

Accuracy and Precision

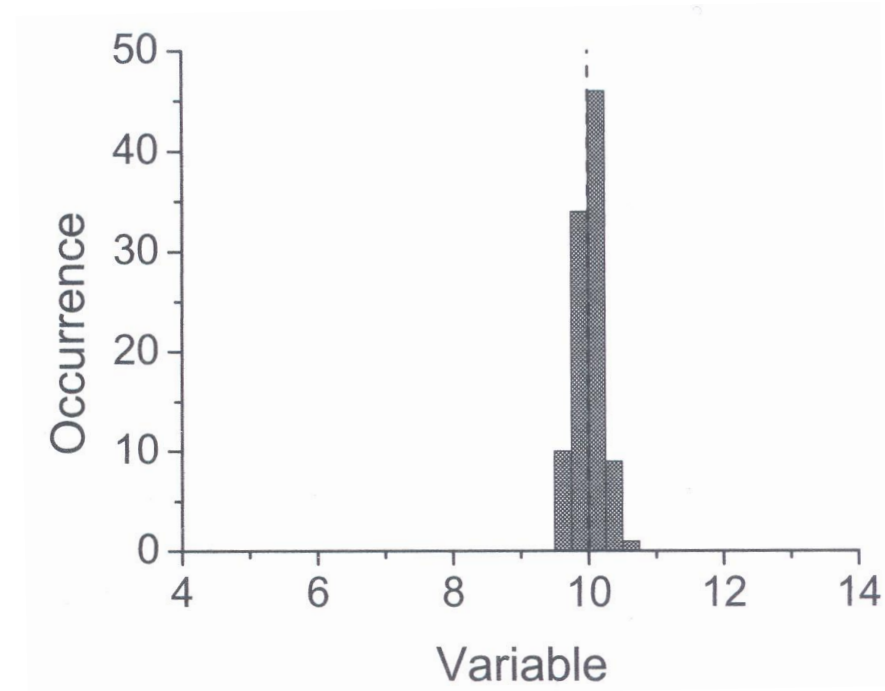
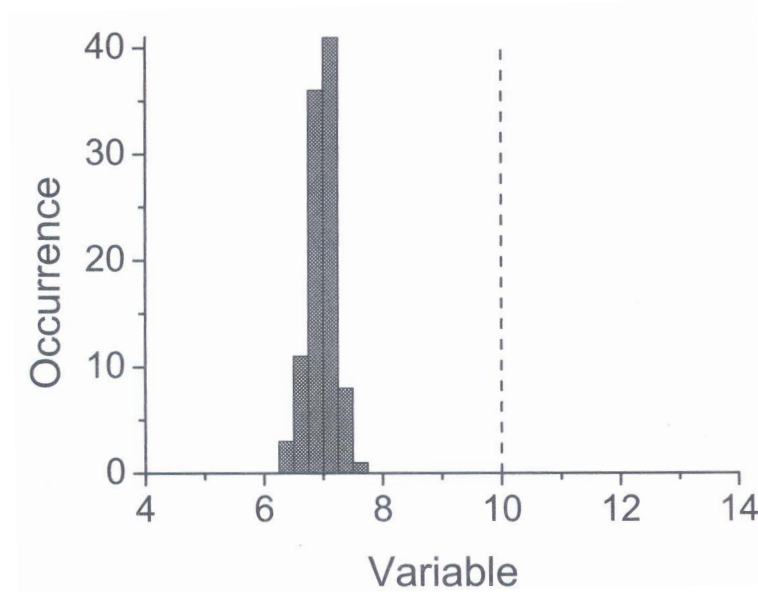
Rafael Mottl

Thomas Uehlinger

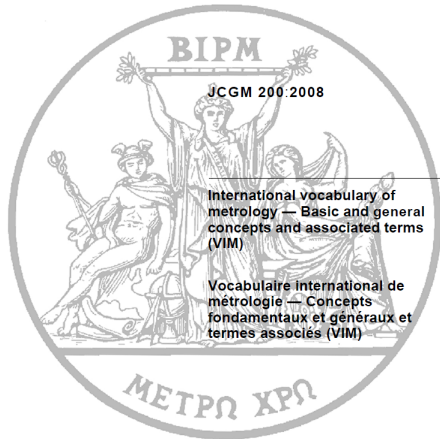
Measuring the voltage of a battery with two voltmeters

- Which one is more accurate? Why?
- Which one is more precise? Why?

