Problem Statement: Abalone Age Prediction

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

Load the dataset

```
data=pd.read_csv("abalone.csv")
```

```
data.head()
```

```
  Sex  Length  Diameter  Height  Whole weight  Shucked weight  Viscera weight
\
0   M   0.455     0.365   0.095        0.5140          0.2245          0.1010
1   M   0.350     0.265   0.090        0.2255          0.0995          0.0485
2   F   0.530     0.420   0.135        0.6770          0.2565          0.1415
3   M   0.440     0.365   0.125        0.5160          0.2155          0.1140
4   I   0.330     0.255   0.080        0.2050          0.0895          0.0395

   Shell weight  Rings
0         0.150     15
1         0.070      7
2         0.210      9
3         0.155     10
4         0.055      7
```

```
data.shape
```

```
(4177, 9)
```

```
data.size
```

```
37593
```

```
data.info()
```

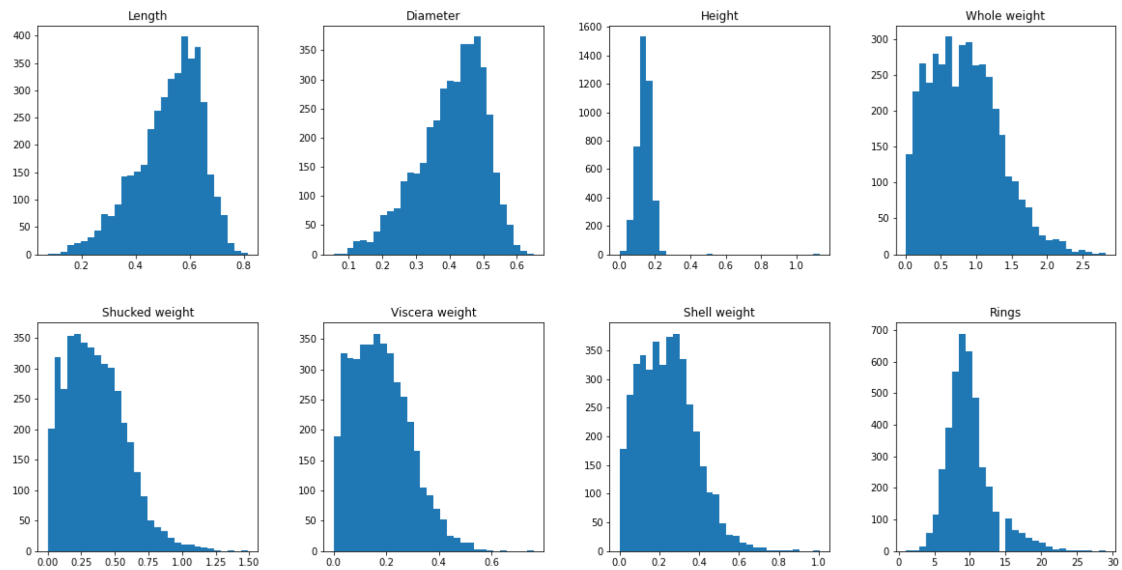
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 4177 entries, 0 to 4176
Data columns (total 9 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   Sex             4177 non-null   object
 1   Length          4177 non-null   float64
 2   Diameter        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   Rings           4177 non-null   int64
dtypes: float64(7), int64(1), object(1)
memory usage: 293.8+ KB
```

Data Analysis & Visualization

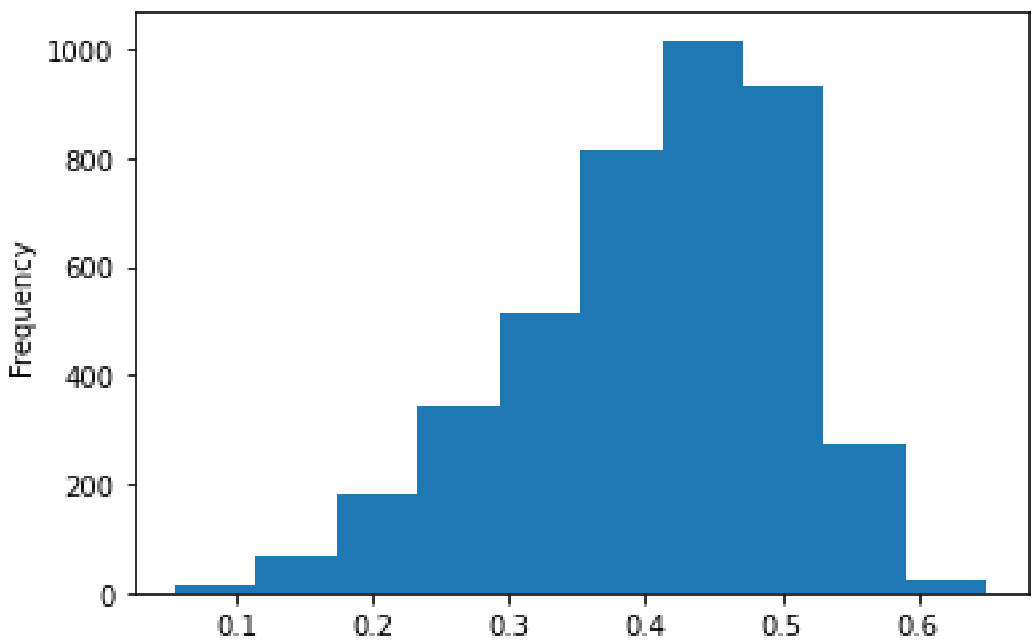
Univariate Analysis

