General Notes

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October 27, 2025

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SIGNIFICANT FIGURES

Keep in mind that for the following examples, it applies to an unlimited number of variables, not just three (x, y, z).

General Formula for Propogating Uncertainties

Given $q = f(x, y, \ldots, z)$

$$\delta q = \sqrt{\left(\frac{\partial f}{\partial x}\delta x\right)^2 + \left(\frac{\partial f}{\partial y}\delta y\right)^2 + \cdots + \left(\frac{\partial f}{\partial z}\delta z\right)^2}$$

Addition or Subtraction

$$f(x, y, z) = x + y + z \rightarrow \delta f(x, y, z) = \sqrt{\delta x^2 + \delta y^2 + \delta z^2}$$

Multiplication or Division

$$f(x, y, z) = \frac{xy}{z} \rightarrow \frac{\delta f}{|f|} = \sqrt{\left(\frac{\delta x}{|x|}\right)^2 + \left(\frac{\delta y}{|y|}\right)^2 + \left(\frac{\delta z}{|z|}\right)^2}$$

Multiplication or division by a constant, c

$$f(x) = cx \rightarrow \delta f = c\delta x$$

Exponents

$$f(x) = x^n \rightarrow \frac{\delta f}{|f|} = |n|\frac{\delta x}{|x|}$$

Special Functions

1. $f(x) = \sin(x) \rightarrow \delta f = \cos(x)\delta x$
2. $f(x) = e^x \rightarrow \delta f = e^x \delta x$
3. $f(x) = \ln(cx) \rightarrow \delta f = \frac{1}{|x|}\delta x$
4. $f(x) = \log_{10}(x) = \frac{\ln(x)}{\ln(10)} = 0.43\ln(x) \rightarrow \delta f = \frac{0.43}{|x|}\delta x$

Average

$$f(x) = \tilde{x} \rightarrow \delta f = \sigma = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(x_i - \tilde{x})^2}$$

Where σ is the standard deviation. Standard error of mean (if $N \geq 5$)

$$SE = \frac{\sigma}{\sqrt{N}}$$