The Percent Difference Calculation

The percent difference between two measurements is simply the difference, in percent, between them. If both measurements are equally likely to be correct, or have similarly sized error bars, we say that for values m_1 and m_2, the percent difference is

$$\text{P. D.} = \frac{|m_1 - m_2|}{\frac{1}{2} \times (m_1 + m_2)} \times 100.$$

The || symbols indicate that you take the absolute value of whatever lies between them ($|-6| = 6$). If the first measurement is well-established and has small error bars, while the second one is an attempt to duplicate this value or has significantly larger associated error bars, the form of the percent difference simplifies to

$$\text{P. D.} = \frac{|m_1 - m_2|}{m_1} \times 100.$$

We determine the difference between the two measurements ($m_1 - m_2$), and then divide it by m_1 to express it as a fraction of the expected value. We then multiply by 100 to turn our fraction into a percent.

Example

The radius of the Earth is $6,371 \pm 8$ kilometers. Imagine that you conduct a simple experiment and measure it yourself, finding a value of $5,800 \pm 600$ kilometers.

What is the percentage difference between the two measurements?

In this case, our first measurement is well-established and has small error bars. The percent difference is thus

$$\text{P. D.} = \frac{|m_1 - m_2|}{m_1} \times 100.$$

$$\text{P. D.} = \frac{|6,371 - 5,800|}{6,371} \times 100 = \frac{571}{6,371} \times 100 = 0.08962 \times 100 = 8.9\%.$$

Did we reproduce the accepted result? We measured a value of $5,800 \pm 600$ kilometers, or $5,800 \pm 10.3\%$. Our measurement was good to 10% and it differed from the accepted value by less than 10%. This suggests that our experiment was successful.