Accuracy



Measurements and their uncertainties (Hughes&Hase)



2.13 (3.5)

measurement accuracy

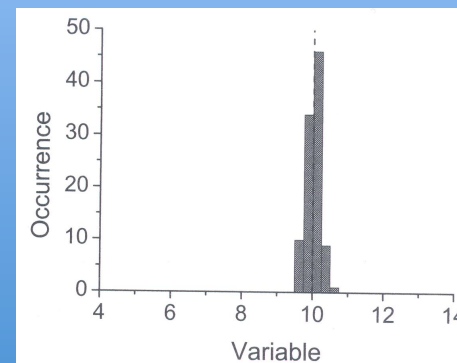
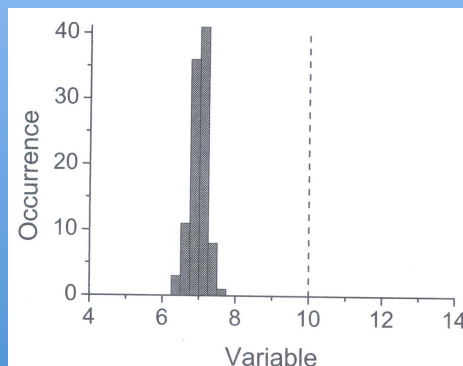
accuracy of measurement

accuracy

closeness of agreement between a measured quantity value and a true quantity value of a measurand

Ultimate reference: Bureau International des Poids et Mesures - International vocabulary of metrology — Basic and general concepts and associated terms (VIM)

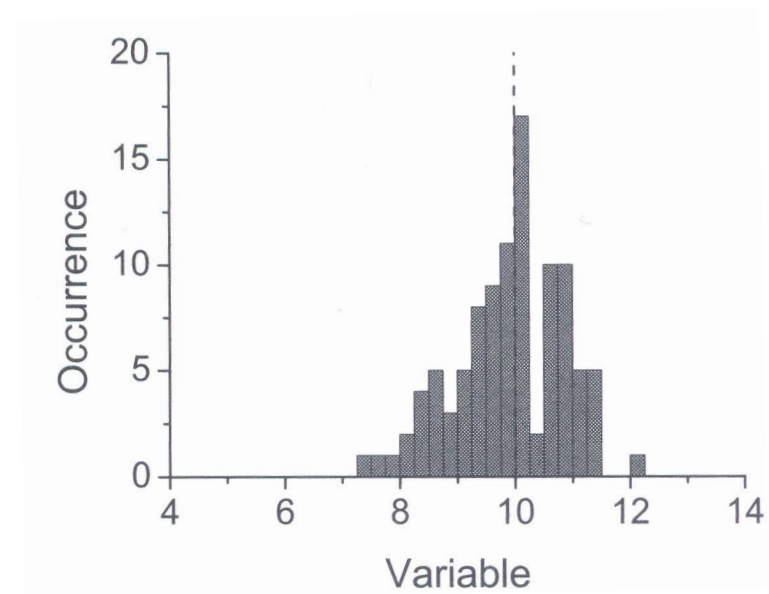
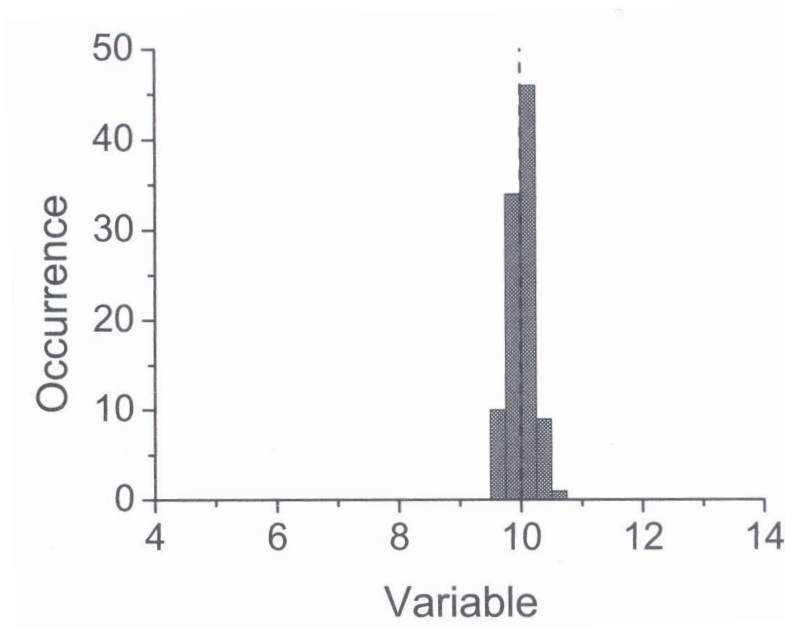
An **accurate** measurement is one in which the exp. results are in agreement with the ‘accepted’ value (comparison to a known value!).



