ANIMAL SPEEDS DATA ANALYSIS

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
import math
from scipy import stats
from bioinfokit.analys import stat
from scipy.stats import norm
from scipy.stats import f_oneway
from sklearn.linear_model import LinearRegression
sns.set()
```

```
dataset = pd.read_csv(r'C:\Users\ss\Documents\Animal_Speeds.csv')
```

```
dataset.head()
```

```
          Animal  Weight Movement_Type  Highspeed
0  House sparrow    0.04        flying       46.0
1        Pelican    7.80        flying       65.0
2        Vulture   11.00        flying       88.0
3         Pigeon    0.35        flying       80.0
4         Puffin    0.58        flying       88.0
```

```
dataset.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 159 entries, 0 to 158
Data columns (total 4 columns):
 #   Column         Non-Null Count  Dtype
---  ------         --------------  -----
 0   Animal         159 non-null    object
 1   Weight         159 non-null    float64
 2   Movement_Type  159 non-null    object
 3   Highspeed      159 non-null    float64
dtypes: float64(2), object(2)
memory usage: 3.8+ KB
```

Exploratory Data Analysis(EDA) and possible Data Transformations

Since the columns "Animal and Movement_Type" are of Object datatype converting into String datatype allows us to perform a proper analysis.

```
dataset['Animal'].astype("string")
```

```
0            House sparrow
1                  Pelican
```

```
2                  Vulture
3                   Pigeon
4                   Puffin
              ...
154    Shortfin mako shark
155      Great white Shark
156           Leopard seal
157          Basking shark
158          Ocean sunfish
Name: Animal, Length: 159, dtype: string
```

```
dataset['Movement_Type'].astype("string")
```

```
0        flying
1        flying
2        flying
3        flying
4        flying
         ...
154    swimming
155    swimming
156    swimming
157    swimming
158    swimming
Name: Movement_Type, Length: 159, dtype: string
```

```
dataset.isnull().sum()
```

```
Animal           0
Weight           0
Movement_Type    0
Highspeed        0
dtype: int64
```

```
dataset.describe() #obtaining statistical information
```

```
              Weight   Highspeed
count     159.000000  159.000000
mean     1994.115969   52.640881
std     12285.311105   34.460258
min         0.001000    1.500000
25%         2.625000   30.000000
50%        22.000000   48.000000
75%       310.000000   70.000000
max    140000.000000  195.000000
```

```
dataset["Movement_Type"].value_counts()
```

```
running     78
swimming    41
flying      27
```

```
climbing    13
Name: Movement_Type, dtype: int64
```

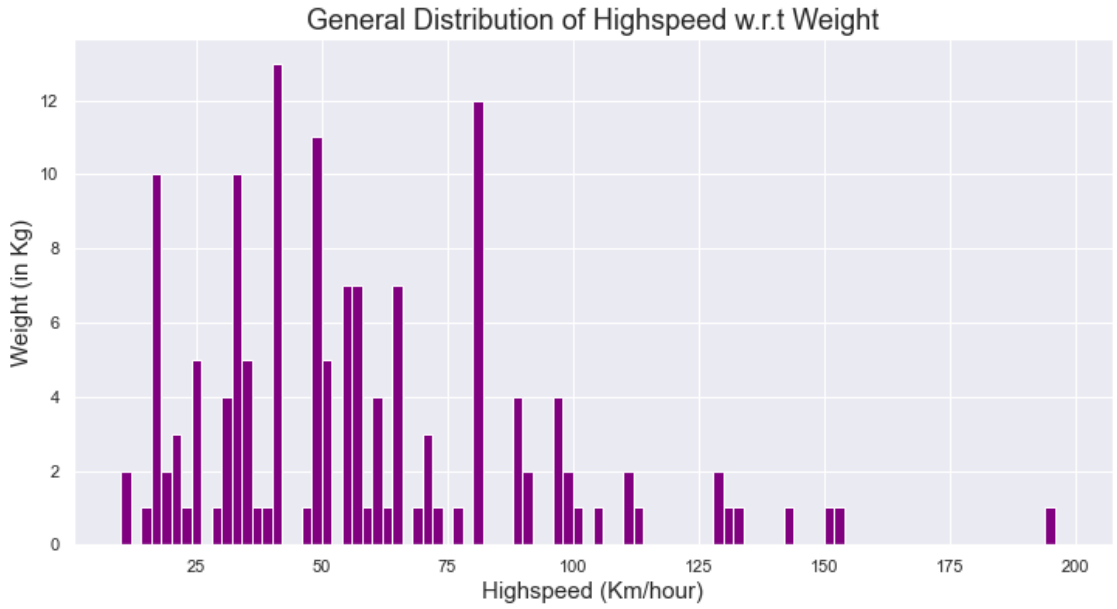
```
# Skewness Function

