

CHAPTER 9: INTRO TO FUNCTIONS

“Cats are intended to teach us that not everything in nature has a function.”

– Not unknown, but unwilling to be identified

Functions are pre-defined features of the general form: $=fNAME(a, b, \dots n)$ where $fNAME$ is the function's name, and $a, b, \dots n$ are that function's complement.

FUNCTION RULES

The rules for working with functions are pretty easy:

- The complement must be entered in precise order.
- Elements of the complement are separated by commas.
- Although Excel is very forgiving about extraneous spaces, it is recommended that no spaces appear in a function, unless they are within a string.
- Function names are *not* case sensitive.

USING SUM()

The most common function is the SUM() function. The general form is:

=SUM (Range)

where *Range* is any range.

To illustrate the SUM() function, consider the following table:

	A	B	C	D	E
1		1			
2		2			
3		3			
4					

To place the sum of the cells B1, B2, and B3 in cell B4:

Step 1: Move to cell B4.

- This is where you want the sum to appear.

Step 2: Type:

=sum (

Step 3: Press **↑** once, to move to one corner of the range.

Step 4: To select the range, hold down **Shift**, and tap **↑** twice.

- Each tap will expand the range.

Step 5: When you have selected the range you want to total, B1:B3, type a right parenthesis, **)**, to close the group.

- At this point, the worksheet should look like this:

	A	B	C	D	E
1		1			
2		2			
3		3			
4		=sum(B1:B3)			

Step 6: Press **↵Enter** to lock the formula into the cell.

Now, move the cursor back to cell B4. What does cell B4 contain? (It will appear in the Formula bar.)

=SUM (B1 : B3)

What does cell B4 display?

6

To see the wonder of spreadsheets, go to cell B1, type a new number, and press **↵Enter**. What this do to cell B4?

OTHER RANGE FUNCTIONS

Three other common functions work very much like the SUM() function:

- =MAX(*Range*) returns the largest number in a range.
- =MIN(*Range*) returns the smallest number in a range.
- =AVERAGE(*Range*) returns the arithmetic mean of all the numbers in a range.

DISPLAY FORMULAS

If a cell's contents are hard to read from the Formula bar, try pressing **F2**. This places you in Edit mode, and displays the formula in the body of the worksheet until you press **↵Enter**.

To display all the formulas in a worksheet, press **Ctrl ~**. (The tilde, ~, is in the upper-left of the keyboard, just below **Esc**.) This will widen cells to accommodate the length of formulas. To return to the normal view, where the results are displayed, press **Ctrl ~** again.

AUTOSUM




Excel's AutoSum feature can make the SUM() function even easier:

Step 1: Duplicate this spreadsheet:

	A	B	C	D
2	Food	1,000.00		
3	Insurance	486.44		
4	Food	3,000.00		
5	Gas	227.88		
6	Total			

Step 2: Now, move to cell B6.

Step 3: To invoke the AutoSum, either:

-  click the AutoSum icon, , and press **↵Enter**, or,
-  press **Alt =** and press **↵Enter**.

LIMITATIONS


Instead of typing the SUM() function, beginners are beguiled into thinking that using AutoSum is easier. I strongly discourage you from using this tool.


Let's try this experiment.


Step 1: Duplicate the following spreadsheet:

	A	B	C	D
1		1999	2000	2001
2	Food	1,000.00	1,200.00	1,300.00
3	Insurance	486.44		
4	Food	3,000.00	3,300.00	
5	Gas	227.88	200.00	
6	Total			

Step 2: Now, move to cell B6.

Step 3: Click the AutoSum icon, , and press **↵Enter**.

Step 4: Move to cell C6, click the AutoSum icon, , and press **↵Enter**.

Step 5: Move to cell D6, click the AutoSum icon, , and press **↵Enter**.

Do you see how fast you get answers? They are wrong, of course, but it was really, really fast! (I know, you don't need the sarcasm, but my point is that you cannot be fast enough to compensate for inaccuracy. Fast is important, but it is always second to accuracy.)

In cell B6, AutoSum included the year in the calculation. In C6, AutoSum returned 3,500.00; it included the numbers in the column above it—up to the first empty cell, that is.

Now, the people at Microsoft are intelligent, and they would not have given you the AutoSum feature if there was not an easy way—several ways, in fact—to solve these problems. Still, the easiest, and most accurate way is to avoid it altogether in favor of the keyboard method. In addition, if that's the right word, typing the SUM() function prepares you for functions yet to come.

