Problem Statement: Abalone Age Prediction

In [ ]:

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

Load the dataset

In [ ]:

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

In [ ]:

```
data.head()
```

Out[ ]:

	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

In [ ]:

```
data.shape
```

Out[ ]:

```
(4177, 9)
```

In [ ]:

```
data.size
```

Out[ ]:

```
37593
```

In [ ]:

```
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
```

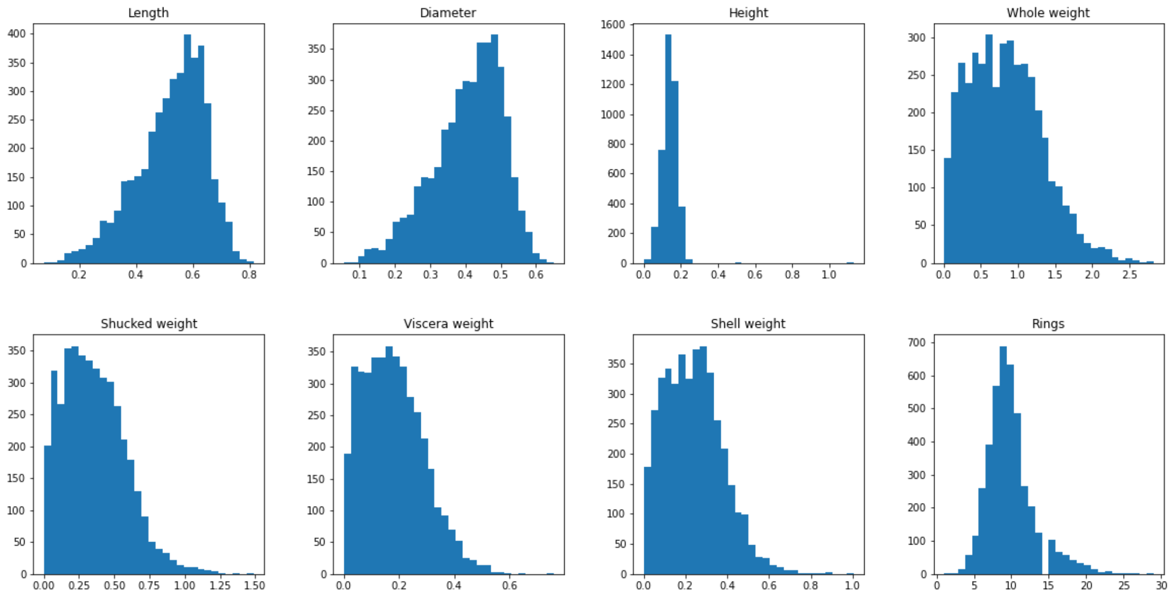
```
 8   Rings           4177 non-null   int64
dtypes: float64(7), int64(1), object(1)
memory usage: 293.8+ KB
```

Data Analysis & Visualization

Univariate Analysis

In [ ]:

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

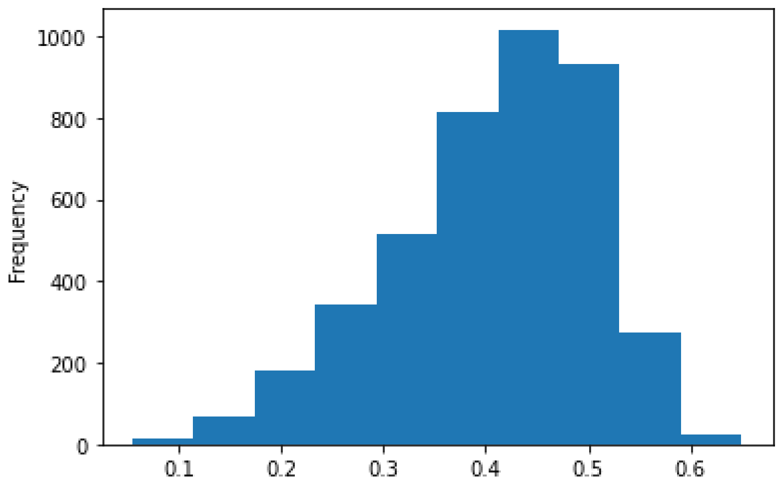


In [ ]:

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

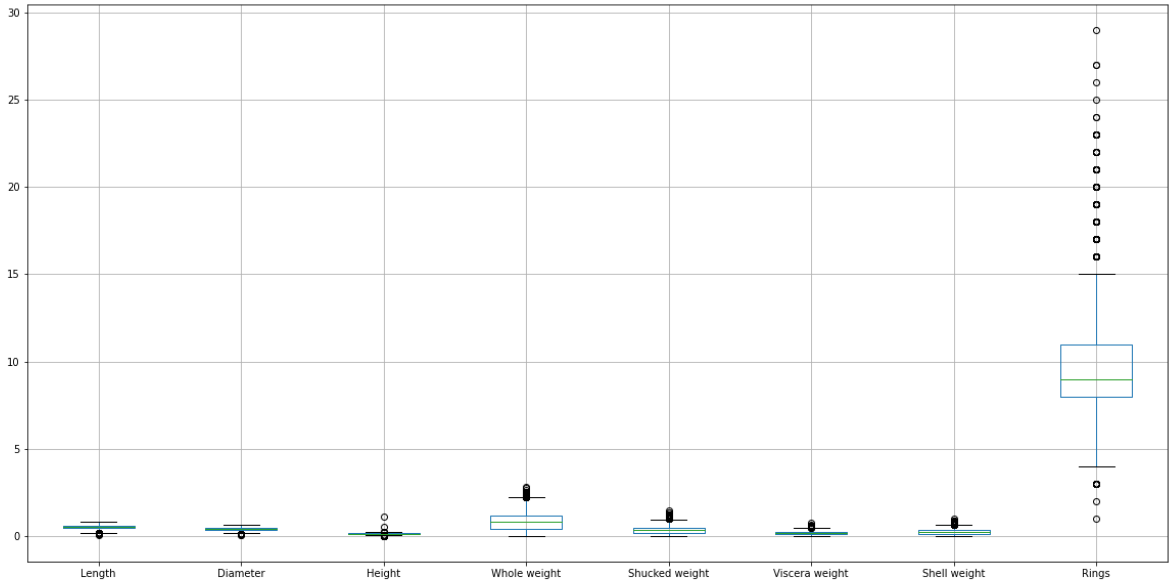
Out[ ]:

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



In [ ]:

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



Bivariate Analysis

In [ ]:

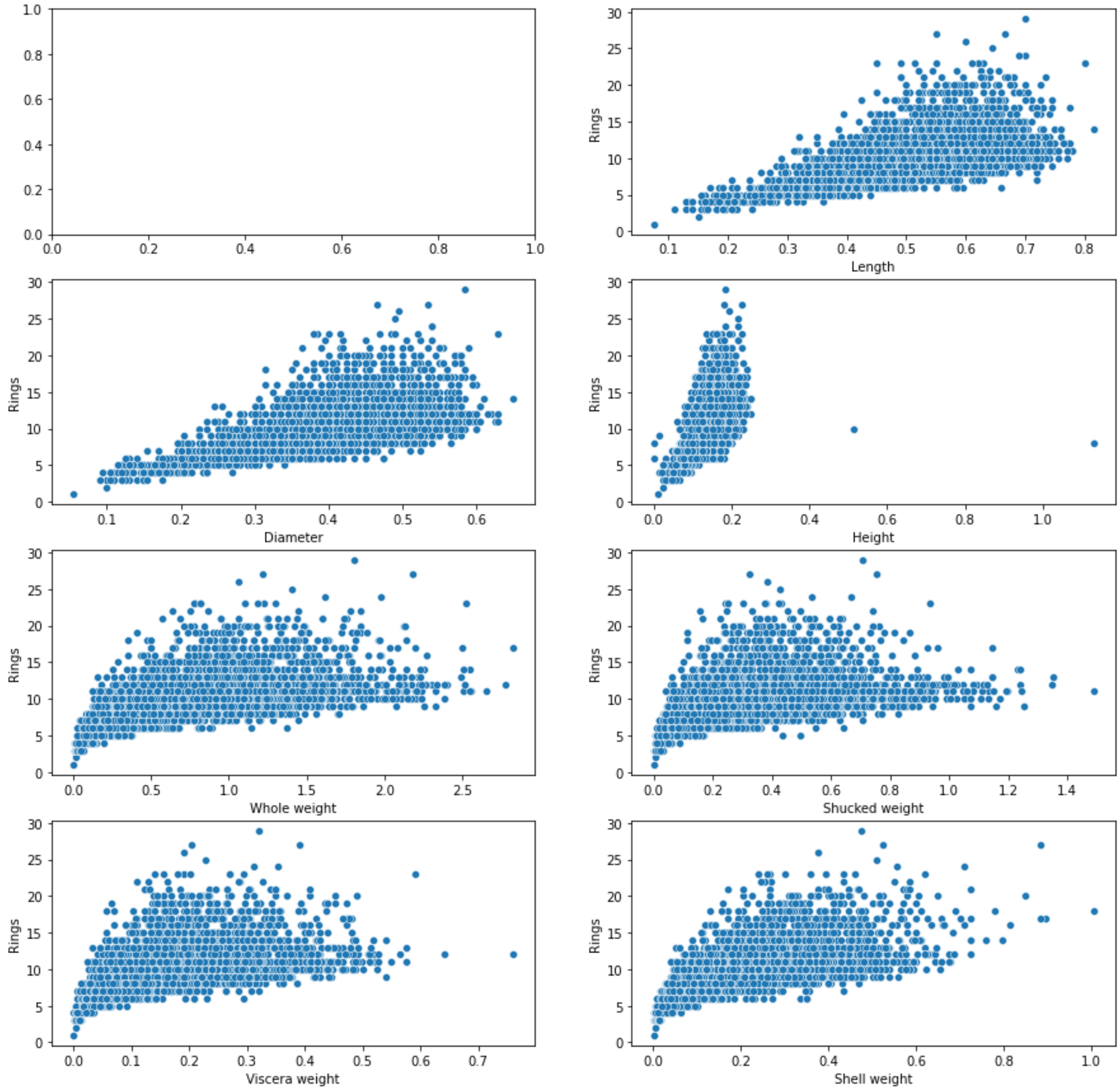
```
data.head()
```

Out[ ]:

	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

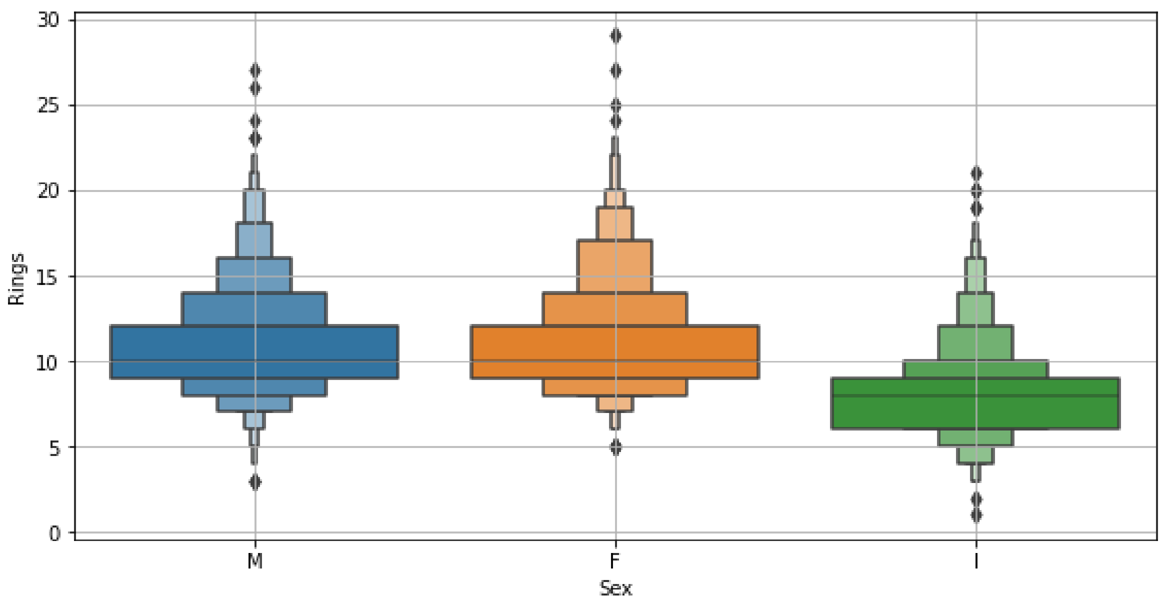
In [ ]:

```
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()
```



In [ ]:

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



Out[ ]:

count	mean	std	min	25%	50%	75%	max

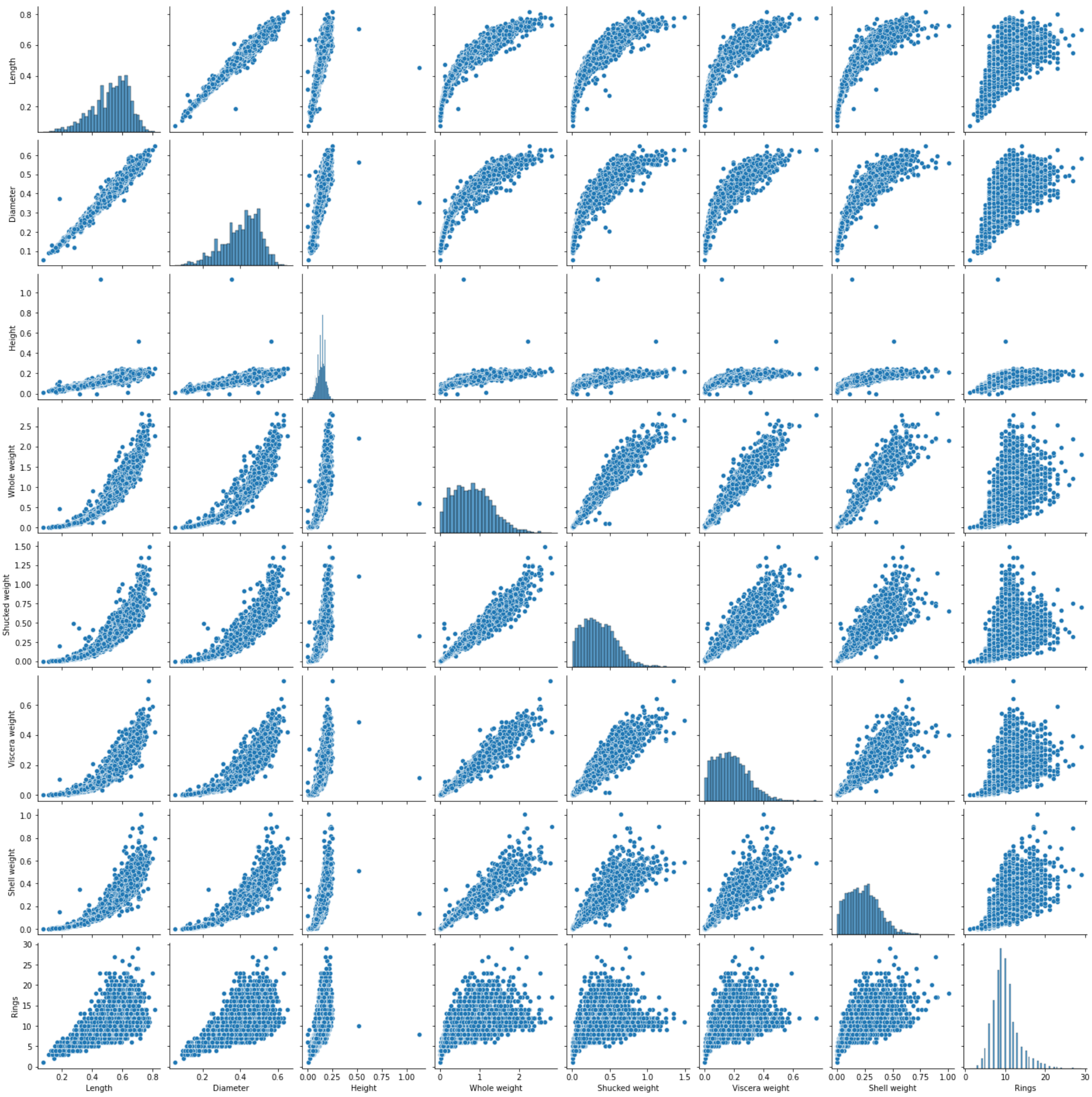
Sex	count	mean	std	min	25%	50%	75%	max
Sex								
F	1307.0	11.129304	3.104256	5.0	9.0	10.0	12.0	29.0
I	1342.0	7.890462	2.511554	1.0	6.0	8.0	9.0	21.0
M	1528.0	10.705497	3.026349	3.0	9.0	10.0	12.0	27.0

Multivariate Analysis

In [ ]:

```
sns.pairplot(data)
```

Out[ ]: <seaborn.axisgrid.PairGrid at 0x161343cad00>



Descriptive statistics

In [ ]:

```
data.describe()
```

Out[ ]:

