Manual for Linear Grapher Spreadsheet

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General Information

About

The Linear Grapher Spreadsheet is an all-purpose spreadsheet for studying almost every aspect of linear equations in two variables.

IMPORTANT: ONLY the fields that are highlighted green should be altered. Altering any other field may change the formulas needed for calculating necessary information. The spreadsheet **should** be password protected so that you cannot alter the other fields. But in case the password protection is missing, please be advised to alter only those fields highlighted in green.

File Types

Linear Grapher Spreadsheet can be found in two forms. One version is a spreadsheet file type (.xls) that is a Microsoft Excel file. The other version is a .ods file type that is an OpenOffice Calc file. OpenOffice Calc can use either file type. I imagine (but have not tested) that Microsoft Excel cannot use the .ods file. Both files have the same functionality, so you are not missing out on anything by using one over the other.

If you do not already have MS Excel, then I would highly recommend using OpenOffice Calc, as it is free and works just as well for this file.

Spreadsheet Layout

The Linear Grapher Spreadsheet has 5 main sections:

The Formula Section (Rows 1-16, Columns A-G) - This section contains the equations being graphed and the points of intersection for every possible pair of lines.

The Points Section (Rows 1-16, Columns H-O) – This section contains the points being graphed for each equation and the x- and y-intercepts for each equation.

The Graph Section (Rows 17-34, Columns A-G) – This section contains the graphs of the equations from the Formula Section.

The Equation Finder Section (Rows 17-34, Columns H-O) – This section contains the fields for finding the equation of a line using either two points or the slope and one point.

The Notes Section (Rows 35-65, Columns A-G) – The section contains various notes on the spreadsheet; much of that information is contained now in this manual.

Applications

Graphing y=mx+b

To graph an equation of the form y=mx+b, go to the box in the upper left-hand corner where it says 'Formula'. Decide which colored line you'd like to use to graph your equation. Line 1 is the blue line. These directions will continue assuming you are graphing your equation as Line 1, the blue line.

The x and y variable are fixed in place. You must input the slope (m) and y-intercept (b) from your equation in the appropriate, green-highlighted fields for Line 1. Type in the number for 'm' for Line 1 (C5) and press enter. Then type in the number for 'b' for Line 1 (F5) and press enter.

The line is immediately graphed in the gold area just below the Formula area. The blue line corresponds to Line 1 (whose text is blue also). The pink line corresponds to Line 2. The yellow line corresponds to Line 3.

You may graph up to 3 lines at a time using Line1, Line2, and Line3.

How the Line is Graphed

The line is graphed by plotting points using pre-selected values for 'x' (the column H3 through H13) and using the x-intercept and y-intercept (J15 and J16 for Line 1) and using the points of intersection with the other lines (Row 15 and 16, Columns A-F).

Changing the Window Size of the Graph

The values of 'x' used to graph a line can be altered in the column H3 through H13. By changing the values of 'x', you can change the horizontal window size.

For example, if you want to see what the line looks like from x= -10 to x= 10, you can change two of the pre-selected values of 'x' to these values. You could change H3 to -10 and H13 to 10. Then the spreadsheet will plot points at x= -10 and x= 10 and display them on the graph in the golden area. This will directly change the window in the horizontal direction. This will also indirectly change the window in the vertical direction.

You cannot directly change the window size in the vertical direction. To change the window in the vertical direction, you must choose 'x' carefully enough to obtain the y-values you want to see on your graph.

Changing the Points that are Being Graphed

You can change the points that are graphed. To obtain different points, you will need to choose different values for 'x'. The values of 'x' that are currently being used to graphed can be found in the column H3 through H13. To get a different point on your graph, change one of these 'x' values to a different value.

To change an x-value, simply click on the field of the x-value you wish to change, type the 'x' value you want, and then hit enter. The graph immediately displays the new point with the specified x-value.

Changing an x-value changes it for all three lines being graphed. There is no way to change the x-value for just one line.

There is no easy way to add extra points in addition to the number that are already present. You would have to add rows and formulas and include the new values in the graph, which means changing the information in the graph itself.

Graphing Horizontal Lines (y=constant)

You can graph horizontal lines. Horizontal lines have equations of the form y=constant. For example, y=3 is a horizontal line. The slope of a horizontal line is 0.

To graph a horizontal line, input m=0 and b=constant from the equation. For example, to graph y=3, we would need to put m=0 and b=3 in the formula portion of the spreadsheet for one of the lines.

