Fish Weight Analysis and Prediction

By Dhrruv Tokas

1. Importing Required Libraries

In [1]:
```
import pandas as pd # For file operations
import matplotlib.pyplot as plt # For visualization
import numpy as np # For numpy model evaluation
from sklearn.preprocessing import OrdinalEncoder # For handling categorical variable
import statsmodels.api as sm # For model summary

import re # For data wrangling

from sklearn.model_selection import train_test_split # For creating training and tes
from sklearn.linear_model import LinearRegression # For linear regression model
from sklearn.ensemble import RandomForestRegressor # For random forest model
from sklearn import metrics # For metric evaulation

import warnings # To disable warnings
warnings.filterwarnings("ignore")
```

2. Data Wrangling

In [2]:
```
# Reading dataset

filepath = "C:/Users/dhrru/Downloads/Air Quality/fish_market.csv"
depvar = "Weight"

def file_process(filepath):
    if ".csv" in filepath:
        data = pd.read_csv(filepath, index_col=False, encoding='unicode_escape')
    elif ".xls" in filepath:
        data = pd.read_excel(filepath, index_col=False)
    elif ".tsv" in filepath:
        data = pd.read_table(filepath, index_col=False)
    elif ".json" in filepath:
        data = pd.read_json(filepath)
    else:
        data = pd.read_csv(filepath, index_col=False, sep=" ")
    return data

data = file_process(filepath)
data = data.loc[:, ~data.columns.str.contains('^Unnamed')]
```

In [3]:
```
# Displaying the dataframe
data
```

Out[3]:

	ï»¿Species	Weight	Length1	Length2	Length3	Height	Width
0	Bream	242.0	23.2	25.4	30.0	11.5200	4.0200
1	Bream	290.0	24.0	26.3	31.2	12.4800	4.3056
2	Bream	340.0	23.9	26.5	31.1	12.3778	4.6961

	ï»¿Species	Weight	Length1	Length2	Length3	Height	Width
3	Bream	363.0	26.3	29.0	33.5	12.7300	4.4555
4	Bream	430.0	26.5	29.0	34.0	12.4440	5.1340
...	...	...	...	...	...	...	...
154	Smelt	12.2	11.5	12.2	13.4	2.0904	1.3936
155	Smelt	13.4	11.7	12.4	13.5	2.4300	1.2690
156	Smelt	12.2	12.1	13.0	13.8	2.2770	1.2558
157	Smelt	19.7	13.2	14.3	15.2	2.8728	2.0672
158	Smelt	19.9	13.8	15.0	16.2	2.9322	1.8792

159 rows × 7 columns

In [4]:
```
# Displaying first 5 rows
data.head(5)
```

Out[4]:

	ï»¿Species	Weight	Length1	Length2	Length3	Height	Width
0	Bream	242.0	23.2	25.4	30.0	11.5200	4.0200
1	Bream	290.0	24.0	26.3	31.2	12.4800	4.3056
2	Bream	340.0	23.9	26.5	31.1	12.3778	4.6961
3	Bream	363.0	26.3	29.0	33.5	12.7300	4.4555
4	Bream	430.0	26.5	29.0	34.0	12.4440	5.1340

In [5]:
```
# Displaying last 5 rows
data.tail(5)
```

Out[5]:

	ï»¿Species	Weight	Length1	Length2	Length3	Height	Width
154	Smelt	12.2	11.5	12.2	13.4	2.0904	1.3936
155	Smelt	13.4	11.7	12.4	13.5	2.4300	1.2690
156	Smelt	12.2	12.1	13.0	13.8	2.2770	1.2558
157	Smelt	19.7	13.2	14.3	15.2	2.8728	2.0672
158	Smelt	19.9	13.8	15.0	16.2	2.9322	1.8792

In [6]:
```
# Displaying dataset columns
data.columns
```

Out[6]:
```
Index(['ï»¿Species', 'Weight', 'Length1', 'Length2', 'Length3', 'Height',
       'Width'],
      dtype='object')
```

In [7]:
```
# Displaying data shape (rows x columns)
data.shape
```

Out[7]:
```
(159, 7)
```

In [8]:
```
# Data description
data.describe()
```

Out[8]:

	Weight	Length1	Length2	Length3	Height	Width
count	159.000000	159.000000	159.000000	159.000000	159.000000	159.000000
mean	398.326415	26.247170	28.415723	31.227044	8.970994	4.417486
std	357.978317	9.996441	10.716328	11.610246	4.286208	1.685804
min	0.000000	7.500000	8.400000	8.800000	1.728400	1.047600
25%	120.000000	19.050000	21.000000	23.150000	5.944800	3.385650
50%	273.000000	25.200000	27.300000	29.400000	7.786000	4.248500
75%	650.000000	32.700000	35.500000	39.650000	12.365900	5.584500
max	1650.000000	59.000000	63.400000	68.000000	18.957000	8.142000

