STAT 495, Fall 2008
Homework Assignment #8

1. A nested design was used to obtain information on possible sources of variability in the hardness of a metal alloy. There are two alloy chemistries. There are three heats of the metal within both chemistries. Within each heat, two ingots are selected. For each ingot the hardness is measured twice. Below are the data.

Chemistry	1						2					
Heats	1		2		3		1		2		3	
Ingots	1	2	1	2	1	2	1	2	1	2	1	2
	40	27	95	69	65	76	30	13	81	43	49	43
	63	30	67	47	54	45	18	17	50	32	66	50

   a) Plot the data.

      - Construct a histogram of all of the data.
      - Construct a graph that shows the variability at each level.
      - Construct an *s* chart.

      You may use JMP or some other computer program to construct the graphs. Interpret what the graphs are telling you. Where does there appear to be large variation?

   b) Go through the hand calculations to construct an analysis of variance table with sources of variation: Chemistry, Heat, Ingot and Measurement.

   c) Give the formulas for the Expected Mean Squares for the components: Chemistry, Heat, Ingot and Measurement.

   d) Compute variance components and express them as a percentage of the total.

   e) Use JMP, or another computer program, to verify your results in parts b), c) and d).

   f) Interpret your results in terms of where improvement efforts should be focused.