

## **ASSIGNMENT 4**

### **Problem Statement: Abalone Age Prediction**

**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-consuming 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.

#### **Attribute Information:**

Given is the attribute name, attribute type, measurement unit, and a brief description. The number of rings is the value to predict: either as a continuous value or as a classification problem.

#### **Name / Data Type / Measurement Unit / Description**

- 1- Sex / nominal / -- / M, F, and I (infant)
- 2- Length / continuous / mm / Longest shell measurement
- 3- Diameter / continuous / mm / perpendicular to length
- 4- Height / continuous / mm / with meat in shell
- 5- Whole weight / continuous / grams / whole abalone
- 6- Shucked weight / continuous / grams / weight of meat
- 7- Viscera weight / continuous / grams / gut weight (after bleeding)
- 8- Shell weight / continuous / grams / after being dried
- 9- Rings / integer / -- / +1.5 gives the age in years

#### **Building a Regression Model**

1. Download the dataset: [Dataset](#)
2. Load the dataset into the tool.

```
[6] df=pd.read_csv('../abalone.csv')
```

```
[7] 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     |

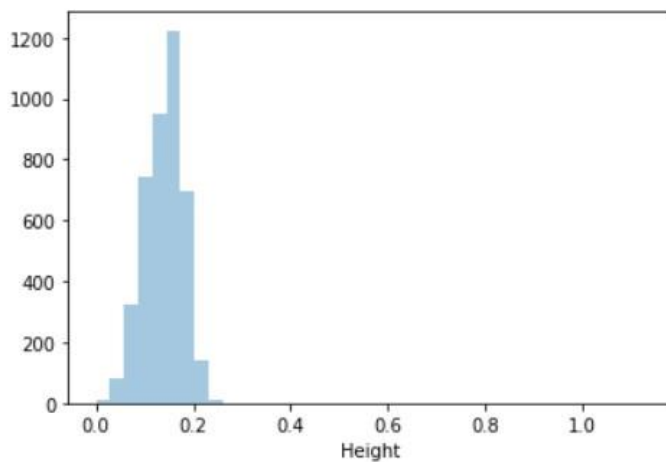
3. Perform Below Visualizations.

### • Univariate Analysis

```
import numpy as np
import pandas as pd
#For plotting
from matplotlib import pyplot as plt
import seaborn as sns
%matplotlib inline
```

```
[9] sns.distplot(df.Height.dropna(), kde=False, bins = 39)
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/distributions.py:2619: FutureWarning:
  warnings.warn(msg, FutureWarning)
<matplotlib.axes._subplots.AxesSubplot at 0x7f02be9339d0>
```



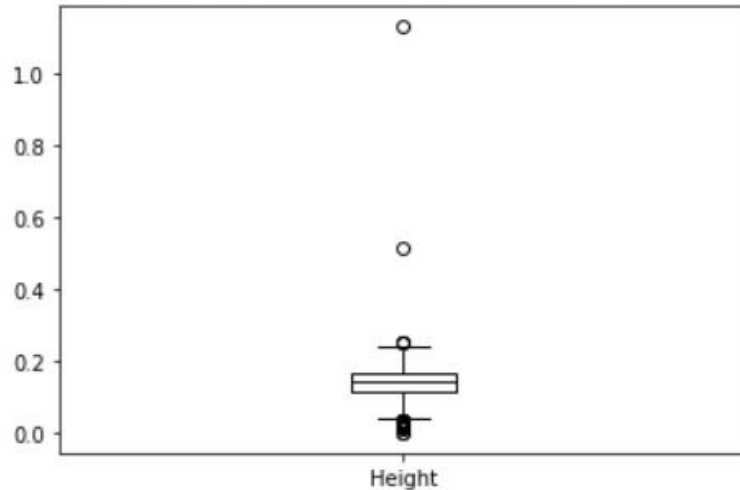
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Box plot:

```
[16] import matplotlib.pyplot as plt
```

```
df.boxplot(column=['Height'], grid=False, color='black')
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f02be793650>
```

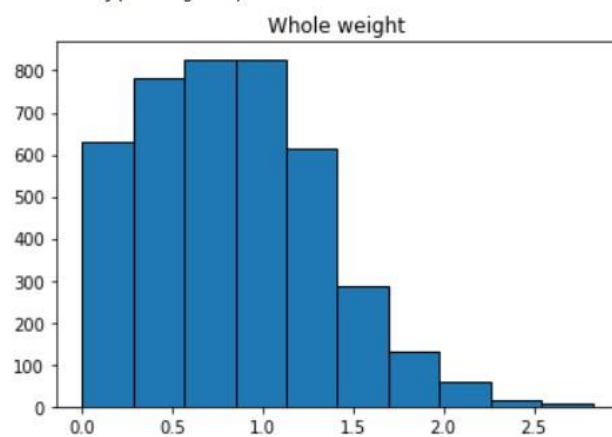


## Histogram:

```
[17] import matplotlib.pyplot as plt
```

```
df.hist(column='Whole weight', grid=False, edgecolor='black')
```

```
array([[<matplotlib.axes._subplots.AxesSubplot object at 0x7f02be1700d0>]],  
      dtype=object)
```



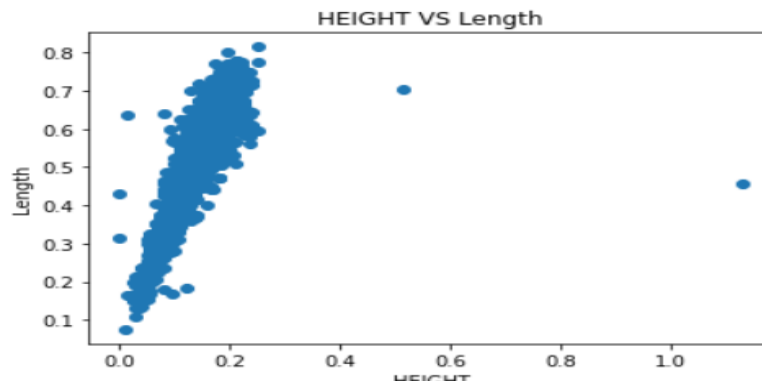
## Bi-Variate Analysis

## 1. Scatterplots

```
[21] import matplotlib.pyplot as plt

#create scatterplot of hours vs. score
plt.scatter(df.Height, df.Length)
plt.title('HEIGHT VS Length')
plt.xlabel('HEIGHT')
plt.ylabel('Length')
```

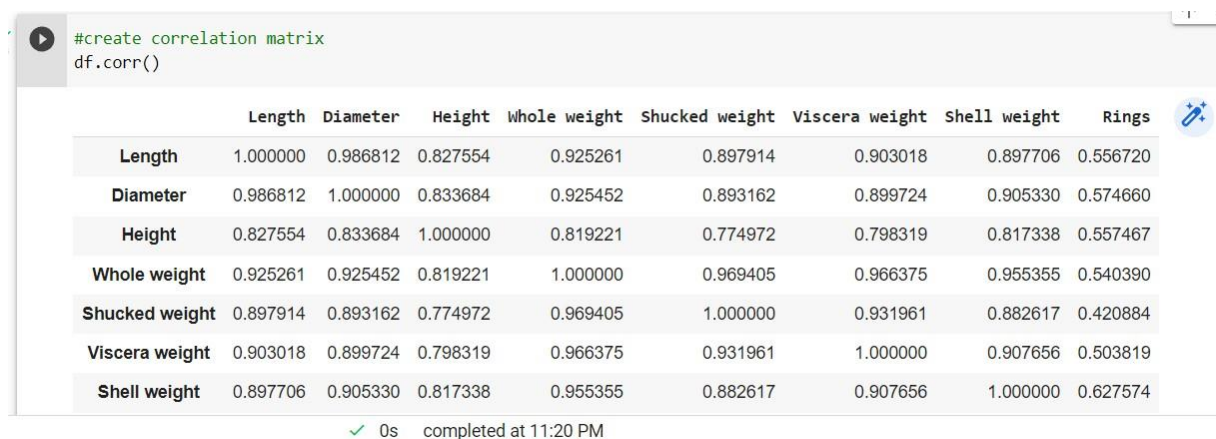
```
Text(0, 0.5, 'Length')
```



## 2. Correlation Coefficients

A Pearson Correlation Coefficient is a way to quantify the linear relationship between two variables.

We can use the `corr()` function in pandas to create a correlation matrix:

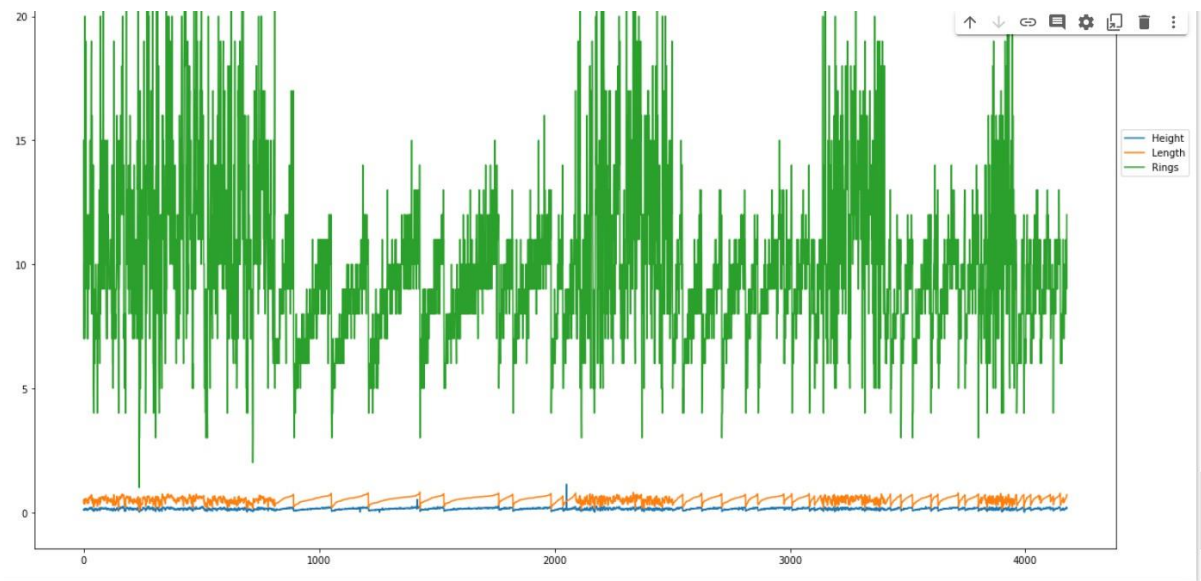


## · Multi-Variate Analysis

### Profile Plot

Profile plot, used to shows the variation in each of the variables, by plotting the value of each of the variables for each of the samples.