```
data.hist(figsize=(20,10), grid=False, layout=(2,4), bins=30)
plt.show()
```

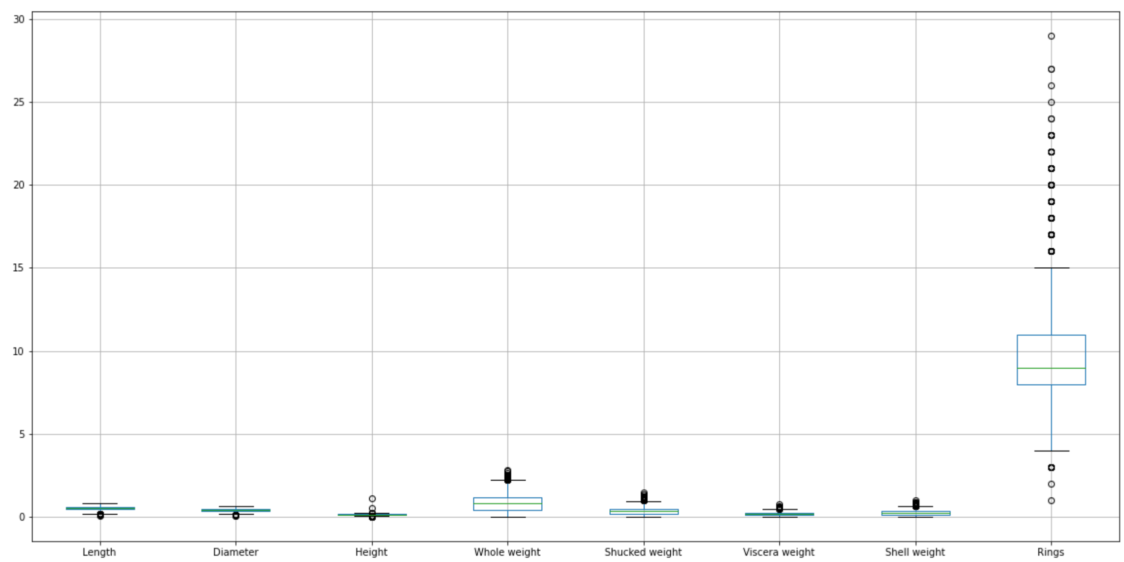



