

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

This standard is issued under the fixed designation E122; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

^{ε1} NOTE—Editorial corrections were made to 8.4.1.2 in November 2011.

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 specified 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*:²

E456 Terminology Relating to Quality and Statistics

3. Terminology

3.1 *Definitions*—Unless otherwise noted, all statistical terms are defined in Terminology E456.

3.2 *Symbols*—Symbols used in all equations are defined as follows:

E = the maximum acceptable difference between the true average and the sample average.

e = E/μ , maximum acceptable difference expressed as a fraction of μ .
 f = degrees of freedom for a standard deviation estimate (7.5).
 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 = $\left[\sum_{i=1}^n (X_i - \bar{X})^2 / (n-1)^{1/2} \right]$, 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 .
 V_o = an advance estimate of V , equal to δ_o/μ_o .
 v = $s/\bar{X}$, the coefficient of variation estimated from the sample.
 v_p = pooled (weighted average) of v from k samples (8.3).

¹ This practice is under the jurisdiction of ASTM Committee E11 on Quality and Statistics and is the direct responsibility of Subcommittee E11.10 on Sampling / Statistics.

Current edition approved Aug. 1, 2009. Published September 2009. Originally approved in 1958. Last previous edition approved in 2007 as E122–07. DOI: 10.1520/E0122-09E01.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.