AUTOCALC

Excel has a feature called AutoCalc, which displays the sum of a range without typing. To see this, select a range of numbers. Their sum will appear in a box in the status bar, at the bottom of the screen.

You can have AutoCalc perform other operations by doing the following:

Step 1: Right-click the status bar.

Step 2: On the resulting shortcut menu, select the desired operation.

- AutoCalc calculates accordingly until you change the operation again.

#NAME?

Let's examine a new function, DYLAN():

	A	B	C	D
1	1			
2	2			
3	=DYLAN(A1:A3)			
4				

Unfortunately, there is no DYLAN() function. If you a function that Excel doesn't recognize, Excel will display:

#NAME?

in the cell. Usually, of course, this results from a spelling misadventure.

TEXT REVISITED

As you recall, a cell can contain:

- text;
- a number; or,
- a formula.

You enter text and numbers simply by typing them. To enter a formula, though, you must tell the machine, by first typing an equal sign, [=]. Excel also allows you to start a formula with [+], [@], or [-], to accommodate refugees from Lotus® 1-2-3.

But what if you want this:

	A	B	C
1	\$2,000	= the new limit	
2			
3	My doman is:	@yale.edu	
4			

If you enter the data as it appears, the results will be:

	A	B	C
1	\$2,000	#Name?	
2			
3	My doman is:	#Name?	
4			

Excel displays: #Name?, because it thinks you are trying to start a formula or function that it doesn't understand.

To start a string of text with one of these characters, precede it with the apostrophe, [']. The single quote says, in effect, "What follows is text." The apostrophe itself will not appear:

	A	B	C
1	\$2,000	= the new limit	
2			
3	My doman is:	'@yale.edu	
4			

NESTED FUNCTIONS

Excel allows you to nest functions. A nested function is one that uses another function as part of its argument. There are only two restrictions:

- You may nest up to seven levels of functions.
- The nested function must return the same value type as the argument.

We will deal with nested functions in the next few chapters.

CIRCULAR REFERENCES

Consider the following spreadsheet. What is the result of the formula in cell A3?

	A	B	C	D	E
1	1				
2	2				
3	=SUM(A1:A3)				
4					

This is known as a circular reference. A circular reference is one that uses the results to calculate the results to calculate the results to calculate . . . *ad infinitum*. A formula or function that contains a circular reference is a bad thing.

If you create a circular reference, Excel will open the Circular Reference toolbar and mark the cell with a ♦, as shown in Figure 173.

	A	B	C	D
1	1			
2	2			
3	♦ 0			




Figure 173

In addition:

Circular:A3


will appear in the Status Bar.

HANDLING CIRCULAR REFERENCES

It is important to deal with circular references immediately:

Step 1: Move the cursor back to the cell that contains the circular reference.

- It will be noted in the status bar; and,
- it will be marked with a ♦; and,
- if it's *still* not clear to you which of the cells contains the circular reference, it will be listed in the drop-down box of the Circular Reference toolbar.

Step 2: Click the Trace Precedents icon,  on the Circular References toolbar.

- Excel will display the cells that are used to calculate the results in the formula, as shown in Figure 175.
- It should be clear which cell is causing the problem.

	A	B	C	D
1	1			
2	2			
3	0			

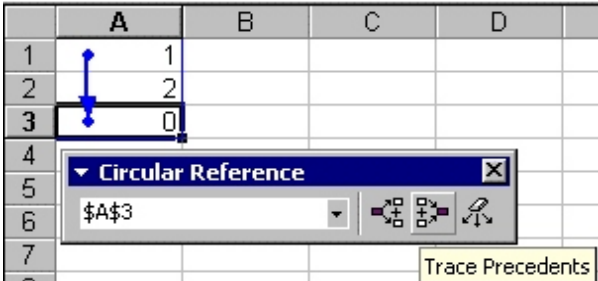


Figure 175

Step 3: Press **(F2)** to go into Edit mode.

Step 4: Correct the formula and press **(←Enter)**.

After successfully eliminating the circular reference, the Circular Reference toolbar will go away, and the status bar will clear.

TROUBLESHOOT CIRCULAR REFERENCES

It's important to deal with a circular reference immediately, because if you close the Circular Reference toolbar, the only reminder that you have a problem is the message in the Status Bar—and Murphy's Law says you will overlook that.

