Excel for Algebra [1]

Lesson 1: Basic Concepts and "Button-ology"

What's a "spreadsheet"? What does "cell" mean?

A spreadsheet consists of a table of cells. Columns of the spreadsheet are named: A, B, C, and so on. Rows of the spreadsheet are numbered: 1, 2, 3, and so on. Cells are identified by their row name and column number, such as **G6** for the cell in column G, row 6.

Every cell contains exactly one of:

- a number (examples: **12** and **-15.3**)
- a string, or text, consisting of letters and other characters (examples: **Radius** and **Area from radius**)
- a formula, starting with an equals sign (examples: **=10*(-3/4)** and **=PI()*G6^2**).

Any cell that contains a formula also has a numeric value that results from evaluating that formula, given the values of any other cells that it refers to. The formula value is kept updated by re-evaluating the formula whenever there is a change to any cell that the formula references.

Fractional representation (say, ¾ = 0.75) cannot be used except inside a formula. If you enter just **3/5** in a cell, Excel will think you mean a date: **5-Mar** (March 5th). To get the fraction meaning, you have to write **=3/5**.

Internally, all arithmetic is done using "floating point binary" numbers. For almost all purposes, you can think of numbers as decimal fractions that have around 15 digits of accuracy.

By default, numbers are displayed as integers (**123**) or decimals (**1.23**), or in scientific notation if they're very large or small ($0.00000000045 = 4.5 \times 10^{-10}$ displays as **4.5E-10**). You can select other formats, such as fractions or percentages. If you enter a percentage, say **30%**, then Excel will store the equivalent decimal value (0.30) and will set the display format for that cell to Percentage. Any decimal value can also be displayed as a Percentage – it just means "for display purposes, multiply by 100 and add a percent sign at the end".

Those formulas don't look like the ones I'm used to. What's up?

Excel and most other computer applications use a mathematical notation that is different from standard algebra. An algebra book will list the formula for area of a circle as $A = \pi r^2$. In Excel, that formula might appear as **=PI()*G6^2** , where the radius *r* is stored in cell **G6** and the formula itself is typed into any other cell.

Following are some common differences that you need to be aware of:

Concept	Standard Algebra Notation	Excel Notation
variable	single letter *or* words or multi-letter names *or* occasionally, multi-word phrases	• column/row reference to another cell • named reference to another cell: 3 or more letters, optionally followed by any combination of digits, underscores (_), periods, and/or more letters
multiplication	not explicitly indicated (*V=lwh)*, or any of several special symbols: · x ⊗ .	* *(asterisk)*
division	fraction bar, division bar, or division operator ÷	/ *(forward-slash)*
raising to an integer power	$(\text{expression})^3$ or $(\text{expression})^{-4}$	(expression)^3 *(carat)* or (expression)^(-4)
raising to any real power (non-negative base only)	$(\text{expression})^{4.5}$	(expression)^4.5
square root	$\sqrt{5}$	SQRT(5)
N-th root (non-negative base only)	$\sqrt[6]{64}$	64^(1/6)
odd root of negative number	$\sqrt[3]{-8}$	*(-8)^(1/3), but doesn't work in some versions*
absolute value	|-13|	ABS(-13)
floor function — largest integer not greater than	$\lfloor -4.5 \rfloor$ *gives -5* *See footnote[2] about notation.*	INT(-4.5)
standard constant: pi	π	PI()
standard constant: *e*	*e*	EXP(1)

[2] This very useful function highlights the importance of knowing what various notations mean. http://mathworld.wolfram.com/FloorFunction.html notes that "in many older and current works...the symbol [*x*] is used". In Excel, the FLOOR function is something different; FLOOR(-4.5) is not even defined. And in many other computer languages and applications other than Excel, the function named "INT" will turn -4.5 into -4, not -5, and some different name is required to get the floor function.

How do I enter and see formulas?

To enter a formula, just click on a cell to select it, type an "=" (equal sign), then any arithmetic expression. In the expression, if you want to refer to the value in another cell, just click on that cell and Excel will enter the name of that cell for you. When you hit the "Enter" key, the formula itself becomes hidden, and the corresponding value appears instead. The formula is still there, however — you just can't see it at the moment.

