

PRECISION and **ACCURACY** are two means by which we can assess correctness and diagnose error.

PRECISION

Precision is defined by how closely measurements are grouped in a given data set. Note that this is a relative measure: while the target on the right shows the most precise set of results out of the three targets, we can envision an even more precise set clustered entirely over the star (as well as less precise results than are shown on the left).



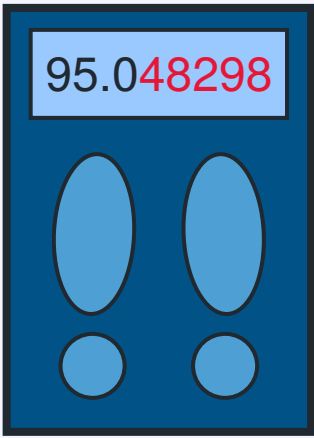
Less Precise



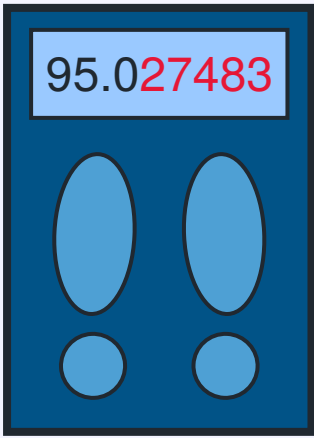
More Precise

RANDOM ERROR

Precision describes random error, which often means that we have reached the limits of a tool's measurement capability. Bathroom scales normally cut off at the first decimal place, because the random error observed beyond that point makes attempts at additional precision useless. A better sensor would be needed to get a more precise measurement.



Weighing 1



Weighing 2

ACCURACY

Accuracy, on the other hand, is ordinarily defined by how well a set of results is centered on the true value of what is being measured (here, the green star), regardless of how tightly the cluster of results is grouped. Note that this is also a relative measure. The targets display increasingly accurate results from left to right, but the center of the cluster on the right may still be off from the center of the target by a tiny distance. What we *can* say is that the cluster of results on the right-side target is more accurate than what we see on the other two targets.



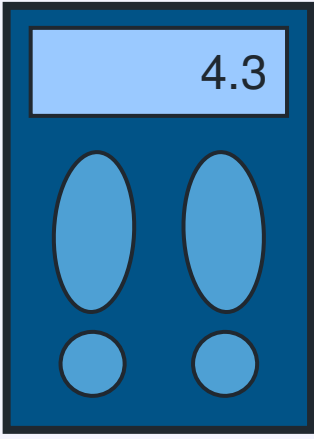
Less Accurate



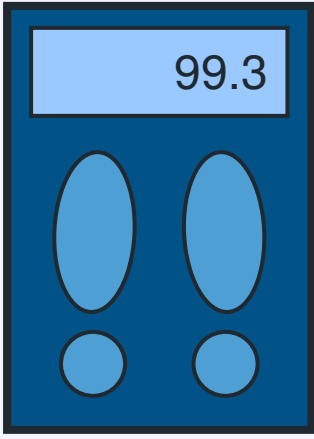
More Accurate

SYSTEMATIC ERROR

Accuracy describes systematic error, which often means that the measurement tool is not properly calibrated or is otherwise malfunctioning. This leads to a bias in results away from the true value. If a scale reads a nonzero number before stepping on it, expect your weight to be off by roughly the same amount. The scale would need to be recalibrated, or the sensor inside the scale may be faulty and need to be fixed or replaced.



Before Weighing



Expecting 95.0

ISO 5725-1

The International Organization of Standards proposes another definition for accuracy in ISO 5725-1, which combines our definitions for precision and accuracy into one metric:

"Closeness of agreement between a *test result*...and the true value" (ISO 5725-1, 3.5)