

ME 120 Experimental Methods

Homework #5: Uncertainty Analysis and Descriptive Statistics in Lab View

1. (10 pts) EMfE Prob. 6.49
2. (10 pts) Tensile tests on two bolts were performed. The data results are:

Bolt Type	Failure Load, kN	S_x , kN	Number of Tests
A	30	2	21
B	34	6	9

Is there a difference between the two types of bolts at a confidence level of 95%? Support your answer with the appropriate statistical analysis.

3. (10 pts) Consider the formula for the deflection of the tip of a rectangular cantilever beam with a load at the end:

$$y = \frac{Pl^3}{3EI}$$

where:

P = load, lb

l = length of beam from support to point of application of the load, in.

E = Modulus of elasticity of beam material, psi

I = moment of inertia of beam cross section, in⁴

$$= \frac{wt^3}{12}$$

where w is the width of the beam in inches, and t is the thickness in inches

Calculate the uncertainty in the prediction of y at 95% confidence given the following measurements:

$$P = 1.0 \times 10^1 \text{ lb}$$

$$l = 12 \text{ in.}$$

$$E = 30 \text{ Mpsi} \pm 5\%$$

$$w = 2.0 \text{ in.}$$

$$t = 0.10 \text{ in.}$$

(Hint: Don't forget about the *implied* uncertainties in P, l, w, and t. Also, when the calculated

quantity takes on the form $y = \frac{Ax_1^{q_1} x_2^{q_2} \dots x_n^{q_n}}{Bx_3^{r_1} x_4^{r_2} \dots x_z^{r_z}}$, one can show that the percent uncertainty (i.e.,

$\frac{U_y}{y}$) takes on the form: $\frac{U_y}{y} = \sqrt{\left(\frac{q_1 U_1}{x_1}\right)^2 + \left(\frac{q_2 U_2}{x_2}\right)^2 + \dots + \left(-\frac{r_1 U_3}{x_3}\right)^2 + \left(-\frac{r_2 U_4}{x_4}\right)^2 + \dots}$, which is the

square root of the sum of the squares of the percent uncertainties in each of the measured

ME 120 Experimental Methods

quantities multiplied by their exponent. This latter form sometimes may be more readily applied than the method shown in class to calculate U_y .

4. (10 pts) Build a Lab View VI that reads a text file containing the data from EMfE Problem 6.2 and calculates the mean and standard deviation of the data. (You can create the text file by entering the data into an Excel spreadsheet and saving it as a text file. Note that there are some nice statistical analysis VI's that will calculate the mean and standard deviation for you.) Make sure you document your VI by editing the documentation portion of 'VI Properties'. Print out the 'complete documentation' of your VI.