

Using Microsoft Excel for Graphical Analysis

Introduction:

Much of the information we gather (data) during our study of chemistry will need to be either manipulated via further calculations or presented graphically. Once a tedious task, the last decade has seen computers of sufficient power arise to handle these problems in short order. Today, you'll be introduced to a spreadsheet program, Microsoft Excel, which will become invaluable as you explore data in the future.

When completed, you are expected to have sufficient skills to use this program in the future without assistance beyond this tutorial. You'll be given a few tasks to complete, each taking approximately 10-20 minutes.

Concept 1: Basic Data Entry and Calculation

Goal 1: Understand the cursors utilized by Microsoft Excel

Lesson 1:

- Begin this lesson by opening the Microsoft Excel program by either using the start menu or the task bar at the bottom of the Windows screen. Once open, you'll be presented with a set of row and columns. The rows are numbered numerically (1, 2, 3...), while the columns are labeled from A to Z and then from AA to AZ and then from BA to BZ and so on. The page you see in front of you is called a worksheet, and the entire document (Excel file) is a workbook. Note the tabs at the bottom of the grid that say "Sheet 1", "Sheet 2"... These are the individual worksheets of the workbook. More worksheets can be added if you like, but we won't do that today.
- At any point of the grid, you have what is referred to as a "cell" that is given the coordinates of column-row. For example, if you are in the upper left cell, you are in cell A1. Any cell can contain information of various types, such as a number, a word, a sentence, a date, or a day. If you can type it, it can go in the cell. Try typing a "1" in cell A1. Note that the cell has not become active (knows you have input any information) until you do one of the following:
 1. Press *Enter* on the keyboard
 2. Press the *Tab* key
 3. Click on another cell with the mouse

When entering data, be sure you activate the cell before doing anything else.

- You can move about the cells by the same methods as mentioned above. Pressing the Enter key will automatically activate the last cell and move you down the column. Pressing the Tab key will activate the last cell and move you across the row. Finally, clicking on a cell will activate the last cell and move you to whatever cell you click on. Try all of these right now.
- You may have noticed that the cursor takes on a few different shapes depending upon its placement on the worksheet. These are shown above in figure I. In (a), the most common cursor is found. Here, clicking will select the cell, while clicking and dragging will select all the cells you drag to. Investigate this by typing what you see in figure I into your worksheet and selecting the cells from A1 to C5.

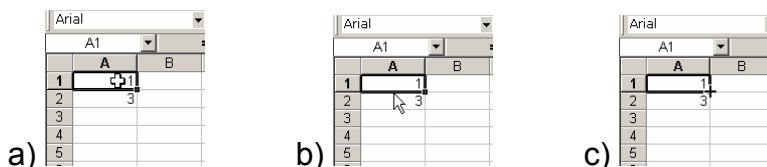


Figure I: Cursors in Excel allow for (a) selection, (b) movement, and (c) autofilling, depending upon where in a cell you place cursor.

- You may have noticed that the cursor takes on a few different shapes depending upon its placement on the worksheet. These are shown above in figure I. In (a), the most common cursor is found. Here, clicking will select the cell, while clicking and dragging will select all the cells you drag to. Investigate this by typing what you see in figure I into your worksheet and selecting the cells from A1 to C5.
- In figure I (b), an arrow is displayed whenever you place the cursor on the border of the selected cell or cells. Clicking and dragging with the arrow cursor will physically move the selected cells to where you want them. Try this by clicking on cell A1, positioning the cursor so that you see the arrow, and then moving cell A1 to cell E1. When you are done, move this cell back to A1.
- The third type of cursor allows you to “autofill” a section based upon trends in the data or a typed-in equation. This is investigated below, but you should try one here to see it in action. To get the “crosshair” cursor, you must move the cursor to the bottom right hand corner of the selected cell. For our example, select both the 1 and 3 in cells A1 and A2 by clicking on A1 and dragging until both A1 and A2 are highlighted (grey) as in figure II (a).



Figure II: An example of using auto fill in Microsoft Excel

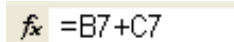
With these basic maneuvering skills in hand, you are ready to continue on.

Goal 2: Entering data, autofilling, entering and copying equations, and determining the average of data.

Lesson 2:

- In columns B1-G1, type the titles of the columns as Data 1, Data 2, Sum, Product, Difference, and Ratio.
- In cell B2 type 1, and in cell B3 type 3. Select both cells by pointing at cell B2 and pressing the mouse button down, holding it down as you drag to cell B3. Release the mouse button. Now position the cursor so that it is at the bottom corner of cell B3. It should be a crosshair. Click and hold the mouse button, and then drag the cursor until the cell B12 has been activated. Release the cursor.

- In cells C2-C12, input any numbers you like by individually entering the numbers into each cell.
- You now want to add the two columns (B and C) where there is data. To do so, simply select cell D2, type equal (=) and then click on the cells B2 and C2. Press enter.
- To copy this equation for the entire column, select the cell D2 and once again use the crosshair cursor to drag the equation down to cell D12. Click on cell D7 and make sure the formula bar (above the spreadsheet) has the correct equation for that cell. The formula bar should read “=B7+C7” as shown below in figure III.



