

Microsoft Excel Array Formulas



Formulas.

Array Formulas.

Entering an Array Formula.

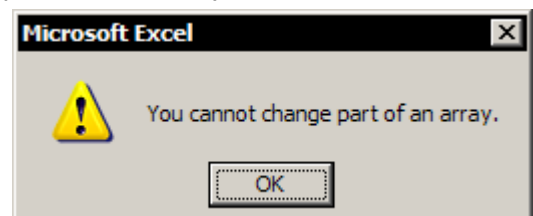
Array formulas are formulas which return a set (an array) of values and are usually entered into a range of cells. Any Excel formula can be entered as an array; some functions require that they are entered as arrays in order to return meaningful results.

Some array formulas are entered into a single cell; this is where the cells that they are referencing need to be considered as an array rather than a range of values. For example, where each individual cell in a range needs to be evaluated independently.

	C1			$\{=A1:A5*B1:B5\}$
	A	B	C	D
1	10	4	40	
2	16	18	288	
3	28	90	2520	
4	20	12	240	
5	95	23	2185	

To enter an array formula, select the area of cells where the results are going to be returned then enter the formula and finally, press CTRL+SHIFT+ENTER. Array formulas are identified in the formula bar enclosed in braces but these are not typed-in. In the illustration, the area C1 to C5 is first selected, then the formula $=A1:A5*B1:B5$ is entered.

You can not delete a single cell in an array formula or insert a row into that section of the worksheet as you can not change part of an array. To delete an array formula you must select the range of cells first. The shortcut key to select the entire current array is CTRL+/. To edit an array formula, make your changes to the formula in the formula bar and then press CTRL+SHIFT+ENTER to re-enter it.



Array formulas offer few advantages over normal formulas other than that they offer an element of protection to the formula without having to use worksheet protection. The following examples illustrate the use of array formulas, firstly showing functions which have to be entered as arrays and finally where an array has to be used in order to obtain the correct result. Most array functions tend to be specialised statistical calculations, the statistical methods are not discussed.

Frequency Distribution.

A *frequency distribution* calculates how often values occur within a range of values and returns a vertical array of numbers. The calculation is done using the FREQUENCY function:

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FREQUENCY(data_array,bins_array).

Where *data_array* is the population of values and *bins_array* is the set of intervals into which the values in *data_array* are grouped. Blank cells and text are ignored.

F1	A	B	C	D	E	F
1	25	99	80		10	2
2	91	48	41		30	8
3	50	9	24		50	9
4	90	42	88		70	1
5	11	71	49		90	9
6	57	100	98			
7	74	20	80			
8	44	33	23			
9	12	36	80			
10	14	75	87			
11	10	44	21			

The number of elements in the returned array is one more than the number of elements in *bins_array*. The extra element in the returned array returns the count of any values above the highest interval.

So, for example, when counting three ranges of values that are entered into

three cells, you should enter the formula into four cells for the full set of results. The extra cell returns the number of values in *data_array* that are greater than the last interval value.

In the illustration, there are 29 observations in the frequency distribution but there are 33 values in the population, the values greater than the top bin limit are not reported.

Dynamic Transposition.

You can use *Edit, Paste Special, Transpose* to shift the vertical and horizontal orientation of a range of cells on a worksheet but the results of the transposition are static and you would have to repeat the transposition if the original values were changed. To return the transposed results as a dynamic formula you need to use the TRANSPOSE function:

B6	A	B	C	D	E
1	Jan	Feb	Mar	Apr	
2	10	20	30	40	
3	100	200	300	400	
4	50	100	150	200	
5					
6	Jan	10	100	50	
7	Feb	20	200	100	
8	Mar	30	300	150	
9	Apr	40	400	200	
10					

TRANSPOSE(array).

Where *array* is the range of cells to be transposed. The formula has to be entered as an array formula into a range that has the same number of rows and columns, respectively, as *array* has columns and rows.

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The first row of *array* becomes the first column of the returned array. Any changes made in the range of cells A1:D4 are reflected in the array of cells, B6:E9.

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Calculating a Trend.

Use the TREND function to calculate a linear trend. This fits a straight line, using the method of least squares, to known dependent and independent variables and returns a new set of dependant variables. A trend is a statistical method of projecting for the future a set of outcomes based on data from the past. To fully understand the calculation method and interpret the results correctly you should consult the Excel documentation and also a publication dealing with statistical theory, search for the subject *linear regression*.

TREND(known_y's,known_x's,new_x's,const).

Where *Known_y's* and *Known_x's* are the known dependent and independent variables respectively. *New_x's* are the new independent variables for which you want TREND to return the corresponding dependent variables.

	B3	fx {=TREND(B2:D2,B1:D1,B1:F1)}				
	A	B	C	D	E	F
1	Year	2003	2004	2005	2006	2007
2	Actuals	2,536	2,845	3,289		
3	Trend	2,514	2,890	3,267	3,643	4,020
4						

In the illustration, known data from the period 2003 to 2005 is being used to calculate

a trend for the period 2003 to 2007.

Single Cell Array Formulas.

This is an example of where a formula has to be entered into a single cell as an array in order for it to calculate correctly. The formula does not return an array of values, rather the values that it is calculating need to be treated as an array. Even if you do not fully understand exactly how the formulas calculate you can nevertheless use the examples as a template to produce this type of calculation. In other words; "copy and paste" and change the cell references.

	A	B	C	D
1	Country	Product	Units	Value
2	UK	Soap	1,789	81,460
3	France	Toothpaste	1,217	11,599
4	Netherlands	Shave	637	63,337
5	Denmark	Laundry	713	97,982
6	Greece	Kitchen	991	23,378
7	Norway	Soap	1,606	56,327
8	Germany	Toothpaste	46	11,101
9	Spain	Shave	888	87,187
10	UK	Laundry	1,244	92,504
11	UK	Laundry	1,537	82,624

The drawback to the function SUMIF is that it only accepts a single criterion value. To add numbers based on multiple conditions you either have to use DSUM or use the IF and SUM functions together entering them as an array formula into a single cell.

Select a single cell, type-in the formula and then press CTRL+SHIFT+ENTER. Do not enter them as normal formulas; they will give quite different results. If the entry fails, double-click the cell and try the array entry again.

Total the Units where the Product is Soap and the Country is UK:

=SUM(IF((B2:B11="Soap")*(A2:A11="UK"),C2:C11))

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Total the Values where the Country is France or Spain:

=SUM(IF((A2:A11="France")+(A2:A11="Spain"),D2:D11))