def skewness(x):
    res = 0
    m = x.mean()
    s = x.std()
    for i in x:
        res += (i-m) * (i-m) * (i-m)
    res /= (len(x) * s * s * s)
    return res

print (" Skewness of Weight =  ", skewness ( dataset['Weight'] ))
print (" Skewness of Highspeed =  ", skewness
( dataset['Highspeed'] ))
```

```
 Skewness of Weight =   9.53606366348767
 Skewness of Highspeed =   1.0447180091747341
```

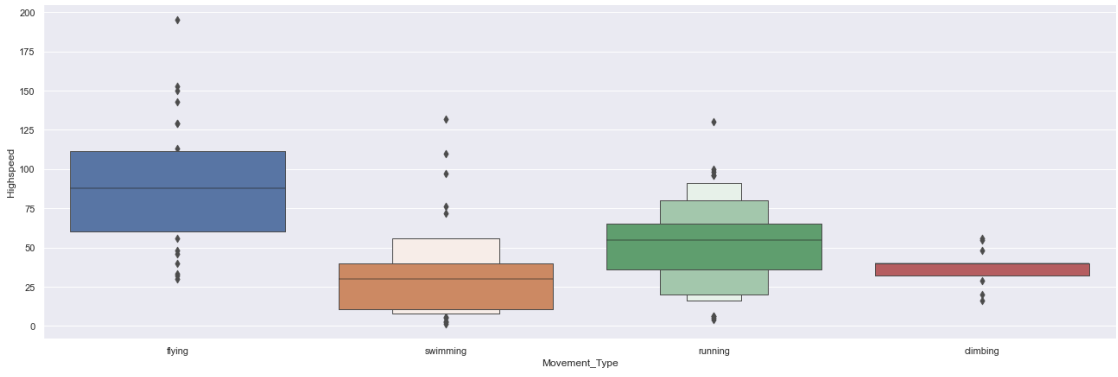
```
plt.figure(figsize=(12, 6))
plt.title('General Distribution of Highspeed w.r.t Weight',size=18)
plt.xlabel('Highspeed (Km/hour)',size=15)
plt.ylabel('Weight (in Kg)',size=15)
plt.hist(dataset.Highspeed, bins=np.arange(10,200,2), color='purple')
```