The image shows a close-up of the Excel formula bar. It contains the text "=B7+C7" preceded by a small icon of a function symbol (fx). The formula bar is highlighted with a light yellow background.

Figure III: The formula bar

- To find the product of the columns B and C, we enter an equation into cell E2 and copy it down to E12. The “*” represents multiplication in Excel, so the formula bar should read “=B2*C2” for cell E2. Copy this equation down to E12.
- With the above knowledge, it should be very easy to find the difference and ratio of the two columns. Try this on your own. If you have difficulty, see if your partner can help. If this does not work, then ask your TA.
- With all the data in place, we can now find the average of all the columns. You have left column A empty for labels, so let's label row 14 with the word “Average”. In other words, select A14 and type “Average”.
- Excel comes with some useful formulas in its memory. So, instead of having to type out the equation for the average, we can use the Excel formula for the average. This is done as follows: in cell D14, type “=average(“. At this point, you have told Excel you want to take the average of some cells, but now you need to tell it which ones. So select all the cells from D2-D12. This is done by pointing at D2, clicking the mouse button and holding it down, and then dragging the mouse button down to D12. Release the mouse button. Now finish the equation in the formula bar by typing in the right parenthesis. The final look of the formula bar should be “=average(D2:D12)”.
- Copy this formula across from D14 to G14.

Goal 3: Practice topics covered in Lesson 2, inserting columns or rows, and making your data look good (formatting).

Lesson 3:

- Create five headings labeled as Name, Exam 1, Exam 2, Exam 3, Final Exam, and Total in columns B1-F1.
- Enter the names and grades for the 6 people in the class that appear below.

<u>Name</u>	<u>Exam 1</u>	<u>Exam 2</u>	<u>Exam 3</u>	<u>Final Exam</u>
Mark	75	86	80	91
Heather	80	86	74	90
Angela	61	90	85	88
Jared	68	79	93	86
Christine	91	75	86	83
Walter	99	98	99	97

- Determine the total percentage for each student, allowing for the fact that the final exam is worth twice as much as the three hour exams. This is done by adding the three hour exam scores to twice the final exam score, then dividing this sum by 5.
- Determine the average for each exam and the totals. Do this by typing “Average” into cell A9. Then, in cell C9 make the formula for the average of Exam 1. Copy this formula all the way across for all the data columns.
- Suppose that there was a pop quiz on the last week, and you needed to add this to the grade sheet. Do this by first inserting a column: select the entire Final Exam column (click on the letter at the top of the column). Right click on any part of the highlighted column and select “Insert”. A column is placed for you in between Exam 3 and the Final Exam columns. Each student scored an 8 on the quiz, so enter the scores.
- You now need to update the Totals column by changing the formula for the student in cell G2. The total is now out of 510 points, so divide by 5.1 instead of 5. Also, you need to add the quiz points to your numerator.
- With the scores as they are, you now want to sort the data. Let’s put the data into alphabetical order based upon the last names. Select the entire table from B2-G7. Now go to “Data” on the menu and drag down until you see “Sort”. When it comes up, it will ask you what you want to sort by, and the first column will be chosen as the default. Say OK to this selection and the data will be sorted.

Concept 2: Graphing and Data Analysis

Goal 1: Create a graph of some experimental data in Microsoft Excel, and then analyze the trend in the data by fitting the data to a straight line. The equation for the straight line is given by the program, yielding the slope and y-intercept.

Lesson 1:

- Begin by opening the spreadsheet labeled “graph data” on your desktop. You can simply double click this file to open it in MS Excel.
- You should see a nice table of numbers representing a simulated kinetics experiment. Don’t worry that your data isn’t exactly what your neighbor has in their sheet, the values for the concentration are *randomly* chosen by the compute.
 - *see how this is done by clicking on one of the cells and viewing the formula bar*
- The data is presented as ‘ordered pairs’, meaning that each row represents a concentration measured at some particular time during the experiment. This also means that the time is our independent data, while the concentration is the dependent data. In other words, column B is our x-data and column C is our y-data.
- Select the data in the table (not the column labels, though).

- Click on the “Chart Wizard” icon in the toolbar. An example of what you might see in the toolbar region is given in Figure IV, below. Note that the Chart Wizard icon is the 2nd icon from the right and looks like a bar graph.



Figure IV: A typical toolbar region in MS Excel. The Chart Wizard is located 2nd from the right in this image, but may appear in a different position in your toolbar.

- Immediately, the chart wizard will come up on your screen. Its first order of business is to have you select the type of chart you will create. Since we are dealing with ordered pairs, you should choose the “XY (Scatter)” option by clicking on it (a blue highlight will appear).
- The types of charts available to you are on the right panel of step 1 of the wizard. When you selected the XY (Scatter) option, the sub-types changed. Our data represents individual data points, so we should plot them as such. The default choice is usually the Scatter plot, but make sure the upper most subtype is selected, as in figure V. Most, if not all, of the plots you make in this course will use this sub-type.

