

EXPERIMENTAL ERRORS

PRECISION

CHEM 251 SDSU

PRECISION

- The **precision** of a set of measurements is how the data is spread around the central tendency; expressed as the range, standard deviation, or variance.
- Precision is further differentiated between **repeatability** and **reproducibility**.
- **Repeatability** is the precision when a single analyst completes a set of measurements in a single session, using the same solutions, equipment, and instruments.
- **Reproducibility** is the precision when the measurements are completed in a separate session, by a different analyst, with different solutions/equipment/instruments, or any combination of these.
- The repeatability is inherently better (less variation) than the reproducibility, as the reproducibility includes additional sources of variability.

INDETERMINATE ERROR

- The factors that influence the precision of a set of measurements are **indeterminate**. They are random variations both in terms of their magnitudes and their sign.
- The random nature of the indeterminate errors provides some benefit; if sufficient measurements are made, the positive and negative fluctuations cancel each other out, and the mean is left unaffected.

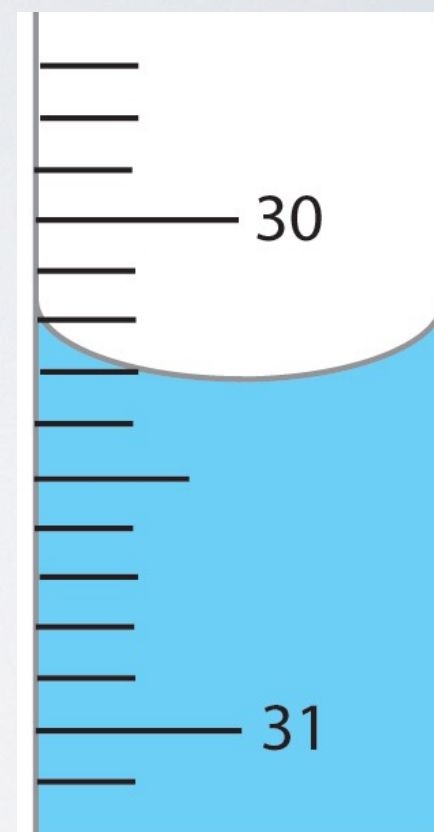
Trial	Value
1	2.785
2	2.759
3	2.756
4	2.762
5	2.777
6	2.751
7	2.773
Mean	2.766
Sted. Dev.	0.012

Yellow cells have values with negative variations from the mean.

SOURCES OF INDETERMINATE ERROR

- Indeterminate errors can be assigned to many components of any analysis including sample collection, sample manipulation, and measurements.
- In sampling, the smaller fraction of the system that is sampled, the greater the chance that small-scale inhomogeneities can impact the repeatability.
- During manipulation of random variations, such as tiny differences in the volume delivered from a pipette, result in indeterminate errors.
- Indeterminate measurement errors come in the form of estimates that must be made about values, such as estimating the volume in a buret when the volume is between markings.

What is the volume?



EVALUATING INDETERMINATE ERROR

- Instrumental indeterminate errors can be quantified relatively easily, by either measuring the standard deviations for replicate measurements or observing the signal fluctuations with no analyte present and find their standard deviation.
- The magnitude of other sources of indeterminate error (e.g. sample treatments) are more difficult to estimate.
- Isolating individual steps of a process (e.g. mass measurements) and performing replicate measurements with those instruments can provide some insight to their contribution to the overall indeterminate error.

Background noise for an instrument