In [9]:
```
# Datatype information
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 159 entries, 0 to 158
Data columns (total 7 columns):
 #   Column      Non-Null Count  Dtype  
---  ------      --------------  -----  
 0   ï»¿Species  159 non-null    object 
 1   Weight      159 non-null    float64
 2   Length1     159 non-null    float64
 3   Length2     159 non-null    float64
 4   Length3     159 non-null    float64
 5   Height      159 non-null    float64
 6   Width       159 non-null    float64
dtypes: float64(6), object(1)
memory usage: 8.8+ KB
```

In [10]:
```
print("Data Shape Before", data.shape)
data.drop_duplicates(keep=False, inplace=True)
print("Data Shape After", data.shape)
```

```
Data Shape Before (159, 7)
Data Shape After (159, 7)
```

In [11]:
```
# Looking for NA/Null values
data.isna().sum()
```

Out[11]:
```
ï»¿Species    0
Weight        0
Length1       0
Length2       0
Length3       0
Height        0
Width         0
dtype: int64
```

In [12]:
```
# Dropping and filling nan values
data.dropna(how='all')
data = data.fillna(0)
```

In [13]:
```
# Estimating coorelation
correlation = data.corr().abs()
correlation
```

Out[13]:

	Weight	Length1	Length2	Length3	Height	Width
Weight	1.000000	0.915712	0.918618	0.923044	0.724345	0.886507
Length1	0.915712	1.000000	0.999517	0.992031	0.625378	0.867050
Length2	0.918618	0.999517	1.000000	0.994103	0.640441	0.873547
Length3	0.923044	0.992031	0.994103	1.000000	0.703409	0.878520
Height	0.724345	0.625378	0.640441	0.703409	1.000000	0.792881
Width	0.886507	0.867050	0.873547	0.878520	0.792881	1.000000

In [14]:
```
# Finding highly coorelated variables
highly_correlated_variables = np.where(correlation>0.8)
highly_correlated_variables = [(correlation.columns[x],correlation.columns[y]) for x
highly_correlated_variables = [re.sub(r'\([^)]*\)', '', x) for x in highly_correlate
highly_correlated_variables
```

Out[14]:
```
['Weight', 'Length1']
```

In [15]:
```
# Finding categorical columns
categorical = data.select_dtypes(exclude=["number","bool"])
print("Numerical Columns: ", len(data.columns)-len(categorical.columns))
numerical = len(data.columns)-len(categorical.columns)
print("Categorical Columns: ", len(data.columns)-numerical)
```

```
Numerical Columns:  6
Categorical Columns:  1
```

In [16]:
```
# Displaying categorical columns
data[list(categorical.columns)]
```

Out[16]:

	ï»¿Species
0	Bream
1	Bream
2	Bream
3	Bream
4	Bream
...	...
154	Smelt
155	Smelt
156	Smelt
157	Smelt
158	Smelt

159 rows × 1 columns

In [17]:
```
# Encoding categorical columns
encoder = OrdinalEncoder()
data[list(categorical.columns)] = encoder.fit_transform(data[list(categorical.column
data
```

Out[17]:

	ï»¿Species	Weight	Length1	Length2	Length3	Height	Width
0	0.0	242.0	23.2	25.4	30.0	11.5200	4.0200
1	0.0	290.0	24.0	26.3	31.2	12.4800	4.3056
2	0.0	340.0	23.9	26.5	31.1	12.3778	4.6961
3	0.0	363.0	26.3	29.0	33.5	12.7300	4.4555
4	0.0	430.0	26.5	29.0	34.0	12.4440	5.1340
...	...	...	...	...	...	...	...
154	5.0	12.2	11.5	12.2	13.4	2.0904	1.3936
155	5.0	13.4	11.7	12.4	13.5	2.4300	1.2690
156	5.0	12.2	12.1	13.0	13.8	2.2770	1.2558
157	5.0	19.7	13.2	14.3	15.2	2.8728	2.0672
158	5.0	19.9	13.8	15.0	16.2	2.9322	1.8792