If you accidentally close the Circular Reference toolbar:

- From the pull-down menu, select **V**iew, **T**oolbars, **C**ircular Reference.

Then, fix the circular reference as you normally would.

Circular references usually occur, as in this example, by selecting an incorrect range. They can also result when one cell refers to another that refers to another that . . . eventually refers back to the first, as shown in Figure 176.

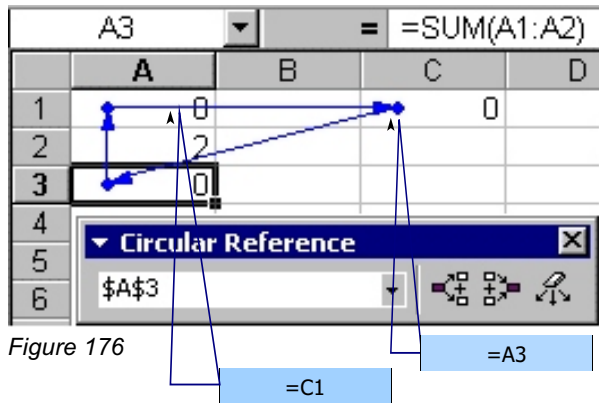


Figure 176

EXPONENTIALS

In addition to the common arithmetic operators (+, -, *, and /), the circumflex (^) serves as the exponential operator. Its general form, $x ^ y$, is equivalent to x^y . Thus:

- 2 ^ 2 returns 2², or 4
- 3 ^ 3 returns 3³, or 9
- 10 ^ 2 returns 10², or 100

POWER() FUNCTION

Excel also provides a helpful function for working with exponentials. In its general form,

=Power (x,y)

returns x to the y power, or x^y , as shown here:

	A	B	C	D
1		2	2	4
2		2	4	16
3		2	6	64
4		2	8	256
5		2	10	1024

=POWER(B5,C5)

NOTES

LAB 3: FUN WITH FUNCTIONS

“I do hate sums. There is no greater mistake than to call arithmetic an exact science. There are permutations and aberrations discernible to minds entirely noble like mine; subtle variations which ordinary accountants fail to discover; hidden laws of number which it requires a mind like mine to perceive. For instance, if you add a sum from the bottom up, and then again from the top down, the result is always different.”

– Mrs. La Touche

This is one of those labs where we are training your finger as much as we are training your brain.

SIMPLE EXAMPLE

Adding things up is one of the most common problems in spreadsheets. In fact, by some estimates the Sum function is used more than all the other functions combined! Let's do a simple example.

Step 1: Recreate this spreadsheet:

	A	B	C	D	E
1		1			
2		2			
3		3			
4	Total				

Step 2: Move to cell B4, where you want the total to appear.

Step 3: Type:

=sum (

Step 4: To go to one corner of the range, press **↑**.

Step 5: To select the range, hold down **Shift**, and tap **↑** twice.

Step 6: When you have selected the range you want to total, B1:B3, type the right parenthesis, **)**.

- At this point, the worksheet should look like this:

	A	B	C	D	E
1		1			
2		2			
3		3			
4	Total	=sum(B1:B3)			

Step 7: Press **↵** to lock the formula into the cell.

GRADE BOOK EXAMPLE

Here's a similar problem. Your teacher has seven students and gives three exams this semester. She wants to know:

- the top score on each test;
- the lowest score on each test;
- the average score on each test; and,
- each student's average score.

Set up the spreadsheet so it looks like this:

	A	B	C	D	E
1	Student	Test 1	Test 2	Test 3	Average
2	Alan	90	80	70	
3	Bill	65	65	65	
4	Cindy	92	81	65	
5	David	86	77	81	
6	Earl	75	60	79	
7	Fred	100	92	93	
8	George	66	58	36	
9	Hillary	90	59	83	
10	Average				
11	Best score				
12	Worst score				

CALCULATE AVERAGE FOR EACH TEST

Step 1: Move to cell B10, where you want the average of the scores from Test 1 to appear.

Step 2: Type:

=average (

Step 3: To move to one corner of the range, press **↑**.

Step 4: To select the range, hold down **Shift**, and tap **↑** seven times.

Step 5: When you have selected the range you want to total, B2:B9, type right parenthesis, **)**.

- Your worksheet should look like this.