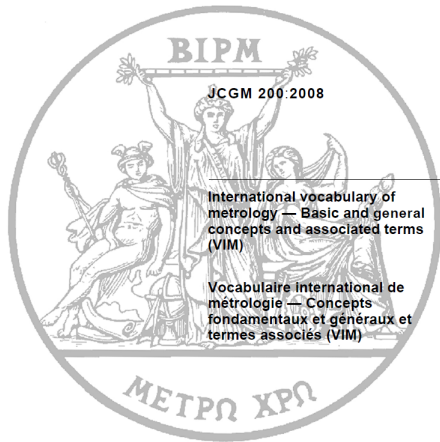
How to determine the accuracy of a measurement device

- No fixed recipe: only possible by comparing to a trusted value of the measured variable
- Calibration of the measurement device...

Precision



Measurements and their uncertainties (Hughes&Hase)



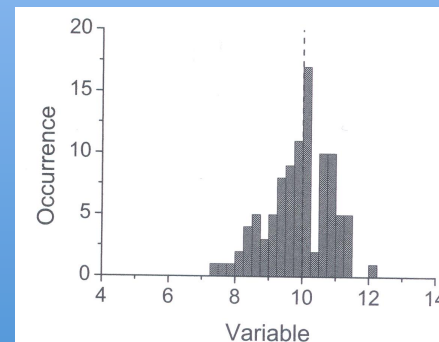
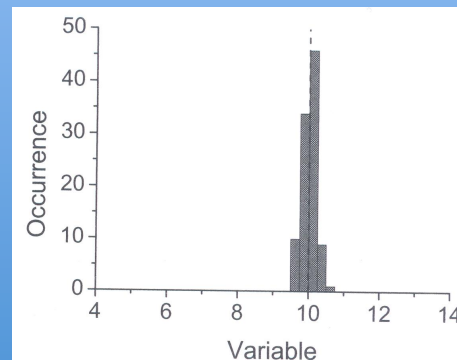
2.15

measurement precision

precision

closeness of agreement between **indications** or **measured quantity values** obtained by replicate **measurements** on the same or similar objects under specified conditions

A **precise** measurement is one where the spread of results is ‘small’, either relative to the average result or in absolute magnitude.



How to determine the precision of a measurement device

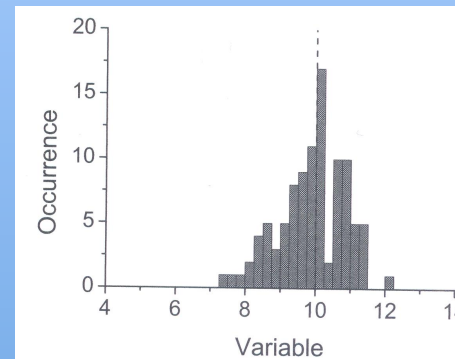
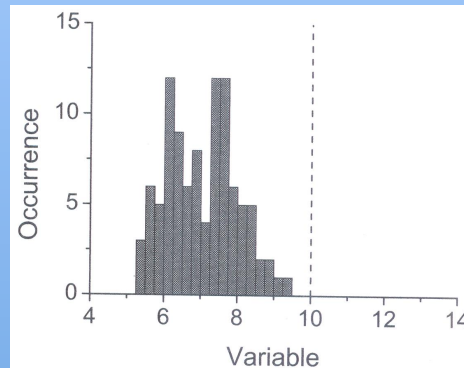
- Analog device (eg. ruler)
- Digital device (eg. voltmeter)
- Device specifications...

