# How Close Is Close Enough?

**Goal:**

Develop standards to use when investigating whether an artist or architect may have intended the ratio of two dimensions to be some specific number.

# Recall:

- Actual lengths are unknowable
- Always give a margin of error for your measurements.
  - Must be big enough so sure actual length is really in that range
  - At the same time, should be as small as possible (and still be true)
- If you measure a length $L$ to be 20 cm $\pm 1$ cm , then

$$19 \text{ cm } \leq L \leq 21 \text{ cm}$$

- If you instead find $L$ to be 20 cm $\pm 1\%$, then

$$.99(20) \text{ cm} \leq L \leq 1.01(20) \text{ cm} \Rightarrow 19.8 \text{ cm } \leq L \leq 20.2 \text{ cm}.$$

- The margin of error of the ratio of two measured lengths magnifies the margin of error for the two lengths.

# Finding range of values for a ratio :

Suppose we know:

- The measured height is within 1% of the actual height:

$$.99h_m \leq h_a \leq 1.01h_m$$

- The measured width is within 1% of the actual width:

$$.99w_m \leq w_a \leq 1.01w_m.$$

Then the actual ratio of these lengths also falls in a range:

$$\frac{\text{smallest } h_m}{\text{largest } w_m} \leq \frac{h_a}{w_a} \leq \frac{\text{largest } h_m}{\text{smallest } w_m}$$

$$\frac{.99h_m}{1.01w_m} \leq \frac{h_a}{w_a} \leq \frac{1.01h_m}{.99w_m}$$

$$.98\left(\frac{h_m}{w_m}\right) \leq \frac{h_a}{w_a} \leq 1.01\left(\frac{h_m}{w_m}\right)$$

**Conclusion:** if margin of error for both measurements is $\pm 1\%$, then the margin of error for the ratio will be (more or less) $\pm 2\%$.