

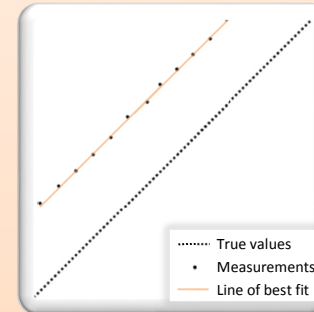
Experimental Error

Errors occur with any measurement, no matter how careful you are.

Carelessness and mistakes are **not** experimental errors.

The **accuracy** of a measurement is how close it is to **the true** value.

Systematic errors are present when values **differ consistently** from the true value.



Inaccurate but precise

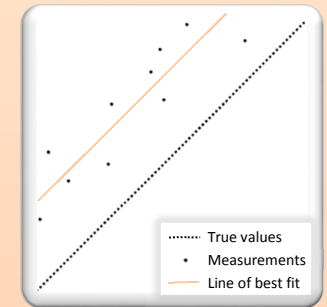
Occurrence and effects of errors need to be **minimised** so that we can confidently draw conclusions.

The **calibration** of an instrument is how close its values **match the true** values.

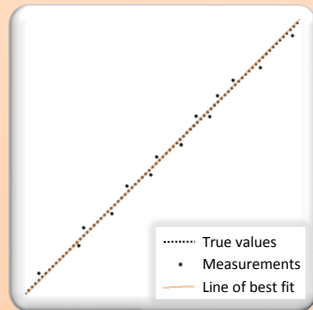
Better **calibration** of equipment will allow for more **accurate** measurements.

Measurements will be more **accurate** if there is less **systematic error**.

Systematic errors lead to a **shift** in the data.



Inaccurate and imprecise



Accurate and precise

Better **resolution** of equipment will allow for more **precise** measurements.

Measurements will be more **precise** if there is less **random error**.

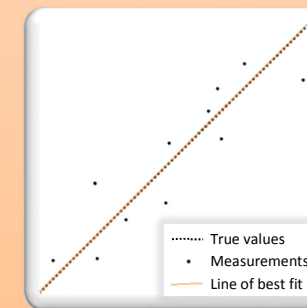
Random errors lead to **scatter** in the data.

The **resolution** of an instrument is the **smallest detail** it can reliably measure.

We usually don't know what the true value is, but it's important to decide how close we might be!

The **precision** of a measurement is how close it would be if it was **measured again**.

Random errors are present when values **differ inconsistently** from the true value.



Accurate but imprecise

The **effect of random error** can be **reduced** by taking many measurements and using an average.

Systematic error can be **detected** by repeating the measurements with different equipment.