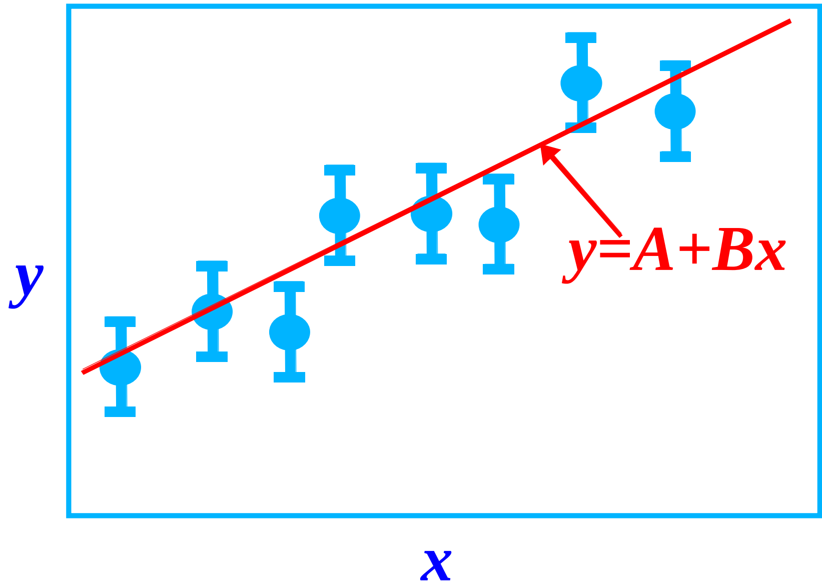
Least Squares Fitting



Best fit to a straight line as determined by the priciple of maximum likelihood.

$$\chi^2 = \sum_{i=1}^{n} \frac{(y_i - [A + Bx_i])^2}{\sigma_y^2}$$

$$\frac{\partial \chi^2}{\partial A} = \frac{\partial \chi^2}{\partial B} = 0$$

Assume all points have same errors. If there are errors in both *y* and *x*, project errors onto y using the slope.

$$\sigma_y^2 \leftarrow \sigma_y^2 + B^2 \sigma_x^2$$

Best fit parameters of line and their errors.

$$A = \frac{\Sigma x_i^2 \, \Sigma y_i - \Sigma x_i y_i \, \Sigma x_i}{\Delta}$$

$$\sigma_B^2 = \frac{n \sigma_y^2}{\Delta}$$

$$B = \frac{n \, \Sigma x_i y_i - \Sigma y_i \, \Sigma x_i}{\Delta}$$

$$\sigma_A^2 = \frac{\Sigma x_i^2 \sigma_y^2}{\Delta}$$

$$\Delta = n \, \Sigma x_i^2 - (\Sigma x_i)^2$$

Deduce error by how well line fits data.

$$\sigma_y^2 = \frac{1}{n-2} \sum_{i=1}^{n} (y_i - A - Bx_i)^2$$

The ChiSquare Test

$$\chi^2 = \sum_{i=1}^{n} \frac{(y_i - f(x_i))^2}{\sigma_y^2}$$

Some Examples of *f(x)*	Number of Parameters
• Weighted Average	1
• Straight Line Fit	2
• Parabola Fit	3
• Exponential	2
• Gaussian	3
• Line with known slope	1

$$\langle \chi^2 \rangle = \mathbf{n}_{\text{d.o.f.}}$$

$$\mathbf{n}_{\text{d.o.f.}} = \mathbf{n}_{\text{data}} - \mathbf{n}_{\text{parameters}}$$

Define $\tilde{\chi}^2 = \frac{\chi^2}{\mathbf{n}_{\text{d.o.f.}}}$ **and use this to test the goodness of fit of the data to the hypothesis of the fit function...**