Assignment 3

Data Visualization and Pre-processing

Description:-

Predicting the age of abalone from physical measurements. The age of abalone is determined by cutting the shell through the cone, staining it, and counting the number of rings through a microscope -- a boring and time-onsuming task. Other measurements, which are easier to obtain, are used to predict age. Further information, such as weather patterns and location (hence food availability) may be required to solve the problem.

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

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

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

	Sex	Length	Diameter	Height	Whole weight	Shucked weight	Viscera weight	Shell weight	Age
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 × 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]:

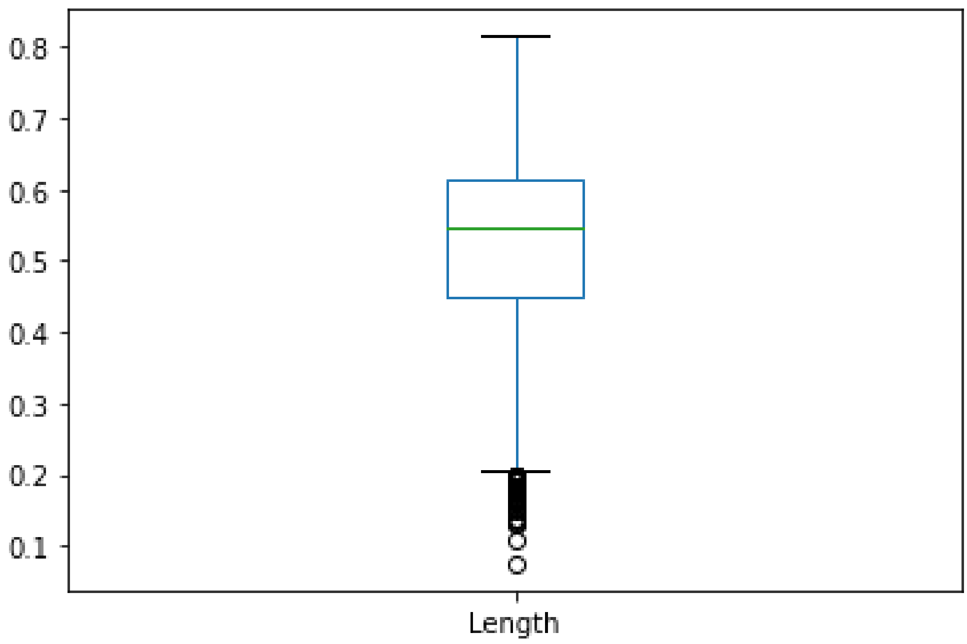
```
M    1528
I    1342
F    1307
Name: Sex, dtype: int64
```

3. Create Charts

In [10]:

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

Out[10]:

