Error Assignment #1

1. Taylor Problem #4.22. This problem is an example of an experiment for which the error analysis can be done in either of two ways: by propagating the estimated errors in the original measurements or by doing a statistical analysis of the various answers.

   A student wants to measure g, the acceleration of gravity, using a simple pendulum, as described briefly in the introduction to Chapter 4 of your text, *An Introduction to Error Analysis*. Because the period is known to be $T = 2\pi\sqrt{l/g}$, where l is the length of the pendulum, she can find g as $g = 4\pi^2 l/T^2$. She measures T for five different values of l and obtains the following results:

Length, l (cm):	57.3	61.1	73.2	83.7	95.0
Time, T (s):	1.521	1.567	1.718	1.835	1.952

   (a) Copy the table of data and add a row in which you list her five computed values of g.

   (b) She estimates that she can read the lengths l within about 0.3% (that is, two or three millimeters). Similarly, she estimates that all of the times are within $\pm 0.2\%$. Use error propagation to find the uncertainty in her values for g.

   (c) Because her values of g are five measurements of the same quantity, we can analyze them statistically. In particular, their standard deviation should represent the uncertainty in any one of her answers. What is the SD, and how does it compare with the uncertainty found by error propagation in part (b)? [You should not expect the agreement to be *especially* good because we don't know the exact nature of her original estimated uncertainties (nor, probably, does she). Nevertheless, the two methods should agree *roughly*, and a large disagreement would be a clear signal that something had gone wrong.]

   (d) What is her final answer for g with its uncertainty? [Use the statistical analysis of part (c), and remember that the final uncertainty is the standard deviation of the mean.] How does her answer compare with the accepted value (in her laboratory) of 979.6 cm/s^2?