

Calibration Example:

Calibration With Standards

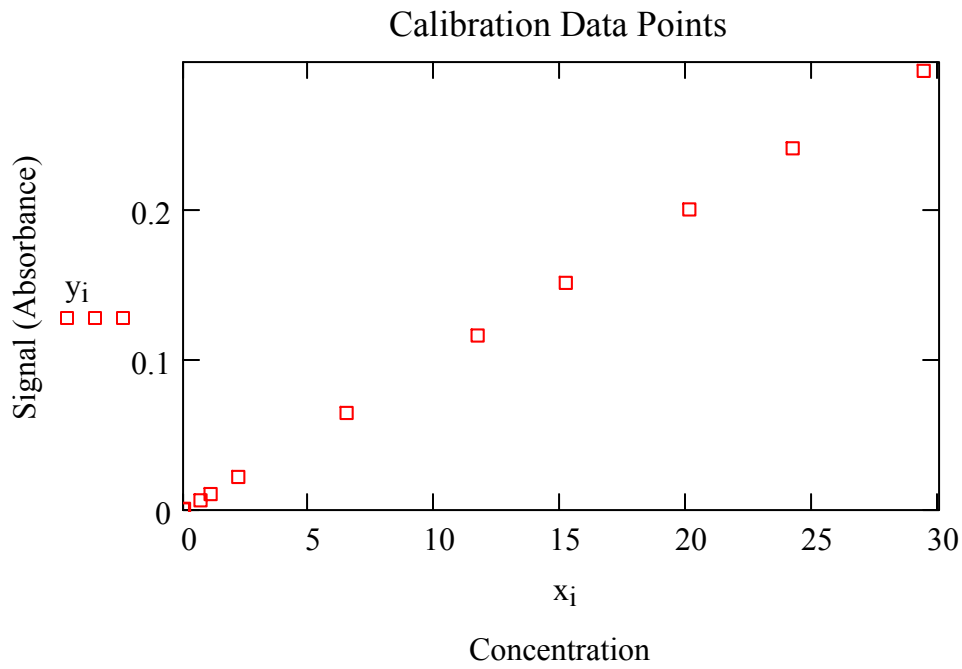
Signal from Standards:

$N := 11$ $i := 1, 2 \dots N$

$x_i :=$

$y_i :=$

0	$2.2152 \cdot 10^{-4}$
0.05	
0.7	$6.785 \cdot 10^{-4}$
1.1	0.00642
2.2	0.01057
6.5	0.02204
11.7	0.06488
15.2	0.11676
20.1	0.15202
24.2	0.20115
29.4	0.24206
	0.29400



Regression Analysis:

$$x_{\text{avg}} := \sum_i \frac{x_i}{N} \quad x_{\text{avg}} = 10.10455$$

$$y_{\text{avg}} := \sum_i \frac{y_i}{N} \quad y_{\text{avg}} = 0.10098$$

$$s_{xy} := \sum_i (x_i \cdot y_i) - \left[\frac{\left(\sum_i x_i \right) \cdot \left(\sum_i y_i \right)}{N} \right] \quad s_{xy} = 11.48360$$

$$s_{yy} := \sum_i (y_i)^2 - \left[\frac{\left(\sum_i y_i \right) \cdot \left(\sum_i y_i \right)}{N} \right] \quad s_{yy} = 0.11491$$

$$s_{xx} := \sum_i (x_i)^2 - \left[\frac{\left(\sum_i x_i \right) \cdot \left(\sum_i x_i \right)}{N} \right] \quad s_{xx} = 1.14761 \times 10^3$$

Calculation of line:

$$\text{Slope} \quad m := \frac{s_{xy}}{s_{xx}} \quad m = 0.01001$$

Intercept:

$$b := y_{\text{avg}} - (m \cdot x_{\text{avg}}) \quad b = -1.29441 \times 10^{-4}$$

$$y_{\text{calc}_i} := m \cdot (x_i) + b$$

Uncertainty Calculations:

In the regression

$$s_r := \sqrt{\frac{s_{yy} - (m^2 \cdot s_{xx})}{N - 2}} \quad s_r = 2.60153 \times 10^{-4}$$

In the slope

$$s_m := \sqrt{\frac{s_r^2}{s_{xx}}} \quad s_m = 7.67947 \times 10^{-6}$$

In the intercept

$$s_b := s_r \cdot \sqrt{\frac{\sum_i (x_i)^2}{N \cdot \sum_i (x_i)^2 - \left(\sum_i x_i\right)^2}} \quad s_b = 1.10336 \times 10^{-4}$$

Analysis of an Unknown:

$$j := 1 \dots 5 \quad M := 5$$

$$\text{signal}_j :=$$

0.04247
0.04251
0.04242
0.04262
0.04258

$$\text{signal}_{\text{avg}} := \sum_j \frac{\text{signal}_j}{M}$$

$$\text{signal}_{\text{avg}} = 0.04252$$

Calculation of unknown

$$\text{unknown} := \frac{\text{signal}_{\text{avg}} - b}{m} \qquad \text{unknown} = 4.26217$$

Calculation of uncertainty in unknown

$$s_{\text{unknown}} := \left[\left(\frac{s_r}{m} \right) \cdot \sqrt{\frac{1}{M} + \frac{1}{N} + \frac{(\text{signal}_{\text{avg}} - y_{\text{avg}})^2}{m^2 \cdot s_{xx}}} \right]$$

$$s_{\text{unknown}} = 0.01472$$

$$\text{RSD} := \frac{s_{\text{unknown}}}{\text{unknown}} \qquad \text{RSD} = 0.34541 \%$$