```
ax = df[["Height", "Length", "Rings"]].plot(figsize=(20,15))  
ax.legend(loc='center left', bbox_to_anchor=(1, 0.5))
```



4. Perform descriptive statistics on the dataset.

Mean median and standard deviation.

```
#calculate mean  
df['Height'].mean()
```

0.041827056607257274

```
[15] #calculate median  
df['Height'].median()
```

0.14

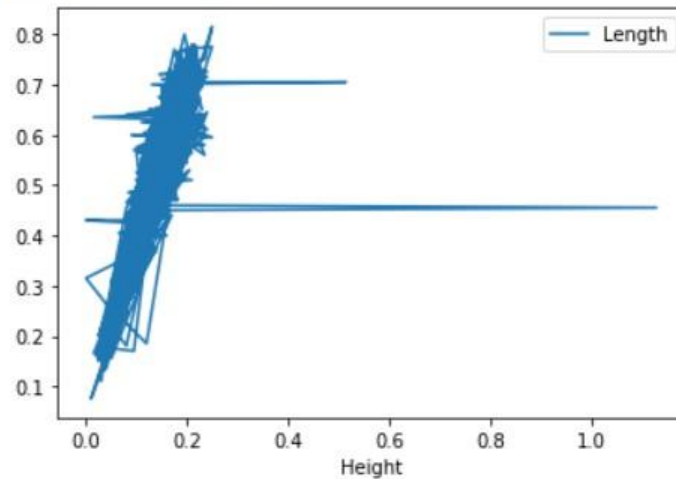
```
[14] #calculate standard deviation  
df['Height'].std()
```

0.041827056607257274

IQR(difference between 75% and 25% quartile)

```
df.plot(x="Height", y="Length")  
IQR=df["Length"].quantile(0.75)-df["Length"].quantile(0.25)  
IQR
```

0.16499999999999998



5. Check for Missing values and deal with them.