```
data["Diameter"].plot(kind='hist')
```

```
<AxesSubplot:ylabel='Frequency'>
```




```
data.boxplot(figsize=(20,10))
plt.show()
```



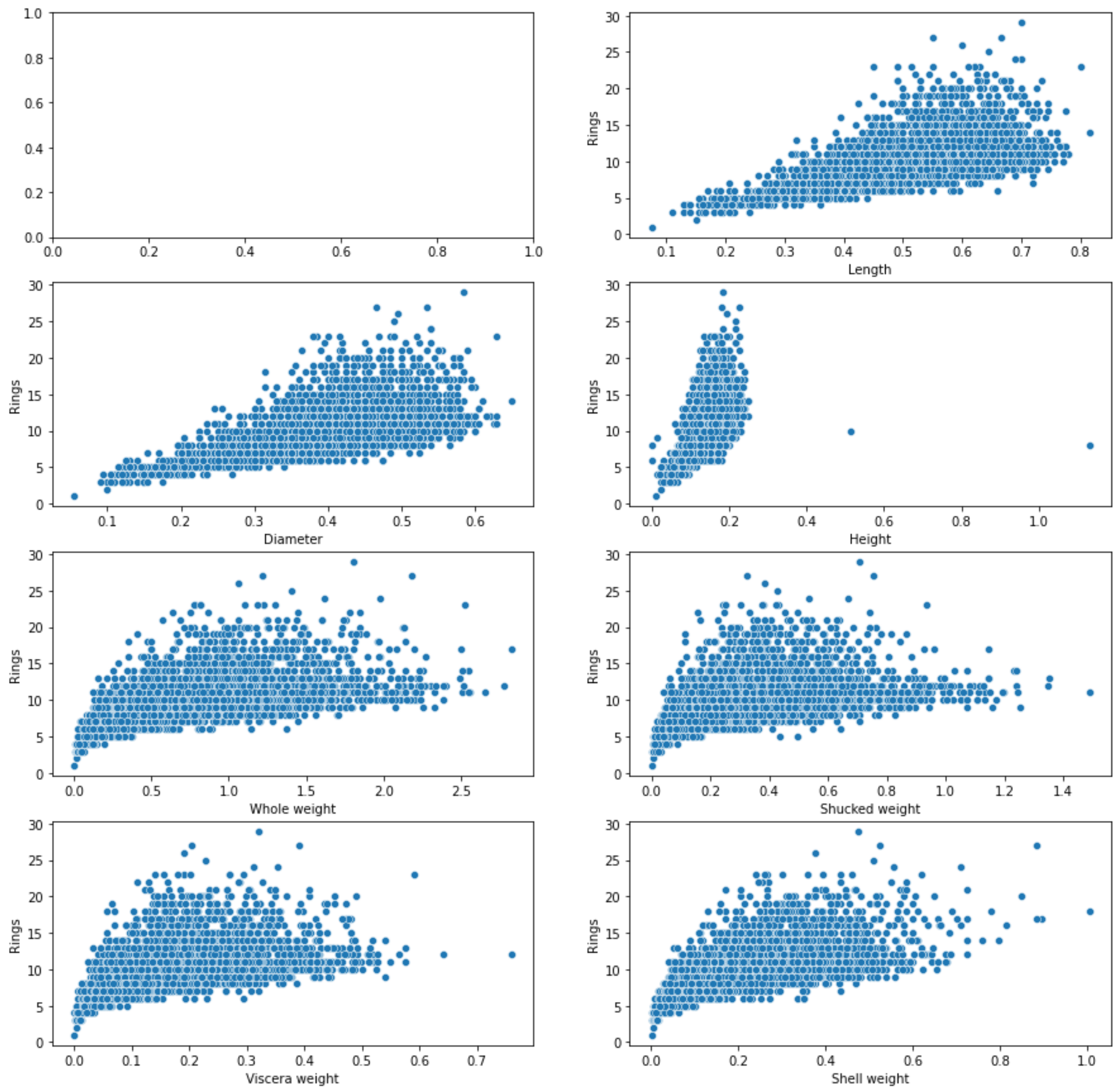
Bivariate Analysis