Summary

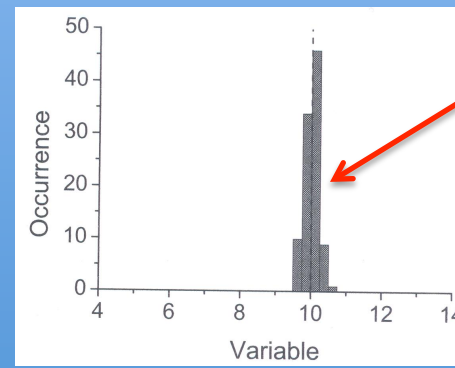
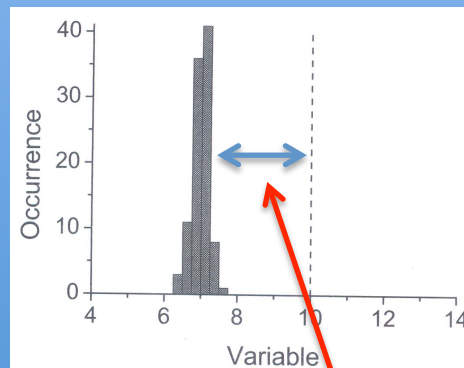
not accurate

accurate

not
precise



precise



width!

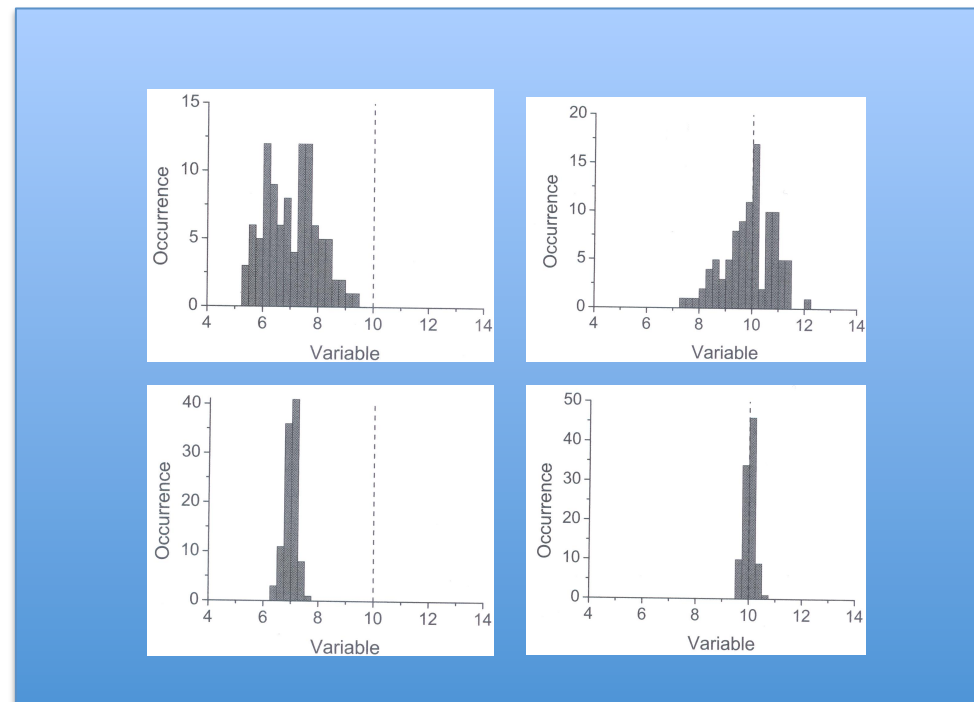
offset w.r.t. accepted value!

Measuring the voltage of a battery with two voltmeters

- Which one is more accurate? Why?
- Which one is more precise? Why?

Connection to measurement errors

- Good precision means that the statistical errors are small
- Good accuracy means that the systematic errors are small



Indicating accuracy and/or precision

- Usually implicitly by means of significant figures: the uncertainty is half the value of the least significant stated digit