1. Answer the following questions (briefly explain your answers)
   a) What is a "test statistic" in the context of Hypothesis testing?
   b) How is the power of a test related to the sample size of a test, assuming that a test statistic is an average of independent samples, and it follows the normal distribution?
   c) Is the power (P) of a test independent of the type I error?
   d) If the sample size is correctly calculated to be 10, would a better experiment result if a sample size of 20 is used?

2. Two types of photoresist (A and B) were used on a total of 8 randomly selected wafers, 4 for A and 4 for B. After patterned with a DUV stepper (using the same mask for all), the average linewidth was measured in \( \mu \text{m} \):

   A: 0.18 0.17 0.18 0.19  
   B: 0.21 0.18 0.19 0.22

   Obtain a 95% confidence interval for the ratio of sigmas. State your assumptions carefully.

3. You are considering introducing a new etch recipe, hoping that it will reliably shrink your after-etch CD. (remember that each nm you shave off the CD gives you about $7/microprocessor you sell!). You have determined that the sigma of the process is 25nm, and it will not be affected by the new process. Using a mask with 0.22\( \mu \text{m} \) lines, and the old etch recipe, the average measured polysilicon linewidth is 0.19\( \mu \text{m} \). You will be willing to switch to the new etch recipe only if you see a 20nm improvement (i.e. your measured pattern goes from 0.19\( \mu \text{m} \) to 0.17\( \mu \text{m} \)) with \( \alpha=0.05 \) and \( \beta=0.10 \). How many samples done with the new process do you need for this experiment?

4. We now have three types of resist to compare: A, B and C. We would like to use an ANOVA table in order to test the hypothesis of equivalence of the three treatments. A few wafers from the first group have already been measured. Look at the 4 measurements below and estimate the total number of wafers we need to measure if we would like to detect deviations in the order of 0.05\( \mu \text{m} \) between groups with a power of 80%, while the type I error is kept at 5%.

   A: 0.32 0.27 0.30 0.27

   Explain all implicit assumptions.