

The Graphical Analysis Program

Introduction

Graphical Analysis is a user-friendly program that allows you to easily graph and analyze data. In this laboratory, you will enter data manually from the keyboard, and in some cases, an interface device to the actual experiment (live data entry). This exercise is design to familiarize you with the basic functions of this program. Additional features may be introduced during the term during experiments.

Data is displayed in spreadsheet form and graphically. You have several options on the scaling and style of graphs. Powerful data analysis tools are provided, including curve fits, derivatives, tangent lines, integrals, etc. Graphical Analysis allows you to create new columns that are based on other data you are collecting, much as you might do with a spreadsheet program (like excel). You can easily copy your data and graph to a word processing or spreadsheet program via the clipboard. We usually print the final product for attachment to laboratory reports.

PART I

Our First Graph (BE SURE TO PRINT WHEN DONE WITH PART I)

Start up the program. We get an X and Y data table with a empty graph to the right.

Note above the X, Y label, the values have a simple title "Data Set". We can change the title of the data set to suite the values we are measuring, like "Gravity", etc.

Enter for x data table the number 1 then 1 in the y column, note how a point on the graph appears, you can move to the next cells via the arrow keys or the mouse cursor.

Now enter 2 for x and 2 for y and again note the two points on the graph. Continue in this manner till you reach 15 to 15, and watch how the graph is created.

If you make a mistake within a column, use the up and down cursor keys to move within the column. Use the left and right cursor keys or mouse to move around within the cell and the Tab key to move between columns.

A straight line appears. The line is the best graph to fit the data points. If not, then you entered the data incorrectly.

If we want to label the axis and perhaps change the range of values we put the mouse cursor on the graph, then we double click. **Do this!**

Entering a label on the y axis:

A Graph Options window opens, with two tabs, Graph Options, Axes Options.

The Axes Options tab may open automatically, if not click it.

On the left side under Y-Axis: heading we have a data box to enter a Label:

Enter **Velocity** in that box and note what happens on the graph after clicking "Done" in the lower right.

Entering a heading for the graph:

Double click the graph again. This time click the Graph Options tab.

Enter a Title: FUN WITH GA included YOUR LAST NAME(S), click done and note the Graphical image now.

Some Toolbar features:

The Toolbar as in most programs is at the top with various icons.

PRINTING: The standard printer icon could print the graph (**do not** do this now).

PRECISE VALUES OF A POINT ON A GRAPH:

If we roam the graph with the cursor values of X and Y of any point in the domain of the graph appear in the lower left of the graph. But if we want a precise value on the actual graph we do as follows.

Click on the first Icon that looks a graph with the label **X=**:

A vertical line appears that can be moved around the graph with the mouse to help us find a precise value on the actual graph. A box showing the range of X and Y you are in appears in the upper part of the graph for your data. In the lower left the precise X, Y values (2 decimal digit accuracy here). The vertical line makes it easy for us to find a particular X value, then with the mouse we can go to the graph with the cursor to get the corresponding Y value. So placing the vertical line on X=5.20 should give us as we move the cursor to precisely on the graph Y=5.20. Do this to see that with precision your value may vary. That is why we always express answers to percents of variation or error.

Obtaining the slope of a straight line (a linear fit) graph

Click the toolbar Icon with a straight line next to a curve with the label **R=**:

In the box that appears we see obviously for this curve the best linear fit ($y=mx + b$) slope $m=1.00$ and y intercept, $b=0$ and a correlation to a straight line which is precise since it is a straight line, namely, $RMSE = 0$ ($RMSE = \text{ROOT MEAN SQUARE ERROR USED TO EVALUATE THE FIT, THE SMALLER THE NUMBER THE BETTER THE FIT}$) NOTE ALSO correlation = 1.000. **Shrink the graph** to about half the window (note dark spots in corner can be grabbed with the mouse to shape the graph).

Importance of linear fits in this lab.

Many of the phenomena you will experiment with are governed by a variety of equations. Many of which can be reduced to straight line graphs by what you plot.

For example: $y^2 = Ax^2 + B$ obviously not a straight line on an x, y graph. But we can plot y^2 vs x^2 we would get a straight line and the slope would be the value of A and the y intercept will be the value of B. We use this technique a lot in this laboratory.

Adding new Columns to calculate with our data set:

Let us assume we want to add a new column to calculate Y^2

We start by clicking on the "Data" menu above.

We choose "New Calculated Column" since we want the values to be calculated by an equation from our other columns. NOTE: we could have added a "New Manual Column" to add data from the key pad. We get the window for the "New Calculated Column"

Under "Labels and Units" enter "y square" for the name and y^2 for the short name;

Equation: we have a wide variety of choices, note the function choices by clicking on the function key (click off the key to close the window).

