Accuracy vs Precision

Accuracy and precision describe the errors in a measured value.

- *Accuracy* is the degree to which a measured value differs from the actual value of that quantity

- *Precision* is the degree to which a series of measurements differ from each other.

Measurement precision

You should always read measured quantities to one significant figure more than the numbers read directly on the scale.

- You would report the length of the green bar at right as 3.23 (or maybe 3.22 or 3.24, according to your eyes).

- The first two digits are directly read from the scale and the final digit is estimated.
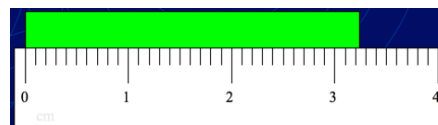
Quantifying Accuracy

Accuracy is quantified as a *percent error* from the actual value:

$$\text{Percent error} = \frac{\text{measured value} - \text{actual value}}{\text{actual value}} \times 100$$

Quantifying Precision

- Precision is often expressed as the *number of significant figures* in the reported measurement.

   Thus, the green bar above is measured to three significant figures.

- Precision can also be expressed as a *margin of error*, which is ½ the size of the least significant digit represented in the measurement device.

   Thus, the length of the green bar above is 3.23 with a margin of error of 0.05.

Types of error

▶ Relative Error - The actual margin of error, as above.

▷ The absolute error cited above would be 0.05.

▶ Relative Error - The margin of error as a percentage or fraction of the measurement.

$$\text{Relative error} = \frac{\text{absolute error}}{\text{measurement}} \times 100$$

▷ The relative error above would be .05 / 3.23 * 100 = 1.5%