```
data.head()
```

```
  Sex  Length  Diameter  Height  Whole weight  Shucked weight  Viscera weight  \
0   M   0.455     0.365   0.095        0.5140          0.2245          0.1010
1   M   0.350     0.265   0.090        0.2255          0.0995          0.0485
2   F   0.530     0.420   0.135        0.6770          0.2565          0.1415
3   M   0.440     0.365   0.125        0.5160          0.2155          0.1140
4   I   0.330     0.255   0.080        0.2050          0.0895          0.0395
```

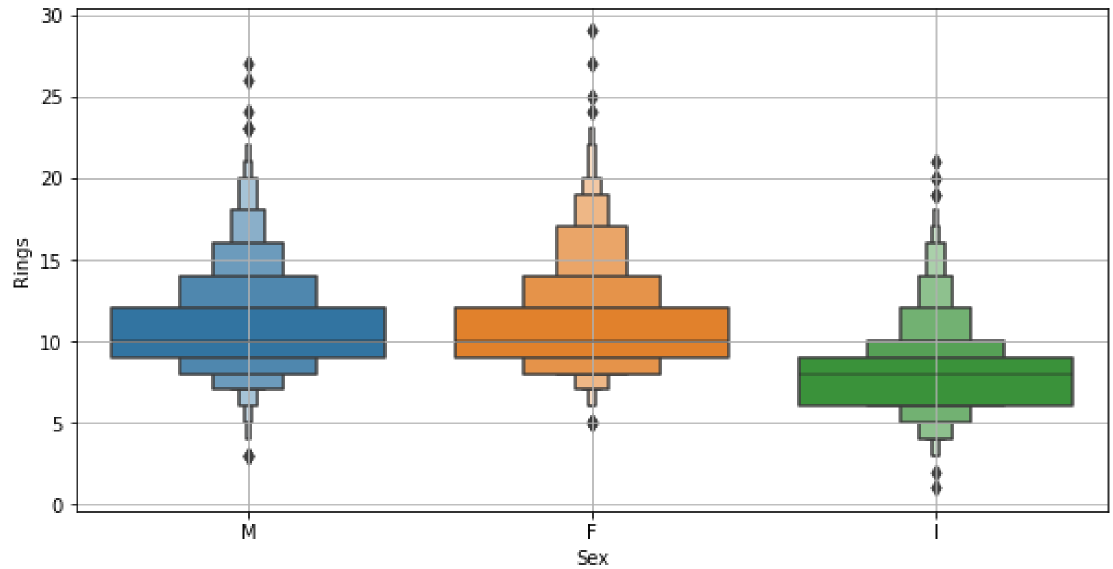
```
   Shell weight  Rings
0         0.150     15
1         0.070      7
2         0.210      9
3         0.155     10
4         0.055      7
```

```
fig, axes = plt.subplots(4,2, figsize=(15,15))
axes = axes.flatten()
for i in range(1,len(data.columns)-1):
    sns.scatterplot(x=data.iloc[:,i], y=data['Rings'], ax=axes[i])
plt.show()
```




```
plt.figure(figsize=(10,5))
sns.boxenplot(y=data['Rings'], x=data['Sex'])
plt.grid()
```

