# Math 151 – Sample Exam 1 – Fall 2015 – Louis Gross

It would be best if you try to take this Sample Exam as if you were sitting in class, using only a calculator. For the actual in-class exam, there will be blank sheets of paper handed out for you to give the answers but it will be important for you to SHOW YOUR WORK even if you are certain your answer is correct. Note that this Sample Exam is slightly longer than the actual exam will be in order to provide additional ractice problems.

1. The below graph shows data on height changes from age 10 to 15 versus height at age 10 for a group of females.
   (a) state whether the data appear to be positively, negatively, or non-correlated and give a rough estimate of R^2 the square of the correlation coefficient, stating whether it is in the range 0-.5 or .5-1. (choose one of these ranges);
   (b) give an estimate for the linear regression line, being careful to state how you derived it (e.g. state what points you used and show how you calculated the line);
   (c) from the regression line you obtained, estimate the height at age 15 for an individual female of height 150 cm at age 10;
   (d) from the regression line you obtained, below what height at age 10 will height change from age 10 to 15 become negative ? Does this make sense?
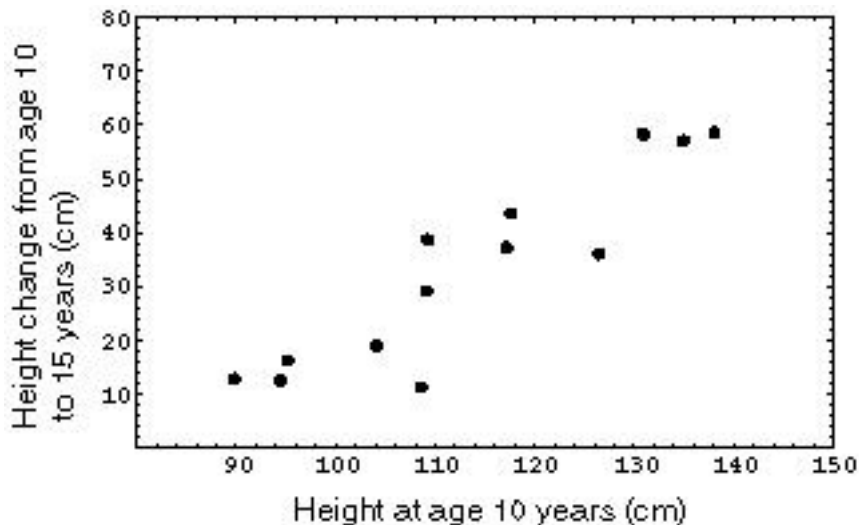
2. For the following sample, compute the mean, median, range, variance and standard deviation: 2, 1, 4, 5, 8, , 4

3, Solve each of the following for y:

   (a) $\log_{10} (4\,y) = 2$ (b) $3\,e^{-2y} = 15$ (c) $\ln (4 + x^2) = 3$

4. Matlab has the following variables a and b (a is leaf length and b is leaf width in mm for leaves from Acer saccharum)
>> a
a =
Columns 1 through 11
40 43 46 49 52 55 58 61 64 67 70
Columns 12 through 19
53 66 48 54 73 52 77 38
>> b
b =
Columns 1 through 11
72 77 83 88 94 99 104 110 115 121 126
Columns 12 through 19
88 96 76 87 114 91 132 66

Describe in words what each of the following lines of Matlab commands produces:
hist(a,5)
plot(a,b,'+')
c=polyfit(a,b,1)

5. A fish pond is designed so that it can hold about 1800 adult tilapia without being overly crowded. Suppose that the pond is initially stocked with 200 tilapia and the fish reproduce so that after 2 years there are approximately 500 tilapia in the pond.

(a) Find an exponential function $N(t) = a\, b^t$ for the number of tilapia in the pond which is consistent with the data given.

(b) At what time will the number of trout reach 1800?

6. Below is Figure 1C from a paper by Enquist and Niklas (Science Feb. 22, 2003). This shows that leaf biomass M_L (measured in kg dry weight) is allometrically related to root biomass M_R (measured in kg dry weight). The linear regression through these data is shown, and note that it approximately goes through the points $(-2, -2)$ and $(1, 0)$ on this log-log graph.

(a) Give an equation which expresses M_L as a function of M_R being sure to estimate any parameters in the equation using the regression line. So you should have an answer with M_L on the left hand side of the equation by itself.

