Equations for Fitting a Linear Calibration Curve.

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$$y = mx + b$$

$$\bar{x} = \frac{1}{N}\sum x_i \;;\; \bar{y} = \frac{1}{N}\sum y_i$$

$$S_{xx} = \sum (x_i - \bar{x})^2 = \sum x_i^{\,2} - \frac{(\sum x_i)^2}{N}$$

$$S_{yy} = \sum (y_i - \bar{y})^2 = \sum y_i^{\,2} - \frac{(\sum y_i)^2}{N}$$

$$S_{xy} = \sum (x_i - \bar{x})(y_i - \bar{y}) = \sum x_i y_i - \frac{\sum x_i \sum y_i}{N}$$

All summations run from *i* = 1 to N.

Slope: m

$$m = \frac{S_{xy}}{S_{xx}}$$

Intercept: b

$$b = \bar{y} - m\bar{x}$$

Regression Standard Deviation: s_r

$$s_r = \sqrt{\frac{S_{yy} - m^2 S_{xx}}{N - 2}}$$

Slope Standard Deviation: s_m

$$s_m = \sqrt{\frac{s_r^{\,2}}{S_{xx}}}$$

Intercept Standard Deviation: s_b

$$s_b = s_r \sqrt{\frac{\sum x_i^2}{N \sum x_i^2 - (\sum x_i)^2}}$$

Error Analyis Equations for a Linear Calibration Curve:

95% confidence level for the slope:

$$m \pm t_{N-2} s_m$$

95% confidence level for the intercept:

$$b \pm t_{N-2} s_b$$

where $t_{N\text{-}2}$ is the Student T-factor for N-2 degrees of freedom.

The standard deviation for results obtained from the calibration curve is s_c:

$$s_c = \frac{s_r}{m} \sqrt{\frac{1}{C} + \frac{1}{N} + \frac{(y_c - \bar{y})^2}{m^2 S_{xx}}}$$

This equation is used to calculate the standard deviation s_c for an average value x_c obtained from of a set of C replicate measurements of an unknown with a mean y_c:

$$x_c = \frac{y_c - b}{m}$$

when the calibration curve contains N points. As with the slope and the intercept, the 95% confidence level for this average is:

$$x_c \pm t_{N-2} s_c$$

where $t_{N\text{-}2}$ is the Student T-factor for N-2 degrees of freedom.