

Rules for Data Tables

Data tables are a concise way to neatly organize a large amount of numerical data and/or observations. Data tables allow a person to quickly find and retrieve important information and identify how a calculated quantity is found. Data tables do not occur in isolation; rather, they are often accompanied by raw data, notes explaining observations, and calculations to support the information in the table.

There are several rules you should follow when constructing data tables:

- Use a computer or straight edge to create the borders of your table
- Use a descriptive title above your data table
- Make sure there is adequate spacing to allow your data table to “stand out”
- The top line of a data table is called the **label line**. It gives a heading to each column. Include units here.
- Each data cell must be completely filled in or filled with an X or NA. If a cell is filled with an X or NA, there must be a full description why this is the case.
- Add a star (*) to the column heading if that specific column is calculated

Example Data Table

The Relationship of Bubble Size to the Volume of Water in Making Large Bubbles

Volume Glycerin (mL)	Volume Soap (mL)	Volume Water (mL)	Diameter Trial 1 (cm)	Diameter Trial 2 (cm)	Diameter Trial 3 (cm)	Diameter Trial 4 (cm)	*Average Diameter (cm)
5	5	2	7	8	9	8	8
5	5	4	12	12	12	12	12
5	5	6	12	18	15	15	15
5	5	8	10	11	14	14	12
5	5	10	6	6	8	8	6

*The average diameter was calculated in the last column. Using the first row of data as an example:

$$d_1 = 7 \text{ cm}$$

$$d_2 = 8 \text{ cm}$$

$$d_3 = 8 \text{ cm}$$

$$d_4 = 9 \text{ cm}$$

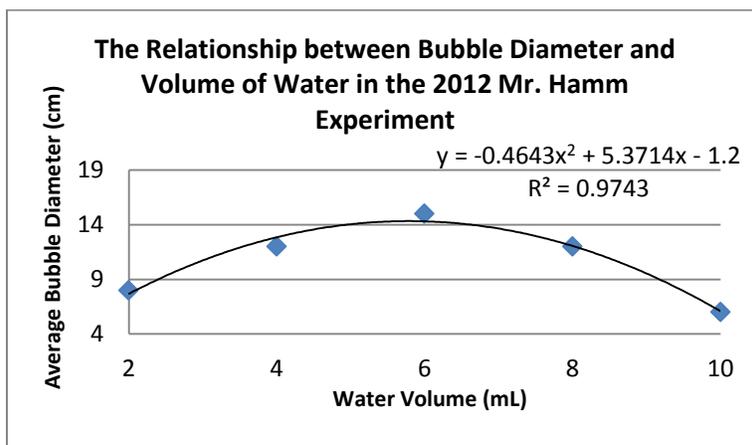
$$d_{\text{avg}} = ?$$

$$d_{\text{avg}} = (d_1 + d_2 + d_3 + d_4) / 4 = (7 + 8 + 8 + 9) / 4 = \underline{8 \text{ cm}}$$

Rules for (X,Y) Scatter Plot Graphs

There are several rules you should follow when constructing a scatter plot graph:

- Use a descriptive title above your scatter plot graph
- Label each axis with a descriptive title and the units included
- Scale each axis to an appropriate range of values
- Plot all of your data points (or your average data points) as simple points on the graph
- Use a line or curve of best fit and include the equation for the line/curve of best fit



Directions for Making Graphs on Vernier LoggerPro

Creating a Graph from Data

1. Open Vernier LoggerPro 3.8.4 on the desktop...two columns will be on the left side and a blank x-y graph will be on the right side of the screen
2. Type the values for your independent variable into the x column and the values for your dependent variable into the y-column – If a red line will show up on the graph connecting your data points, right-click on the graph, select Graph Options, then de-select (uncheck) the box labeled “Connect Data Points.” You should now have a red dot at each of your data points.
3. You can autoscale your data by right-clicking on the graph and selecting “autoscale” or selecting the  button on the top menu bar.
4. You can create a linear line of best fit by selecting the  button on the top of the screen. A text box will come up on the screen with the equation for your line of best fit as well as the correlation value and Sum of Squared Error (SSE...lower is better). You can create a curved line of best fit by selecting the  button on the top of the screen in the menu bar as well. A dialogue box will open where you can select the type of curve fit (polynomial, exponential, etc.) and try to fit the curve to the data using the “try fit” button. Remember, if your coefficients are very near zero, you have too many degrees in your polynomial and should reduce this value as those extra degrees are giving you no additional correlation. RMSE = Root Mean Square Error...lower is better.
5. To add a title to your graph, right-click on the graph and select Graph Options. You can type your title in here and also create titles for the two axes and include your labels.
6. When you are ready to print your graph, first select File -> Page Setup. Select “Landscape” for your printing preferences and go ahead and print your graph. ***It is strongly recommended you preview your graph first by selecting File -> Print Preview.***

Using Vernier Probes with Logger Pro

1. First, connect the probe(s) with the LabPro Data Logger and connect the LabPro to power and the computer.
2. Next, open Logger Pro 3.8.4 and the computer should immediately recognize the probe attached. If not, give the computer one minute and then check all of your connections to ensure that nothing is loose.
3. Before starting to collect data, click on the data collection  button on the top menu bar. Here, you will select the length of time you will collect data and the units (seconds, minutes, etc.), the sampling rate (how often samples of data are collected by the probe), and how you will start the data collection. To start data collection, click on the collect  button on the top menu bar.

Calculating and Representing Error

Absolute Error: When an absolute “right answer” is known, you can calculate the absolute error by simply finding the absolute value of the difference between your answer and the “right answer.”

$$\text{Absolute Error} = | \text{Your Answer} - \text{Right Answer} |$$

Percent Error: The percent error indicated how well you are measuring and calculating. You may have a very small absolute error, say 2 units off. But if the “right answer” is only 4 units, then you were 50% off, a significant value.

$$\text{Percent Error} = \frac{| \text{Accepted Value} - \text{Experimental Value} |}{\text{Accepted Value}} \times 100$$

Mean Squared Error: The mean squared error is used when many data points are compared with an accepted answer or set of accepted answers. To calculate MSE, you simply find each residual value (abs. value of difference between accepted value and experimental value), square each residual, and find the average of all of the squared residuals.