SPA5201 - Physics Laboratory

Lecture 4

Graphs and curve fitting

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January 2020

Remember to follow the conventions of scientific writing (as detailed in Communication Skills for Physicists)

- Labelled axes
  - sensible numbers
- With (sensible) units
- And key or legend (if appropriate)
- Sensible symbols
  - with error bars (if appropriate)
- All figures numbered and captioned

- However, recall: Logbooks are not “works of art”

General advice

- Plot data points, preferably including error bars (if appropriate)
- Do not plot lines, or join points using lines

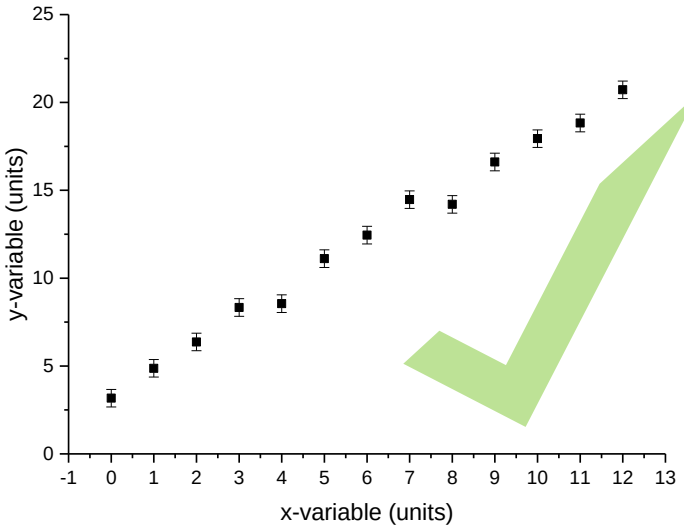

Fig 1: Plotted points…

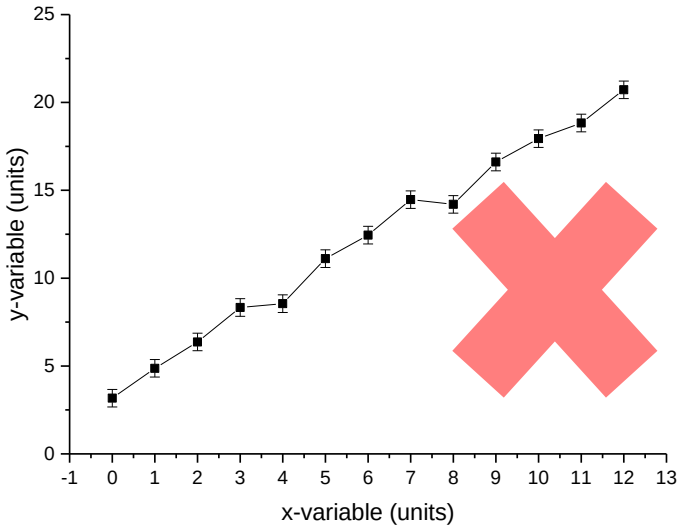

Fig 2: Plotted points with lines…

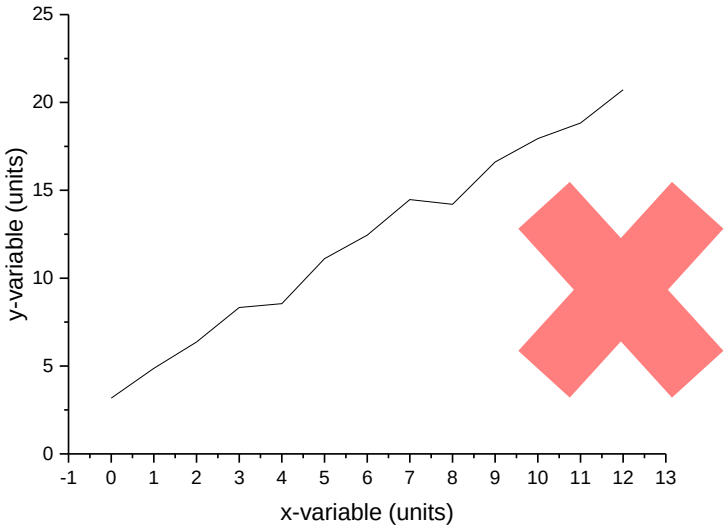

Fig 3: Plotted lines…

You can (and will) fit curves to your data (see later this lecture)

