

INTRODUCTION TO KALEIDAGRAPH

INTRODUCTION

Kaleidagraph is a spreadsheet/graphics application we will use often in lab this semester, and you may find it useful for other courses as well. Copies of the application can be downloaded from the server and used on computers connected to the college network. Although there is no limit as to the number of copies downloaded from the server, only 47 applications can be in use at any one time. Copies of the software will only run on computers connected to the network and loaded with the proper key sharing software.

This reference is meant to acquaint you with the very basics of Kaleidagraph.

OVERVIEW

The application consists of data tables and graphs. When you open the application, the first step is usually to create or edit a data table. This is done with the “New” and “Open” commands from the **File** menu. You can enter data in data tables, manipulate the data in data tables, and make graphs of the data in data tables. Once a graph has been created, it can be edited in a huge variety of ways. Kaleidagraph is similar to other spreadsheets, like Excel, but there are some differences worth keeping in mind.

- Data tables and graphs are saved as separate files. If you only save a graph but not the data table from which it is generated, there will be some procedures that cannot be performed unless the data table used to create the graph originally has been opened also.
- All the cells in a column will have the same data type (Floating Point, or Text, e.g.)
- Calculations are done on an entire column. One cannot select only a portion of the data.
- In general, it is best not to highlight a column or portion of a column. Weird things can happen. (It is too confusing to go into here. Just trust us on this one!)

DATA TABLES

First, you need to enter your data into a data table. You will want to name your columns something descriptive. Change column headings in your data table by simply double-clicking on the header. The default column headings are capital letters. These headings will appear on the axes of any graphs you make using this data table, so it is best to put both a descriptive word and the units in these headings.

You can insert/delete rows and columns, append columns, put series of numbers in a column, etc., as options under the **Data** menu. You can also Cut, Copy, and Paste whatever is highlighted in the data table using options under the **Edit** menu.

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One of the most useful features of Kaleidagraph is the Formula Entry window (**Windows** menu, then “Formula Entry”). This allows you to perform an operation on an entire column. In the Formula Entry window, you refer to columns by a “c” followed by a number. The initial column is Column 0. (You can find the column number of the active cell in the lower left of the Data window.) For example, if you have a length measurements in the 0th column and width measurement in the next column, you can create a column of area values by typing

$$C2 = C0 * C1$$

in the Formula Entry window. This is one of those times you do NOT want to highlight a column. Kaleidagraph treats the highlighted column as the new Column 0, and then you do not get the result you expect. (This is one of the idiosyncrasies of the software you will learn to know if not necessarily love.)