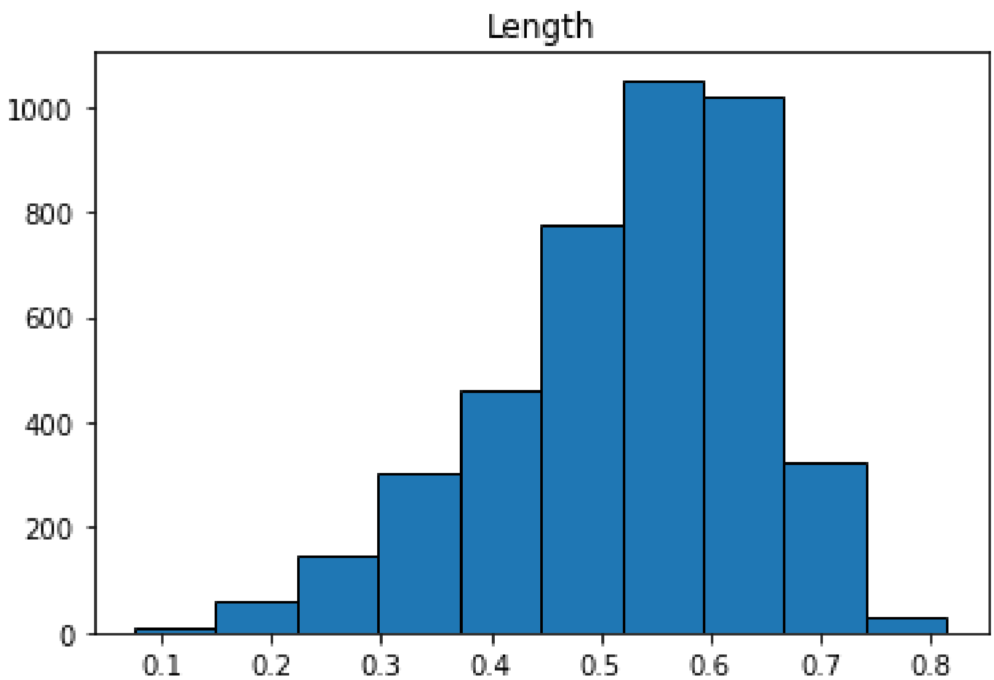


In [11]:

```
file_data.hist(column='Length', grid=False, edgecolor='black')
```

Out[11]:

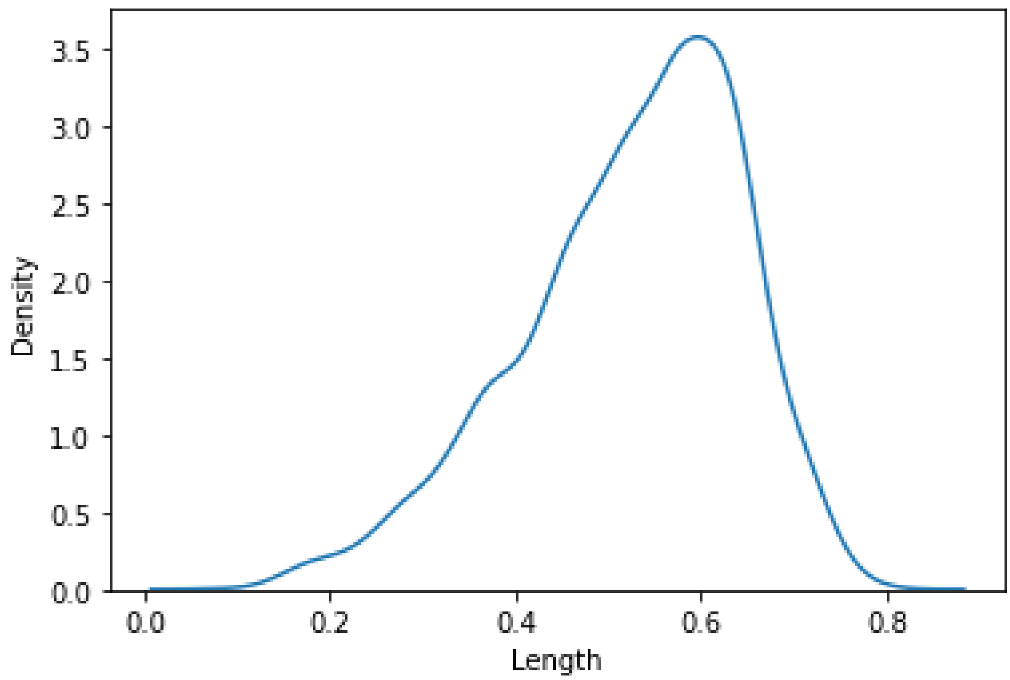
```
array([[]], dtype=object)
```



In [12]:

```
sns.kdeplot(file_data['Length'])
```

Out[12]:



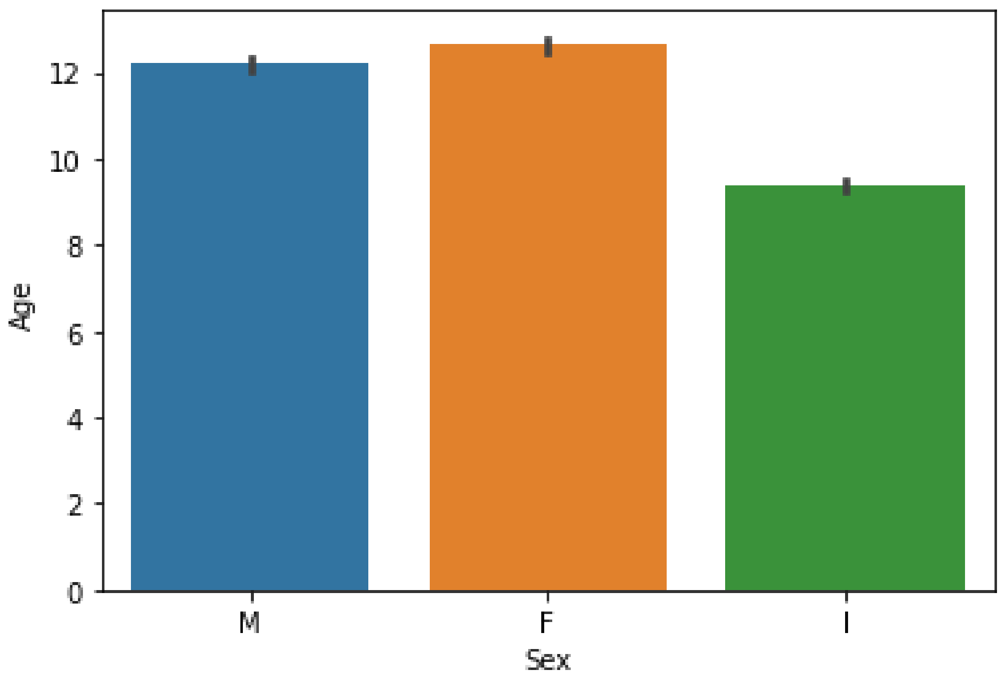
Bi - Variate Analysis

1. Barplot

In [13]:

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

Out[13]:



2. Correlation Coefficients

In [14]:

```
file_data.corr()
```

Out[14]:

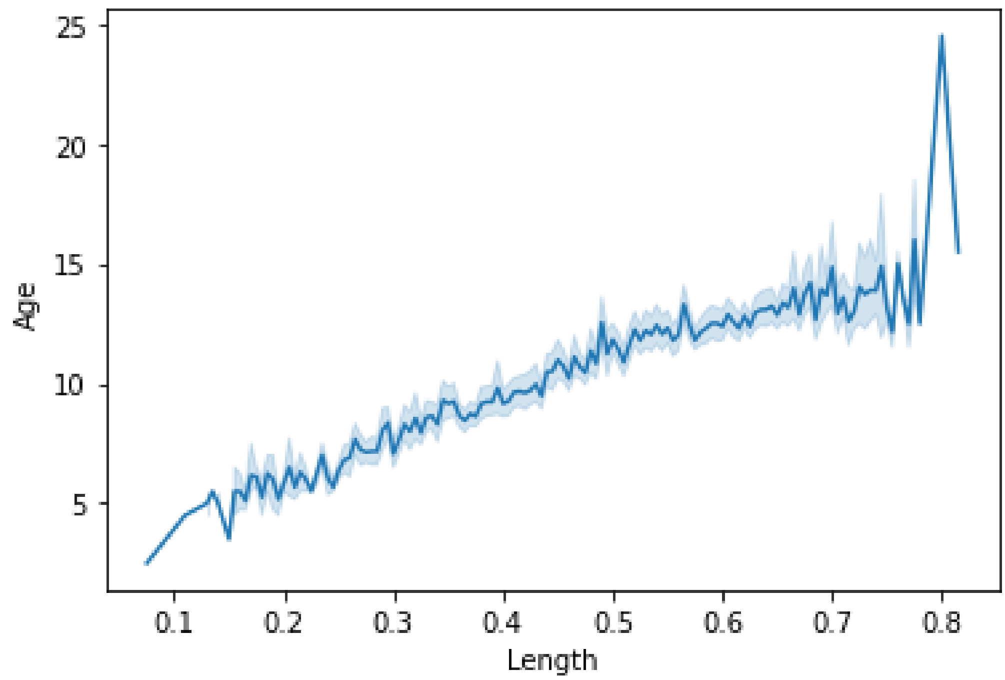
	Length	Diameter	Height	Whole weight	Shucked weight	Viscera weight	Shell weight	Age
Length	1.000000	0.986812	0.827554	0.925261	0.897914	0.903018	0.897706	0.556720
Diameter	0.986812	1.000000	0.833684	0.925452	0.893162	0.899724	0.905330	0.574660
Height	0.827554	0.833684	1.000000	0.819221	0.774972	0.798319	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]:

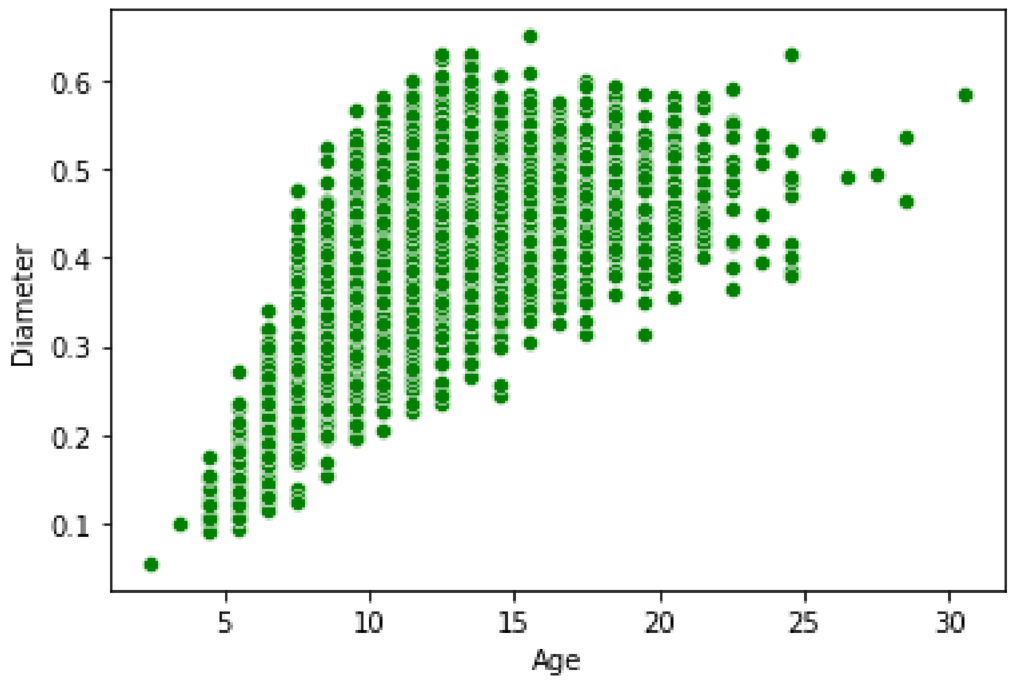


4. Scatter Plot

In [16]:

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

Out[16]:

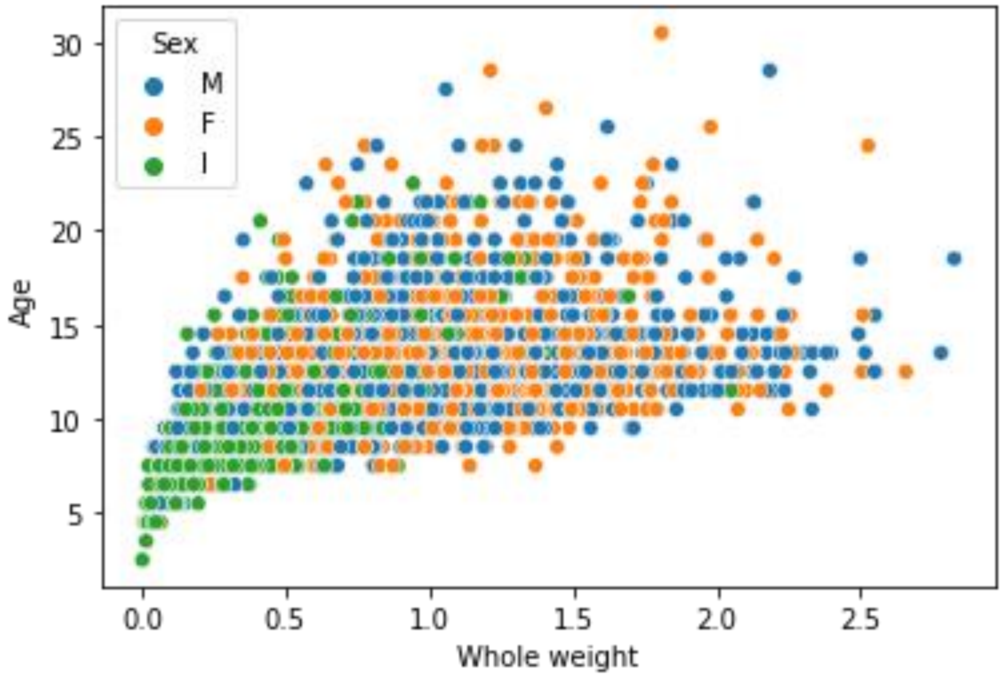


Multi - Variate Analysis

In [17]:

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

Out[17]:



4. Perform descriptive statistics on the dataset.

In [18]:

```
file_data.shape
```

Out[18]:

```
(4177, 9)
```

In [19]:

```
file_data.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   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]:

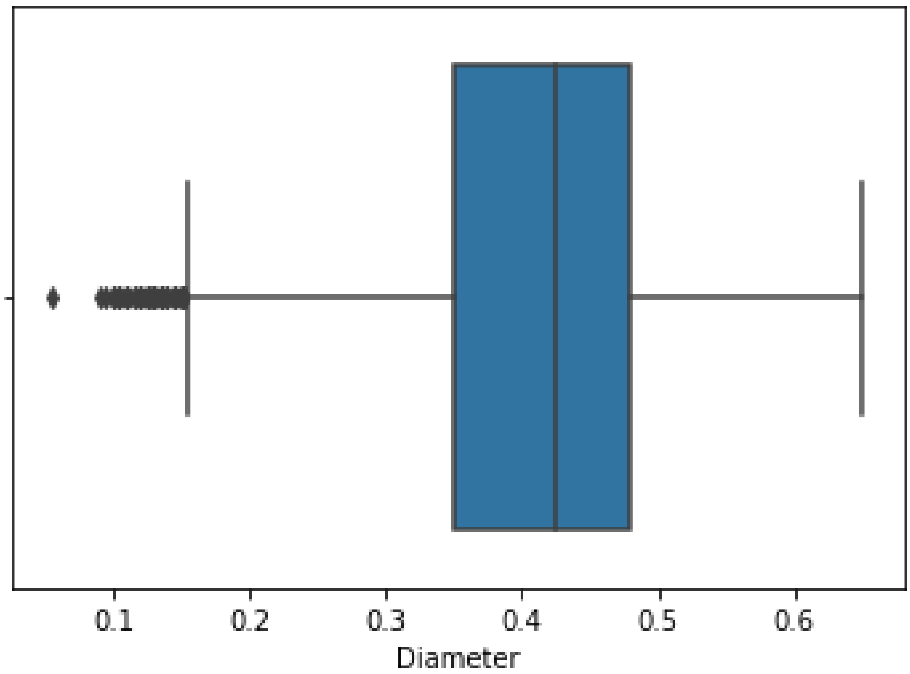
```
0.75    1.1530
```

```
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]:

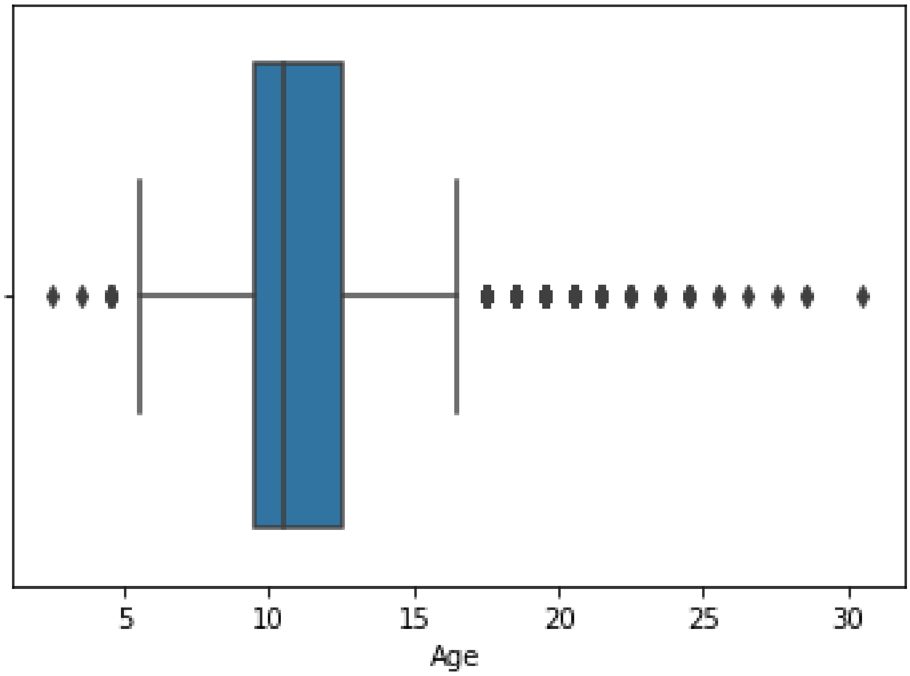
```
Sex                False
Length             False
Diameter           False
Height             False
Whole weight       False
Shucked weight     False
Viscera weight     False
Shell weight       False
Age                False
dtype: bool
```

