Example: Multiple Standard Addtions

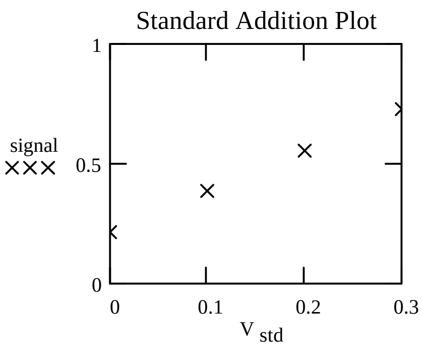
$g_{sample} := 3.12$ mass of sample, in g

$C_{std} := 300.0$ conc of added standard, in ppm

$V_a := 25$ volume of sample solutions, in mL

$V_{std} := (0\ \ 0.1\ \ 0.2\ \ 0.3)^T$ $\quad signal := (0.214\ \ 0.386\ \ 0.554\ \ 0.728)^T$ std addition data

Since all the sample solutions were diluted to the same volume, there is no need to correct the signal for dilution. Let's take a look at the standard addition plot (to verify linearity).



Looks linear; here are the LS estimates

$b_0 := \text{intercept}(V_{std}, signal)$ $\quad b_0 = 0.2140$

$b_1 := \text{slope}(V_{std}, signal)$ $\quad b_1 = 1.7100$

$S_{xx} := 3 \cdot \text{Var}(V_{std})$ $\quad xbar := \text{mean}(V_{std})$

Point Estimate of Analyte Concentration:

$Vprime := \dfrac{b_0}{b_1}$ $\quad Vprime = 0.1251$ $\quad C_a := C_{std} \cdot \dfrac{Vprime}{V_a}$ $\quad C_a = 1.5018$ concentration *in sample solution*, in ppm

$\mu g_{analyte} := C_a \cdot 100$ $\quad \mu g_{analyte} = 150.1754$ mass of analyte in chewing gum sample, in ug (assumes 1 ppm = 1 ug/mL)

$conc := \dfrac{\mu g_{analyte}}{g_{sample}}$ $\quad conc = 48.1332$ concentration of analyte *in original sample*, in ppm

Std Error of Point Estimate, from Residuals

$fit := b_1 \cdot V_{std} + b_0$ $\quad res := signal - fit$ $\quad s_{res} := \sqrt{\dfrac{1}{2} \cdot \sum \overrightarrow{res^2}}$ $\quad s_{res} = 1.7321 \cdot 10^{-3}$

$s(Vprime) := \dfrac{s_{res}}{b_1} \cdot \sqrt{1 + \dfrac{1}{4} + \dfrac{(Vprime + xbar)^2}{S_{xx}}}$ $\quad s(Vprime) = 1.6840 \cdot 10^{-3}$ std error of Vprime

$se_{Ca} := s(Vprime) \cdot \dfrac{C_{std}}{V_a}$ $\quad se_{Ca} = 0.0202$ std error of solution point estimate, in ppm

$se := se_{Ca} \cdot \dfrac{100}{g_{sample}}$ $\quad se = 0.6477$ standard error of analyte conc estimate in original sample, in ppm

$t := qt(.975, 2)$ $\quad t = 4.3027$ $\quad t \cdot se = 2.7868$ width of 95% CI

The concentration of aluminum in the chewing gum is 48.1 ± 2.8 ppm (95% CL)