

MSA (Measurement Systems Analysis) 4th Edition Errata Sheet

Analysis of Results – Numerical

- 5) Compute the average bias of the n readings.

$$avg\ bias = \frac{\sum_{i=1}^n bias_i}{n}$$

- 6) Compute the repeatability standard deviation (see also Gage Study, Range Method, below):

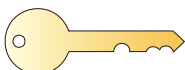
$$\sigma_{repeatability} = \sigma_r = \frac{\sum_{i=1}^n (X_i - \bar{X})^2}{n-1}$$

If a *GRR* study is available (and valid), the repeatability standard deviation calculation should be based on the study results.

- 7) Determine if the repeatability is acceptable by calculating the

$$\%EV = 100 [EV/TV] = 100 [\sigma_{repeatability}/TV]$$

Where the total variation (*TV*) is based on the expected process variation (preferred) or the specification range divided by 6 (see also *GRR* study below).



If the *%EV* is large (see Chapter II, section D), then the measurement system variation may be unacceptable. Since the bias analysis assumes that the repeatability is acceptable, continuing the analysis with a measurement system with a large *%EV* will lead to misleading and confusing results.

- 8) Determine the t statistic for the bias:³⁴

$$\sigma_b = \sigma_r / \sqrt{n}$$

$$t\ statistic = t_{bias} = \frac{average\ bias}{\sigma_b}$$

- 9) Bias is acceptable (statistically zero) at the α level if

- the p-value associated with t_{bias} is **more** than α ; or

³⁴ The uncertainty for bias is given by σ_b .