	Length	Diameter	Height	Whole weight	Shucked weight	Viscera weight	Sh weig
count	4177.000000	4177.000000	4177.000000	4177.000000	4177.000000	4177.000000	4177.0000
mean	0.523992	0.407881	0.139516	0.828742	0.359367	0.180594	0.2388
std	0.120093	0.099240	0.041827	0.490389	0.221963	0.109614	0.1392
min	0.075000	0.055000	0.000000	0.002000	0.001000	0.000500	0.0015
25%	0.450000	0.350000	0.115000	0.441500	0.186000	0.093500	0.1300
50%	0.545000	0.425000	0.140000	0.799500	0.336000	0.171000	0.2340
75%	0.615000	0.480000	0.165000	1.153000	0.502000	0.253000	0.3290
max	0.815000	0.650000	1.130000	2.825500	1.488000	0.760000	1.0050

Handle The Missing values

In [ ]:

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

Out[ ]:

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

In [ ]:

```
data.isnull().sum()
```

Out[ ]:

```
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

In [ ]:

```
data.skew()
```

Out[ ]:

```
Length           -0.639873
Diameter         -0.609198
Height            3.128817
Whole weight      0.530959
Shucked weight    0.719098
Viscera weight    0.591852
```

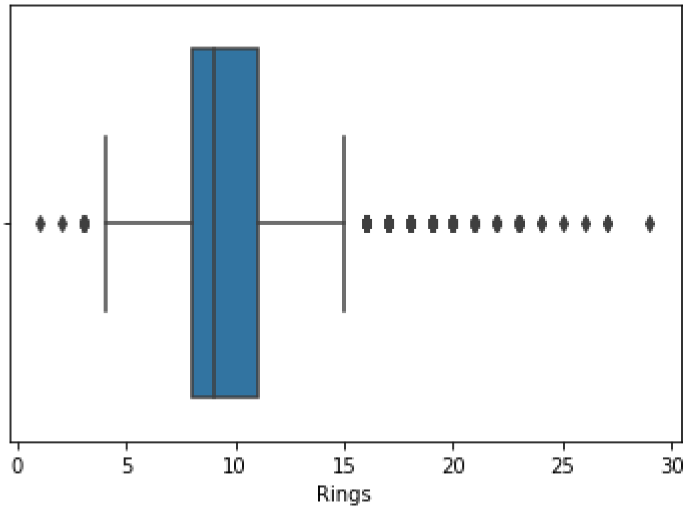
```
Shell weight      0.620927
Rings             1.114102
dtype: float64
```

In [ ]:

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

Out[ ]:

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

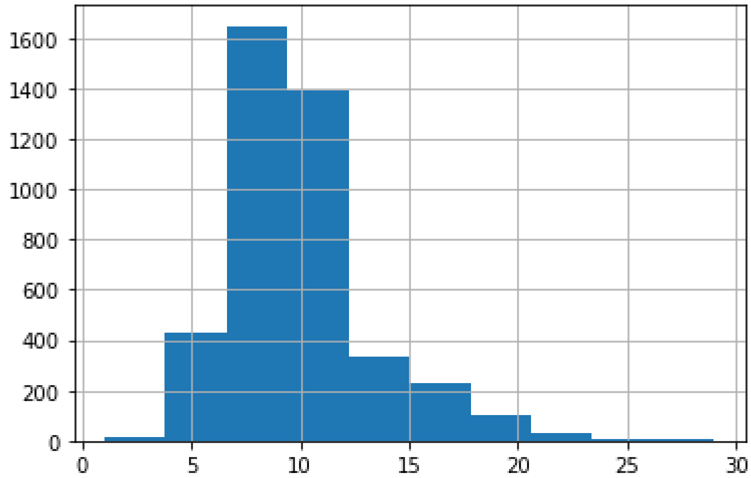


In [ ]:

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

Out[ ]:

```
<AxesSubplot:>
```



In [ ]:

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

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

In [ ]:

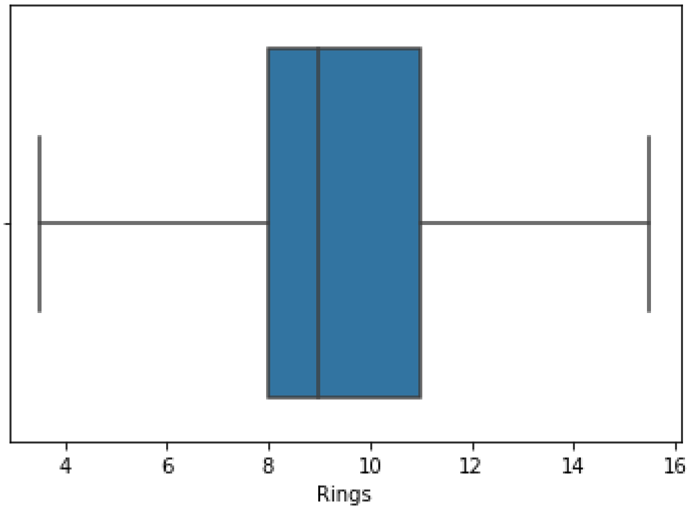
```
# Flooring And Capping

