

1.2.2 Uncertainties - graphical methods

Often, we combine data by graphing it and finding a gradient or intercept. We need to be able to determine the uncertainty in the gradient and the intercept.

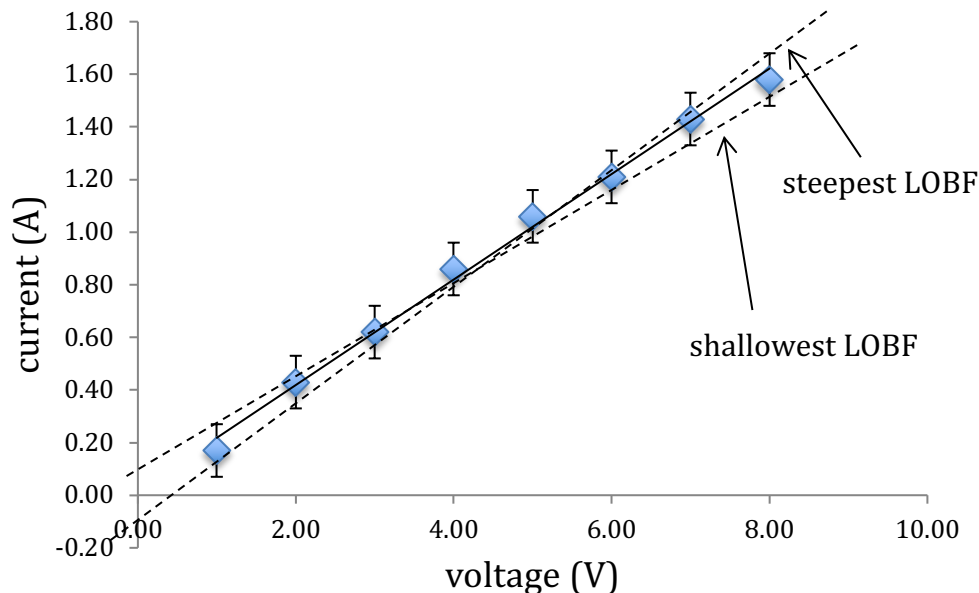


Consider the data, below:

voltage (V)	current (A)	$\pm I$ (A)
1.00	0.17	0.10
2.00	0.43	0.10
3.00	0.62	0.10
4.00	0.86	0.10
5.00	1.06	0.10
6.00	1.21	0.10
7.00	1.43	0.10
8.00	1.58	0.10

We have a table of voltage and corresponding values of current. We also have uncertainty values for our current readings. The uncertainty values for voltage are negligible.

Let's look at how we plot this data.



We have used error bars to show the uncertainties in our current values. The solid line shows the 'line of best fit' (LOBF) we would draw in the absence of error bars, and represents our best interpretation of the trend of the data.

However, with error bars we have flexibility in where we draw our LOBF. Provided our line passes within the boundaries of the error bars it is consistent with our data. The dotted lines show two extreme examples of possible LOBF.

These two extreme lines give an indication of the uncertainty in the gradient and the intercept.

Uncertainty in gradient

The best estimate of the gradient is the average of the steepest LOBF gradient and the shallowest LOBF gradient.

$$\text{gradient} = \frac{(\text{steepest LOBF gradient} + \text{shallowest LOBF gradient})}{2}$$

The uncertainty in the gradient is $\pm$ half the difference between the two gradients.

$$\text{uncertainty} = \pm \frac{(\text{steepest LOBF gradient} - \text{shallowest LOBF gradient})}{2}$$

(1)  From the graph above, find a value for the gradient and the uncertainty in the gradient.

(2)  Physically, what does the gradient of this graph represent?

Uncertainty in intercept

The best estimate of the y-intercept is the average of the maximum and minimum intercepts.

The uncertainty in y-intercept is $\pm$ half the difference between the maximum and minimum intercepts.

(3)  From the graph above, find a value for the y-intercept and the uncertainty in the y-intercept.