```
(array([ 2.,  0.,  1., 10.,  2.,  3.,  1.,  5.,  0.,  1.,  4., 10.,
5.,
         1.,  1., 13.,  0.,  0.,  1., 11.,  5.,  0.,  7.,  7.,  1.,
4.,
         1.,  7.,  0.,  1.,  3.,  1.,  0.,  1.,  0., 12.,  0.,  0.,
0.,
         4.,  2.,  0.,  0.,  4.,  2.,  1.,  0.,  1.,  0.,  0.,  2.,
1.,
         0.,  0.,  0.,  0.,  0.,  0.,  0.,  2.,  1.,  1.,  0.,  0.,
0.,
         0.,  1.,  0.,  0.,  0.,  1.,  1.,  0.,  0.,  0.,  0.,  0.,
0.,
         0.,  0.,  0.,  0.,  0.,  0.,  0.,  0.,  0.,  0.,  0.,  0.,
0.,
         0.,  1.,  0.]),
 array([ 10,  12,  14,  16,  18,  20,  22,  24,  26,  28,  30,  32,
34,
         36,  38,  40,  42,  44,  46,  48,  50,  52,  54,  56,  58,
60,
         62,  64,  66,  68,  70,  72,  74,  76,  78,  80,  82,  84,
86,
         88,  90,  92,  94,  96,  98, 100, 102, 104, 106, 108, 110,
112,
        114, 116, 118, 120, 122, 124, 126, 128, 130, 132, 134, 136,
```

```
138,
       140, 142, 144, 146, 148, 150, 152, 154, 156, 158, 160, 162,
164,
       166, 168, 170, 172, 174, 176, 178, 180, 182, 184, 186, 188,
190,
       192, 194, 196, 198]),
 <BarContainer object of 94 artists>)
```




```
# Movement_Type vs Highspeed
sns.catplot(y = "Highspeed", x = "Movement_Type", data =
dataset.sort_values("Highspeed", ascending = False), kind="boxen",
height = 6, aspect = 3)
plt.show()
```



a) Detailed Descriptive Analysis of the data set.

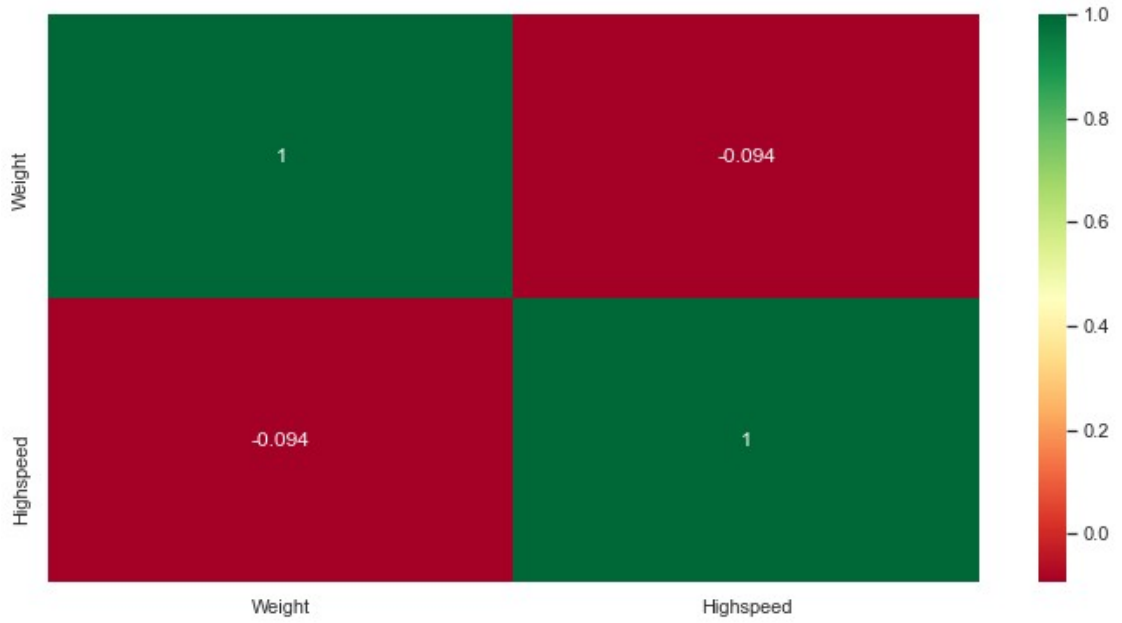
```
groupby_m = dataset.groupby(['Movement_Type']).mean()
groupby_v = dataset.groupby(['Movement_Type']).var()
groupby_s = dataset.groupby(['Movement_Type']).std()
```

