Absolute and Relative Error

Absolute and relative error are two types of error with which every experimental scientist should be familiar. The differences are important.

Absolute Error: Absolute error is the amount of physical error in a measurement, period. Let's say a meter stick is used to measure a given distance. The error is rather hastily made, but it is good to $\pm 1mm$. This is the absolute error of the measurement. That is,

$$absolute\ error = \pm 1mm\ (0.001m).$$

In terms common to *Error Propagation*

$$absolute\ error = \Delta x$$

where *x* is any variable.

Relative Error: Relative error gives an indication of how good a measurement is relative to the size of the thing being measured. Let's say that two students measure two objects with a meter stick. One student measures the height of a room and gets a value of 3.215 meters $\pm 1mm$ (0.001m). Another student measures the height of a small cylinder and measures 0.075 meters $\pm 1mm$ (0.001m). Clearly, the overall accuracy of the ceiling height is much better than that of the 7.5 cm cylinder. The comparative accuracy of these measurements can be determined by looking at their relative errors.

$$relative\ error = \frac{absolute\ error}{value\ of\ thing\ measured}$$

or in terms common to *Error Propagation*

$$relative\ error = \frac{\Delta x}{x}$$

where *x* is any variable. Now, in our example,

$$relative\ error_{ceiling\ height} = \frac{0.001m}{3.125m} \bullet 100 = 0.0003\%$$

$$relative\,error_{cylinder\ height} = \frac{0.001m}{0.075m} \bullet 100 = 0.01\%$$

Clearly, the relative error in the ceiling height is considerably smaller than the relative error in the cylinder height even though the amount of absolute error is the same in each case.