§2.2.2 Confidence level and confidence intervals

How can we judge the reliability of the experimental values?

The reliability of data is related to the presence of random error and the probability.

For a set of the infinite data, its error can be expressed by normal distribution curve (Gaussian distribution).

The curve is showed as follows:

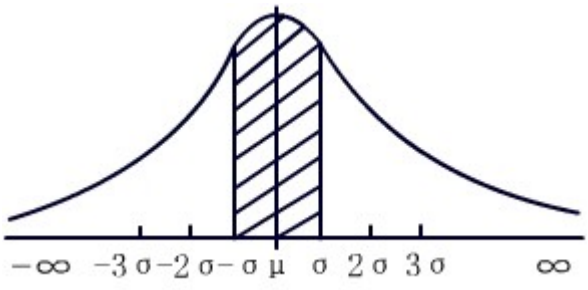
$(x - \mu)$ is abscissa, and the frequency of the error y is Y-axis:

The curve is determined by σ. The less the σ is, the higher and narrower the curve is, and the precision of the data is

The value of σ is width of the inflexion of the curve to the symmetry axis, and the height of the peak is 1/[σ(2π)1/2].

The area between the normal distribution curve and the abscissa represents the probability of the errors (which can be obtained by the integral of the Gaussian equation)

area	probability
$-\infty \sim +\infty$	100%
$m \pm \sigma$	68.3%
$m \pm 2\sigma$	99.5%
$m \pm 3\sigma$	99.7%



The probability of the random error for a set of data will be 99.7% between $\mu \pm 3\sigma$.

Confidence level is the reliability of the person's judgment. The value of the reliability of a set of results is equal to that of the probability.

Confidence level is the probability of the occurrence of the true value between a certain range as the experimental value is the center.

Confidence interval is the range of the true value under certain confidence level as the experimental value is the center.

The confidence interval is given by $$\mu = \overline{X} \pm t \cdot \frac{s}{\sqrt{n}}$$

s--deviation for finite measurement times

n--measurement times

Measurement times *n*	Confidence level				
	50%	90%	95%	99%	99.5%
2	1.000	6.314	12.706	63.657	127.32
3	0.816	2.920	4.303	9.925	14.089
4	0.765	2.353	3.182	5.841	7.453
5	0.741	2.132	2.776	4.604	5.598

6	0.727	2.015	2.571	4.032	4.773

Discussion:

1. When the confidence level is constant:

n increases, t decreases, confidence interval is narrowed. 2. When n is constant: confidence level increases , t increases , confidence interval is broaden.