```
#By this we knew in a descriptive way how avg weight influences
highspeed
print('MEAN values of weight and highspeed with respect to Movement
Type:' + str(groupby_m))
print('VARIENCE of weight and highspeed with respect to Movement
Type:' + str(groupby_v))
print('STANDARD DEVIATION of weight and highspeed with respect to
Movement Type:' + str(groupby_s))
```

```
MEAN values of weight and highspeed with respect to Movement Type:
Weight  Highspeed
Movement_Type
climbing         40.285000  36.923077
flying            6.290704  90.259259
running         295.632577  52.582051
swimming       7153.940098  32.963415
VARIENCE of weight and highspeed with respect to Movement Type:
Weight    Highspeed
Movement_Type
climbing       3.774053e+03   142.576923
flying         8.961863e+01  1707.660969
running        5.248597e+05   642.112141
swimming       5.583348e+08   869.441878
STANDARD DEVIATION of weight and highspeed with respect to Movement
Type:                      Weight  Highspeed
Movement_Type
climbing          61.433320  11.940558
flying             9.466712  41.323855
running          724.472048  25.339932
swimming       23629.108246  29.486300
```

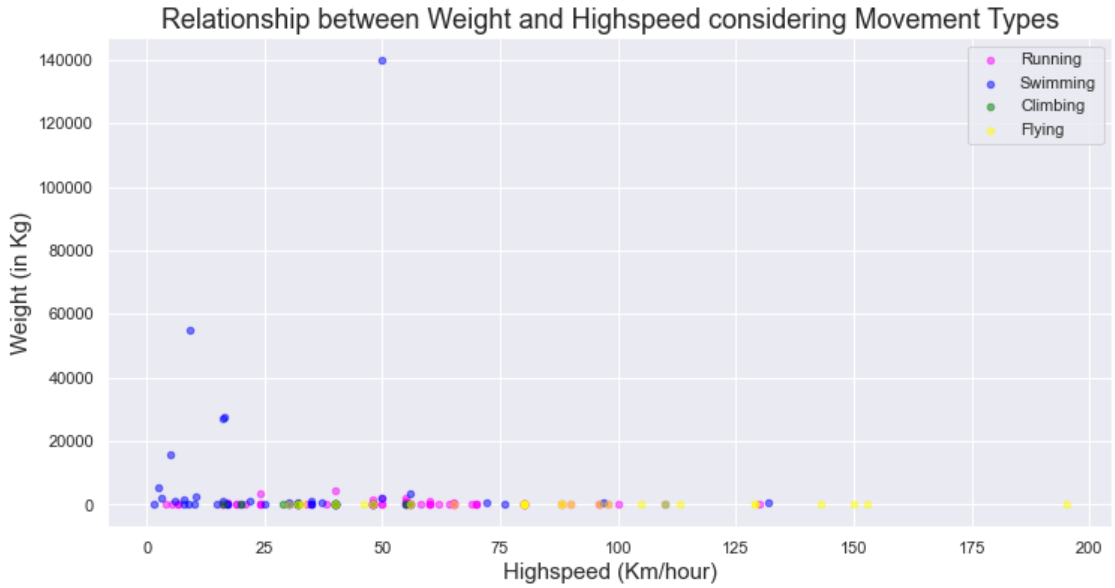
It is also clear from above statistical analysis that,the intuition larger animals are generally faster than smaller animals is FALSE. The heaviest animals are not the fastest ones, instead the lower the avg.weight the higher is the highspeed. They are negative coefficients.