Graphing Vertical Lines (x=constant)

You cannot graph vertical lines on this spreadsheet.

Graphing an Equation of the Form Ax+By=C

To graph an equation in standard form (Ax+By=C), you will need to convert it to an equation in slope-intercept form (y=mx+b). You will either need to do this manually (solve for y) or you can use the built-in Equation Finder on the spreadsheet (Rows 17-34, Columns H-N).

To use the Equation Finder, you will need to know two points (x,y) on the line. These can be found from the equation you have by plugging in a value for 'x' and solving 'y'. Often times, it is easy to find the x- and y-intercepts from this form of the equation as well.

Once you find two points (x,y), plug them into the Equation Finder in the fields J21, K21 and J22, K22. The resulting equation of the form y=mx+b will be calculated immediately and displayed in Row J24 through N24. Use this result to graph the equation (See 'Graphing y=mx+b').

Finding the Equation of a Line Using Two Points

You can find the equation of a line given two points using the Equation Finder in the spreadsheet.

Plug the two points (x,y) into the Equation Finder in the fields J21, K21 and J22, K22. The resulting equation (of the form y=mx+b) will be calculated immediately and displayed in Row J24 through N24.

Finding the Slope of a Line Using Two Points

You can find the slope of a line given two points using the Equation Finder in the spreadsheet.

Plug the two points (x,y) into the Equation Finder in the fields J21, K21 and J22, K22. The resulting slope will be calculated immediately and displayed in the field K23.

Finding the Equation of a Line Using the Slope and a Point

You can find the equation of a line given the slope and a point on the line using the Equation Finder in the spreadsheet.

Plug the slope of the line into the field K30. Plug the point (x,y) into the fields J28,K28. The resulting equation (of the form y=mx+b) will be calculated immediately and displayed in the Row J32 through N32.

Finding the Intercepts

You can find the x-intercept and y-intercept for each equation that you are graphing. The x-intercepts for Lines 1, 2, and 3 are found at fields J16, K16, and L16, respectively. The y-intercepts for Lines 1, 2, and 3 are found at fields J15, K15, and L15, respectively.

To graph a line, the equation must be in the form y=mx+b. If you equation is of the form Ax+By=C, then please see 'Graphing an Equation of the Form Ax+By=C'.

Solving a System of Linear Equations in Two Variables

You can solve a system of linear equations in two variables using this spreadsheet. **The solution to a system of equations occurs where the two graphs intersect one another.**

To solve a system of linear equations using this spreadsheet, you must first graph both equations. To graph an equation, it must be of the form y=mx+b.

After graphing both equations in the system, the solution to the system occurs where the graphs intersect each other. It will be marked on the graph and the point will be specified in the 'Points of Intersection' area of the spreadsheet (Rows 13-16, Columns A-F).

If you graphed the two equations in the system as Line 1 and Line 2, the solution to the system is the intersection (x,y) of Lines 1 and 2, which is given in the fields B15,B16.

You can graph your equations as any two lines in the 'Formula' section, since the spreadsheet automatically finds the intersection of every possible pair of lines for you.

Special Case: If the coordinates of the intersection are #DIV/0!, then there is one of two possibilities. Either the lines are parallel and don't intersect, in which case there is NO SOLUTION to the system of equations or the two equations are identical and therefore the lines are the same, in which case you have a dependent system with an infinite number of solutions.

Errors and Limitations

#DIV/0!

If you get this as a result, that means a division by zero is occurring somewhere in the calculations. This is a problem, because dividing by zero is undefined. Here's what it means, depending on where you find it:

x-intercept (fields J16,K16,L16) – A #DIV/0! here means that there are no x-intercepts for the line you are graphing. This will happen when graphing a horizontal line.

Slope (field K23 or K24) – A #DIV/0! here means that the slope is undefined. The slope is undefined when you have a vertical line.

Points of Intersection (fields B15,B16 or D15,D16 or F15,F16) – A #DIV/0! Here means that either the two lines do not intersect (which means there is no solution to the system of equation involving those two lines) or the two lines are identical (which means there are an infinite number of solutions to the system of equations).
You should not get a #DIV/0! anywhere else in the spreadsheet. If you do, this is a sign that something isn't working the way it should.

Inputting Fractions

To input a fraction, you must type an equals sign first. For example, to type in ½, you need to type "=1 / 2". The spreadsheet stores your input as a fraction, but displays your input as a decimal (see 'Decimals').

