

## Using Graphical Analysis 4.0

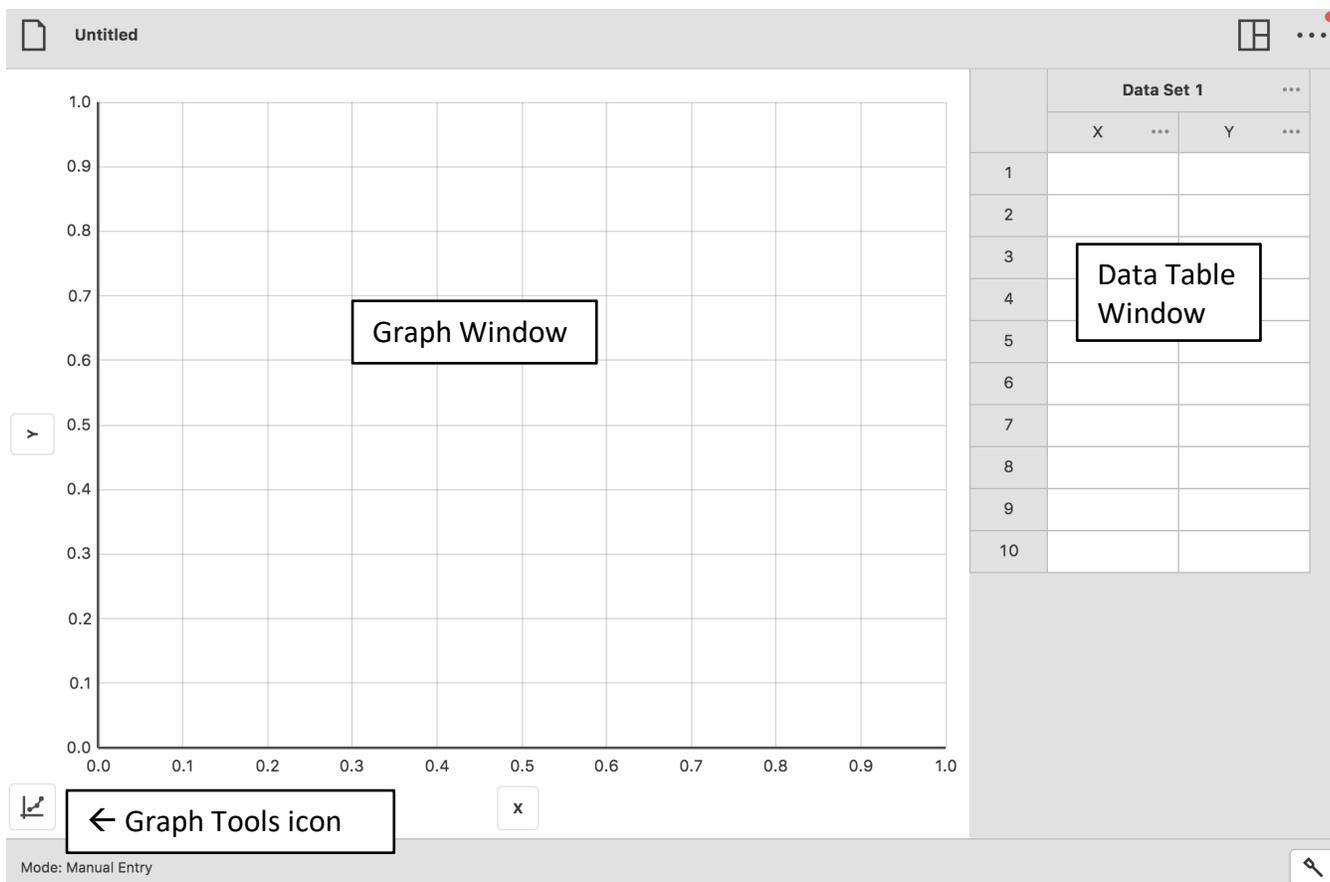
This is a program that's not as powerful as Logger Pro, but is free for everyone (as of 2018) and able to be used cross-platform [Chromebook, computer (both Mac and PC), iOS including iPads, & Android]. It's a little different than Logger Pro, and it doesn't label things as nicely, meaning you'll have to figure out a bit more going from a general formula (such as  $y = mx + b$ ) to a specific one for your data. Also, when we use sensors to collect data, it will be on Logger Pro. However, Graphical Analysis is in many ways simpler than Logger Pro, so... you choose and use what you need.

