Appendix A

Statistical Treatment of Random Error

When it is practicable to make many readings of a measurement, the scatter of the readings can be used to indicate the uncertainty.

For example, the width d of a piece of wood could be measured at many different points and a quantitative estimate of the scatter of the readings can be obtained by calculating the difference between each reading and the average value. The average of these values gives the average deviation.

	Width (cm)		**Devitation from Mean (cm)**
	12.32		0.03
	12.35		0.00
	12.34		0.01
	12.38		0.03
	12.32		0.03
	12.36		0.01
	12.34		0.03
	12.38		0.03
Sum	98.79	Sum of Absolute deviation from mean	0.17

Mean $\overline{d} = 98.97/8 = 12.35$. Avergae Deviation $\sigma = 0.17/8 = 0.02$.

You would report the measured width as $(\overline{d} \pm \sigma) = (12.35 \pm 0.02)cm$.

In general, if a quantity x is measured N times, then the mean of x is

$$\overline{x} = \frac{\sum_i x_i}{N}$$

and the average deviation as

$$\sigma = \frac{\sum_i |x_i - \overline{x}|}{N}$$

There is a lot more to statistics than this, starting from the design and sampling techniques of experiments through the calculation of results, but this is sufficient for our elementary purposes.