ECE 71 – Engineering Computations in C
Extra Credit Assignment – October 1, 2009

Professor Kriehn
Due By: Midnight on Monday, October 5, 2009

Print out your I/O diagram, algorithm, and commented code for your solution.

HOMEWORK #12 (Extra Credit) – Best Fit Data

As an engineer, you setup an experiment to verify Ohm's Law, which states:

$$V = I \cdot R$$

where V is the voltage (V), I is the current (A), and R is the resistance (Ω). As part of the experiment, you apply a voltage to a 10 kΩ resistor, measure the current, and take the following data:

Voltage (V)	Current (mA)
10	0.95
20	2.13
30	3.01
40	3.96
50	5.21

Write a program that first prompts the user to enter the number of data points that will be entered into the program. Then prompt the user to input the voltage and current for each data point, read in the data, and use it to calculate the best-fit line and correlation coefficient for your experimental data. Then print your best fit-slope m, best-fit y-intercept b, and the correlation coefficient r.

Use the equations for the best-fit slope m, the best-fit y-intercept b, and the correlation coefficient r.

PLEASE NOTE THAT THESE EQUATIONS ARE SLIGHTLY DIFFERENT THAN THE ONES GIVEN IN THE BOOK. THE EQUATIONS IN THE BOOK HAVE AN ERROR. USE THESE EQUATIONS ONLY!

$$m = \frac{n \cdot \sum_{k=1}^{n} x_k y_k - \sum_{k=1}^{n} x_k \cdot \sum_{k=1}^{n} y_k}{n \cdot \sum_{k=1}^{n} x_k^2 - \left(\sum_{k=1}^{n} x_k \right)^2} \tag{1}$$

$$b = \frac{\sum_{k=1}^{n} y_k - m \sum_{k=1}^{n} x_k}{n} \tag{2}$$

$$r = \frac{n \cdot \sum_{k=1}^{n} x_k y_k - \sum_{k=1}^{n} x_k \cdot \sum_{k=1}^{n} y_k}{\sqrt{n \cdot \sum_{k=1}^{n} x_k^2 - \left(\sum_{k=1}^{n} x_k \right)^2} \sqrt{n \cdot \sum_{k=1}^{n} y_k^2 - \left(\sum_{k=1}^{n} y_k \right)^2}} \tag{3}$$

Specifications: Use the following variables:

Integer Values:
num_data_pts – Stores the number of data points
k – Dummy variable for your for loop

Floating Point Values:
x – Stores your current *x* value
y – Stores your current *y* value
sumx – Stores a running summation of your *x* values
sumy – Stores a running summation of your *y* values
sumx2 – Stores a running summation of your x^2 values
sumy2 – Stores a running summation of your y^2 values
sumxy – Stores a running summation of your $x \cdot y$ values
num_mr – Temporary variable to calculate the numerator of the *m* and *r* equations
denom_m – Temporary variable to calculate the denominator of the *m* equation
denom_r – Temporary variable to calculate the denominator of the *r* equation
m – Stores the final *m* value
b – Stores the final *b* value
r – Stores the final *r* value

Note that most of these variables will need to be initialized to 0 when you declare them. Why?

You can use the example code in Section 3.8 of your book as a basis for developing your solution, but you will run into problems if you follow it exactly because the equations given in the book are slightly incorrect. Again, use the equations given here.

When you run your program, you should get the following:

```
~> hw12.o
Welcome to the Linear Regression Program

Enter the Number of Data Points: 5

Please Enter the Voltage and Current: 10 0.95
Please Enter the Voltage and Current: 20 2.13
Please Enter the Voltage and Current: 30 3.01
Please Enter the Voltage and Current: 40 3.96
Please Enter the Voltage and Current: 50 5.21

The Best Fit Slope m = 0.104
The Best Fit y-Intercept b = -0.053
The correlation coefficient r = 0.9982
~>
```

If you want to check your program further, use the following website to help you:

http://math.hws.edu/javamath/config_applets/ScatterPlotApplet.html