```
plt.show()
data.groupby('Sex')['Rings'].describe()
```

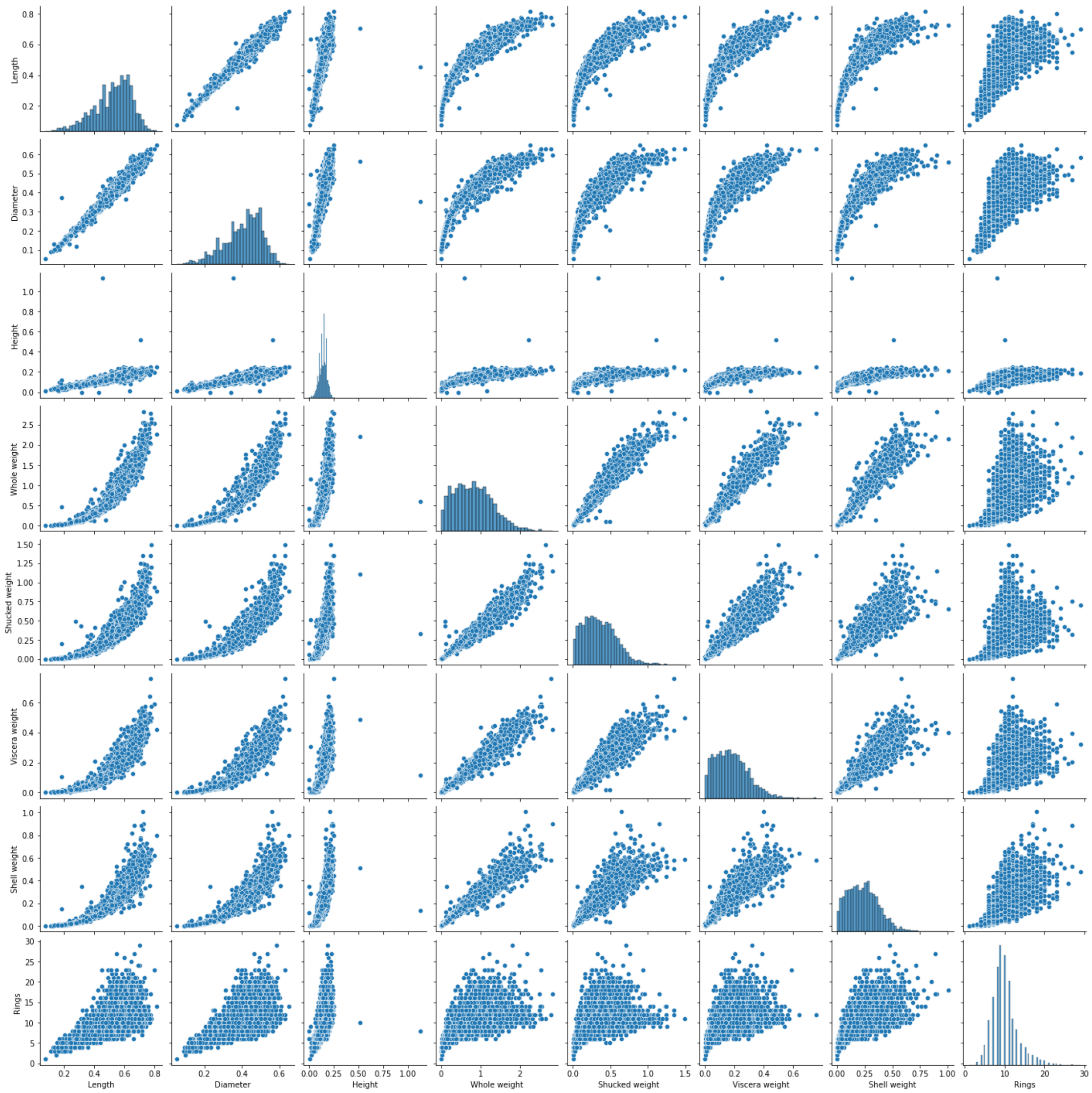


	count	mean	std	min	25%	50%	75%	max
Sex								
F	1307.0	11.129304	3.104256	5.0	9.0	10.0	12.0	29.0
I	1342.0	7.890462	2.511554	1.0	6.0	8.0	9.0	21.0
M	1528.0	10.705497	3.026349	3.0	9.0	10.0	12.0	27.0

Multivariate Analysis

```
sns.pairplot(data)

<seaborn.axisgrid.PairGrid at 0x161343cad00>
```



Descriptive statistics

```
data.describe()
```

```
            Length     Diameter       Height  Whole weight  Shucked weight  \
count  4177.000000  4177.000000  4177.000000   4177.000000     4177.000000
mean      0.523992     0.407881     0.139516      0.828742        0.359367
std       0.120093     0.099240     0.041827      0.490389        0.221963
min       0.075000     0.055000     0.000000      0.002000        0.001000
25%       0.450000     0.350000     0.115000      0.441500        0.186000
50%       0.545000     0.425000     0.140000      0.799500        0.336000
75%       0.615000     0.480000     0.165000      1.153000        0.502000
max       0.815000     0.650000     1.130000      2.825500        1.488000

       Viscera weight  Shell weight        Rings
count     4177.000000   4177.000000  4177.000000
mean         0.180594      0.238831     9.933684
```

```
std          0.109614     0.139203     3.224169
min          0.000500     0.001500     1.000000
25%          0.093500     0.130000     8.000000
50%          0.171000     0.234000     9.000000
75%          0.253000     0.329000    11.000000
max          0.760000     1.005000    29.000000
```

Handle The Missing values

```
data.isnull().any()
```

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