```
# Finds correlation between Independent and dependent attributes

plt.figure(figsize = (12,6))
sns.heatmap(dataset.corr(), annot = True, cmap = "RdYlGn")

plt.show()
```




```
# Scatter plot of Weight and Highspeed

ax1 = dataset[dataset['Movement_Type'] ==
'running'].plot(kind='scatter', x='Highspeed', y='Weight',
color='magenta', alpha=0.5, figsize=(12, 6))
dataset[dataset['Movement_Type'] == 'swimming'].plot(kind='scatter',
x='Highspeed', y='Weight', color='blue', alpha=0.5, figsize=(12 ,6),
ax=ax1)
dataset[dataset['Movement_Type'] == 'climbing'].plot(kind='scatter',
x='Highspeed', y='Weight', color='green', alpha=0.5, figsize=(12 ,6),
ax=ax1)
dataset[dataset['Movement_Type'] == 'flying'].plot(kind='scatter',
x='Highspeed', y='Weight', color='yellow', alpha=0.5, figsize=(12 ,6),
ax=ax1)
plt.legend(labels=['Running', 'Swimming', 'Climbing', 'Flying'])
plt.title('Relationship between Weight and Highspeed considering
Movement Types', size=18)
plt.xlabel('Highspeed (Km/hour)',size=15)
plt.ylabel('Weight (in Kg)',size=15)
```

```
Text(0, 0.5, 'Weight (in Kg)')
```



This scatterplot clearly shows that the coefficients have a negative linear relationship with eachother,i.e If weight increases highspeed decreases and vice versa.

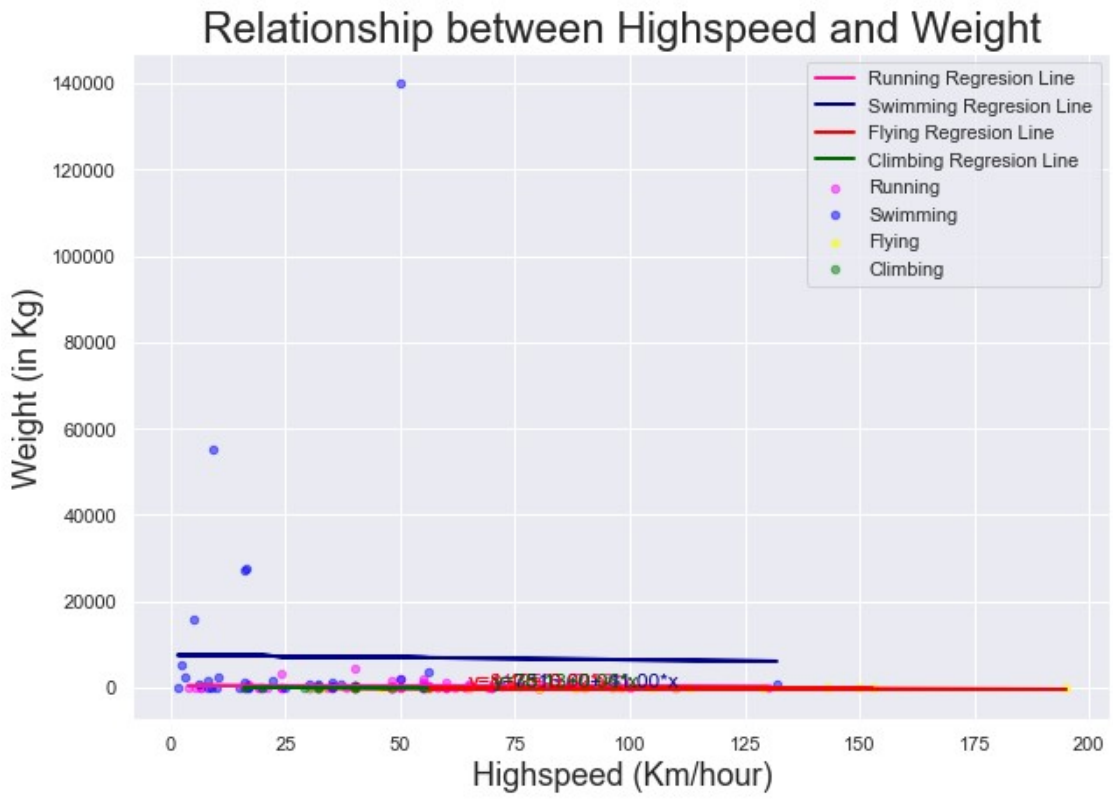
b) Performing Linear Regresssion with scatter plot to analyze relationship between Weight and Highspeed taking into account covariable Movement Type

