

IE 361 Lab#2/ 2nd Measurement Study

_____ (Name)

Before handing in Lab #1, record below from the top of page 2 on Lab #1 the summary statistics that you report.

From the "first sample" of $n = 8$ measurements on different peanuts:

$$\bar{y} = \underline{\hspace{2cm}} \qquad s_y = \underline{\hspace{2cm}}$$

From the "second sample" of $m = 6$ measurements on the same peanut:

$$\bar{y} = \underline{\hspace{2cm}} \qquad s = \underline{\hspace{2cm}}$$

Before coming to Lab #3, treating the 8 peanuts as a random sample of all peanuts of this type use the first material of Module 4 to make approximate 95% confidence limits for σ_x , the real item-to-item variability in peanut size (uninflated by measurement noise). (This involves using $\hat{\sigma}_x = \sqrt{s_y^2 - s^2}$, $\hat{v} = \hat{\sigma}_x^4 / \left((s_y^4 / (n-1)) + (s^4 / (m-1)) \right)$ as given in the slides, and the limits $\hat{\sigma}_x \sqrt{\hat{v} / \chi_{\text{upper}}^2}$ and $\hat{\sigma}_x \sqrt{\hat{v} / \chi_{\text{lower}}^2}$.)

Lower Limit _____

Upper Limit _____

Organize yourselves into Tables of at least 4 people (we want multiple "operators" in this Lab and 2 or 3 is probably not adequate). In the measuring, before making each measurement, close the jaws of the caliper *and reset the "zero" on the dial.*

Take one peanut from your bag. Measure it once, and let everyone at your table do the same. Repeat this 4 more times, so that this peanut gets measured 5 times by each person at the table. Record the measurements below and calculate the sample means and standard deviations. (Record measurements to 1/100th of an inch and the summary statistics to one additional decimal place.)

First Peanut

Student #1	Student #2	Student #3	Student #4	Student #5	Student #6
$\bar{y}_1 =$	$\bar{y}_2 =$	$\bar{y}_3 =$	$\bar{y}_4 =$	$\bar{y}_5 =$	$\bar{y}_6 =$
$s_1 =$	$s_2 =$	$s_3 =$	$s_4 =$	$s_5 =$	$s_6 =$

As a way of getting some feel for what a one-way ANOVA summarizes, do the following.

Find the **sample VARIANCE of all** ($5 \times (\text{the number of students})$) **measurements** in the table above. (Note that the units here are square inches!) Then multiply this by $5 \times (\text{the number of students}) - 1$ to get the "total sum of squares" ($SSTot$ from Module 4).

$SSTot = \underline{\hspace{2cm}}$

Find the simple **arithmetic average of the sample VARIANCES** in the table on page 2. This is

$\frac{1}{\text{number of students}} \sum_{i=1}^{\text{number of students}} s_i^2$ and (for this case where sample sizes are all the same) is the "error mean square" (*MSE*) from Module 4. Multiply this by

$$(5-1)(\text{number of students})$$

and you have the "error sum of squares" (*SSE* from Module 4).

$$SSE = \underline{\hspace{2cm}}$$

The ANOVA "treatment sum of squares" is the difference between *SSTot* and *SSE*. (That is, $SSTr = SSTot - SSE$.) What is that number here?

$$SSTr = \underline{\hspace{2cm}}$$

Before coming to Lab #3 run the JMP "Fit Model" procedure to obtain a one-way ANOVA table and verify that your numbers above agree with entries of that table. Staple a printout from that session to this Lab for turning in. (To get an ANOVA table to print out, at first do NOT designate "students" as "random effects.")

Redo the JMP "Fit Model" procedure after switching "students" to be "random effects" and find 95% confidence limits for σ_δ and for σ_{device} . (You'll need to take square roots of limits that come on the printout.)

95% limits for σ_{device} (a "repeatability" standard deviation):

95% limits for σ_δ (a "reproducibility" standard deviation):

Take a second peanut from the bag and repeat the data collection summarized at the top of page 2 of this lab for a second peanut. You can record the data in the table below:

Second Peanut

Student #1	Student #2	Student #3	Student #4	Student #5	Student #6

Now make the range-based single number estimates of $\sigma_{\text{repeatability}}$, $\sigma_{\text{reproducibility}}$, and $\sigma_{\text{R\&R}}$ discussed on pages 20-26 of the text and in Module 5. You may summarize some of your calculations in the table below.

	Student #1	Student #2	Student #3	Student #4	Student #5	Student #6	
Peanut #1	$\bar{y}_{11} =$ $R_{11} =$	$\bar{y}_{12} =$ $R_{12} =$	$\bar{y}_{13} =$ $R_{13} =$	$\bar{y}_{14} =$ $R_{14} =$	$\bar{y}_{15} =$ $R_{15} =$	$\bar{y}_{16} =$ $R_{16} =$	$\Delta_1 =$
Peanut #2	$\bar{y}_{21} =$ $R_{21} =$	$\bar{y}_{22} =$ $R_{22} =$	$\bar{y}_{23} =$ $R_{23} =$	$\bar{y}_{24} =$ $R_{24} =$	$\bar{y}_{25} =$ $R_{25} =$	$\bar{y}_{26} =$ $R_{26} =$	$\Delta_2 =$

$\hat{\sigma}_{\text{repeatability}} =$ _____

$\hat{\sigma}_{\text{reproducibility}} =$ _____

$\hat{\sigma}_{\text{R\&R}} =$ _____