Fitting 2-dimensional data with uncertainty in both variables: brief theory and program overview

Advanced Lab II
Colorado School of Mines
Department of Physics
Averages
Averages
Unweighted

$$\overline{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$

Weighted

$$\overline{x} = \frac{\sum_{i=1}^{n} w_i \cdot x_i}{\sum w_i}$$
Weighted Least Squares
Weighted Least Squares
Weighted Least Squares
Weighted Least Squares

Hypothesis: The best model for a set of data minimizes the weighted sum of squares of deviations between the data and the model.
Total Least Squares (Orthogonal Distance Regression)
Total Least Squares (Orthogonal Distance Regression)
Goodness of fit
Goodness of Fit

\[ \chi^2 \equiv \sum_{i=1}^{N} \left( \frac{y_i - f(x_i)}{\sigma_i} \right)^2 \]

Number of data points
Residual
Uncertainty in data

neutrons.ornl.gov/workshops/sns.../Laub_Ch_i-Square_Data_Fitting.pdf
If the difference between the model predicted value and the actual value is equal to the uncertainty in the value, we have a contribution of 1 to the $X^2$. 

$$
\chi^2 \equiv \sum_{i=1}^{N} \left( \frac{y_i - f(x_i)}{\sigma_i} \right)^2
$$

- Residual
- Uncertainty
Goodness of Fit

\[ \chi^2 \equiv \sum_{i=1}^{N} \left( \frac{y_i - f(x_i)}{\sigma_i} \right)^2 \]

Residual
Uncertainty

neutrons.ornl.gov/workshops/sns../Laub_Chi-Square_Data_Fitting.pdf
Goodness of Fit

Reduced $\chi^2 = \frac{\chi^2}{\text{DOF}}$

Degrees of freedom (points – parameters in model)

The reduced $X^2$ statistic accounts for the number of points we are fitting.