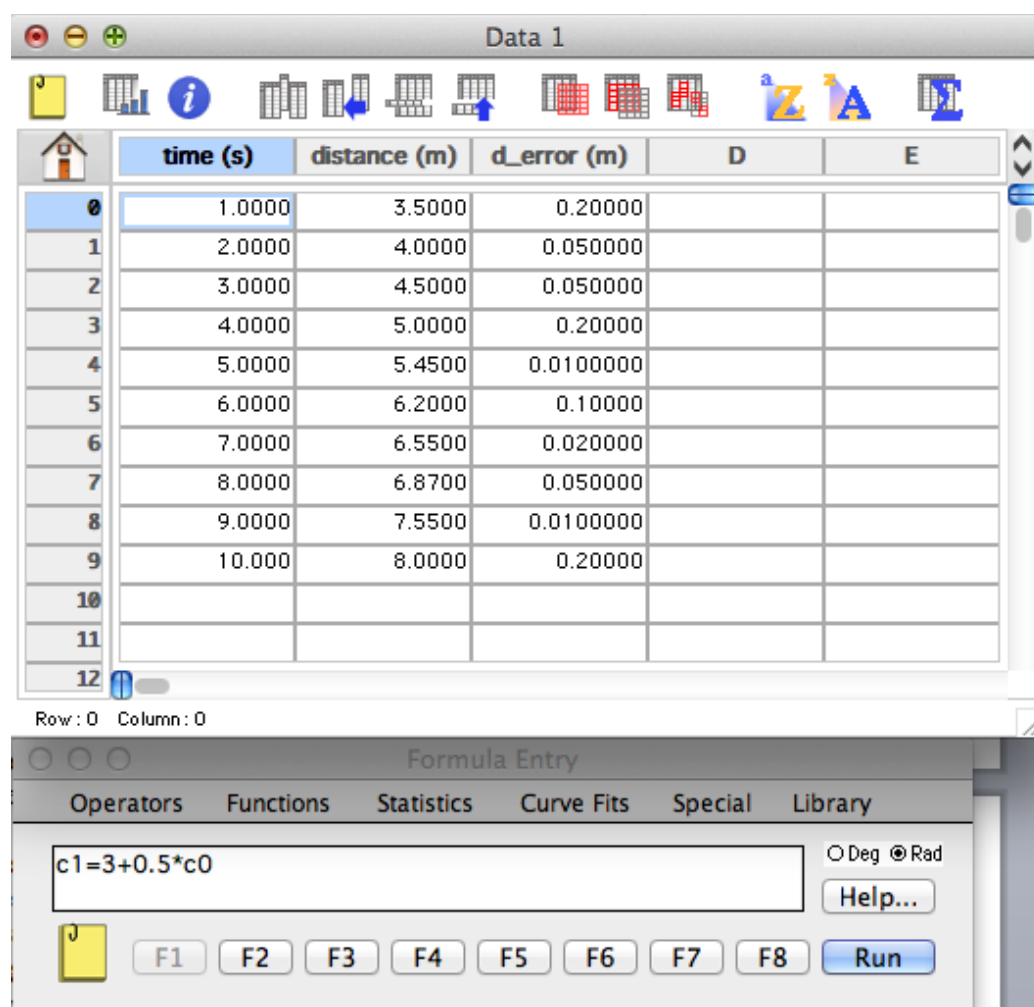


Figure 1. Creating a calculated column with the Formula Entry Window.

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If you make a change to a data column used in a formula, the calculated column does not automatically update. You need to run the formula again. This is where the function buttons at the bottom of the Formula Entry window come in handy. You can save each formula and recall equations to use again without having to retype them.

GRAPHING

You can make a graph of your data by choosing one of the options from the **Gallery** menu (not the **Plot** menu as you might reasonably assume). The usual one for laboratory data is the Linear-Scatter graph. When you select it, it will ask you which column you want on which axis. Select “New Plot”, and the program produces the graph immediately.

Kaleidagraph automatically chooses the minimum and maximum values for each axis and how to scale each axis. To change the appearance of the graph (change axis limits, plot symbol, etc.), go to the **Plot** menu.

The next step is to add error bars to your graph to show how precise your measurements are. In the **Plot** menu, select “Error Bars...” (duh). A dialog box comes up with check boxes labeled “X Err” and “Y Err” next to the column name of the data graphed on the y-axis. To add error bars for the x-axis data, check “X Err”. A new box comes up with pop-up menus that allow you to select the source of the error bars. You entered the uncertainties into a data column, select “Data Column” the name of the column containing the uncertainties in the x-axis data. If all the data have the same uncertainty, select “Fixed Error” then enter the number in the “Fixed Value” box. Once you do this, click “OK”. You are now back at the first dialog box. Check “Y Err” and repeat the process to select the data column containing uncertainties for the y-axis data, then click “Plot” in the first dialog. When you are done, you should see your graph with error bars added. (If your measurement uncertainties are very small, the error bars may not be much bigger than the plot symbol.)

CURVE FITTING

Now you are ready to find a best fit function to your data. The graphical package does this by trying many possible straight lines and determining by how much the line vertically misses each data point. Since these “miss distances” (more properly called residuals) are both positive and negative in general, it makes no sense to add them together to see what the total “miss distance” is. Instead, the residuals are each squared and then added together, creating a single number representing how well the line follows the data. The fitting procedure finds the straight line that minimizes the sum of the squares of the residuals and prints out the slope and y-intercept of this line. The application also estimates the uncertainties in the slope and y-intercept by testing how much variation in these two parameters are necessary to cause the sum of the squares of the residuals to

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increase significantly. You can do a weighted fit, which means data points with smaller uncertainties “count” more than ones with larger uncertainties.

To do this, you need to use the “General” option under the **Curve Fit** menu. Choose “fit1”, and then click “Define”. This is the window in which you specify the function relationship to be used in the fitting procedure. The application uses M0 for the independent variable and m1, m2, m3, etc., for parameters to be determined from the fit. You also must provide initial values for these parameters for it to use as it starts the searching procedure. Since the equation of straight line involves two parameters (the slope and y-intercept), the appropriate formula is as follows.

$m1+m2*M0;m1=1;m2=1$

Notice that the initial values of the y-intercept (m1) and the slope (m2) are given as 1, even though you could have come up with better trial values. In a linear fit, these starting values are usually sufficient. (If you are graphing very large or very small numbers, you will need to give a better estimate.) These initial values give the computer a starting point for its fit procedure.

