Complete Regression - Lab

Introduction

Now have all the necessary functions to calculate the slope, intercept, best-fit line, prediction and visualizations. In this lab you will put them all together to run a regression experiment and calculate model loss.

Objectives

You will be able to:

- Run a complete regression analysis through code only

The formulas

Here are all the formulas to put everything in perspective

Slope

$$m = \frac{\overline{x} \cdot \overline{y} - \overline{xy}}{(\overline{x})^2 - \overline{x^2}}$$

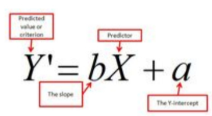
Intercept

$$b = \overline{y} - m\overline{x}$$

R-squared

$$R^2 = 1 - \frac{SS_{RES}}{SS_{TOT}} = \frac{\sum_i(y_i - \hat{y}_i)^2}{\sum_i(y_i - \overline{y})^2}$$

Prediction



Use the functions created earlier to implement these formulas to run a regression analysis using X and Y as input variables.

In [70]:

```python
# Combine all the functions created so far to run a complete regression experiment.
# Produce an output similar to the one shown below.

import numpy as np
import matplotlib.pyplot as plt
from matplotlib import style
style.use('ggplot')


def calc_slope(xs,ys):

    m = (((np.mean(xs)*np.mean(ys)) - np.mean(xs*ys)) /
         ((np.mean(xs)**2) - np.mean(xs*xs)))

    return m

def best_fit(xs,ys):

    m = calc_slope(xs,ys)
    b = np.mean(ys) - m*np.mean(xs)

    return m, b

def reg_line (m, b, X):

    return [(m*x)+b for x in X]

def sum_sq_err(ys_real,ys_predicted):

    sse =  sum((ys_predicted - ys_real) * (ys_predicted - ys_real))

    return sse

def r_squared(ys_real, ys_predicted):

    # Calculate Y_mean , squared error for regression and mean line , and calculate r-squared
    y_mean = [np.mean(ys_real) for y in ys_real]

    sq_err_reg= sum_sq_err(ys_real, ys_predicted)
    sq_err_y_mean = sum_sq_err(ys_real, y_mean)

    # Calculate r-squared
    r_sq =  1 - (sq_err_reg/sq_err_y_mean)

    return r_sq
```

```
def plot_reg(X,Y,Y_pred):
    plt.scatter(X,Y,color='#003F72',label='data')
    plt.plot(X, Y_pred, label='regression line')
    plt.legend(loc=4)
    plt.show()
    return None

X = np.array([1,2,3,4,5,6,7,8,9,10], dtype=np.float64)
Y = np.array([7,7,8,9,9,10,10,11,11,12], dtype=np.float64)

m, b = best_fit(X,Y)
Y_pred = reg_line(m, b, X)
r_squared = r_squared(Y,Y_pred)

print ('Basic Regression Diagnostics')
print ('----------------------------')
print ('Slope:', round(m,2))
print ('Y-Intercept:', round(b,2))
print ('R-Squared:', round(r_squared,2))
print ('----------------------------')
print ('Model: Y =',round(m,2),'* X +', round(b,2))

plot_reg(X,Y,Y_pred)

# Basic Regression Diagnostics
# ----------------------------
# Slope: 0.56
# Y-Intercept: 6.33
# R-Squared: 0.97
# ----------------------------
# Model: Y = 0.56 * X + 6.33
```

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Basic Regression Diagnostics
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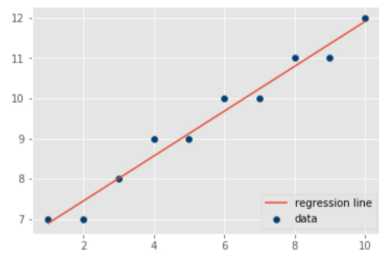
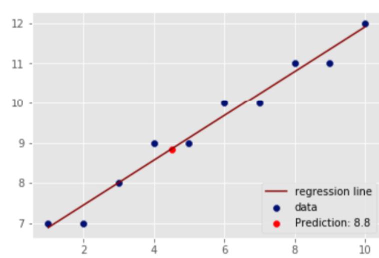


Make Predictions

Predict and plot the value of y using regression line above for a new value of x = 4.5.

In [66]:
```
x_new = 4.5
y_new = (m*x_new)+b
y_new

plt.scatter(X,Y,color='#000F72',label='data')
plt.plot(X, Y_pred, color='#880000', label='regression line')
plt.scatter(x_new,y_new,color='r',label='Prediction: '+ str(np.round(y_predicted,1)))
plt.legend(loc=4)
plt.show()
```



Level up - Optional

Load the "heightWeight.csv" dataset. Use the height as an independant and weight as a dependant variable and draw a regression line to data using your code above. Calculate your R-square for the model and try to predict new values of Y.

Summary

In this lab, we ran a complete simple regression analysis experiment using functions created so far. Next We shall see how we can use python's built in modules to perform such analyses with a much higher level of sophistication.