MATH 17A - DISCUSSION #1

Problem 1. TRIAL AND ERROR

A zoologist is studying the relationship between weight (w) and height (h) for giant pandas. Based on initial measurements she forms a hypothesis for the functional relationship between weight and height for this animal,

$$w = 0.2h^2.$$

She wants to confirm her hypothesis by comparing this relationship to measured data. The height of the panda varies between 0 and 3 meters.

1. Plot the functional relationship.
   To do this, type the R commands found in Table 1 in the console of R or R Studio (after the > prompt). There are 3 lines of code that need to be entered to generate a plot. Each entry in the table below contains a line of code. Each column contains exactly one correct line of code. Identify the correct code in each column. Try running them to determine the correct code.

Table 1:

	A	B	C
1	`h=seq(from=0; to=3; by=0.01)`	`w=0.2(h^2)`	`plot(h,w,xlab="h (m)",ylab="w (kg)",type="l")`
2	`h=seq(from=0, to=3, by=0.01)`	`w=0.2h^2`	`plot(h,w,xlab="h (m)",ylab="w (kg)")`
3	`h=seq(to=0, from=3, by=0.01)`	`w=0.2*h^2`	`plot(w,h,xlab="h (m)",ylab="w (kg)",type="l")`

2. For each incorrect entry in the table (there are 6, 2 in each column), state what is wrong with the code.
3. On the same plot, the zoologist wants to plot the measured data contained in table 2 below. To do this, type the following R commands in the console of R Studio (after the > prompt).

   ```
   mh=c(0.5,1.0,2.0,2.5)
   mw=c(0.056,0.44,0.80,1.5)
   lines(mh,mw,type="p")
   ```

4. There are three main differences between the code we used previously to plot a function and this code for plotting scatter points. What are they?

Table 2:

	Measured height (meters)	Measured weight (kilograms)
Specimen 1	0.5	0.056
Specimen 2	1.0	0.44
Specimen 3	2.0	0.80
Specimen 4	2.5	1.5

5. Does the data agree with the zoologist's hypothesis? Can you propose a method to quantify how "close" the predicted function is to the measured data?

Problem 2. ENERGY CONSUMPTION AND SIZE OF ANIMALS

Basal metabolic rate (BMR) is the minimal rate of energy expenditure per unit time by endothermic animals at rest. That is, the BMR is the amount of energy that an animal needs to keep the body functioning at rest through processes such as breathing, blood circulation, controlling body temperature, cell growth, brain and nerve function, and contraction of muscles. A human's basal metabolic rate typically accounts for about 60 to 75% of the calories they burn every day. Below you will try to determine the functional relationship between BMR and W by making different plots of the data.

Table 3: Body weight (W) and basal metabolic rate (BMR) of several different mammals.

	approximate body weight, W (lbs)	basal metabolic rate, BMR (kcal/day)
elephant	10000	18000
horse	1000	3200
human	200	960
cat	8	86
rat	2	30
mouse	0.5	10

1. Make a plot of basal metabolic rate vs. body weight using the commands below. Can you identify the relationship between an animal's BMR and weight? Can you even distinguish all of the data points? What is preventing you from doing this?

```
w = c(10000, 1000, 200, 8, 2, 0.5)
bmr = c(18000, 3200, 960, 86, 30, 10)
plot( w, bmr, xlab="weight (lbs)", ylab="BMR (kcal/day)")
```

2. Make a log-log plot using the commands below (after entering the data above).

```
logw=log10(w)
logbmr=log10(bmr)
plot(logw, logbmr, xlab="log(weight)", ylab="log(BMR)")
```

3. Make a semilog (log-linear plot), i.e. plot $\log_{10}(w)$ vs. bmr, by altering the appropriate command above.
4. Which of these three plots suggest a functional relationship between basal metabolic rate and body weight? Use the appropriate graph to find a function which approximates the data.