

Calculations in Excel

Spreadsheet formulas
Functions

Spreadsheet formulas




- Spreadsheets can be used to do a wide range of calculations, data analysis
 - Basic arithmetic
 - Built-in functions
- Functions can be “nested” and combined
- This is the reason to use spreadsheets

Cell formulas: basic arithmetic




- Use an “=” to start a formula
- Arithmetic operators are:

Operation	Symbol
Addition	+
Subtraction	-
Multiplication	*
Division	/
Exponent	^

Entering formulas, getting the results

SUM		:	  		=1+2				
	A	B	C	D	E	F	G	H	
1									
2									
3					=1+2				
4									

Editing a cell – the formula bar and the cell itself show the formula

E3		:	  		=1+2				
	A	B	C	D	E	F	G	H	
1									
2									
3					3				
4									

After hitting Enter, the formula bar still shows the formula, but the cell shows the result

B	C
Formula	Result
=3^2	9
=9^1/2	4.5
=9^(1/2)	3
=9^0.5	3
=9^-0.5	0.333333
=8^(1/3)	2

Parentheses used
to determine order
of operations

Operations inside
parentheses done
first



Comparison operators

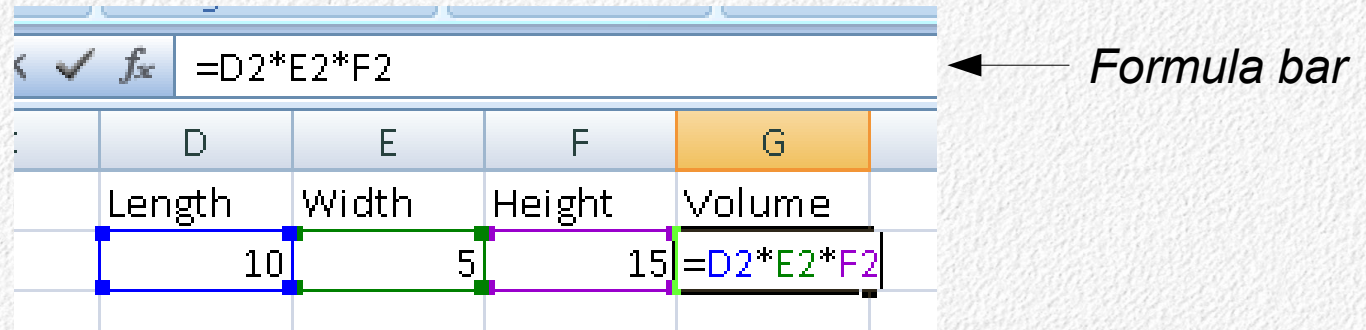
- Used to compare one value to another
- Return only “True” or “False”
 - True is equal to 1 to a computer
 - False is equal to 0
- = , equals
- > , greater than
- < , less than
- >= , greater than or equal to
- <= , less than or equal to
- <> , not equal to

F	G
Formula	Result
=1=0	FALSE
=1>0	TRUE
=1<0	FALSE
=1>=0	TRUE
=1<=0	FALSE
=1<>0	TRUE

Cell references

- Spreadsheet formula in one cell often uses data in another cell(s)
 - If the data changes, the formula automatically re-calculates, updates formula's result
- Pointers to other cells are cell references
- Cell references can be absolute or relative
 - Absolute = refers to a particular cell, won't change if the formula is copy/pasted elsewhere
 - Relative = refers to a cell by its position relative to the cell that holds the formula, changes if the formula is copy/pasted elsewhere

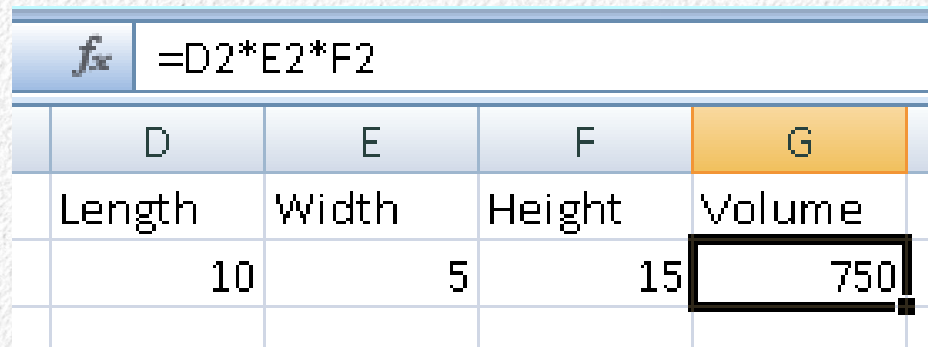
Example: relative references



A screenshot of an Excel spreadsheet. The formula bar at the top shows `=D2*E2*F2`. An arrow points to the formula bar with the label "Formula bar". The spreadsheet has columns D, E, F, and G. Row 1 contains the headers "Length", "Width", "Height", and "Volume". Row 2 contains the values "10", "5", and "15". The cell G2 is selected, and its formula bar shows `=D2*E2*F2`. Colored lines connect the formula cells to their respective data cells: a blue line from D2 to D2, a green line from E2 to E2, and a purple line from F2 to F2.

	D	E	F	G
	Length	Width	Height	Volume
	10	5	15	<code>=D2*E2*F2</code>

`=D2*E2*F2` says "the cell in my row three columns left, the cell in my row two columns left, the cell in my row one column left"



A screenshot of the same Excel spreadsheet. The formula bar still shows `=D2*E2*F2`. The cell G2 now displays the result of the calculation, "750".

