Problem Set #4

Issued: Monday, March 3, 2003
Due: Wednesday, March 12, 2003

Problem 1

Working with an excimer laser stepper, you have determined that linewidth measurements and random variation show a standard deviation of 0.04 µm. Using a mask with 0.18 µm lines, the average measured polysilicon linewidth is 0.20 µm. You are contemplating a switch to a different photoresist, hoping it will give you linewidths closer to the mask pattern. You will be willing to switch to the new resist only if you see a 0.02 µm improvement (i.e. your measured pattern goes from 0.20 µm to 0.18 µm) with α=0.05 and β=0.05. How many samples done with the new process do you need for this experiment?

Problem 2

A process engineer determined the following entries in an ANOVA table for some data he collected from a randomized block design (to guard against differences in the different tools used to conduct the experiment). The treatment averages for the responses were 55, 68, 56, 66, and 55.

source of variation	sum of squares	degrees of freedom	mean square	F ratio	Pr > F
average					
blocks	534	2			
treatments	498				
residual	40				
total		15			

(a) Complete the ANOVA table. (Note: it *is* possible to determine all non-shaded entries.)

(b) Based on the probability of observing the F-ratio for the treatments, does the engineer have evidence that there is a treatment effect (that is to say, that the treatment as a whole matters)? A block effect?

(c) Construct and describe the relevant reference distribution for the treatment averages. That is to say, we would like to know how y_t is distributed (where the subscript t indicates which treatment was used), and the parameters of that distribution. Once you know this distribution, you can draw conclusions about *individual* treatments (rather than the treatment effect as a whole as in part b). For each of the five treatments, indicate whether or not you believe that specific treatment has an effect.

(d) How should the experiment be conducted to allow valid conclusions to be drawn?

Problem 3

Do Problem 3 on pg. 222 of Drain. Show an ANOVA table with your explanations.

Problem 4

Do Problem 4 on pg. 222-223 of Drain. Again show your ANOVA table.