# Statistical methods and when to use them

## Systematic uncertainties

Experimental uncertainties that cannot be measured by repetition of the measurements are known as *systematic uncertainties*. These are either due an imperfection of the measurement device (say, a slow stopwatch) or an inability to measure more precisely. The first case can be corrected by standardizing or calibrating the instrument to known behaviors but most of the time will be smaller than the precision of the instrument.

For the latter case, it depends on the style of the instrument. If it is an *analog* device, then the uncertainty due to its precision is given as half the increment of the markings. If the device is *digital*, then the uncertainty is the smallest digit since we cannot see indications between the final digit.

A measurement is then reported as [units].

## Mean and associated uncertainty (standard deviation of the mean)

When taking many points *of the same thing*, we can find the *random* uncertainty associated to conducting the experiment. We can take the mean and associated uncertainty to summarize all the trials conducted. We expect that the uncertainty decreases with an increased number of repeated measurements. You would then report the measurement as [units].

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