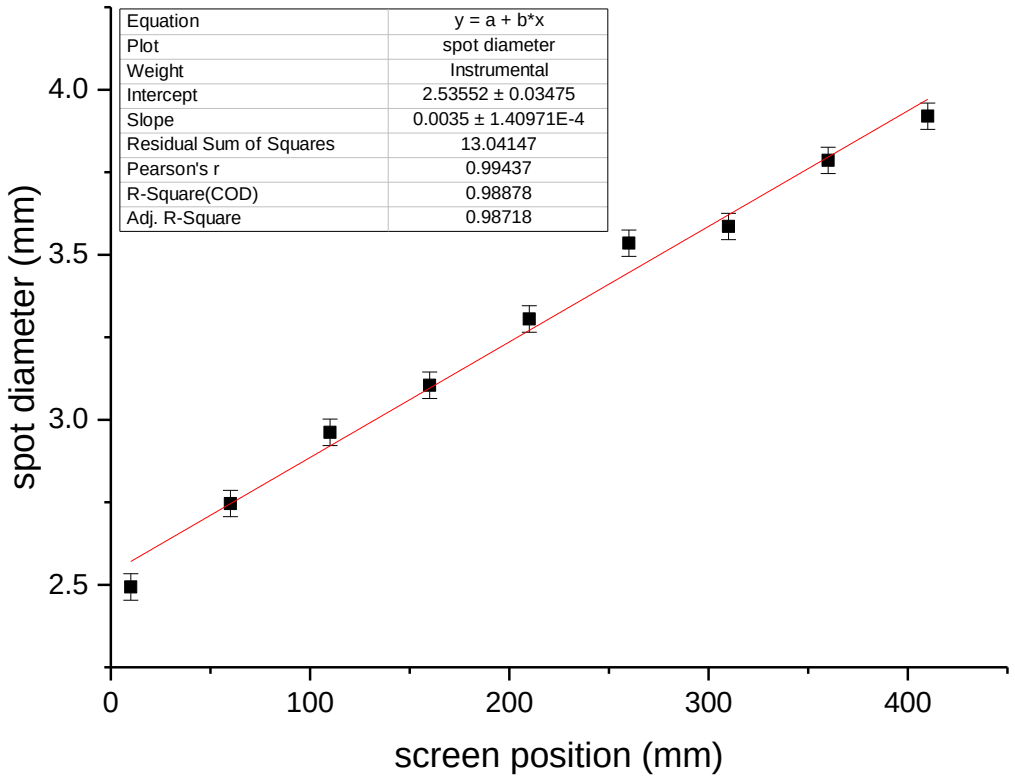

Fig Q: Average laser spot diameter versus screen distance from aperture.

…or you may want to include a "guide to the eye"

General advice

- Good tables make life easier

Quantity P	Quantity Q	error in Q	Quantity R	error in R
units of P	units of Q	units of Q	units of R	units of R

Quantity P	Quantity Q
units of P	units of Q
± error in P	± error in Q

Quantity P	Q1	Q2	Q3	<Q>	error in <Q>
units of P	units	units	units	units of Q	units of Q

In general, try and plot linear graphs when possible

- e.g. if

$$p = \frac{C}{q^2} + A$$

then plot p versus $\frac{1}{q^2}$ to obtain a straight line

- Use a table to carry out the relevant calculations

software can help with calculations

	A(X)	B(Y)	C(yEr±)	D(Y)	E(Y)	F(yEr±)
Long Name	x-variable	y-variable	y error	p-variable	q-variable	q error
Units	x units	y units	y units	p units	q units	q units
Comments	dummy dat			f(x)	g(y)	
F(x)=			0.5	Col(A)/20	5e-4*(Col(B))^2	5e-4*(Col(C))^2
1	0	3.2	0.5	0	0.00512	1.25E-4
2	1	4.9	0.5	0.05	0.01201	1.25E-4
3	2	6.4	0.5	0.1	0.02048	1.25E-4
4	3	8.3	0.5	0.15	0.03445	1.25E-4
5	4	8.6	0.5	0.2	0.03698	1.25E-4
6	5	11.1	0.5	0.25	0.06161	1.25E-4
7	6	12.5	0.5	0.3	0.07813	1.25E-4
8	7	14.7	0.5	0.35	0.10804	1.25E-4
9	8	14.2	0.5	0.4	0.10082	1.25E-4
10	9	16.6	0.5	0.45	0.13778	1.25E-4
11	10	17.9	0.5	0.5	0.1602	1.25E-4
12	11	18.8	0.5	0.55	0.17672	1.25E-4
13	12	20.7	0.5	0.6	0.21424	1.25E-4
14						

Specific software does not matter for calculations

- Can transfer data easily from Excel to Origin

(demonstrate from excelnumbers to BlankOrigin)

- Can import data files easily into Origin

(demonstrate using BlankOrigin and csvdata1.csv)

Why Origin?

- Now being taught in SCM (1st year)
- Can produce publication quality graphics
- Can fit a very large number of functions (including user defined)

Manipulating, plotting and fitting demo 1

- Using manipulatingandPlotting1.opj

plot curve, fit curve

plot line, fit line

Fitting and fitting errors demo 2

- Using linearnoisyfits.opj

Note than in all cases we fit $y = mx + c$

…and obtain $m \pm \sigma_m$ and $c \pm \sigma_c$ for use in further error propagation

Fitting and fitting errors demo 3

- Using blankpeak.opj

Beware of the function fitted

Plotting multiple data sets demo 4

- Using linearmultiplot.opj

…can also “drag” columns into existing plots

Closing remarks

- Do practice using the software
- Beware of taking errors generated by software “on faith”
  - Software can underestimate or overestimate errors
- Do not waste time in the lab making plots look “perfect”
- Annotations/alterations in pen are perfectly acceptable
- Hand written captions/numbers etc are perfectly acceptable

- But do make “publication quality” plots for all future formal reports