(b) If you compare two plants, with plant A having twice the root biomass of plant B, is the leaf biomass of plant A twice that of plant B, less than twice or more than twice?

log Leaf Biomass M_L (y-axis) vs log Root Biomass M_R (x-axis), panel C.
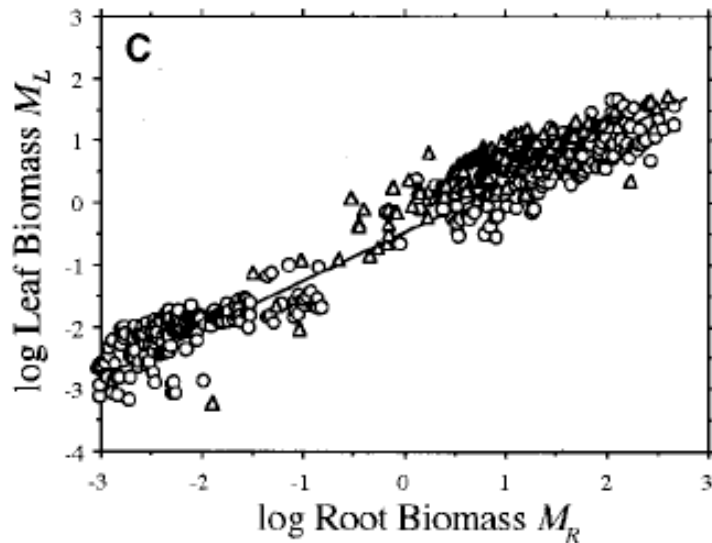
7. The following weights (in grams) were obtained from a group of 20 measurements of seeds when plants were grown in a greenhouse : $41, 38, 35, 48, 57, 51, 46, 56, 51, 37, 42,$ $41, 36, 59, 52, 38, 54, 37, \; 39, 44.$

(a) Construct a histogram for these data, using a width class of size 5.

(b) From this histogram, state whether the arithmetic mean of the data is larger, smaller or equal to the midrange (the midpoint of the data set's range) of the data.

(c) Based upon this data set, approximately what fraction of seeds from similarly grown plants do you expect to weigh greater than 50 grams?

8. Below is a semi-logarithmic graph of drug concentration (mg/ml) in the blood of a patient following administration of a single dose of the drug at time 0. Note that the data clearly fall on a line.

(a) What was the initial concentration of drug at time 0 (e.g. what is D(0))?

(b) Give an equation for D(t) = drug concentration at time t hours following drug administration.

(c) At what time should a second drug dose be given if it is to be administered when the drug concentration has fallen to 5% of the initial concentration?
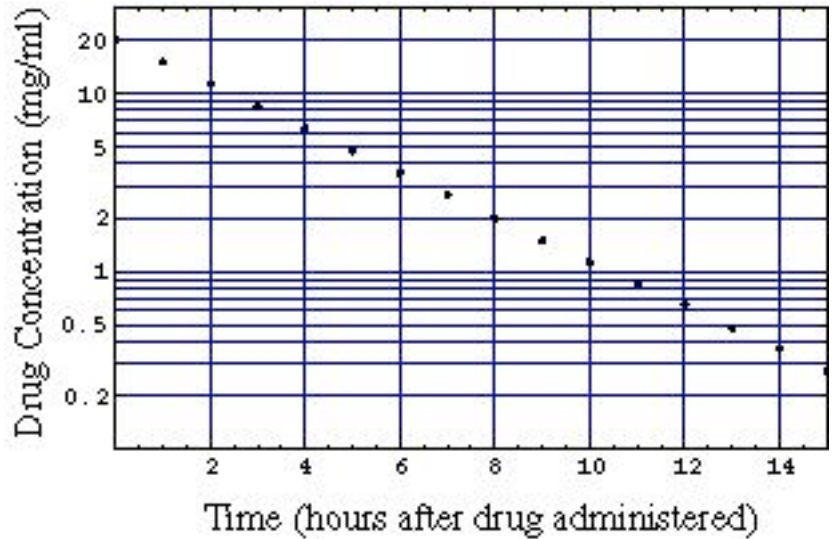
9. The below is Figure 1D from the paper by Nie et al. (Exceptionally low daily energy expenditure in the bamboo-eating giant panda - Science 349:171-174 - July 10, 2015) we discussed in class. It shows the almost linear relationship between daily energy expenditure (DEE) of terrestrial mammals plotted against body mass (M) when both are calculated on a natural logarithm scale (ln).

(a) Choose two points in this figure that you suggest reasonably fall on or near the linear realationship between DEE and M and state what they are as (ln M, ln DEE)

(b) For your two points, find the equation for the line between them, expressing this as an equation ln (DEE) = a ln (M) + b.

(c) For the equation you found in (b), express this as allometric function – that is find DEE as a function of M.