	D	E	F	G
	Length	Width	Height	Volume
	10	5	15	750

Once entered the formula bar still shows the formula, but the cell shows the result of the calculation

Relative references change when the cell is copied and pasted

<i>f_x</i>	=D2*E2*F2			
	D	E	F	G
	Length	Width	Height	Volume
	10	5	15	=D2*E2*F2
	8	6	5	

<i>f_x</i>	=D3*E3*F3 ←			
	D	E	F	G
	Length	Width	Height	Volume
	10	5	15	750
	8	6	5	240

Absolute references

- References that don't depend on position of the formula
 - Don't change when cell is copied/pasted
 - Made by placing a dollar sign before the row and/or column reference
 - Can mix them – e.g. absolute column, relative row
- Example: calculating relative frequencies
 - Have a count for each row, and a total
 - Need to divide the count for each row by the same total
- Need absolute cell references allow the count to change with each row, but keep the total the same

Allele frequencies – proportions

First entry

fx =E2/E\$8				
C	D	E	F	G
	Allele	Count	Frequency	
	A	22	0.12941	
	B	135		
	C	9		
	D	3		
	E	1		
	Total	170		

Copied and pasted to rest

fx =E6/E\$8				
C	D	E	F	G
	Allele	Count	Frequency	
	A	22	0.12941	
	B	135	0.79412	
	C	9	0.05294	
	D	3	0.01765	
	E	1	0.00588	
	Total	170		

Why copy/paste instead of entering the formula repeatedly?

Functions

- Functions are mini programs built into Excel
 - Most take one or more arguments
 - All return a result
- Structure of functions:
 - Function name
 - Followed by open parentheses with no space
 - Arguments (if needed) are within the parentheses
 - Spaces within the parentheses are ignored

Examples of functions with no arguments

	A	B	C	
1	Function	Returns	Explanation	
2	pi()	3.141592654	Value of pi to 15 decimal places	
3	rand()	0.751827802	A random uniform number	
4	false()	FALSE	Enters the logical value FALSE into the cell	
5	true()	TRUE	Enters the logical value TRUE into the cell	
6	today()	1/17/2012	Enters today's date	
7	now()	1/17/2012 10:17	Enters today's date and current time	
8				

Functions with variable numbers of arguments

- Some functions operate on whatever entries (of the right data type) you specify
 - All arguments treated the same
 - Order/position doesn't matter
- The number of entries varies depending on the data
- Examples are `sum()`, `average()`, `stdev()`...

Sums take variable numbers of arguments

=SUM(D2,D3,D4,D5)							
	C	D	E	F	G	H	I
		Data					
		9.5					
		9.9					
		12.0					
		10.7					
Sum		=SUM(D2,D3,D4,D5)					

SUM(number1, [number2], [number3], [number4], [number5], ...)

=SUM(D2:D5)			
	C	D	E
		Data	
		9.5	
		9.9	
		12.0	
		10.7	
Sum		=SUM(D2:D5)	

SUM(number1, [number2], ...)

Ranges of cells with a colon

Functions with specific arguments

- Some functions take a specific set of arguments
 - Optional arguments = default settings will be used if not specified (may get wrong answer, but will run)
 - Mandatory arguments = you will get an error message without them
- The order/position of the arguments tells Excel what they are – need to enter them in the correct order
- Mandatory first, optional at the end (if any)

Example: the if() function

- The function if() executes an “if...then...else” statement
- It takes three arguments
 - A logical test (if)
 - A value if the test returns true (then)
 - A value if the test returns false (else)
- The order of the arguments tells Excel which is which

✕ ✓ <i>fx</i> =if(d2>d\$7)						
B	C	D	E	F	G	H
		Data	Above the mean?			
		9.5	=if(d2>d\$7)			
		9.9	IF(logical_test, [value_if_true], [value_if_false])			
		12				
		10.7				
	Mean	10.525				

Excel prompts you for the needed arguments as you enter the function

✕ ✓ <i>fx</i> =if(d2>d\$7,"Yes")						
B	C	D	E	F	G	H
		Data	Above the mean?			
		9.5	=if(d2>d\$7,"Yes")			
		9.9	IF(logical_test, [value_if_true], [value_if_false])			
		12				
		10.7				
	Mean	10.525				

✕ ✓ <i>fx</i> =if(d2>d\$7,"Yes","No")						
B	C	D	E	F	G	H
		Data	Above the mean?			
		9.5	=if(d2>d\$7,"Yes","No")			
		9.9	IF(logical_test, [value_if_true], [value_if_false])			
		12				
		10.7				
	Mean	10.525				

Combining functions, doing math on their results

fx			
=SUM(D2:D6)/COUNT(D2:D6)			
D	E	F	
Data			
11.9			
11.9			
12.8			
15.3			
10.7			
12.52			

fx		
=SUM(D2:D5)^2		
D	E	
Data	Square of sum of data	
9.5	1772.41	
9.9		
12.0		
10.7		

Nesting functions

- Functions can be used as arguments to other functions
 - Evaluated from inside out
- Examples...

Nesting functions

fx =SIN(RADIANS(90))			
	D	E	F
	1		

But, be careful...
harder to error
check

fx =TDIST(D7/D8, COUNT(D2:D5)-1, 2)					
	C	D	E	F	
		Data			
		9.5			
		9.9			
		12.0			
		10.7			
	Mean	10.5			
	Std Error	0.551324			
	p-value	0.000314			