

UNIVERSITY OF ILLINOIS AT CHICAGO  
Mechanical Engineering

**IE 446**  
**Problem Set #3**

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Reading: Montgomery, Ch. 3 (still)

1. (Montgomery 3-14) Two quality control technicians measure the surface finish of a metal part, obtaining this data (assume measurements are normally distributed):

Technician 1	1.45	1.37	1.21	1.54	1.48	1.29	1.34	
Technician 2	1.54	1.41	1.56	1.37	1.20	1.31	1.27	1.35

- (a) Assuming the variances are equal, construct a 95% confidence interval on the mean difference in surface-finish measurements.
- (b) Construct a 95% confidence interval estimate of the ratio of the variances of technician measurement error. What does this tell you about the assumption we made in the last problem?
- (c) Construct a 95% confidence interval on the variance of measurement error for Technician 2.
2. (Montgomery 3-2, 3-22)
- (a) Consider tensile strength of a material fiber, where experience indicates that the standard deviation is 2 psi. A random sample of 8 fibers is selected and tested, and the average tensile strength is found to be 127 psi. Construct a 95% lower confidence interval on the mean tensile strength.
- (b) Test the hypothesis that the mean tensile strength equals 125 psi, versus the hypothesis that the mean tensile strength exceeds 125 psi, using  $\alpha = 0.05$ . What is the  $P$ -value for this test? What does that mean, in one or two clear sentences?
3. (Montgomery 3-31, numbers changed) Consider the internal pressure strength of two candidate types of glass bottles for soft drinks. Assume it is known that  $\sigma_1 = \sigma_2 = 2.6$  psi. From a random sample of  $n_1 = n_2 = 16$  bottles the mean pressure strengths are observed to be  $\bar{x}_1 = 170.8$  psi and  $\bar{x}_2 = 176.8$  psi. The company will use bottle design 2 only if its pressure strength exceeds that of bottle design 1 by at least 5 psi. Based on the sample data and  $\alpha = 0.05$ , should they use bottle design 2? What is the  $P$ -value for this test?
4. In problem set 2, problem 3, you derived a general expression for determining the sample size for detecting a true mean of  $\mu_1 \neq \mu_0$  with probability  $1 - \beta$  if the type I error is  $\alpha$ .

- (a) Apply the procedure to the following values:

$\mu_0$	$\mu_1$	$\sigma^2$	$\alpha$	$\beta$
22	23.5	5	0.05	0.05

In other words, find a sample size  $n$  that will give a test with a power of 95% given a producer's risk of 5%.

- (b) Repeat the procedure, using  $\alpha = 0.01$  and  $\beta = 0.05$ .
- (c) Repeat the procedure, using  $\alpha = 0.05$  and  $\beta = 0.01$ .
- (d) Repeat the procedure, using  $\alpha = 0.01$  and  $\beta = 0.01$ .
- (e) What general conclusions, if any, can be drawn from the results of (a)–(d)?