Translated excerpt of the „**Clausthaler Kurs**“ held by **Prof. Leschonski** 1982
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Chapter 5.1.2.1 random errors

If a series of samples is taken from a perfectly mixed basic population, the compounding of each, e.g. with respect to particle size distribution, will not be constant but will be subject to a statistical fluctuation. This is also valid for ideal accidentally mixtures. The dimension of the random error is due to sample size and the width of particle size distribution.

In case the number of particles in a sample is small compared to the number of particles in the basic population, the probability to detect a special property among the measured particles can be approximated by a binominal distribution. In case the sample amount is big enough the binominal distribution may be replaced by the Gaussian distribution. If a probability ***P*** is predefined for the fluctuation of the measured value around the expected value ***Q*** including its absolute error ***f***, the Students-t-test ***t*** for a sample amount ***n*** is:

$$n = \frac{t^2}{f^2} Q\,(1-Q) = \frac{t^2}{\left(\frac{f}{Q}\right)^2}\left(\frac{1}{Q}-1\right)$$

Or resolved to the relative error ***f/Q*** = f_{rel}

$$\frac{f}{Q} = \frac{t}{\sqrt{n}}\sqrt{\frac{1-Q}{Q}}$$

For a probability of ***P*** = 95% and ***n*** > 100 follows ***t*** ≈ 2 .
This enables to calculate the sample amount, in this case the number of particles ***n*** necessary for preset values of ***Q*** and f_{rel} = ***f/Q*** .

	f/Q =0,1%	*f/Q* = 1%	*f/Q* = 2%	*f/Q* = 5%	*f/Q* = 10%
Q = 0,2:	$n = 1{,}6\times10^7$	$n = 1{,}6\times10^5$	$n = 1{,}6\times10^4$	$n = 1{,}6\times10^3$	***n* = 1600**
Q = 0,5:	$n = 4\times10^6$	$n = 4\times10^4$	$n = 10^4$	***n* = 1600**	***n* = 400**
Q = 0,8:	$n = 10^6$	$n = 10^4$	***n* = 2500**	***n* = 400**	***n* = 100**

Sample amount ***n*** for ***P*** = 95%

It is obvious that for small relative errors a sample needs to consist of large particle numbers. This demand is commonly easily fulfilled in fine grained samples but special consideration is necessary with indirect and direct counting technologies. …..