	A	B	C	D	E
1	Student	Test 1	Test 2	Test 3	Average
2	Alan	90	80	70	
3	Bill	65	65	65	
4	Cindy	92	81	65	
5	David	86	77	81	
6	Earl	75	60	79	
7	Fred	100	92	93	
8	George	66	58	36	
9	Hillary	90	59	83	
10	Average	=average(B2:B9)			
11	Best score				
12	Worst score				

- If it doesn't, press **Esc**, and start again.

Step 6: If it looks like it should, press **↵** to lock the formula into the cell.

Now, simply repeat these steps for cells C10 and D10. There is, of course, an easier way to do this, but our focus here is making sure we have trained your fingers.

CALCULATE THE BEST SCORE FOR EACH TEST

Step 7: Move to cell B11, where you want the largest score from Test 1 to appear.

Step 8: Type:

=max (

Step 9: To move to one corner of the range, press **↑** twice.

Step 10: To select the range, hold down **Shift**, and tap **↑** seven times.

Step 11: When you have selected the range, B2:B9, type a right parenthesis, **)**.

- Your worksheet should look like this:

	A	B	C	D	E
1	Student	Test 1	Test 2	Test 3	Average
2	Alan	90	80	70	
3	Bill	65	65	65	
4	Cindy	92	81	65	
5	David	86	77	81	
6	Earl	75	60	79	
7	Fred	100	92	93	
8	George	66	58	36	
9	Hillary	90	59	83	
10	Average	83.0	71.5	71.5	
11	Best score	=max(B2:B9)			
12	Worst score				

- If it does not, press **Esc**, and start again.
- Now, take a look at the numbers. What should the answer be?

Step 12: If it looks like it should, press **↵** to lock the formula into the cell.

- The answer, of course, is 100—the highest number in the range.

FINE THE WORST SCORE

Step 13: Move to cell B12, where you want the lowest score from Test 1 to appear.

Step 14: Type:

=min (

Step 15: To move to one corner of the range, press **↑** three times.

Step 16: To select the range, hold down **Shift**, and tap **↑** seven times.

Step 17: When you have selected the range you want to total, B2:B9, type a right parenthesis, **)**.

- At this point, the worksheet should look like this:

	A	B	C	D	E
1	Student	Test 1	Test 2	Test 3	Average
2	Alan	90	80	70	
3	Bill	65	65	65	
4	Cindy	92	81	65	
5	David	86	77	81	
6	Earl	75	60	79	
7	Fred	100	92	93	
8	George	66	58	36	
9	Hillary	90	59	83	
10	Average	83.0	71.5	71.5	
11	Best score	100	92	93	
12	Worst score	=min(B2:B9)			

- if it does not, press **Esc**, and start again.
- Again, before you do the next step, take a look at the numbers. What should the answer be?

Step 18: If it looks like it should, press **Enter** to lock the formula into the cell.

- The answer, of course, is 65—the smallest score in the range.

Step 19: repeat these steps for cells C11 and D11.

- There is an easier way to do this, but your fingers can use the exercise.

CALCULATE STUDENT AVERAGES

Before we calculate Alan's average, let's take a look at it. Without worrying about the spreadsheet, what should the answer be? The average of 90, 80, and 70 is 80. Let's see if Excel agrees:

Step 20: Move to cell E2, where you want Alan's average to appear.

Step 21: Type:

=average (

Step 22: To move to a corner of the range, tap **←** once.

Step 23: To select the range, hold down **Shift**, and tap **←** two more times.



Step 24: When you have selected the range, B2:D2, type the right parenthesis, **)**.

Step 25: Press **Enter** to lock the formula into the cell.

- The answer, of course, is 80.

Step 26: Repeat these steps for cells E3 through E9.

We only want the answers to the nearest tenth:

Step 27: Select column E, and click  to increase the number of decimal places that appear, or  to decrease the number of decimal places.

- The results should look like this:

	A	B	C	D	E
1	Student	Test 1	Test 2	Test 3	Average
2	Alan	90	80	70	80.0
3	Bill	65	65	65	65.0
4	Cindy	92	81	65	79.3
5	David	86	77	81	81.3
6	Earl	75	60	79	71.3
7	Fred	100	92	93	95.0
8	George	66	58	36	53.3
9	Hillary	90	59	83	77.3
10	Average	83.0	71.5	71.5	
11	Best score	100	92	93	
12	Worst score	65	58	36	

NOTES