6. Find the outliers and replace the outliers

In [35]:

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

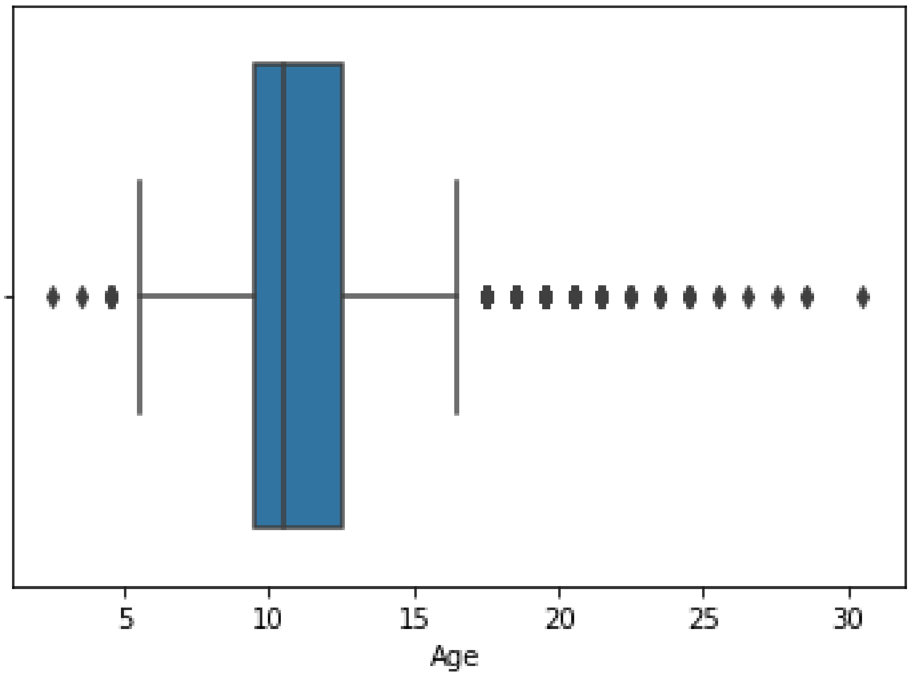
Out[35]:



In [36]:

```
x = file_data.Age
sns.boxplot(x=x)
```

Out[36]:



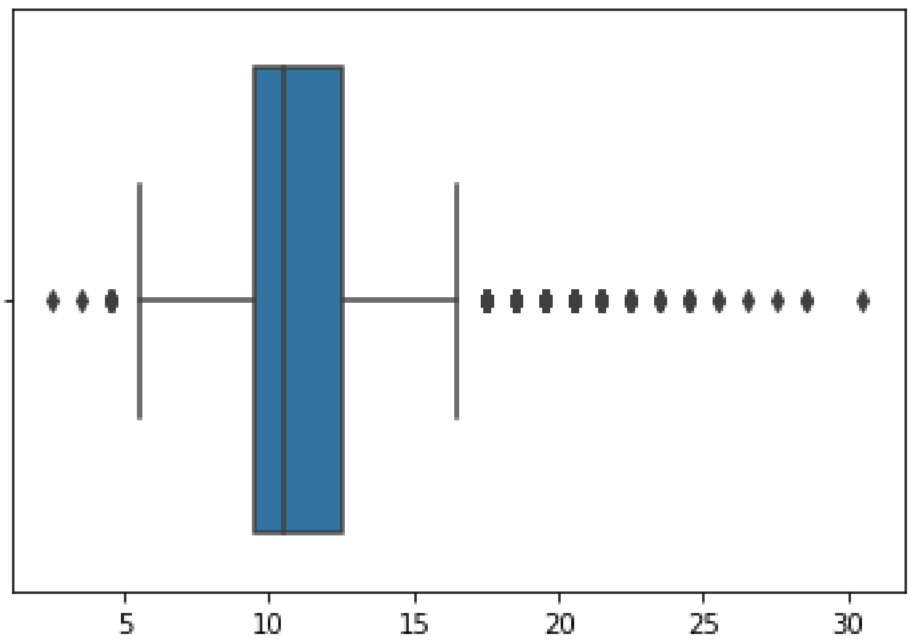
In [37]:

```
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, 1.094
5, 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

	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
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

	Length	Diameter	Height	Whole weight	Shucked weight	Viscera weight	Shell weight	Age	Sex_F	Sex_I	Sex_M
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_st
ate =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
```