**1) Getting Started.** Open the *Graphical Analysis 4.0* program on your device. On Chromebooks, this is a Chrome Web extension. If you don't have it yet, you'll need to type in 'Chrome Web Extensions' and then enter Vernier Graphical Analysis. If it's already on your Chromebook you should be able to access it by clicking the circle on the lower left corner and then selecting the correct icon or typing in 'Graphical Analysis'.

\*\* For seniors with an iPad, you'll need to go to the App store and download the application.

**2) Enter Data.** Click on 'manual entry' at this point. A graph and Data Table will open. Click on the Data Table on the three dots next to the X, and choose Column Options. Choose what you want to name the x-axis variable, your units, and your level of precision. Click 'APPLY'. Repeat this for the Y axis variable. You may also rename the entire Data Set if you choose. Now, enter data for each column.

**3) Title Your Graph and Scale Your Graph.** Click on the small icon called **Graph Tools** that looks like a graph at the lower left corner. Choose 'Edit Graph Options', which is at the bottom of the menu. From here give your graph an appropriate title, and scale your graph so that 0 is your lowest point on each axis, and the top of your scale on each axis is included. You may either enter this by hand, or choose "Always Show 0" from the drop-down menu for each axis. *NOTE: Choosing the drop-down menu means your largest point will be at the very corner of the graph, making it hard for you to extrapolate any data points larger than this.*



**4) Line of Best Fit.** Click on the **Graph Tools** icon again. Choose 'Apply Curve Fit' from the menu. Here there are a variety of choices you can have to see what best fits your data. Try 'Linear' from the drop-down menu at first. A line will appear and a dialog box will be shown with information about the line graph. The higher the correlation ( $r$  value, the better the fit. Often times we'll look for an  $r$  value of 0.96 to 0.99+ [an  $r$  value of 1.00 is a perfect fit]. Unlike Logger Pro, your mathematical model is still shown in the general format of  $y = mx + b$ . You should rewrite this in terms of your specific data. For example: Velocity = (5.1 m/s/s)\*time + 2.0 m/s

**5) If the straight line is NOT a good fit**

Then you will need to make it a straight line by linearizing your data. In order to have the best idea about how to do this, consult the Graphical Methods Summary given to you in class, and that you should have taped into the front of your composition book. You will need to create a new calculated column. Click the three dots on either of your variables. A menu will open with three choices. Choose 'Add Calculated Column'. This will take a column of data you already have and manipulate it in the way you want. For example, if you want to square each data point on a data column you called 'Time', you should name your new column 'Time squared' and have units of 'sec<sup>2</sup>'. Then choose 'Insert Expression'. There are a number of options you can choose. In this case I would choose the button at the top left, which is ' $A * X^B$ '. Note you can choose parameter A (in this case I'd choose 1), column X (in this case I'd choose Time from the drop-down menu), and parameter B (in this case I'd choose 2). Click 'Apply'.

NOTE: If your graph doesn't appear to change, go back to the Graph Window and make sure your columns are positioned the way you want by clicking on the variable name on each axis and choosing the specific column of data you want displayed on each axis. Once you have each axis the way you want, you can try a linear fit again.

**6) Save Your Graph.** Once you have entered data and gotten a curve fit (or even before this), you'll want to save your graph. Click on the icon at the upper left corner of your graph, which will currently be called 'Untitled'. On a Chromebook you can choose 'Save As...' or 'Export'. Save As will save the file with an extension name of **.ambl**. This can be read by any other device with Graphical Analysis. If you want to include your graph in a Google Doc, you'll need to Export it as a picture. Be careful where you save the graph! It may default to saving in your Downloads folder on your Chromebook, but in order to share this with others you would want to save it to your Drive. Similarly, when you Export your file, do so as a Graph Image. Once again, you can do so either to your Drive or to the Downloads folder. The exported file will initially be saved as a .png file, which you can convert to a PDF later if you choose (see below).

**7) To Find Your Graph.** If you've saved it to your Drive, place it somewhere you'll remember, maybe a special folder for AP Physics! If you saved it to the Downloads folder, you'll need to find this by going to the circle on the lower left corner of your Chromebook's home screen. Click on this. When you see a search window pop up, type the word 'Files'. This will take you to the Downloads folder. While you can't print the saved image, you can convert it to a PDF if you choose. You could also insert the saved image (the .png file) into a Google Doc if it will be part of a lab write-up.

**8) To Reopen a File.** Go back into Graphical Analysis, and select the 'Choose File' button on the upper right side of the initial screen. You should be able to see a list of the .ambl files you've saved.