M442 Fall 2017, Assignment 4, due Friday Sept. 29

1. [10 pts] Use nonlinear regression to fit the data stored in *nlregdata2.mat* (available on the course web site) to the relation

$$y = p_1 x_1^{p_2} x_2^{p_3}.$$

In particular, find the regression values for $\vec{p}$, the value of the SSR $E(\vec{p})$ and the standard deviation for your fit.

2. [10 pts] Use nonlinear regression to fit the data stored in *systemregressiondata2.mat* (available on the course web site) to the nonlinear system

$$\begin{aligned} y_1 &= p_1 x_1^{p_2} + p_3 e^{p_4 x_2} \\ y_2 &= p_5 e^{p_4 x_1} + p_6 x_2^{p_2}. \end{aligned}$$

In particular, find the regression values for $\vec{p}$, the value of the SSR $E(\vec{p})$ and the standard deviation on each component for your fit.

Note. For this problem take $p_0 = (.01, .1, .01, .1, 1, 1)$ as your initial parameter values. You will need to specify a choice of *options* in your *fminsearch* call to eliminate the error message. Use *doc fminsearch* to learn how.

3. [10 pts] An object is shot straight upward with initial velocity v. Ignoring air resistance, and assuming gravity is the only force acting on the object, use dimensional analysis to determine the general form for the greatest height the object achieves. Discuss whether or not your result makes sense physically.

4. [10 pts] For a fluid such as oil moving through a pipe, the velocity v at a certain point along the pipe will generally depend on the diameter D of the pipe, the density ρ of the fluid, the viscosity μ of the fluid, and the pressure drop $\frac{dp}{dx}$ at the point. **Ignoring viscosity**, use dimensional analysis to find a general form for the dependence of v on the other variables.

5. [10 pts] Under certain circumstances, the velocity of a water wave (such as you might see at a beach over spring break) is known to depend on the acceleration due to gravity g, the length of the wave l, and the depth of the water D. Use the method of dimensional analysis to determine a general form for the velocity of such a wave in terms of these variables.