```
df_running = dataset[dataset['Movement_Type'] == 'running']
df_swimming = dataset[dataset['Movement_Type'] == 'swimming']
df_flying = dataset[dataset['Movement_Type'] == 'flying']
df_climbing = dataset[dataset['Movement_Type'] == 'climbing']

# polynomial
run_fit = np.polyfit(df_running.Highspeed, df_running.Weight, 1)
swim_fit = np.polyfit(df_swimming.Highspeed, df_swimming.Weight, 1)
fly_fit = np.polyfit(df_flying.Highspeed, df_flying.Weight, 1)
climb_fit = np.polyfit(df_climbing.Highspeed, df_climbing.Weight, 1)
print(run_fit)
print(swim_fit)
print(fly_fit)
print(climb_fit)
```

```
[ -2.31764338 417.49902019]
[ -11.00190739 7516.60053255]
[-0.02355144  8.4164396 ]
[ 0.05830771 38.13210008]
```

```
# scatter plots and regression lines

df_running = dataset[dataset['Movement_Type'] == 'running']
df_swimming = dataset[dataset['Movement_Type'] == 'swimming']
```

```
df_flying = dataset[dataset['Movement_Type'] == 'flying']
df_climbing = dataset[dataset['Movement_Type'] == 'climbing']

# Scatter plots.
ax1 = df_running.plot(kind='scatter', x='Highspeed', y='Weight',
color='magenta', alpha=0.5, figsize=(10, 7))
df_swimming.plot(kind='scatter', x='Highspeed', y='Weight',
color='blue', alpha=0.5, figsize=(10, 7), ax=ax1)
df_flying.plot(kind='scatter', x='Highspeed', y='Weight',
color='yellow', alpha=0.5, figsize=(10, 7), ax=ax1)
df_climbing.plot(kind='scatter', x='Highspeed', y='Weight',
color='green', alpha=0.5, figsize=(10, 7), ax=ax1)

# regression lines
plt.plot(df_running.Highspeed, run_fit[0] * df_running.Highspeed +
run_fit[1], color='deeppink', linewidth=2)
plt.plot(df_swimming.Highspeed, swim_fit[0] * df_swimming.Highspeed +
swim_fit[1], color='darkblue', linewidth=2)
plt.plot(df_flying.Highspeed, run_fit[0] * df_flying.Highspeed +
fly_fit[1], color='red', linewidth=2)
plt.plot(df_climbing.Highspeed, run_fit[0] * df_climbing.Highspeed +
climb_fit[1], color='darkgreen', linewidth=2)

# regression equations
plt.text(65, 230, 'y={:.2f}+{:.2f}*x'.format(run_fit[1], run_fit[0]),
color='deeppink', size=12)
plt.text(70, 130, 'y={:.2f}+{:.2f}*x'.format(swim_fit[1],
swim_fit[0]), color='darkblue', size=12)
plt.text(65, 230, 'y={:.2f}+{:.2f}*x'.format(fly_fit[1], fly_fit[0]),
color='red', size=12)
plt.text(70, 130, 'y={:.2f}+{:.2f}*x'.format(climb_fit[1],
climb_fit[0]), color='darkgreen', size=12)

# legend, title and labels.
plt.legend(labels=['Running Regresion Line', 'Swimming Regresion
Line', 'Flying Regresion Line', 'Climbing Regresion Line','Running',
'Swimming','Flying','Climbing'])
plt.title('Relationship between Highspeed and Weight', size=24)
plt.xlabel('Highspeed (Km/hour)',size=18)
plt.ylabel('Weight (in Kg)',size=18);
```



As to perform Multiple Linear Regression we need to Handle Categorical Data