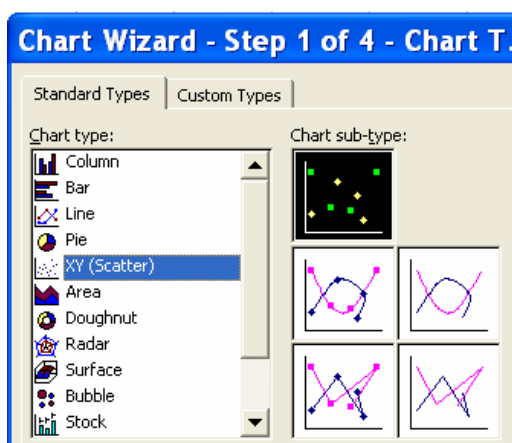


Figure V: Step 1 of 4 in the Chart Wizard. In this example the XY (Scatter) option has been selected with a sub-type without lines.

- Click the “Next” button of the wizard twice to move to step 3. In this step, you will fill in the axis title for both the independent and dependent variables. Type in the corresponding names (with unit labels) into the spaces provided.
 - While you’re at it, let’s get rid of those pesky gridlines. Click on the ‘Gridlines’ tab and uncheck the box that says “Major gridlines”.
- Click the “Next” button to move to step 4 of the wizard. Here you have the option of placing your graph on the same page as the data you have used, or having the graph appear in a totally new worksheet. Choose “As new sheet” and leave the default name. Click finish to see your graph, which might look like that in Figure VI.
 - While you have a moment, take the time to investigate the marker used in your graph. Often times, you’ll need to change its color or shape to suit a particular need (or just because you like triangles over circles). To make a change, double click on one of the data points to bring up “Format Data Series” dialog box.

- The default for this dialog box is the “Patterns” tab, which is where we want to be. The right side allows you to change the properties of the markers used to represent your data points, while the left side allows you to format any lines on the graph. Change the shape of the marker by clicking on the style drop down menu and choosing the triangle shape (Δ). Change the background color to “no color”. Finally, change the size to 7 pts. Click OK to see the changes.
- Your job is not finished, however. This data is graphed, but we might be able to learn from the trend we see. That is, the data is linear, so it is useful to “fit” the data with a straight line and get the equation for that line. Luckily, MS Excel has a simple, built in method of doing this, called a “trendline”.

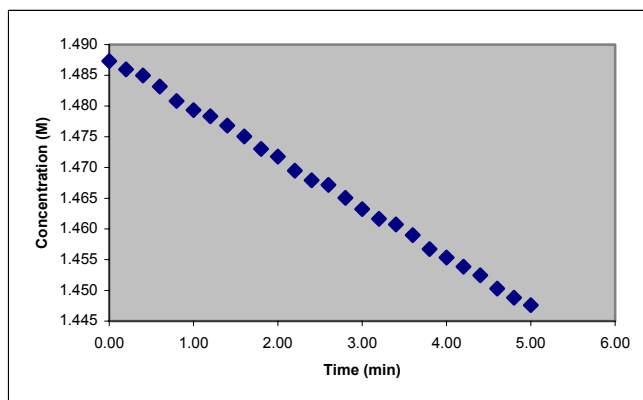


Figure VI: The finished plot of the data points only.

- To create a trendline, simply right click on any data point in the graph, and then choose “Add Trendline” from the drop down menu. The data looks linear, so choose the linear option in the ‘trend/regression style’ gallery in Add Trendline dialog box.
- To add the equation of your line to your plot, click on the “Options” tab. Now select “Display Equation on Chart” and “Display R-Squared Value on Chart”. Click OK.
- Note that the equation displayed used x and y for the axis variables. These are not the names of our axis. Single click on the equation to activate this text box, and then change the “x” and “y” into their respective variables. This should look like Figure VII when you are all done.

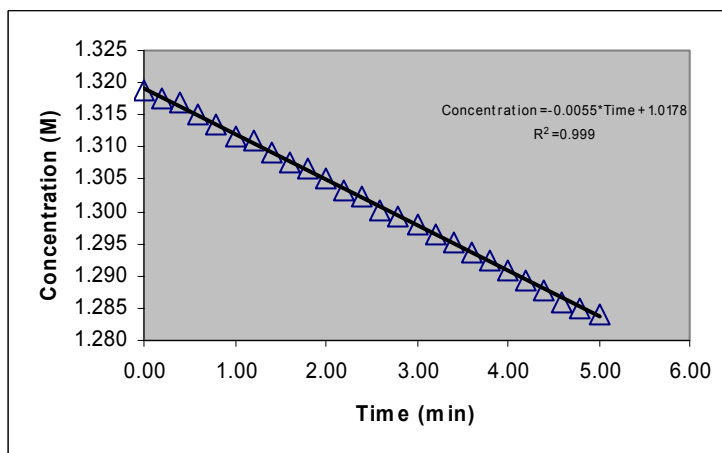


Figure VII: Your finished plot with trendline, equation of line and data points