In [1]:
```
import pandas as pd
import numpy as np
```

In [2]:
```
db = pd.read_csv('leo07.csv')
db
```

Out[2]:

	Hours	Score
0	1	48
1	1	78
2	1	72
3	2	70
4	2	66
5	3	92
6	4	93
7	4	75
8	4	75
9	5	80
10	5	95
11	5	97
12	6	90
13	6	96
14	7	99
15	8	99

In [3]:
```
from sklearn.linear_model import LinearRegression
```

In [4]:
```
length = 16
X = np.array(db['Hours']).reshape(length, 1)
y = np.array(db['Score']).reshape(length, 1)
```

In [5]:
```
reg = LinearRegression().fit(X, y)
```

In [6]:
```
reg.score(X, y)
```

Out[6]: 0.6202557608810646

In [7]:
```
reg.coef_
```

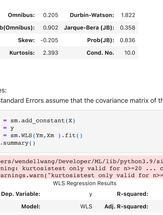
Out[7]: array([[5.26388889]])

In [8]:
```
reg.intercept_
```

Out[8]: array([61.75694444])

In [9]:
```
import matplotlib.pyplot as plt
```

In [10]:
```
plt.scatter(X, y,  color='black')
plt.plot(X, reg.predict(X), color='blue', linewidth=3)
plt.show()
```



In [11]:
```
import statsmodels.api  as sm
y_hat = reg.predict(X)
Xm = sm.add_constant(X)
Ym = y
Km = sm.OLS(Ym,Xm ).fit()
Km.summary()
```

```
/Users/wendellwang/Developer/ML/lib/python3.9/site-packages/scipy/stats/stats.py:1603: User
Warning: kurtosistest only valid for n>=20 ... continuing anyway, n=16
  warnings.warn("kurtosistest only valid for n>=20 ... continuing "
```

Out[11]: OLS Regression Results

Dep. Variable:	y	**R-squared:**	0.620
Model:	OLS	**Adj. R-squared:**	0.593
Method:	Least Squares	**F-statistic:**	22.87
Date:	Thu, 23 Sep 2021	**Prob (F-statistic):**	0.000292
Time:	14:18:29	**Log-Likelihood:**	-57.384
No. Observations:	16	**AIC:**	118.8
Df Residuals:	14	**BIC:**	120.3
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	61.7569	4.984	12.391	0.000	51.067	72.447
x1	5.2639	1.101	4.782	0.000	2.903	7.625

Omnibus:	0.205	**Durbin-Watson:**	1.822
Prob(Omnibus):	0.902	**Jarque-Bera (JB):**	0.358
Skew:	-0.205	**Prob(JB):**	0.836
Kurtosis:	2.393	**Cond. No.**	10.0

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

In [12]:
```
Xm = sm.add_constant(X)
Ym = y
Km = sm.WLS(Ym,Xm ).fit()
Km.summary()
```

```
/Users/wendellwang/Developer/ML/lib/python3.9/site-packages/scipy/stats/stats.py:1603: User
Warning: kurtosistest only valid for n>=20 ... continuing anyway, n=16
  warnings.warn("kurtosistest only valid for n>=20 ... continuing "
```

Out[12]: WLS Regression Results

Dep. Variable:	y	**R-squared:**	0.620
Model:	WLS	**Adj. R-squared:**	0.593
Method:	Least Squares	**F-statistic:**	22.87
Date:	Thu, 23 Sep 2021	**Prob (F-statistic):**	0.000292
Time:	14:18:29	**Log-Likelihood:**	-57.384
No. Observations:	16	**AIC:**	118.8
Df Residuals:	14	**BIC:**	120.3
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	61.7569	4.984	12.391	0.000	51.067	72.447
x1	5.2639	1.101	4.782	0.000	2.903	7.625

Omnibus:	0.205	**Durbin-Watson:**	1.822
Prob(Omnibus):	0.902	**Jarque-Bera (JB):**	0.358
Skew:	-0.205	**Prob(JB):**	0.836
Kurtosis:	2.393	**Cond. No.**	10.0

