

Designing experiments for classroom physics

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Determine a value of a quantity
What is the value of y ?

Test a claim about a value of a quantity
Is the value of $y = \#$?

Linearization of data
 $y = f(x)$

Trial	x	y	z	w
1				
2				
3				
4				

Slope intercept form
 $w = Az + B$
 $y = mx + b$

Feature of LoBF	Estimated quantity
Slope	A
Vert. coordinate of vert. intercept	B

Determine chain of custody from setting up experiment to target quantity

Actions and tools Obtained outcomes

Preparation to make sure

objects are at the right places, at the right times, doing the right things

for instruments to be applied to obtain

measured quantities

that can be analyzed using physical principles

to obtain target quantity

Labeled diagram

Procedures
"Push cart 1 toward ..."

Instrument	Quantity	Symbol
Motion sensor	Velocity of cart 1 before collision	$v_{1,x,i}$

p_x and ΔJ_x

$$p_{1,x,i} + p_{2,x,i} + \Delta J_{EXT,x} = p_{1,x,f} + p_{2,x,f}$$

Consider uncertainty when comparing values

Recorded value
Error bars
Other values plausible for future trials

"y has an uncertainty of $\pm(\text{value})$ units"

Idioms "Two values of a variable are (not) roughly within experimental uncertainty of each other."

Determine a relationship between two quantities
How does x affect (\quad) ?

If needed, translate status of response into value of quantity: $(\quad) \rightarrow y$

Concisely notate variables

⚠ MC trap: Proposed procedure that includes changing a variable that should not be changed

Test a claim about a relationship between two quantities
Test claim that x affects (\quad) according to ...

Claim style 1: When x_1 , then $(\quad)_1$, but when x_2 , then $(\quad)_2$.

Claim style 2: x and (\quad) are related according to $(\quad) = f(x)$.

Concisely notate variables and putative relationship(s)

Add cases if needed

Note claimed behavior of y

Estimate uncertainties in derived quantities

Measured quantities p, q, \dots
Uncertainties in p, q, \dots
Formula
Estimated uncertainty of y
Plausible alternative values of p, q, \dots
Plausible alternative value of y

Determine chain of custody from setup to each target quantity

Present actual values of variables obtained using data					Brainstorm hypothetical values of variables that would be consistent with claim					Brainstorm hypothetical values of variables that would be inconsistent with claim				
Trial	x	y	z	w	Trial	x	y	z	w	Trial	x	y	z	w
1					1					1				
2					2					2				
3					3					3				
4					4					4				

Describe general features in table and/or plot(s)

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Match
"The data are consistent with the claim."

Match
"The data are inconsistent with the claim."