Homework Assignment Number Eight

Problem 1. (6 points)
Perform a single-variable linear regression using the model

$$y = b_0 + b_1 x$$

(a) Report the mean value and standard deviation of the slope, b_1.
(b) Report the mean value and standard deviation of the intercept, b_0.
(c) Report the measure of fit.
Use the data in the file "file.hw08p01.txt" available on the website.
Note the first column in the data file is *y*. The second column is *x*.

Problem 2. (8 points)
Perform a single-variable polynomial regression using the model

$$y = b_0 + b_1 x + b_2 x^2$$

(a) Report the mean value and standard deviation of the regression coefficient for the quadratic term.
(b) Report the mean value and standard deviation of the regression coefficient for the linear term.
(c) Report the mean value and standard deviation of the regression coefficient for the constant term.
(d) Report the measure of fit.
Use the data in the file "file.hw08p02.txt" available on the website.
Note the first column in the data file is *y*. The second column is *x*.

Problem 3. (8 points)
Perform a multivariate linear regression using the model

$$y = b_0 + b_1 x_1 + b_2 x_2$$

(a) Report the mean value and standard deviation of the regression coefficient for the first independent variable, x_1.
(b) Report the mean value and standard deviation of the regression coefficient for the second independent variable, x_2.
(c) Report the mean value and standard deviation of the regression coefficient for the constant term.
(d) Report the measure of fit.
Use the data in the file "file.hw08p03.txt" available on the website.
Note the first column in the data file is *y*. The second column is x_1. The third column is x_2.

Problem 4. (6 points)

Consider the isomerization reaction:

$$A \rightarrow B$$

The reaction rate is given by

$$rate = C_A k_o e^{-\frac{E_a}{RT}} \quad \text{[moles/liter/minute]}$$

where

concentration of A: C_A [moles/liter]
prefactor: k_o [1/minute]
activation energy for reaction: E_a [Joules/mole]
constant: $R = 8.314$ [Joules/mole/K]
temperature: T [K]

The reaction is measured at a constant concentration of A, C_A=0.1 mol/liter, over a variety of temperatures. The rate is recorded. The rate as a function of temperature is given in tabular form in the file "file.hw08p04.txt" (containing 108 data points).

(a) Convert this equation to a form, which is linear in rate constants, k_o and E_a.
(b) Report the mean and standard deviation of the activation energy, E_a.
(c) Report the mean and standard deviation of the reaction rate prefactor, k_o.

Problem 5. (12 points)

On the project page of the course website, there is a zip file containing data for the "Data Wrangling with Carbon Fiber Mechanical Properties". This file contains the results from many tensile test experiments on carbon fibers. For the first experiment in the first data set **only**, determine

(a) strain at fracture
(b) ultimate tensile strength
(c) elastic modulus average and standard deviation
(d) report the limits in terms of strain that you chose for your regression and justify.
(e) provide a plot of the entire raw data
(f) provide a plot of the relevant data to (a), (b) and (c) and indicate strain at fracture, ultimate tensile strength and modulus regression on the plot.