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
For Weight Function:

$$w = \frac{1}{y^2}$$

In [13]:
```
Xm = sm.add_constant(X)
Ym = y
Km = sm.WLS(Ym,Xm,weights=1.0 / (y_hat ** 2)).fit()
Km.summary()
```

```
/Users/wendellwang/Developer/ML/lib/python3.9/site-packages/scipy/stats/stats.py:1603: User
Warning: kurtosistest only valid for n>=20 ... continuing anyway, n=16
  warnings.warn("kurtosistest only valid for n>=20 ... continuing "
```

Out[13]: WLS Regression Results

Dep. Variable:	y	**R-squared:**	0.591
Model:	WLS	**Adj. R-squared:**	0.562
Method:	Least Squares	**F-statistic:**	20.26
Date:	Thu, 23 Sep 2021	**Prob (F-statistic):**	0.000499
Time:	14:18:29	**Log-Likelihood:**	-58.851
No. Observations:	16	**AIC:**	121.7
Df Residuals:	14	**BIC:**	123.2
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	61.0397	4.852	12.580	0.000	50.633	71.446
x1	5.4496	1.211	4.501	0.000	2.853	8.047

Omnibus:	0.816	**Durbin-Watson:**	1.856
Prob(Omnibus):	0.665	**Jarque-Bera (JB):**	0.321
Skew:	-0.344	**Prob(JB):**	0.852
Kurtosis:	2.905	**Cond. No.**	8.10

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
For Weight Function:

$$w = \frac{1}{y}$$

In [14]:
```
Xm = sm.add_constant(X)
Ym = y
Km = sm.WLS(Ym,Xm,weights=1.0 / (y_hat)).fit()
Km.summary()
```

```
/Users/wendellwang/Developer/ML/lib/python3.9/site-packages/scipy/stats/stats.py:1603: User
Warning: kurtosistest only valid for n>=20 ... continuing anyway, n=16
  warnings.warn("kurtosistest only valid for n>=20 ... continuing "
```

Out[14]: WLS Regression Results

Dep. Variable:	y	**R-squared:**	0.608
Model:	WLS	**Adj. R-squared:**	0.580
Method:	Least Squares	**F-statistic:**	21.72
Date:	Thu, 23 Sep 2021	**Prob (F-statistic):**	0.000368
Time:	14:18:29	**Log-Likelihood:**	-58.067
No. Observations:	16	**AIC:**	120.1
Df Residuals:	14	**BIC:**	121.7
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	61.3708	4.911	12.497	0.000	50.838	71.903
x1	5.3604	1.150	4.660	0.000	2.893	7.827

Omnibus:	0.365	**Durbin-Watson:**	1.839
Prob(Omnibus):	0.833	**Jarque-Bera (JB):**	0.289
Skew:	-0.274	**Prob(JB):**	0.865
Kurtosis:	2.635	**Cond. No.**	9.01

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
For Weight Function:

$$w = \frac{1}{(y - \bar{y})^2}$$

In [15]:
```
Xm = sm.add_constant(X)
Ym = y
Km = sm.WLS(Ym,Xm,weights=1.0 / ((y-y_hat) ** 2)).fit()
Km.summary()
```

```
/Users/wendellwang/Developer/ML/lib/python3.9/site-packages/scipy/stats/stats.py:1603: User
Warning: kurtosistest only valid for n>=20 ... continuing anyway, n=16
  warnings.warn("kurtosistest only valid for n>=20 ... continuing "
```

Out[15]: WLS Regression Results

Dep. Variable:	y	**R-squared:**	0.939
Model:	WLS	**Adj. R-squared:**	0.935
Method:	Least Squares	**F-statistic:**	217.4
Date:	Thu, 23 Sep 2021	**Prob (F-statistic):**	6.39e-10
Time:	14:18:29	**Log-Likelihood:**	-49.949
No. Observations:	16	**AIC:**	103.9
Df Residuals:	14	**BIC:**	105.4
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	60.5362	2.540	23.837	0.000	55.089	65.983
x1	5.4891	0.372	14.743	0.000	4.691	6.288

Omnibus:	19.645	**Durbin-Watson:**	1.981
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	2.386
Skew:	0.098	**Prob(JB):**	0.303
Kurtosis:	1.119	**Cond. No.**	45.3

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

In [ ]:
```
```