Statistics

The science of *interpreting* numerical data.

Attempts to answer key question: How certain are we that a particular measurement has yielded the true value for the quantity of interest?

**Answer:** In science, *never* 100% certain!

Scientists quantify the degree of uncertainty by using *error bars*:

*e.g.:* “We measured the distance to this supernova to be 50 ± 10 Mpc.”

In astronomy, reported uncertainties are typically “1 sigma” (1σ) in size. In the language of statistics, this means (for this example): “We have confidence that the true distance to the supernova is between 40 and 60 Mpc at the 68% level.” Put another way: “We are 68% certain that the true distance to the supernova is between 40 and 60 Mpc.”

Doubling the size of the reported error bar (i.e., to 2 sigma) increases the confidence to 95% that the true value is within the reported limits (i.e., now 50 ± 20 Mpc).

Tripling the size of the reported error bar (i.e., to 3 sigma) increases the confidence to 99.7% that the true value is within the reported limits (i.e., now 50 ± 30 Mpc).

i.e. A “3σ” result is one that you believe has only a 0.3% chance of being wrong.