When the formula and initial values are correct, check “Weight Data” and click OK to return to the previous Curve Fit window. Now, check the box next to the y-axis name. You should now be prompted to choose a column to use for the weighting. Click the arrows to scroll to the column containing the uncertainties for the y-axis. (The mathematical routines used can only weight the data based on the y-axis errors. They are quite complicated as it is. They would be even more complicated if they took both x and y errors into account.) Click “OK” twice, and the fit routine begins. Once it is finished, you should see a best-fit line and an information box on your graph. If you don’t see the box, select “Display Equation” from the **Plot** menu. The box contains the best values of the slope and y-intercept and the uncertainties in each.

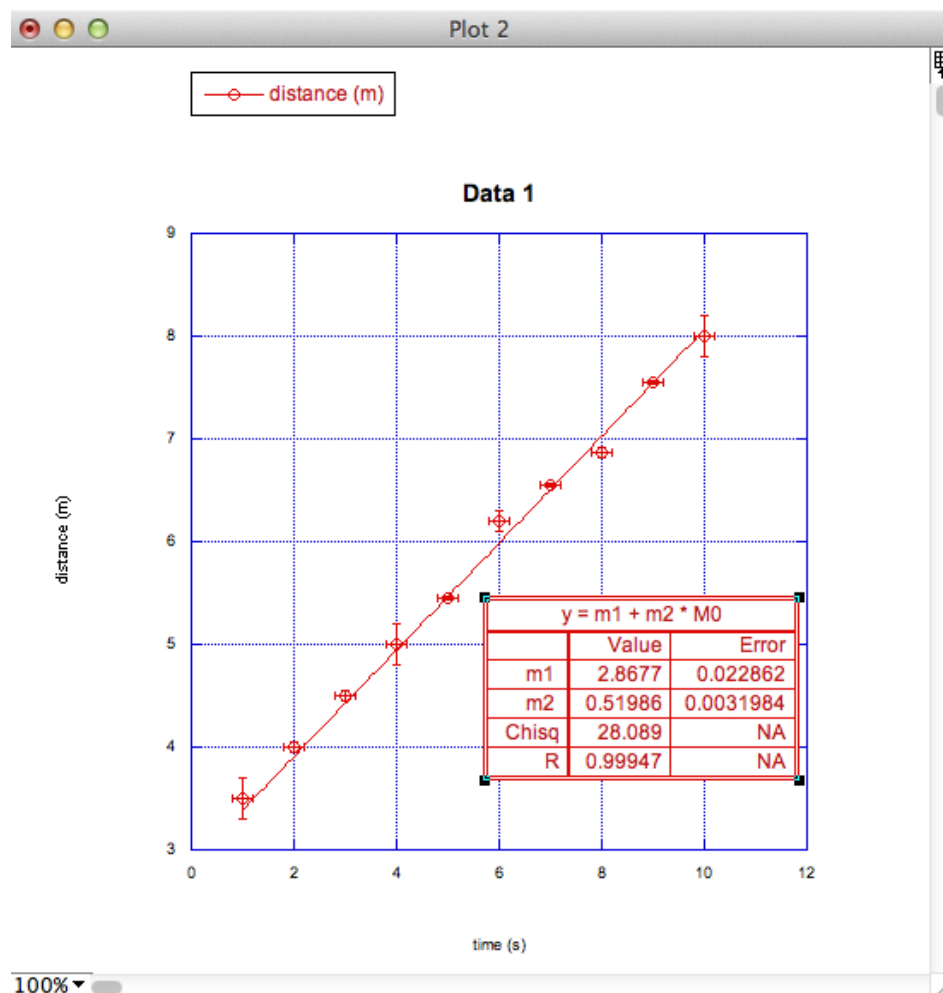


Figure 2. Graph with General Curve Fit results.

Of course, the General curve fit equation can be modified to fit any function to the data. Just remember that “M0” represents the independent variable, and “m1”, “m2”, “m3”, etc. are the parameters to be determined by the fit.

CALCULUS

Kaleidagraph has a set of Calculus macro routines to take derivatives and integrals of data numerically. When the data window is active, the **Macros** menu appears in the menu bar. We will probably only use the “Integrate-Area” macro. Here is a step-by-step procedure:

First, you must load the Calculus Macro file.

File Menu -> Open

Choose Applications/Kaleidagraph4.1/Examples/Macros/Calculus.EQN

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Run the Macro.

With the Data window active, choose the Macros Menu -> Integrate-Area.

In the first pop-up window,

X Column: Enter the Column Number for the “dx” quantity.

Y Column: Enter the Column Number for the “f(x)” data.

(Remember the first column in a Kaleidagraph table is Column 0.)

In the next window, set the integration limits.

Xmin = lower bound

Xmax = upper bound

Yref = 0

The final window returns the value of the integral.