To see formulas, the key combination **ctrl-`** switches the entire spreadsheet between displaying values and displaying formulas. (**ctrl-`** means to hold down the Ctrl key, then press the grave-accent key. If you have trouble finding the grave-accent key, look for the tilde ~ . They are usually on the same key, at upper left of keyboard.)

Now, about names... Every cell has at least one name — the combination of its column name and its row name. C9 means the cell in column C, row 9. It's possible to define your own "friendly" names, but this is an advanced topic and is not recommended because it almost always causes problems in the long run. There is also another notation you may run into if you receive spreadsheets from someone else — see footnote[3].

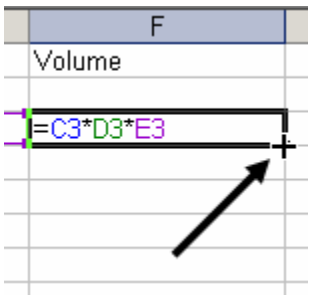
To repeat, it's generally best to refer to cells by their column-row names, like **C4**.

This allows, for example, to easily make a table of box measurements in which column C contains a number of different widths, columns D and E contain the corresponding lengths and heights, and column F contains a series of formulas that give the volume (volume = width*length*height). For example (assuming that **ctrl-`** has been pressed so that formulas are displayed):

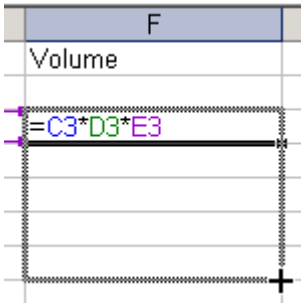
	A	B	C	D	E	F
1			Width	Length	Height	Volume
2						
3			5	10	15	=C3*D3*E3
4			7	9	11	=C4*D4*E4
5			9	9	12	=C5*D5*E5
6			12	12	12	=C6*D6*E6
7			5	10	15	=C7*D7*E7

[3] Excel also supports another notation, called "R1C1", in which cells are referenced by names like R14C5 meaning "row 14, column 5", or RC[-2] meaning "same row, 2 columns to the left". You can switch back and forth between R1C1 notation and the notation used in this document, by going in the menu system to Tools > Options, selecting the tab named General, then checking or un-checking the box labeled "R1C1 reference style".

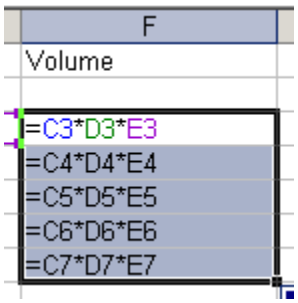
A table like this can be constructed quickly by entering the formula in just one cell (at F3, enter **=C3*D3*E3**). Then, "stretch" the formula by selecting its cell, placing your cursor over the little box at lower right corner, then press-and-dragging to stretch the box over multiple cells. For example:



stretched



gives



Notice that cell references inside the formula are modified so that new copies of the formula refer to different cells. Stretching vertically changes the row numbers, as in this case. If you stretched horizontally, the column names in the formula would change.

You can move cells, or blocks of cells, by selecting and dragging them. You can cut or copy, then paste cells or blocks of cells by using ctrl-X or ctrl-C, then ctrl-V, or by using the Edit menu.

Important: cell references that use column names and row numbers may change any time you move a formula, or copy and paste it, or stretch it. Whether this happens depends on whether the column name and/or row number is preceded by a dollar sign "$". The dollar sign prevents updating. For example, if you move a formula 2 columns to the right and 4 columns down, then:

- **=C4** becomes **=E8** (both row and column updated: C→E, 4→8)
- **=$C4** becomes **=$C8** (only row updated, 4→8)
- **=C$4** becomes **=E$4** (only column updated, C→E)
- **=C4** becomes **C4** (no change)

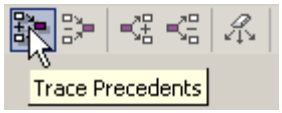
This feature can be very powerful, but also very dangerous. It is easy to end up with a formula that is incorrect after it has been moved or stretched, because a cell reference was modified when it should not have been, or vice versa. You should check that your formulas remain as you intended, anytime you move or stretch one.

Using names like C5 make my formulas hard to read. How can I be sure the references are what I intended?