```
data.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
```

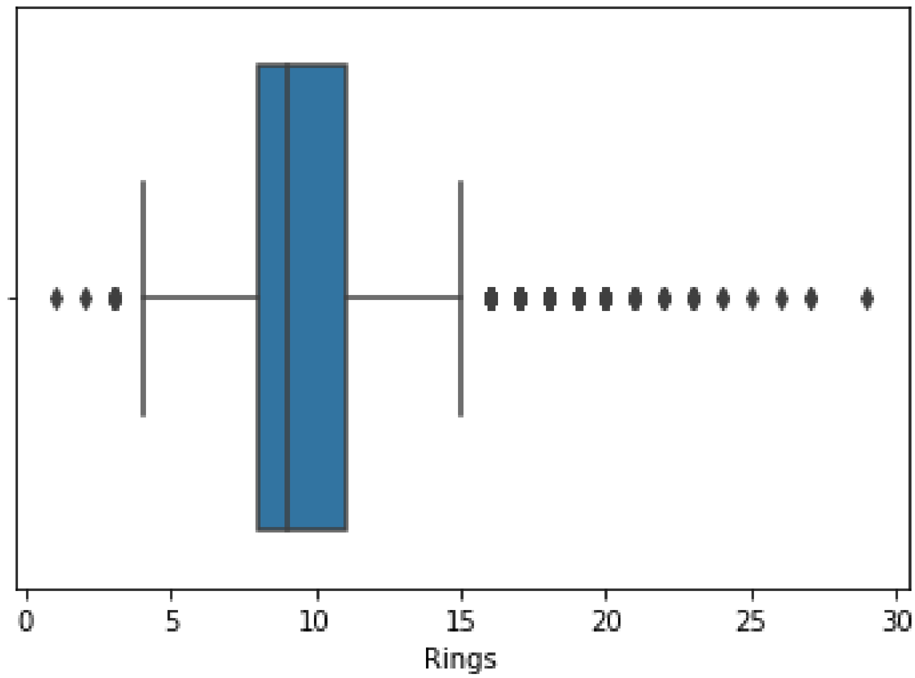
Find the outliers

```
data.skew()
```

```
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
Rings               1.114102
dtype: float64
```

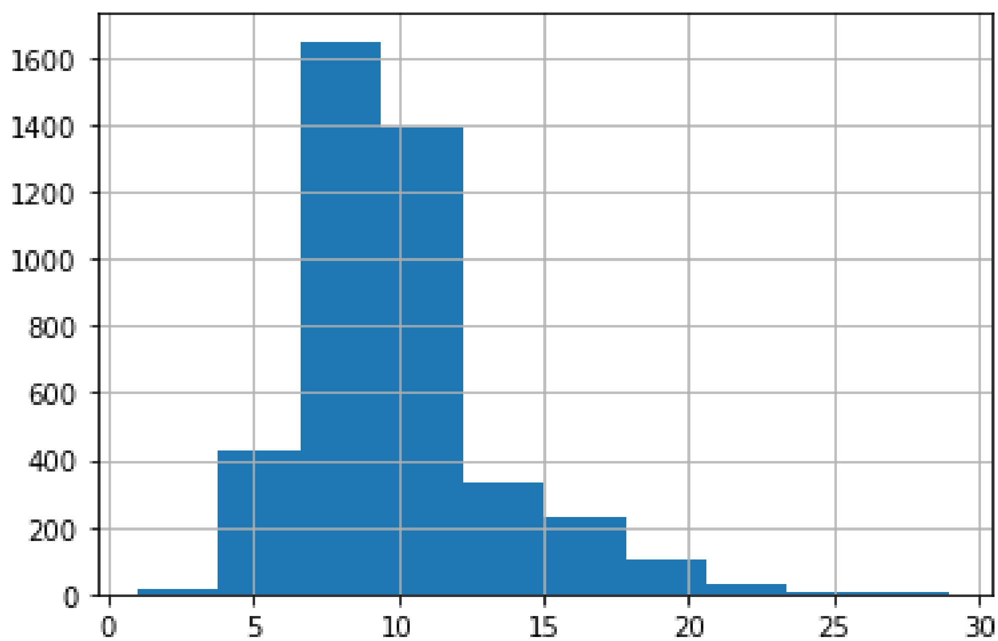
```
sns.boxplot(x=data['Rings'],data=data)
```

