

# Microsoft Excel – Lookup Formulas Vlookup



## Lookup Formulas – Vlookup & Hlookup

Lookup formulas return a value from a table of values in a worksheet range, you can use your finger to locate a single value once but where the value frequently changes or you need to look up a set of data then you need to automate the process with formulas. There are several different methods and an entire category of functions to choose from. The most commonly used functions are VLOOKUP and HLOOKUP, which are amongst the most difficult to master. The easiest method of all is an *Intersection*, which is hardly used at all. There is no Intersection function, rather it is an operator which probably explains why it is neglected, most people using Excel do not know that it exists.

## VLOOKUP and HLOOKUP

Both functions have a similar structure; VLOOKUP performs a *vertical* lookup, HLOOKUP a *horizontal*. A look up is where you provide one piece of information to look up a piece of associated information. For example, you have a product number and you want to look up the associated product description or price etc.

Firstly, you must decide whether the look up is horizontal or vertical. It is not the table of values in the worksheet that determines this but rather the information that you are providing and on which edge of the table it is stored. A vertical look up looks down the left hand edge of the table and attempts to match the value provided, when it is matched then it looks across the table to the right and returns a value from a column that you specify. Whereas a horizontal look up looks across the top row of the table and when the value is matched, it looks down into the table to return a value from a row that you specify.

Whilst the process is called a *look up*, you never actually look up or look to the left. You always use the top or left hand side edge of the table and look down or to the right. An easy way to distinguish between the functions is to say that a Horizontal uses the Headings and the function HLOOKUP. If the data that you are providing is not located at the top or left hand edge then you should not use these functions at all, use a combination of MATCH and INDEX instead.

The specific column or row in the table is specified as a local *index value*, not by using the usual column letter or row number descriptors and the behaviour of the look up (how it finds a matching value) is governed by a set of internal rules depending on whether the *Range\_Lookup* argument of the function is set to TRUE or FALSE and whether or not the values in the lookup row or column are sorted in ascending order.

	A	B	C	D	E	F
1						
2						
3			Jan	Feb	Mar	Apr
4		Sweeties	25	100	30	12
5		Sarnies	34	67	35	89
6		Sausages	60	25	56	75
7		Sherberts	56	17	48	25
8						

There is a table of data in the range of cells B3:F7.

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If you give the reference "Feb" and want to look up the "Sausages" figure for that month then it is a horizontal lookup and the row index is 4. That is, row index value 4 in the table of values, not row 6 in the worksheet; the value is local to the table. The *Range\_Lookup* should be FALSE because the headings are not in alphabetical order.

Should you give the reference "Sweeties" and want to look up the "Feb" figure for that month then it is a vertical lookup and the column index is 3. That is, the local column index value 3 in the table and not "D" which is the global worksheet column reference. The *Range\_Lookup* should be FALSE because the descriptions are not in alphabetical order.

**VLOOKUP(lookup\_value,table\_array,column\_index\_num,range\_lookup)**

**HLOOKUP(lookup\_value,table\_array,row\_index\_num,range\_lookup)**

Where *lookup\_value* is the data provided, *table\_array* the table of values, row or column index local to the table where the data is returned from and *range\_lookup* a logical value specifying either FALSE, an exact match or TRUE, an approximate match according to a set of internal rules. It is TRUE if it is omitted.

	A	B	C	D
1	Country	Population	GDP	
2	United States	266.7	7,600.0	
3	Japan	125.7	5,100.0	
4	Germany	81.3	2,500.0	
5	France	58.4	1,600.0	
6	United Kingdom	58.7	1,200.0	
7	Italy	56.9	1,200.0	
8	Brazil	164.2	883.3	
9	China	1,230.0	636.7	
10				
11	United States	1,230.0		

Be careful using these functions as there is much room for error, in particular pay attention to the last argument *range\_lookup* as this will quite dramatically change the nature of the values retrieved. It is usually good practice to enter the first three arguments first and then experiment with the last one and test your formula using a range of different look up values.

In this example, the formula has failed. We wanted to type a country into cell A11 and then look up the corresponding population. But the list of countries in column A is not sorted in ascending order and therefore searches alphabetically to match the look up value. Even though an exact match can be found it is not retrieved. Be careful with unsorted text, it should always be FALSE in the last argument.

But not every look up is FALSE, often the TRUE look up is very useful where there is no exact matching value as the approximation will find the closest value or the top value in the table. Indeed, it will guarantee that a value from the appropriate vector is always retrieved.

In this example, we have a series of bands of values and a tax rate that is applied at each band. The bands are sorted in ascending order. The values that we are looking up will

	A	B	C	D	E
1	Band	Rate			
2	10,000	2.5%			
3	15,000	3.0%			
4	20,000	3.5%			
5	25,000	4.0%			
6	30,000	4.5%			
7					
8	18,975	3.0%			

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never exactly match any of the band values and could even exceed the top band, nevertheless the TRUE look up will always retrieve the correct value. An intermediate value will return the value of the lower band and an over limit value returns the last band value.

The only possible problem we could have here is where we were looking up a value less than the lower band, the formula would return the #NA error value. To cure this problem we should base the band values from an origin of zero and set the corresponding rate table value to zero also, thus the formula would always return a value and never an error.

	A	B
1	Band	Rate
2	10,000	2.5%
3	15,000	3.0%
4	20,000	3.5%
5	25,000	4.0%
6	30,000	4.5%
7	9,999,999	#N/A
8		
9	50,000	4.5%
10		

To govern the upper and lower boundaries of the look up values either introduce a zero band as discussed or wrap the look up formula inside a conditional structure where you test for the #NA error using the ISNA function. To control the behaviour of the over limit values and prevent data being returned where the lookup value significantly exceeds any expected value, cap the top limit and force the top value in the table to return an #NA error by using the NA function. Cell reference B7 in the illustration contains the formula, =NA() and the following formula in B9 either returns an

appropriate value or zero:

**=IF(ISNA(VLOOKUP(A9,A2:B7,2)),0,VLOOKUP(A9,A2:B7,2))**