing

In [46]: *from sklearn.model\_selection import train\_test\_split*

In [47]: *x = file\_data.iloc[:, 1:7]*  
x

Out[47]:

	Length	Diameter	Height	Whole weight	Shucked weight	Viscera weight
0	0.455	0.365	0.095	0.5140	0.2245	0.1010
1	0.350	0.265	0.090	0.2255	0.0995	0.0485
2	0.530	0.420	0.135	0.6770	0.2565	0.1415
3	0.440	0.365	0.125	0.5160	0.2155	0.1140
4	0.330	0.255	0.080	0.2050	0.0895	0.0395
...	...	...	...	...	...	...
4172	0.565	0.450	0.165	0.8870	0.3700	0.2390
4173	0.590	0.440	0.135	0.9660	0.4390	0.2145
4174	0.600	0.475	0.205	1.1760	0.5255	0.2875
4175	0.625	0.485	0.150	1.0945	0.5310	0.2610
4176	0.710	0.555	0.195	1.9485	0.9455	0.3765

4177 rows × 6 columns

```
In [48]: y = file_data.iloc[:, -1]
y
```

```
Out[48]: 0      16.5
1       8.5
2      10.5
3      11.5
4       8.5
...
4172    12.5
4173    11.5
4174    10.5
4175    11.5
4176    13.5
Name: Age, Length: 4177, dtype: float64
```

```
In [49]: x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.25,random_state =42)
```

```
In [50]: x_train
```

```
Out[50]:
```

	Length	Diameter	Height	Whole weight	Shucked weight	Viscera weight
3823	0.615	0.455	0.135	1.0590	0.4735	0.2630
3956	0.515	0.395	0.140	0.6860	0.2810	0.1255
3623	0.660	0.530	0.175	1.5830	0.7395	0.3505
0	0.455	0.365	0.095	0.5140	0.2245	0.1010
2183	0.495	0.400	0.155	0.8085	0.2345	0.1155
...	...	...	...	...	...	...
3444	0.490	0.400	0.115	0.5690	0.2560	0.1325
466	0.670	0.550	0.190	1.3905	0.5425	0.3035
3092	0.510	0.395	0.125	0.5805	0.2440	0.1335
3772	0.575	0.465	0.120	1.0535	0.5160	0.2185
860	0.595	0.475	0.160	1.1405	0.5470	0.2310

3132 rows × 6 columns

```
In [51]: y_train
```

```
Out[51]: 3823    10.5
3956    13.5
3623    11.5
0      16.5
2183     7.5
...
3444    10.5
466     13.5
3092    12.5
3772    10.5
860     7.5
Name: Age, Length: 3132, dtype: float64
```

```
In [52]: print(x_train.shape, x_test.shape)
```

(3132, 6) (1045, 6)

## 11. Build the Model

```
In [53]: from sklearn.linear_model import LinearRegression
```

```
In [54]: model=LinearRegression()
```

```
In [55]: model.fit(x_train,y_train)
```

```
Out[55]: LinearRegression()
```

## 12. Train the Model

```
In [56]: Y_predict_train = model.predict(x_train)
Y_predict_train
```

```
Out[56]: array([11.25888828, 11.95379472, 12.33692259, ..., 11.12903068,
               10.71152746, 11.59516371])
```

## 13. Test the Model

```
In [57]: y_predict = model.predict(x_test)
y_predict
```

```
Out[57]: array([13.0478407 , 11.43166184, 15.59825921, ..., 13.69440346,
               11.79279231, 10.83037939])
```

## 14. Measure the performance using Metrics

```
In [58]: from sklearn.metrics import mean_squared_error
import math
print(mean_squared_error(y_test, y_predict))
print(math.sqrt(mean_squared_error(y_test, y_predict)))
```

```
4.862459933051859
2.205098622069285
```