STAT 514 Homework#1 (Due Thursday 09/03/15 BEFORE CLASS)

1. The time to repair an electronic instrument is a normally distributed random variable measured in hours. The repair times for 16 such instruments chosen at random are as follows:

Hours							
159	280	101	212	224	379	179	264
222	362	168	250	149	260	485	170

(a) You wish to know if the mean repair time exceeds 225 hours. Set up appropriate hypotheses for investigating this issue.

(b) Test the hypotheses you formulated in part (a). What are your conclusions? Use $\alpha = 0.05$.

(c) Find the P- value for the test.

(d) Construct a 95 percent confidence interval on mean repair time.

2. Suppose I generate 10 random variables in the following manner. I first generate a variable X from a Normal distribution with mean 5 and variance 1. I then randomly sample 10 variables $Y_1, Y_2, ..., Y_{10}$ from a Normal with mean 0 and variance $\frac{1}{2}$ and add the variable X to each one. This creates 10 random variables

$$Z_i = X + Y_i \qquad i = 1, 2, ...10.$$

(a) What is the $\mathrm{E}(Z_i)$? What is the $\mathrm{Var}(Z_i)$?

(b) What is the $\mathrm{E}(\overline{Z})$? What is the $\mathrm{Var}(\overline{Z})$?

3. The deflection temperature under load for two different formulations of ABS plastic pipe is being studied. Two samples of 12 observations each are prepared using each formulation and the deflection temperatures (in °F) are reported in below: Do the data support a claim that the mean

Formulation 1						Formulation 2					
206	193	192	188	207	210	177	176	198	197	185	188
205	185	194	187	189	178	206	200	189	201	197	203

deflection temperature under load for formulation 1 exceeds that of formulation 2 by at least 3°F?

4. In semiconductor manufacturing wet chemical etching is often used to remove silicon from the backs wafers prior to metalization. The etch rate is an important characteristic of this process. Two different etching solutions are being evaluated. Eight randomly selected wafers have been etched in each solution, and the observed etch rates (in mils/min) area as follows.

(a) Do the data indicate that the claim that both solutions have the same mean etch rate is valid? Use $\alpha = 0.05$ and assume equal variances.

(b) Find a 95% confidence interval on the difference in mean etch rates.

Solution 1				Solution 2			
9.9	10.6	9.4	10.3	10.2	10.6	10.0	10.2
10.0	9.3	10.3	9.8	10.7	10.4	10.5	10.3

(c) Use appropriate plots to investigate the adequacy of the assumptions of normality and equal variances.

5. (SAS/Graph Exercise) Construct an power curve for a two-sided t-test with $\alpha = .01$, $\sigma = 8$ and $n = 10$ (total of 20 observations) by calculating the power when δ = 0,2,4,6,8,10,12,14 and 16.

6. Montgomery 2.17

7. Montgomery 2.43

8. In a two-factor ANOVA, factor A has 3 levels and factor B has 5 levels. There are 4 observations in each treatment, except that there are only 3 observations for two treatments (A=1, B=3 and A=3, B=4) due to drop out.

(a) What are the degrees of freedom for each of the following: (a.1) factor A; (a.2) factor B; (a.3) interaction AB; (a.4) model; (a.5) error.

(b) If SSA=226 and SSE=604, compute the F-statistic for testing for a factor A main effect, and give the degrees of freedom of the test.

9. In a mixed effects model, factor A is random with 3 levels and B is fixed with 2 levels. If SSA=100, SSB=60, SSAB=40, and MSE=10, calculate the appropriate F-statistics to test for
(a) factor A effects;
(b) factor B effects;
(c) interaction.