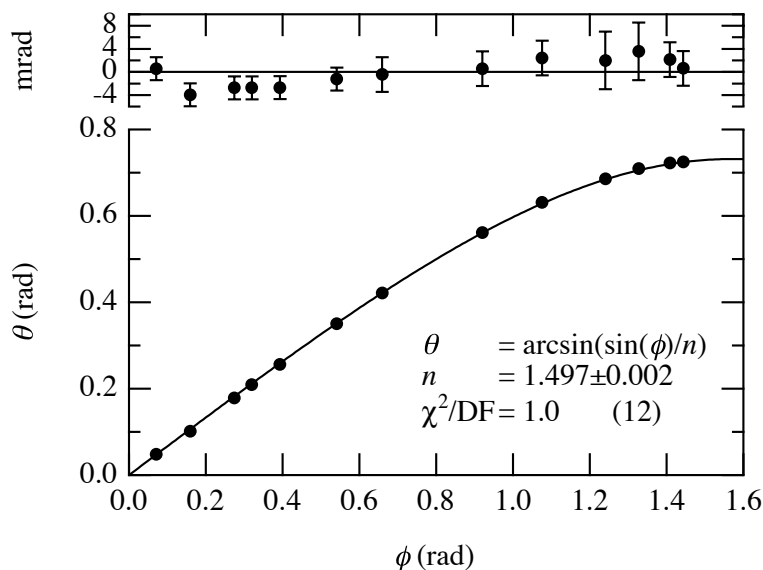


Quantity	Definition or Expression	Excel Function
<b>mean</b> — your best guess for the quantity you measured	$\bar{y} = \frac{1}{N} \sum_{n=1}^N y_n$	=AVERAGE()
<b>standard deviation</b> — a measure of the width of the distribution of your data points	$\sigma_y = \left[ \frac{1}{N-1} \sum_{n=1}^N (y_n - \bar{y})^2 \right]^{1/2}$	=STDEV()
<b>standard deviation of the mean (aka standard error)</b> — your best guess for the <i>random</i> uncertainty of the measurement	$\sigma_{\bar{y}} = \frac{\sigma_y}{\sqrt{N}}$	=STDEV()/SQRT(COUNT())
<b>weighted average</b> — this is how to combine several measurements of the same thing that have different uncertainties	$\bar{x} = \frac{\sum_i x_i/\sigma_i^2}{\sum_i 1/\sigma_i^2} \quad \sigma = \left[ \sum_i 1/\sigma_i^2 \right]^{-1/2}$	

Error Propagation		
general uncorrelated errors $z = z(x, y)$	$\delta z = \left[ \left( \frac{\partial z}{\partial x} \delta x \right)^2 + \left( \frac{\partial z}{\partial y} \delta y \right)^2 \right]^{1/2}$	
sum $z = x + y$	$\delta z = \sqrt{(\delta x)^2 + (\delta y)^2}$	
product $z = xy$	$\frac{\delta z}{z} = \left[ \left( \frac{\delta x}{x} \right)^2 + \left( \frac{\delta y}{y} \right)^2 \right]^{1/2}$	
generalized product $z = x^m y^n$	$\frac{\delta z}{z} = \sqrt{\left( m \frac{\delta x}{x} \right)^2 + \left( n \frac{\delta y}{y} \right)^2}$	

## Plotting and Analyzing Results



### Residuals

- Do they appear random?
- Are about 2/3 of the points within one error bar from the zero line?

### Fit Results

- Does the curve describe the data trends well?
- Are the parameter values reasonable?
- Is the reduced value of  $\chi^2$  approximately equal to 1?