```
# As Movement_Type is Nominal Categorical data we will perform OneHotEncoding

mt = dataset[["Movement_Type"]]
mt = pd.get_dummies(mt)
mt.head()
```

```
   Movement_Type_climbing  Movement_Type_flying  Movement_Type_running
\
0                       0                     1                      0

1                       0                     1                      0

2                       0                     1                      0

3                       0                     1                      0

4                       0                     1                      0


   Movement_Type_swimming
```

```
0                       0
1                       0
2                       0
3                       0
4                       0
```

```
# Concatenate dataframe --> dataset + mt

data = pd.concat([dataset, mt], axis = 1)
data.head()
```

```
          Animal  Weight Movement_Type  Highspeed
Movement_Type_climbing  \
0  House sparrow    0.04        flying       46.0
0
1        Pelican    7.80        flying       65.0
0
2        Vulture   11.00        flying       88.0
0
3         Pigeon    0.35        flying       80.0
0
4         Puffin    0.58        flying       88.0
0

   Movement_Type_flying  Movement_Type_running  Movement_Type_swimming

0                     1                      0                       0

1                     1                      0                       0

2                     1                      0                       0

3                     1                      0                       0

4                     1                      0                       0
```

```
# create linear regression object
mlr = LinearRegression()

# fit linear regression
mlr.fit(data[['Weight', 'Movement_Type_climbing']], data['Highspeed'])
#mlr.fit(data[['Weight', 'Movement_Type_flying']], data['Highspeed'])
#mlr.fit(data[['Weight', 'Movement_Type_running']], data['Highspeed'])
#mlr.fit(data[['Weight', 'Movement_Type_swimming']],
data['Highspeed'])

# get the slope and intercept of the line best fit.
print(mlr.intercept_)

print(mlr.coef_)
```

```
54.65164887042415
[-2.81924964e-04 -1.77172146e+01]
```

```
mlr.fit(data[['Weight', 'Movement_Type_flying']], data['Highspeed'])
print(mlr.intercept_)
print(mlr.coef_)
```

```
45.33498830833482
[-1.61941725e-04  4.49252897e+01]
```

```
mlr.fit(data[['Weight', 'Movement_Type_running']], data['Highspeed'])
print(mlr.intercept_)
print(mlr.coef_)
```

```
53.67272737725616
[-2.68671932e-04 -1.01124792e+00]
```

```
mlr.fit(data[['Weight', 'Movement_Type_swimming']], data['Highspeed'])
print(mlr.intercept_)
print(mlr.coef_)
```

```
59.483937313252405
[-2.96638773e-05 -2.63083091e+01]
```

Calculating Pearson Corelation Coefficient

```
# dataframes containing movement type
df_run = data[data['Movement_Type'] == 'running']
df_swim = data[data['Movement_Type'] == 'swimming']
df_fly = data[data['Movement_Type'] == 'flying']
df_climb = data[data['Movement_Type'] == 'climbing']

# pearson correlation coefficient and p-value
pearson_coef, p_value = stats.pearsonr(df_run.Weight,
df_run.Highspeed)
print(pearson_coef)

# pearson correlation coefficient and p-value
pearson_coef, p_value = stats.pearsonr(df_swim.Weight,
df_swim.Highspeed)
print(pearson_coef)

# pearson correlation coefficient and p-value
pearson_coef, p_value = stats.pearsonr(df_fly.Weight,
df_fly.Highspeed)
print(pearson_coef)

# pearson correlation coefficient and p-value
pearson_coef, p_value = stats.pearsonr(df_climb.Weight,
df_climb.Highspeed)
print(pearson_coef)
```

-0.08106444591487529
-0.013729064027144265
-0.102806176144271
0.011333044318740729