```
<AxesSubplot:xlabel='Rings'>
```




```
data['Rings'].hist()
```

```
<AxesSubplot:>
```




```
print('skewness value of Age: ',data['Rings'].skew())
```

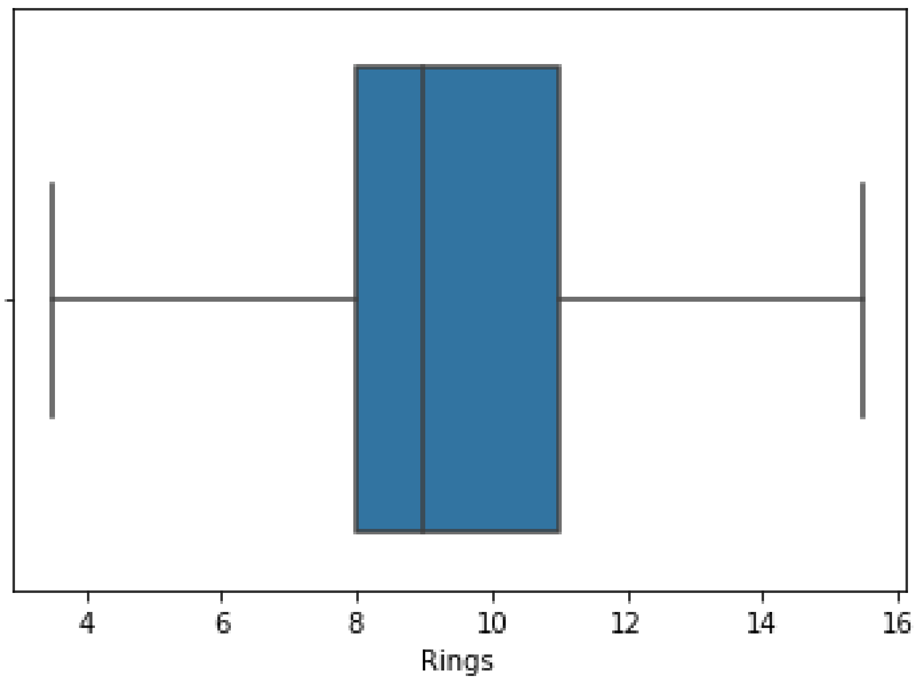
```
skewness value of Age:  1.114101898355677
```

```
# Flooring And Capping
```

```
Q1 = data['Rings'].quantile(0.25)
Q3 = data['Rings'].quantile(0.75)
IQR = Q3 - Q1
whisker_width = 1.5
lower_whisker = Q1 -(whisker_width*IQR)
upper_whisker = Q3 +(whisker_width*IQR)
data['Rings']=np.where(data['Rings']>upper_whisker,upper_whisker,np.where(dat
a['Rings']<lower_whisker,lower_whisker,data['Rings']))
```

```
sns.boxplot(x=data['Rings'],data=data)
```

```
<AxesSubplot:xlabel='Rings'>
```



Categorical encoding

```
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   Rings           4177 non-null   float64
dtypes: float64(8), object(1)
memory usage: 293.8+ KB
```

```
#Label Encoding

from sklearn.preprocessing import LabelEncoder

le=LabelEncoder()

data['Sex']=le.fit_transform(data['Sex'])

data.head()
```

```
   Sex  Length  Diameter  Height  Whole weight  Shucked weight  \
0    2   0.455     0.365   0.095        0.5140          0.2245
1    2   0.350     0.265   0.090        0.2255          0.0995
2    0   0.530     0.420   0.135        0.6770          0.2565
3    2   0.440     0.365   0.125        0.5160          0.2155
4    1   0.330     0.255   0.080        0.2050          0.0895

   Viscera weight  Shell weight  Rings
0          0.1010         0.150   15.0
1          0.0485         0.070    7.0
2          0.1415         0.210    9.0
3          0.1140         0.155   10.0
4          0.0395         0.055    7.0
```

```
data["Sex"].unique()
```

```
array([2, 0, 1])
```

Split the data into training and testing

```
data.head(5)
```

```
   Sex  Length  Diameter  Height  Whole weight  Shucked weight  \
0    2   0.455     0.365   0.095        0.5140          0.2245
1    2   0.350     0.265   0.090        0.2255          0.0995
2    0   0.530     0.420   0.135        0.6770          0.2565
3    2   0.440     0.365   0.125        0.5160          0.2155
4    1   0.330     0.255   0.080        0.2050          0.0895

   Viscera weight  Shell weight  Rings
0          0.1010         0.150   15.0
1          0.0485         0.070    7.0
2          0.1415         0.210    9.0
3          0.1140         0.155   10.0
4          0.0395         0.055    7.0
```