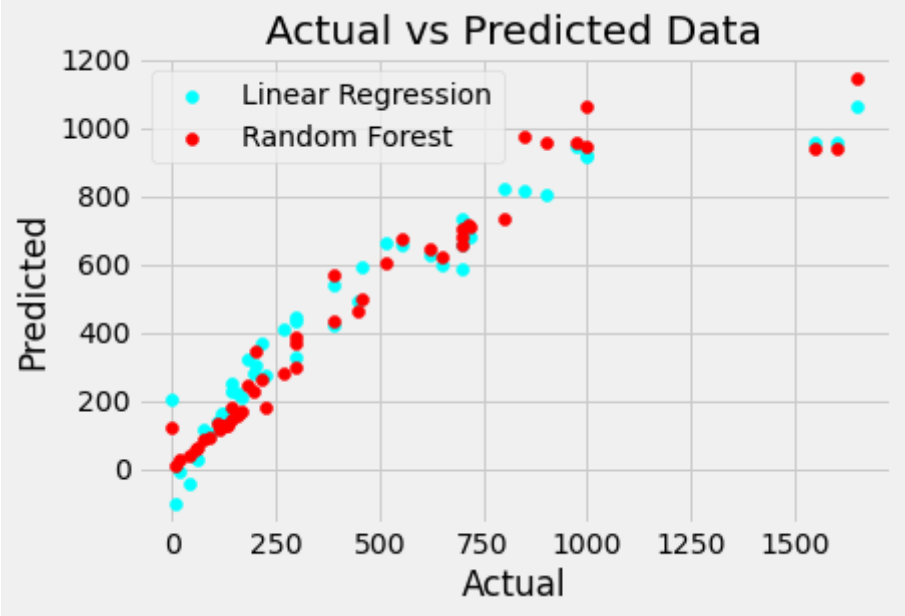
159 rows × 7 columns

3. Regression

In [18]:
```
# Comparing linear regression with random forest regression
def perform_regression(depvar):
    train = data.loc[:,data.columns !=depvar]
    test = data.loc[:,data.columns ==depvar]
    test_size = 0.3
    X_train, X_test, y_train, y_test = train_test_split(train, test, test_size=test_
    linear_regression = LinearRegression()
    linear_regression.fit(X_train, y_train)
    linear_regression_prediction = linear_regression.predict(X_test)
    print("Linear Regression:")
    print("\nCoefficients: ", linear_regression.coef_)
    print("Variance score: {}".format(linear_regression.score(X_test, y_test)))
    print("\nMean Absolute Error: ", metrics.mean_absolute_error(y_test,linear_regre
    print("Measn Square Error: ", metrics.mean_squared_error(y_test,linear_regressio
    print("Root Mean Square Error: ", np.sqrt(metrics.mean_squared_error(y_test, lin
    lr_model_coefficient=pd.DataFrame(linear_regression.coef_[0],train.columns)
    lr_model_coefficient.columns = ['Coefficient']
    print("\n", lr_model_coefficient)
    plt.style.use('fivethirtyeight')
    plt.scatter(y_test,linear_regression_prediction, color = 'aqua')
    plt.title('Actual vs Predicted Data')
    plt.xlabel('Actual')
    plt.ylabel('Predicted')

    random_forest = RandomForestRegressor()
    random_forest.fit(X_train, y_train)
    random_forest_prediction = random_forest.predict(X_test)
```

```
    print("\n\nRandom Forest:")
    print("Variance score: {}".format(random_forest.score(X_test, y_test)))
    print("\nMean Absolute Error: ", metrics.mean_absolute_error(y_test,random_fores
    print("Measn Square Error: ", metrics.mean_squared_error(y_test,random_forest_pr
    print("Root Mean Square Error: ", np.sqrt(metrics.mean_squared_error(y_test, ran
    plt.style.use('fivethirtyeight')
    plt.scatter(y_test,random_forest_prediction, color = 'red')
    plt.legend(labels = ('Linear Regression','Random Forest'),loc='upper left')
    plt.show()

    model = sm.OLS(y_train, X_train)
    ols = model.fit()
    print("\nModel Summary:")
    print(ols.summary())

perform_regression(depvar)
```

```
Linear Regression:

Coefficients:  [[ 32.23127412  77.03170566   3.58802961 -59.15912131  55.09577962
   21.62966986]]
Variance score: 0.827677555496389

Mean Absolute Error:  104.29357951497195
Measn Square Error:  30070.300811974255
Root Mean Square Error:  173.4079029686198

             Coefficient
ï»¿Species    32.231274
Length1       77.031706
Length2        3.588030
Length3      -59.159121
Height        55.095780
Width         21.629670


Random Forest:
Variance score: 0.8558879234539298

Mean Absolute Error:  72.48960416666667
Measn Square Error:  25147.585997062502
Root Mean Square Error:  158.57990414003442
```




```
Model Summary:
                                OLS Regression Results
==============================================================================
```

```
===
Dep. Variable:                  Weight   R-squared (uncentered):                   0.
922
Model:                             OLS   Adj. R-squared (uncentered):              0.
917
Method:                  Least Squares   F-statistic:                              20
5.8
Date:                 Wed, 15 Jun 2022   Prob (F-statistic):                    1.08e
-55
Time:                         17:53:26   Log-Likelihood:                          -70
5.14
No. Observations:                 111   AIC:                                      14
22.
Df Residuals:                     105   BIC:                                      14
39.
Df Model:                           6
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
ï»¿Species   -55.8717      8.036     -6.953      0.000     -71.805     -39.939
Length1      237.9644     54.339      4.379      0.000     130.220     345.709
Length2     -189.0668     58.242     -3.246      0.002    -304.550     -73.583
Length3      -25.5113     25.057     -1.018      0.311     -75.194      24.172
Height        13.5274     13.695      0.988      0.326     -13.626      40.681
Width         75.9398     29.698      2.557      0.012      17.053     134.826
==============================================================================
Omnibus:                       17.964   Durbin-Watson:                   1.543
Prob(Omnibus):                  0.000   Jarque-Bera (JB):               20.934
Skew:                           0.981   Prob(JB):                     2.85e-05
Kurtosis:                       3.825   Cond. No.                         303.
==============================================================================

Notes:
[1] R² is computed without centering (uncentered) since the model does not contain a
constant.
[2] Standard Errors assume that the covariance matrix of the errors is correctly spe
cified.
```

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