Cell references can be visualized in two ways. First, whenever you have a formula selected, the formula and corresponding cells are highlighted and color-coded to match:

C	D	E	F
Width	Length	Height	Volume
5	10	15	=C3*D3*E3
7	9	11	=C4*D4*E4
9	9	12	=C5*D5*E5
12	12	12	=C6*D6*E6
5	10	15	=C7*D7*E7

Second, you can use the Formula Auditing toolbar to have Excel draw arrows from the referenced cells into the formula cell. To do that, select the formula cell, then click the Trace Precedents button:



gives

C	D	E	F
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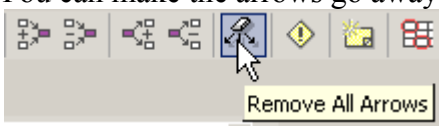
7	9	11	=C4*D4*E4
9	9	12	=C5*D5*E5
12	12	12	=C6*D6*E6
5	10	15	=C7*D7*E7

If you can't find the Trace Precedents button, be sure that the Formula Auditing Toolbar is displayed. To do that, click into the menu system View > Toolbars, and be sure there is a checkmark next to Formula Auditing.

When you start Trace Precedents, you can only have one formula selected. However, if your formulas form a chain or a tree, you can get arrows that show various steps in the chain or tree by clicking the Trace Precedents button again and again. In this case, arrows will be drawn for all cells at the same step, no matter how many there are.

You can make the arrows go away by clicking

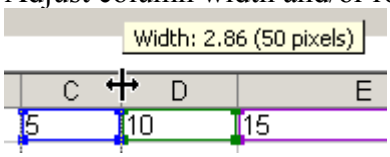


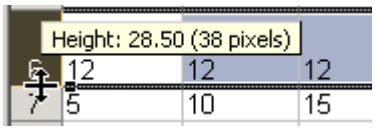
How can I make my spreadsheet prettier?

Here are some easy things that help:

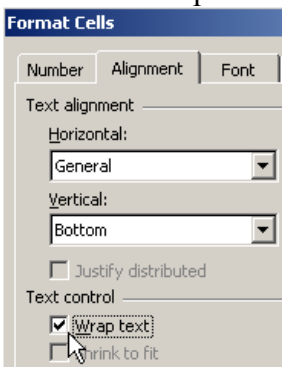
- Set text size, font, and attributes (color, bold, italics)

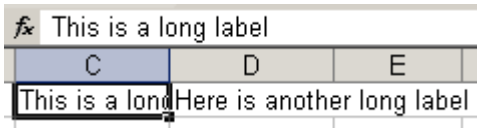
- Adjust column width and/or row height by sliding the separators:



or


- Make text "wrap" within a cell. To do this, use Format > Cells > Alignment tab, and check the "Wrap text" box.

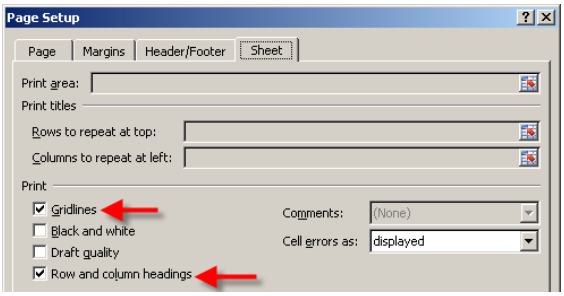


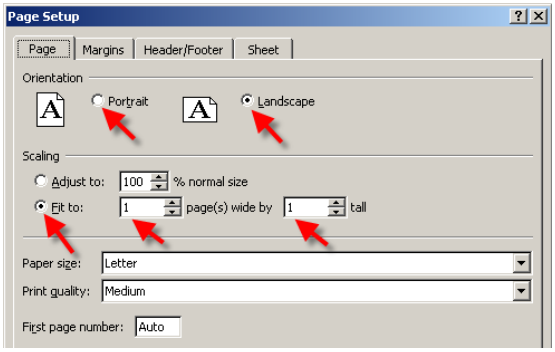


becomes


How about controlling printouts?

There are options to print column and row headings, to print gridlines, to adjust page layout (portrait versus landscape), and to force printouts to fit on a certain number of pages. All of these options can be accessed through Print Preview, by clicking Page Setup. This will bring up a dialog as shown below. The dialog has four tabs; the options you care about are on the Sheet and Page tabs.





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