Assignment 11 — Due December 12, 2003

1. An experimenter was interested in the relationship between temperature and heart rate in the common grass frog. The temperature was manipulated in 2-degree increments ranging from 2 to 18 C with heart rates recorded at each temperature in beats per minute. (A different, randomly selected, frog was used at each temperature.)

Temp	2	4	6	8	10	12	14	16	18
Heart rate	5	11	10	13	22	23	30	28	32

   Find (without using the computer) the least squares estimates of slope and intercept viewing heart rate as the dependent variable (i.e. heart rate as a function of temperature). Include a graph of heart rate versus temperature.

2. The data below were compiled as part of a hydrological study of the feasibility of forecasting actual water yield from knowledge of the amount of snow cover in early spring. The variable X represents the amount of snow (in equivalent inches of water) in the Snake River (Wyoming) watershed on April 1. The variable Y is the measured yield of water in inches from this watershed during the months of April to July.

Year	X	Y	Year	X	Y
1925	39.3	23.0	1932	35.1	17.4
1926	24.2	12.4	1933	31.5	14.9
1927	52.4	24.9	1934	21.1	10.5
1928	37.9	22.7	1935	27.6	16.1
1929	30.5	14.1	1936	26.0	13.2
1930	25.1	12.9	1937	38.4	20.8
1931	12.4	8.8			

   (Note: It is acceptable, and advisable, that you use R to assist in computations on this problem. See R Appendix 14.8 for details. The calculations in parts (e) and (f) should be done without direct aid of the computer.)

   (a) Make a plot of the data, plotting Y vs X. Comment on the plot.

   (b) Indicate the model underlying a simple linear regression of Y on X. Define all symbols. State the assumptions on which an analysis is based.

   (c) Find the least squares estimates of the slope and intercept. Give 95% confidence limits for each coefficient.

   (d) Estimate with 95% confidence limits the variance of Y about the theoretical straight line (i.e. σ_e^2).

   (e) Find 95% confidence limits for the expected (population mean) water yield when 20 equivalent inches of snow are measured on April 1.

   (f) Suppose that on April 1, 1938, the equivalent water content of the snow cover was 20.0 inches. Find 95% confidence limits for the actual amount of April to July water yield for that year. Discuss the difference between these limits and those found in (e).

   (g) Make a plot of the residuals versus the predicted values for Y. Comment on how well the assumptions given in (b) appear to be met.

3. (a) Consider the following regression data where the values of Y corresponding to $X = -4$ and $X = 0$ are missing.

X	-4	0	1	3
Y	---	---	5	8

   Suppose, however, that you know $\hat{b}_1$=.5 and $\hat{b}_0$=6. Find the 2 missing values of Y. (Hint: Look at the form of the equations for $\hat{b}_1$ and $\hat{b}_0$.)

(b) Discuss how your work on (a) relates to the notion of degrees of freedom for error.

Readings:

- Week 15: Course Notes, Chapter 14, Chapter 15.1, 15.2.

Assignment 12 — Optional

1. It has been hypothesized by Kleinfelt that there is a 1/7 chance that an emergency visit to a veterinary clinic will fall on a given day of the week, i.e. all days are equally likely. Over the duration of a year, it was found that for a specific veterinary clinic, 87 visits occurred on a Saturday, 67 on a Sunday, and 246 occurred during a weekday (Monday to Friday). Is there evidence that Kleinfelt is incorrect?

2. An experiment is performed to compare the efficacy of 3 drugs on curing rats suffering from a particular form of white blood cell deficiency. Drug A was administered to 48 randomly selected rats of which 19 were cured. Drug B was given to 85 randomly selected rats of which 44 were cured. Drug C was given to 70 randomly selected rats of which 27 were cured. Determine whether the drugs have differing efficacies.

Readings: Course Notes: Chapter 13, sections 1–5.