

## Lab 0 – The Length of a Human Hand

**Objective** – To measure and compare the lengths of our right and left hand, and to find the distribution of hand sizes in our class.

**Theory** – The size of a person's hand is determined by genetics, and correlates to height, shoe size, as well as other observables. Over any given population, there will be a range of hand sizes. Also, the left and right hands are not necessarily the same size.

Here, we define length of a hand to be the distance from the base of the palm to the tip of the middle finger (See Fig. 1). (*in a real lab report, there would be relevant equations to discuss rather than a definition of hand length. F=ma, for example.*)

### Data Set and Calculations

Right Hand Length (RH):  $17.9 \pm 0.3$  cm  
Left Hand Length (LH):  $18.1 \pm 0.3$  cm

$$\Delta L = |RH - LH| = 0.2\text{cm}$$

The absolute error in the measured lengths (0.3cm) is estimated from the ability to find the exact base of palm and tip of finger on a meter stick with a precision of millimeters. Clearly this is the greatest source of uncertainty in this lab.

$$\begin{aligned}\delta(\Delta L) &= \sqrt{(\delta RH)^2 + (\delta LH)^2} \\ &= \sqrt{(0.3\text{cm})^2 + (0.3\text{cm})^2} \\ &= .4\text{ cm}\end{aligned}$$

**Discussion** – The difference in my hand length is  $0.2 \pm 0.4$  cm, which is consistent with the difference being zero. These hands could be the same length, but we cannot tell as the precision of our measurement is limited by the ruler. If we used a magnifying glass to read the ruler, or perhaps first traced out our hand onto a piece of paper, we could potentially reduce our absolute error to below 0.2cm.

As a class, we charted the length of our left hands in a histogram. Hand length was seen to vary greatly over a wide range (16-21cm). Interestingly, there was just one average, between 17-18 cm. I'd expected to see two clearly defined peaks – one average for men, another for women. The bin size of the histogram was likely too small to see such detail.

The exact way in which to measure a hand could have been more clearly defined – there is a lot of deviation in where you might determine the top and bottom of your hand. Or perhaps even if these issues were resolved, we might still see similar results, which would indicate that hand length is not correlated to gender as previously thought.

**Conclusion** – While I measured a difference in the lengths of my left and right hands, the difference is within the uncertainty of the experiment. To answer the experimental question: my hands are the same size. More precise measurements are needed to conclusively determine if there is difference.

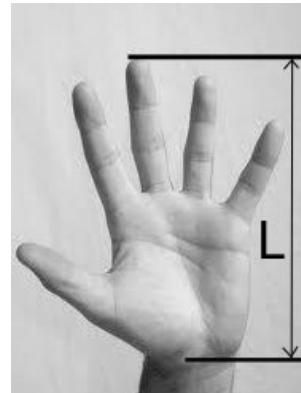


Figure 1: The standard hand length.