Unfortunately, spreadsheets don't like to display fractions. All numbers on the spreadsheet are displayed as decimals. You can input a fraction, but the spreadsheet will display your input as a decimal. The calculations are performed using the precise fraction that you input. It is advisable to use fractions for input as opposed to their decimal approximation (ie input 1/3 instead of .33 or input 1/6 instead of .17). Even though they display the same in the spreadsheet, the calculations are not done the same. The fractions are always more precise than the decimal, so it is best to use a fraction.

Decimal Outputs

All calculated output will display rounded to 2 decimal places.

For Example: Assume the spreadsheet has to do this calculation: .0002*(-5)+3

This should equal 2.999. However, the spreadsheet will come up with the answer 3. The reason for this is that the spreadsheet rounds the answer to 2 decimal places.
Another example:

An output of 2/7 will display as 0.29, whereas it really equals 0.2857142857...

The graph appears to keep track of all the decimal places and still gives you a pretty good graph, but the numbers on the spreadsheet will only display two decimal places. Because of this, I would not rely on this spreadsheet for any calculations involving a number that requires more than 2 decimal places to be distinguished or a fraction that requires more than 2 decimal places to be distinguished.

These numbers are okay as input (and you can trust the relative precision of the output):

0.5
213.74
½
1/3=0.333333 (while this is too many decimal places, it will display as .33 which is accepted as 1/3)
¾=0.75 (2 decimal places to describe this number, so it is good).

These numbers are risky as input (and I would not trust the precision of the output):

0.001
22/7=3.142857143 (too many decimal places, will show as 3.14)
3/8=0.375 (too many decimal places, will show as 0.38)

For Example: I would not rely on the x-intercept that the spreadsheet displays if it had to be calculated using a slope of 22/7, because 22/7 has too many decimal places, which means the x-intercept may very likely have more than 2 decimal places, which means it has been rounded off.

This shouldn't pose too much of a problem for the average student, because it is pretty rare that you will want more than 2 decimal places of precision for most problems and for most problems, the fractions that are encountered aren't so awful (they can usually be distinguished with just two decimal places).

If you are in need of more decimal places, it is possible to change the inputs to display more decimal places, which in turn would cause the outputs to display more decimal places. You'll have to figure that one out though. Be prepared for 'wonky' things to happen (things that will need to be fixed), because these spreadsheets are pretty particular about the number of decimal places matching up in all fields (ie if the output here is 4 decimal places, then the input over here must be specified to handle 4 decimal places too).

Why didn't I just set it up so that the output could display 10 decimal places? If I wanted the output to display to 10 decimal places, then the inputs would have to be written to 10 decimal places. This means that the number 3 would have to display as 3.0000000000, which takes up a lot of space and which I find annoying.

Chances are that most of the time you will be working with nicer numbers that won't require 10 decimal places for accuracy. However, numbers that require about 2 decimal places for accuracy are a bit more common.

Vertical Lines

There was no easy way to set up the spreadsheet to allow vertical lines. Since these are relatively rare

for the average student to encounter, I decided it wasn't worth the trouble trying to squeeze it on the spreadsheet for graphing. You cannot graph vertical lines on this spreadsheet.

Blank Fields

The spreadsheet regards a blank field as a 0 (zero). Leaving a field blank with no input is the same as putting a 0 (zero).

Printing

The spreadsheet has been formatted for printing. The spreadsheet will print 5 pages in the following way:

Page 1 – The Formula Section, which contains the equations being graphed and the points of intersections.

Page 2 – The Points Section, which contains the 10 points being graphed for each equation and x- and y-intercepts for each equation.

Page 3 – The Graph Section, which is the golden area and contains the graph. (Yes, the page will print with the gold, so beware if you are using color ink.)

Page 4 – The Equation Finder Section

Page 5 – The Notes Section

I doubt you would need all five pages every time you want to print. I would recommend printing only those pages you really need by selecting to print only specific pages in the Print window. For instance, if you only needed the equations and the graphs, then I would print only specifically pages 1,3 in the Print window.

Contact Information

I will set up a thread on my forum for this discussing the Linear Grapher Spreadsheet. The forum is located at the following url: http://www.algebrahut.com/mathforums/

Please use this forum to report issues, ask questions on how to use, and give feedback. I am also thinking of posting a how-to video at this forum to walk users through how to use this spreadsheet.

If this forum isn't working, you can also email me at dfaullin@dc3.edu.