**Assignment on Linear Regression: The following table shows the results of a recently conducted study on the correlation of the number of hours spent driving with the risk of developing acute backache. Find the equation of the best fit line for this data.**

In [2]:

```
import pandas as pd
import numpy as np
```

In [3]:

```
X_driving_hours = [10, 9, 2, 15, 10, 16, 11, 16]
y_risk_score = [95, 80, 10, 50, 45, 98, 38, 93]
```

In [16]:

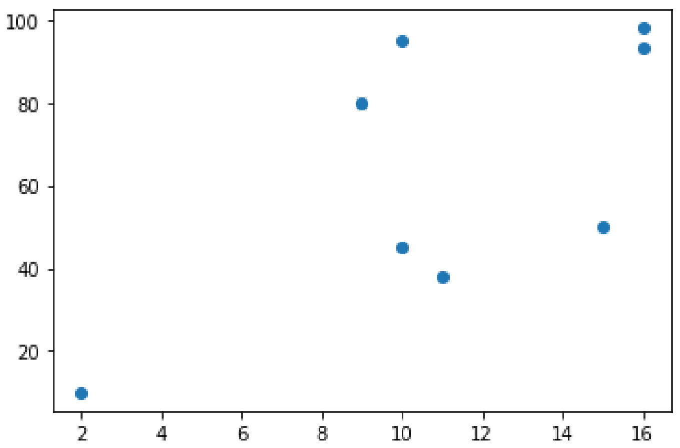
```
import matplotlib.pyplot as plt
```

In [18]:

```
plt.plot(X_driving_hours, y_risk_score, "o")
```

Out[18]:

```
[<matplotlib.lines.Line2D at 0x7fc79c42d520>]
```




1. **Finding coefficients b0, b1 that satisfy the equation y = b1x + b0 for given data**

In [12]:

```
# helper functions
def mean(values):
    return sum(values) / float(len(values))

def variance(values, mean):
    return sum([(x-mean)**2 for x in values])

def covariance(x, mean_x, y, mean_y):
    covar = 0.0
    for i in range(len(x)):
        covar += (x[i] - mean_x) * (y[i] - mean_y)
    return covar
```

In [9]:

```
# x = [row for row in X_train]
# y = [col for col in y_train]
# mean_x, mean_y = mean(x), mean(y)
# var_x, var_y = variance(x, mean_x), variance(y, mean_y)
# print('x stats: mean=%.3f variance=%.3f' % (mean_x, var_x))
```

```
# print('y stats: mean=%.3f variance=%.3f' % (mean_y, var_y))
```

```
x stats: mean=12.400 variance=33.200
y stats: mean=65.200 variance=3342.800
```

In [24]:

```
def find_coefficients(x, y):
    x_mean, y_mean = mean(x), mean(y)
    b1 = covariance(x, x_mean, y, y_mean) / variance(x, x_mean)
    b0 = y_mean - b1 * x_mean
    return [b0, b1]
```

In [25]:

```
b0, b1 = find_coefficients(X_driving_hours, y_risk_score)
print('Coefficients: B0=%.3f, B1=%.3f' % (b0, b1))
```

```
Coefficients: B0=12.585, B1=4.588
```

**The equation for the given data (in the form y = b0 + b1x)  y = 12.585 + 4.588x**

In [52]:

```
from sklearn.linear_model import LinearRegression
X = np.array(X_driving_hours).reshape(-1, 1)
y = np.array(y_risk_score).reshape(-1, 1)
lm = LinearRegression().fit(X, y)
lm.coef_
```

Out[52]:

```
array([[4.58789861]])
```

In [53]:

```
lm.intercept_
```

Out[53]:

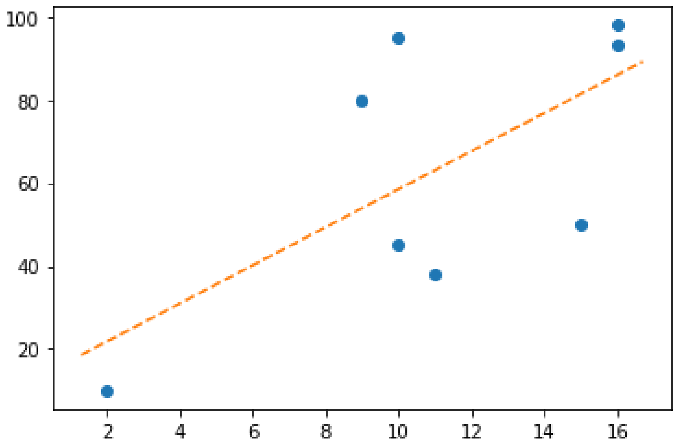
```
array([12.58462796])
```

In [46]:

```
def abline(slope, intercept):
    axes = plt.gca()
    x_vals = np.array(axes.get_xlim())
    y_vals = intercept + slope * x_vals
    plt.plot(x_vals, y_vals, '--')
```

In [54]:

```
plt.plot(X_driving_hours, y_risk_score, "o")
abline(b1, b0)
```




## 1 Prediction

## 1. Prediction

In [28]:

```
def linear_regression(X_train, y_train, X_test):
    predictions = list()
    b0, b1 = find_coefficients(X_train, y_train)
    for row in X_test:
        yhat = b0 + b1 * row
        predictions.append(yhat)
    return predictions
```

In [35]:

```
# Calculate Root Mean Squared Error
from math import sqrt
def calc_rmse(actual, predicted):
    sum_err = 0.0
    for i in range(len(actual)):
        pred_err = predicted[i] - actual[i]
        sum_err += (pred_err ** 2)
    mean_err = sum_err / float(len(actual))
    return sqrt(mean_err)
```

In [20]:

```
#Splitting into training and testing dataset to try prediction
from sklearn.model_selection import train_test_split
X_train, X_test, Y_train, Y_test = train_test_split(X_driving_hours, y_risk_score, test_
size = 1/3, random_state = 0 )
```

In [36]:

```
predictions = linear_regression(X_train, y_train, X_test)

rmse = calc_rmse(y_test, predictions)
```

In [37]:

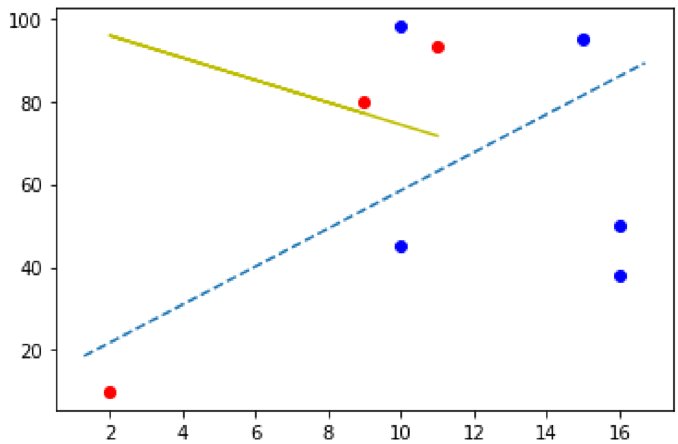
```
rmse
```

Out[37]:

```
51.10473549830038
```

In [48]:

```
plt.plot(X_train, y_train, "bo")
plt.plot(X_test, y_test, "ro")
plt.plot(X_test, predictions, "y")
plt.plot()
abline(b1, b0)
plt.show()
```




**The above graph indicates the following:**

**Blue Dots: Training samples**
**Red Dots: Testing samples**
**Blue Dashed Line: best fit line**
**Yellow Line: predicted output best fit line. This line has a negative slope because of the very small number of samples used; the samples were originally intended to be used entirely as a training set.**

In [ ]:

```

```