The "Variables" key gives us the choice of using the two columns for calculations by setting up a formula. Click the Y and we note "Y" appears as the start of our equation.

To square the values we use the ^ square function and type 2 next to the "Y" giving us " Y^2 " as our equation for the new column. Click done and new column appears filled with the square of each value in the corresponding Y value.

To see your handy work click "Insert" and "Graph" and the classic parabola appears vs the original x axis. Click the icon with $f(x) =$ and note the choices of **polynomial functions** you can try to fit this graph with. **Choose "Try Fit" AND THEN FIRSTLY THE "LINEAR" OPTION, THEN CLICK "ok" AND NOTE THE LINE APPEARS AND OBVIOUSLY DOES NOT FIT THE DATA NOTE THE "RMSE" in the box that appears. Next PICK THE QUADRATIC AND then the CUBIC using "Try Fit" & "OK". Which Graph fits the data best and why! Compare the RMSE values and its obvious which is the best fit.**

Shrink this graph so that both graphs appear.

"PRINT the screen" by first viewing what you have by using the "File" column, "Print Preview" to see what you have. Put your name and partners name on it IF IT'S NOT IN THE TITLE OF THE GRAPH.

PRINT the nest last page (PART II DATA SHEET).

After this class is over be sure to look over the information on the Graphical Analysis program found in the appendix of the laboratory Manual.

NAME(S) _____

PART II DATA SHEET

BE SURE YOU HAVE PRINTED THE LAST PART BEFORE YOU CLOSE THE PROGRAM. NOW CLOSE THE PROGRAM AND RESTART IT AND THE SIMPLE BLANK DATA SET COLUMNS X AND Y WILL REAPPEAR WITH AN EMPTY GRAPH PRACTICE GRAPH INTERPRETATION

Enter the following data which comes from a curve $y^2 = Ax^2 + B$ but our x column is actually the x^2 value and y column is the y^2 value so we are plotting this data as a straight line.

so here X is the x^2 values and Y is the y^2 values in the equation above

YOU MIGHT TRY COPY THIS DATA FROM THE COMPUTER AND PASTE INTO GA!

X	Y
888	15.35
1679	28.89
2510	42.77
3668	61.71
4933	82.15
6456	106.49
8273	134.21
10318	165.17

Put this data in and a graph will appear.

1. Assume we need the value of y that corresponds to $x^2 = 5398$. Use the line technique for the x axis and line up with 5398 as close as possible now read on value on the graph i.e. y^2
Then put the precise value of here $y^2 =$ _____ then take the square root for $y =$ _____
2. We need the value of c which comes from the original formula with $A = .077$ c
i.e. $y^2 = Ax^2 + B$ but plotted as $Y = AX + B$ so A is the line's slope which we calculate c from!
 $A =$ _____ $c =$ _____
3. We need the value of q which is gotten from the B of the original equation defined from $B = 1/q$
 $B =$ _____ $q =$ _____
4. How good is the data correlating to a straight line? RMSE= _____ Correlation= _____
This means?

5. Be sure your name(s) are in the title of the graph. Then **Shrink it** in the window as before.
6. Add a new column to the data set that automatically (do not do this manually) calculates cube of the Y column values (effectively y^6). **List the last three values in the column here heed this**

WARNING: IF YOU DO NOT SEE A DECIMAL IN THE LAST VALUES OF THE Y^3 COLUMN (scientific notation is used to extreme values) THEN THE WIDTH OF THE COLUMN IS BAD. You can expand column width by putting pointer on the boundary and clicking to expand.

Last three values are?

7. NEXT Get the graph of Y cubed ("Insert" "Graph") and fit it into the window. USE THE Icon $f(x) =$ which shows possible curves: Now use the "Try Fit" and "OK" for the options, QUADRATIC, CUBIC AND QUARTIC of possible curves to fit the best curve to the data. **Specify here THE curve by NAME** that you believe fits the data the best. **WHY ARE YOU MAKING THIS CHOICE? SHOW INFO WHY?**

Write here **the coefficient values** of the best fit also (A, B, etc)!

8 PRINT WHAT YOU HAVE, PUT YOUR NAME ON IT WITH YOUR PARTNER AND HAND IT IN if no names are in any of the graph titles. Staple both printed graphical outputs and this sheet and hand in as your first assignment. NOTE: YOU ARE HANDING IN TWO PRINTED PAGES WITH GRAPHS AND THIS LAST DATA SHEET.