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(data['R
```

In [ ]:

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

Out[ ]: <AxesSubplot:xlabel='Rings'>



Categorical encoding

In [ ]:

```
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
```

In [ ]:

```
#Label Encoding

from sklearn.preprocessing import LabelEncoder

le=LabelEncoder()

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

In [ ]:

```
data.head()
```

Out[ ]:

	Sex	Length	Diameter	Height	Whole weight	Shucked weight	Viscera weight	Shell weight	Rings
0	2	0.455	0.365	0.095	0.5140	0.2245	0.1010	0.150	15.0
1	2	0.350	0.265	0.090	0.2255	0.0995	0.0485	0.070	7.0

	Sex	Length	Diameter	Height	Whole weight	Shucked weight	Viscera weight	Shell weight	Rings
2	0	0.530	0.420	0.135	0.6770	0.2565	0.1415	0.210	9.0
3	2	0.440	0.365	0.125	0.5160	0.2155	0.1140	0.155	10.0
4	1	0.330	0.255	0.080	0.2050	0.0895	0.0395	0.055	7.0

In [ ]:

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

Out[ ]:

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

Split the data into training and testing

In [ ]:

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

Out[ ]:

	Sex	Length	Diameter	Height	Whole weight	Shucked weight	Viscera weight	Shell weight	Rings
0	2	0.455	0.365	0.095	0.5140	0.2245	0.1010	0.150	15.0
1	2	0.350	0.265	0.090	0.2255	0.0995	0.0485	0.070	7.0
2	0	0.530	0.420	0.135	0.6770	0.2565	0.1415	0.210	9.0
3	2	0.440	0.365	0.125	0.5160	0.2155	0.1140	0.155	10.0
4	1	0.330	0.255	0.080	0.2050	0.0895	0.0395	0.055	7.0

In [ ]:

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

In [ ]:

```
X
```

Out[ ]:

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

4177 rows × 7 columns

In [ ]:
```
Y
```

Out[ ]:
```
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
```

In [ ]:
```
y.shape
```

Out[ ]:
```
(4177, 0)
```

Scale the independent variables

In [ ]:
```
from sklearn.preprocessing import StandardScaler
ss = StandardScaler()
X_scaled = ss.fit_transform(X)
```

Split the data into training and testing

In [ ]:
```
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,
```

Build the Model

`Training the Model` `Testing the Model`

In [ ]:
```
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

In [ ]:
```
#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

In [ ]:
```
lr = LinearRegression()
lr.fit(x_train, y_train)
```

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

In [ ]:
```
#Testing the model
lr_test_pred = lr.predict(x_test)
```

In [ ]:
```
lr_test_pred
```

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

In [ ]:
```
#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
```

In [ ]:
```
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

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

Out[ ]:
```
Ridge(alpha=0.01, normalize=True)
```

In [ ]:
```
#Testing the model
ridge_model_pred = ridge_mod.predict(x_test)
```

In [ ]:
```
ridge_model_pred
```

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

In [ ]:
```
#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

In [ ]:
```
dt =  DecisionTreeRegressor()
dt.fit(x_train, y_train)
```

Out[ ]:
```
DecisionTreeRegressor()
```

In [ ]:
```
#Testing the model
dt_test_pred = dt.predict(x_test)
```

In [ ]:
```
dt_test_pred
```

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

In [ ]:
```
#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

In [ ]:
```
knn = KNeighborsRegressor(n_neighbors = 4 )
knn.fit(x_train, y_train)
knn.fit(x_test, y_test)
```

Out[ ]:
```
KNeighborsRegressor(n_neighbors=4)
```

In [ ]:
```
#Testing the Model
knn_test_pred = knn.predict(x_test)
```

In [ ]:
```
knn_test_pred
```

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

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

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

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

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