```
df.isnull()
```

|      | Sex   | Length | Diameter | Height | Whole weight | Shucked weight | Viscera weight | Shell weight | Rings |
|------|-------|--------|----------|--------|--------------|----------------|----------------|--------------|-------|
| 0    | False | False  | False    | False  | False        | False          | False          | False        | False |
| 1    | False | False  | False    | False  | False        | False          | False          | False        | False |
| 2    | False | False  | False    | False  | False        | False          | False          | False        | False |
| 3    | False | False  | False    | False  | False        | False          | False          | False        | False |
| 4    | False | False  | False    | False  | False        | False          | False          | False        | False |
| ...  | ...   | ...    | ...      | ...    | ...          | ...            | ...            | ...          | ...   |
| 4172 | False | False  | False    | False  | False        | False          | False          | False        | False |
| 4173 | False | False  | False    | False  | False        | False          | False          | False        | False |
| 4174 | False | False  | False    | False  | False        | False          | False          | False        | False |
| 4175 | False | False  | False    | False  | False        | False          | False          | False        | False |
| 4176 | False | False  | False    | False  | False        | False          | False          | False        | False |

4177 rows × 9 columns

No missing values.

6. Find the outliers and replace them outliers

## Outliers Identification

There are different ways and methods of identifying outliers, but we are only going to use some of the most popular techniques:

- Skewness

### Skewness

the skewness value should be within the range of -1 to 1 for a normal distribution, any major changes from this value may indicate the presence of outliers.



```
print('skewness value of ring: ',df['Rings'].skew())  
print('skewness value of height: ',df['Height'].skew())
```

```
skewness value of ring: 1.114101898355677  
skewness value of height: 3.1288173790659615
```

value of 3.12 shows the variable has been rightly skewed,

indicating the presence of outliers.

## Outliers Treatment

- Trimming.

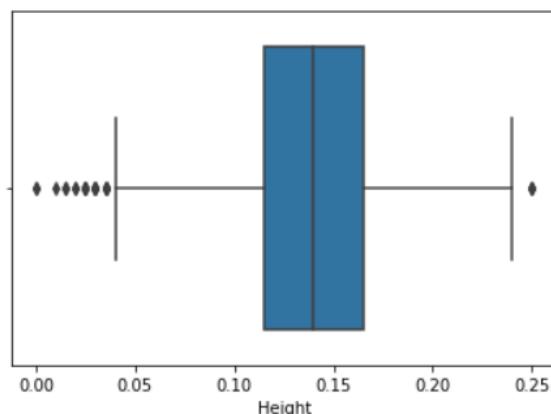
in this method, we removed and completely drop all the outliers, the line of code below creates an index for all data points and drop the index values.

```
[36] Q1 = df['Height'].quantile(0.10)
      Q3 = df['Height'].quantile(0.90)
      IQR = Q3 - Q1
      whisker_width = 1.5
      lower_whisker = Q1 - (whisker_width*IQR)
      upper_whisker = Q3 + (whisker_width*IQR)
      index=df['Height'][(df['Height']>upper_whisker)|(df['Height']<lower_whisker)].index
      df.drop(index,inplace=True)
```



```
sns.boxplot(df['Height'],data=df)
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pass the
FutureWarning
<matplotlib.axes._subplots.AxesSubplot at 0x7f02bc5345d0>
```



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7. Check for Categorical columns and perform encoding.

There are no categorical data:

8. Split the data into dependent and independent variables

## Splitting the Dataset into the Independent Feature Matrix:

```
X = df.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]]
```

## Extracting the Dataset to Get the Dependent Vector

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

```
[15  7  9 ...  9 10 12]
```

9. Scale the independent variables

It is a pre-processing step. This technique used to **normalize** the range of independent variables.

Variables that are used to determine the target variable are known as features.

### 1. MIN-MAX SCALING

In min-max scaling or min-man normalization, we re-scale the data to a range of **[0,1]** or **[-1,1]**.

$$X_{norm} = \frac{X - X_{min}}{X_{max} - X_{min}}$$

## 2. STANDARDIZATION

In this, we scale the features in such a way that the distribution has mean=0 and variance=1.

$$z = \frac{x - \mu}{\sigma}$$

```
from sklearn import preprocessing

#extracting values which we want to scale
x = df.iloc[:, 1:4].values
print ("\n ORIGINAL VALUES: \n\n", x)
#MIN-MAX SCALER
min_max_scaler = preprocessing.MinMaxScaler(feature_range =(0, 1))
new_x= min_max_scaler.fit_transform(x)
print ("\n VALUES AFTER MIN MAX SCALING: \n\n", new_x)
Standardisation = preprocessing.StandardScaler()
new_x= Standardisation.fit_transform(x)
print ("\n\n VALUES AFTER STANDARDIZATION : \n\n", new_x)
```

ORIGINAL VALUES:

```
[[0.455 0.365 0.095]
 [0.35  0.265 0.09 ]
 [0.53  0.42  0.135]
 ...
 [0.6   0.475 0.205]
 [0.625 0.485 0.15 ]
 [0.71  0.555 0.195]]
```

VALUES AFTER MIN MAX SCALING:

```
[[0.51351351 0.5210084  0.38      ]
 [0.37162162 0.35294118 0.36      ]
 [0.61486486 0.61344538 0.54      ]
 ...
 [0.70945946 0.70588235 0.82      ]
 [0.71222222 0.72268000 0.6      ]]
```

10. Split the data into training and testing

```
▶ from sklearn.model_selection import train_test_split

training_data, testing_data = train_test_split(df, test_size=0.2, random_state=25)

print(f"No. of training examples: {training_data.shape[0]}")
print(f"No. of testing examples: {testing_data.shape[0]}")
```

No. of training examples: 3340  
No. of testing examples: 835

## 11. Build the Model

### USING LINEAR REGRESSION :

```
| from sklearn import preprocessing
y = df['Rings'].values.reshape(-1, 1)
x = df['Height'].values.reshape(-1, 1)

| from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X,y,test_size=1/3,random_state=0)

| from sklearn.linear_model import LinearRegression
regressor = LinearRegression()

regressor.fit(X_train, y_train)

LinearRegression()
```

## 12. Train the Model

```
▶ regressor.fit(X_train, y_train)

LinearRegression()
```

```
[63] y_pred = regressor.predict(X_test)
      y_pred
```

```
array([[ 8.95492379],
       [10.00093634],
       [ 9.47793007],
       ...,
       [14.44648972],
       [ 8.17041437],
       [ 9.73943321]])
```

```
[64] y_test
```

```
array([[ 7],
       [10],
       [11],
       ...,
       [15],
       [ 9],
       [11]])
```

```
[65] #plot for the TRAIN

plt.scatter(X_train, y_train, color='red') # plotting the observation line

plt.plot(X_train, regressor.predict(X_train), color='blue') # plotting the regression line

plt.title("Salary vs Experience (Training set)") # stating the title of the graph

plt.xlabel("Years of experience") # adding the name of x-axis
plt.ylabel("Salaries") # adding the name of y-axis
plt.show() # specifies end of graph
```



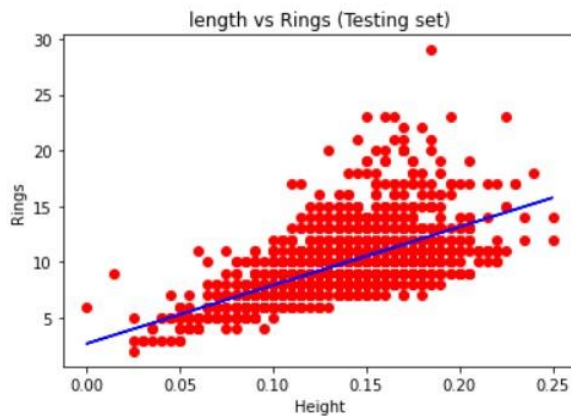
### 13. Test the Model

```
#plot for the TEST

plt.scatter(X_test, y_test, color='red')
plt.plot(X_train, regressor.predict(X_train), color='blue') # plotting the regression line

plt.title("length vs Rings (Testing set)")

plt.xlabel("Height")
plt.ylabel("Rings")
plt.show()
```



#### 14. Measure the performance using Metrics

```
[67] from sklearn.metrics import mean_absolute_error, mean_squared_error
```

```
[68] mae = mean_absolute_error(y_test, y_pred)
      mse = mean_squared_error(y_test, y_pred)
      rmse = np.sqrt(mse)
```

```
▶ print(f'Mean absolute error: {mae:.2f}')
  print(f'Mean squared error: {mse:.2f}')
  print(f'Root mean squared error: {rmse:.2f}')
```

```
Mean absolute error: 1.85
Mean squared error: 6.34
Root mean squared error: 2.52
```