Homework Set 2, Modeling I

1. (Supply and Demand Curves: Refer to Figure 2.4) Let $D(x) = 10 - x$ and $S(x) = x - 1$ (here, x is quantity and the $y-$values measure price).

    (a) Find the equilibrium.

    (b) If $q_1 = 7$, compute the quantities and prices for the first 4 market adjustments. Will the sequence of points converge to the equilibrium? Start with another q_1- Do you notice the same type of behavior?

    (c) Use your previous computations to write p_2 in terms of p_1, p_3 in terms of p_2, or more generally, $p_{k+1} = f(p_k)$. What do you notice about $f \circ f$?

    (d) Redo the first two parts if $S(x) = 3x - 1$, and if $S(x) = \frac{1}{2}x - 1$. In general, how can the supply curve be changed to introduce wild fluxuations in the market?

2. Problem 2.4, p. 35 (in Chapter 2)

3. (This problem refers to our work with the Universal Scaling Law) If $\beta = \frac{1}{3}$ and $\gamma = \frac{1}{2}$, $n = 3$, $N = 10$, compute the volume of blood in the circulatory system.

4. Critique our models relating the mass to metabolism (which in turn, related mass to frequency of the heart beat). In particular, discuss the assumptions being made- are they reasonable? In particular, if our second model is "better", what might be the critical error in the assumption from the first model?

5. (Matlab Exercise) Here we examine the question of whether or not it is possible to have three small groups of data, each with a best line slope of $-1/3$, but when we take them all at once, it has a best line slope of $-1/4$. Download the data from our class website `InterGroup.mat`. To load the data into Matlab, type `load InterGroup` You will see several sets of data. The small datasets are $(d1, Gp1)$, $(d2, Gp2)$, and $(d3, Gp3)$, and the data as a whole is (D, G). Find the best line for each of the data sets- What is the answer to our question?

6. (Matlab Exercise) Download the dataset on our class website that gives the periods of rotation of the planets in our solar system. On the internet, find Kepler's Third Law and verify it using Matlab's data fitting tool.