



Standard Practice for Calculating Sample Size to Estimate, With a Specified Tolerable Error, the Average for a Characteristic of a Lot or Process¹

This standard is issued under the fixed designation E 122; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers simple methods for calculating how many units to include in a random sample in order to estimate with a prescribed precision, a measure of quality for all the units of a lot of material, or produced by a process. This practice will clearly indicate the sample size required to estimate the average value of some property or the fraction of nonconforming items produced by a production process during the time interval covered by the random sample. If the process is not in a state of statistical control, the result will not have predictive value for immediate (future) production. The practice treats the common situation where the sampling units can be considered to exhibit a single (overall) source of variability; it does not treat multi-level sources of variability.

2. Referenced Documents

2.1 ASTM Standards:

E 456 Definitions of Terms Relating to Statistical Methods²

3. Terminology

3.1 *Definitions*—Unless otherwise noted, all statistical terms are defined in Definitions E 456.

3.2 Symbols:

- E = maximum tolerable error for the sample average, that is, the maximum acceptable difference between true average and the sample average.
 e = E/μ , maximum allowable sampling error expressed as a fraction of μ .
 k = the total number of samples available from the same or similar lots.
 μ = lot or process mean or expected value of X , the result of measuring all the units in the lot or process.
 μ_0 = an advance estimate of μ .

- N = size of the lot.
 n = size of the sample taken from a lot or process.
 n_j = size of sample j .
 n_L = size of the sample from a finite lot (7.4).
 p' = fraction of a lot or process whose units have the nonconforming characteristic under investigation.
 p_0 = an advance estimate of p' .
 p = fraction nonconforming in the sample.
 R = range of a set of sampling values. The largest minus the smallest observation.
 R_j = range of sample j .
 $\bar{R}$ = $\sum_{j=1}^k R_j/k$, average of the range of k samples, all of the same size (8.2.2).
 σ = lot or process standard deviation of X , the result of measuring all of the units of a finite lot or process.
 σ_0 = an advance estimate of σ .
 s = $[\sum_{i=1}^n (X_i - \bar{X})^2/(n-1)]^{1/2}$, an estimate of the standard deviation σ from n observation, X_i , $i = 1$ to n .
 $\bar{s}$ = $\sum_{j=1}^k s_j/k$, average s from k samples all of the same size (8.2.1).
 s_p = pooled (weighted average) s from k samples, not all of the same size (8.2).
 s_j = standard deviation of sample j .
 t = a factor (the 99.865th percentile of the Student's distribution) corresponding to the degrees of freedom f_0 of an advance estimate σ_0 (5.1).
 V = σ/μ , the coefficient of variation of the lot or process.
 V_0 = an advance estimate of V (8.3.1).
 v = $s/\bar{X}$, the coefficient of variation estimated from the sample.
 v_j = coefficient of variation from sample j .
 $\bar{X}$ = numerical value of the characteristic of an individual unit being measured.
 $\bar{X}$ = $\sum_{i=1}^n X_i/n_i$ average of n observations, X_i , $i = 1$ to n .

4. Significance and Use

4.1 This practice is intended for use in determining the sample size required to estimate, with prescribed precision, a measure of quality of a lot or process. The practice applies

¹ This practice is under the jurisdiction of ASTM Committee E11 on Statistical Methods and is the direct responsibility of Subcommittee E11.30 on Data Analysis.

Current edition approved Oct. 10, 2000. Published January 2001. Originally published as E122–89. Last previous edition E122–99.

² *Annual Book of ASTM Standards*, Vol 14.02.