```python
X = data.iloc[:, 0:7]
Y = data.iloc[:,-1]
```

```python
X
```

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

      Viscera weight
0             0.1010
1             0.0485
2             0.1415
3             0.1140
4             0.0395
...              ...
4172          0.2390
4173          0.2145
4174          0.2875
4175          0.2610
4176          0.3765

[4177 rows x 7 columns]
```

```python
Y
```

```
0       15.0
1        7.0
2        9.0
3       10.0
4        7.0
        ...
4172    11.0
4173    10.0
4174     9.0
4175    10.0
4176    12.0
Name: Rings, Length: 4177, dtype: float64
```

```python
y.shape
```

```
(4177, 0)
```

Scale the independent variables

```
from sklearn.preprocessing import StandardScaler
ss = StandardScaler()
X_scaled = ss.fit_transform(X)
```

Split the data into training and testing

```
from sklearn.model_selection import train_test_split
x_train, x_test, y_train, y_test = train_test_split(X_scaled, Y, test_size = 0.3, random_state = 1)
```

Build the Model

```
Training the Model Testing the Model
```

```
import csv
with open("abalone.csv") as csv_file:
    csv_reader = csv.reader(csv_file)
    data = pd.DataFrame([csv_reader], index = None)
for val in list(data[1]):
    print(val)
```

```
['M', '0.455', '0.365', '0.095', '0.514', '0.2245', '0.101', '0.15', '15']
```

Training and Testing Module

1.Linear Regression 2.Ridge 3.Decision Tree Regression 4.KNeighborsRegressor

```
#importing all the neccessary models and metrics
from sklearn.linear_model import LinearRegression
from sklearn.linear_model import Ridge
from sklearn.tree import DecisionTreeRegressor
from sklearn.neighbors import KNeighborsRegressor

from sklearn.metrics import mean_squared_error, r2_score
```

1. Linear Regression

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

```
LinearRegression()
```

```
#Testing the model
lr_test_pred = lr.predict(x_test)
```

```
lr_test_pred
```

```
array([8.49722433, 7.64369059, 7.82520883, ..., 8.55677832, 9.02884473,
       5.96561877])
```

```
#measuring the performance
mse = mean_squared_error(y_test, lr_test_pred)
print('Mean Squared error of testing Set: %2f'%mse)
```

```
Mean Squared error of testing Set: 3.524602
```

```
p = r2_score(y_test, lr_test_pred)
print('R2 Score of testing set:%.2f'%p)
```

```
R2 Score of testing set:0.52
```

1. Ridge

```
ridge_mod = Ridge(alpha=0.01, normalize=True)
ridge_mod.fit(x_train, y_train)
ridge_mod.fit(x_test, y_test)
```

```
Ridge(alpha=0.01, normalize=True)
```

```
#Testing the model
ridge_model_pred = ridge_mod.predict(x_test)
```

```
ridge_model_pred
```

```
array([8.54031033, 8.48463396, 7.96838487, ..., 8.77493484, 9.03881023,
       5.83582085])
```

```
#Measuring the performance
acc = r2_score(y_test, ridge_model_pred)
print('Score of testing Set: %2f'%acc)
```

```
Score of testing Set: 0.523227
```

1. Decision Tree Regression

```
dt =  DecisionTreeRegressor()
dt.fit(x_train, y_train)
```

```
DecisionTreeRegressor()
```

```
#Testing the model
dt_test_pred = dt.predict(x_test)


dt_test_pred
```

```
array([12.,  9., 10., ...,  7.,  9.,  4.])
```

```
#Measuring the Performance
dacc = mean_squared_error(y_test, dt_test_pred)
print('Mean Squared Error of testing Set: %2f'%dacc)
```

```
Mean Squared Error of testing Set: 6.126994
```

1. KNN Regression

```
knn = KNeighborsRegressor(n_neighbors = 4 )
knn.fit(x_train, y_train)
knn.fit(x_test, y_test)
```

```
KNeighborsRegressor(n_neighbors=4)
```

```
#Testing the Model
knn_test_pred = knn.predict(x_test)
```

```
knn_test_pred
```

```
array([ 8.75,  9.5 , 10.5 , ...,  8.  ,  7.5 ,  5.  ])
```

```
#Measuring the Performance
kacc= r2_score(knn_test_pred,y_test)
print('Score of testing Set: %2f'%kacc)
```

```
Score of testing Set: 0.400555
```

```
kmse = mean_squared_error(knn_test_pred,y_test)
print('Score of testing Set: %2f'%kmse)
```

```
Score of testing Set: 2.602460
```