Excel: Lookup functions

V1.0

Contents

Introduction

Lookup calculations are very commonly used within Excel. They allow you to search for and find values within tables that match certain criteria. This course will introduce you to some traditional lookup functions, but more importantly the brand new and massively more powerful XLOOKUP function. To use this functon you must have an up to date and updated version of Office 365 on your computer

Whilst not mandatory, we do recommend very strongly that you attend our **Excel: Working with Data** course prior to attending In particular you will be using **Tables** and **Structured References** throughout this course. An understanding of the basic of using spreadsheets is also required.

Objectives

On successful completion of this course participants will be able to:

- Use traditional lookup functions such as VLOOKUP and HLOOKUP
- Use nested INDEX and MATCH functions to perform more flexible lookups
- Use the new XLOOKUP function to perform easier and more powerful lookup calculations

Excel: Lookup functions

1 Lookup Functions

a. VLOOKUP

A very common situation in Excel when you are working with a data list is that you have a good number of adjacent columns of data. The first column has values in ascending order, and the other columns, some other sets of values which correspond to those in the first column. Given a value that appears somewhere in the first column, you can search for it and then take the corresponding value in one of the other columns.

The VLOOKUP function (V for vertical) handles this situation. It's syntax is as follows:

=VLOOKUP (value, table, col_index, [range_lookup])

value - The value to look for in the first column of a table.

table - The table from which to retrieve a value.

col_index - The column in the table from which to retrieve a value.

range_lookup - [optional] TRUE = approximate match (default). FALSE = exact match.

For example:

=VLOOKUP("xxx",A1:G70,3)

In this example the first argument ("xxx") is the value to be searched for. The second argument (A1:G70) is the group reference to the data list. The third argument is the number of the column you want to extract the output value from.

A fourth argument is optional, and determines what happens if the value you are searching for is not in the first column. If the fourth argument is set to TRUE or omitted, VLOOKUP will return the value corresponding to the last value found lower than the one looked for. If it is FALSE, it will return #N/A.

Example of vertical lookup in use –

	A	B	C
1	Years Service	Meal Entitlement	
2	0	Free Sandwiches	
3	6	Luncheon Vouchers	
4	10	Free Buffet	=VLOOKUP(30,A1:B8,2)
5	16	3 course set dinner	
6	21	3 course a la carte	=VLOOKUP(30,A1:B8,2,TRUE)
7	26	eat in executive dining room	
8	30	eat in Hilton Rooftop Rest	
9			
10			
11			

In this example the result of the formula in both cases will display **eat in Hilton Rooftop Rest**

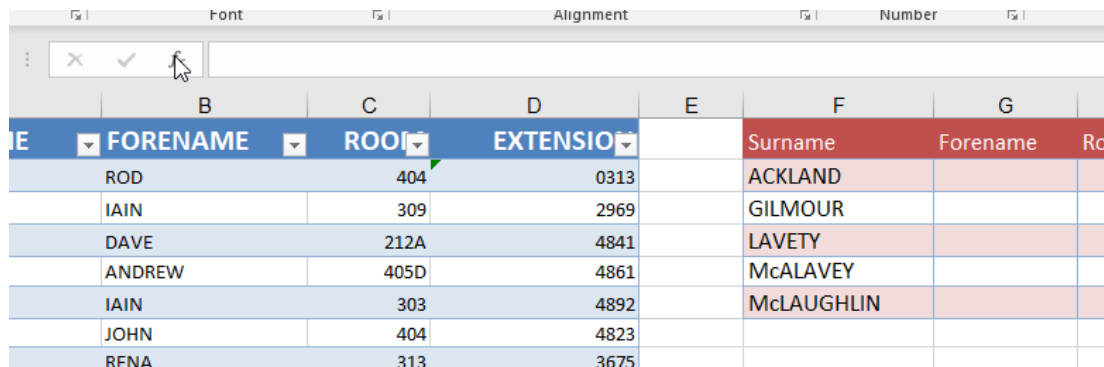### b. Exact Match lookups

An exact match lookup will look down a column of your lookup table. It will return an answer when it finds the value that you are looking for. If it reaches the bottom of your table without finding an answer then it will return the value #N/A.

🔧 Task: Using VLOOKUP for exact match lookups

1. Open the **1 – Lookup Functions.xlsx** worksheet from the practice files folder

2. Open the **Exact Match** worksheet by clicking on it's sheet tab (if necessary)

3. Take a moment to review the worksheet:

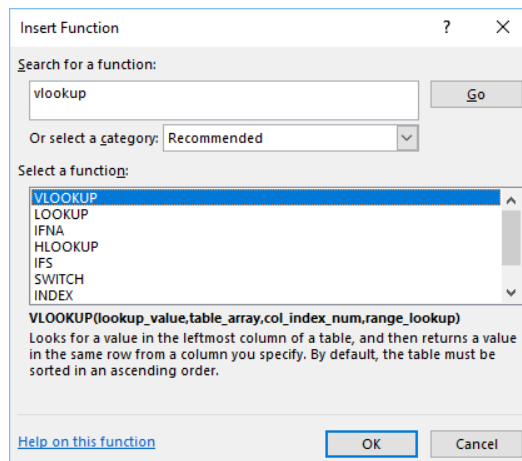   There is a table in cells **A1:D64**. The table is named **tbl_staff_list**

4. Select Cell **G2**

5. From the formula bar select the Insert Function (fx) command

6. In the dialogue box that appears, type **vlookup** in the **Search for a function:** box

7. Click **GO**

8. Click **OK**

9. In the **Lookup_value** field, type **F2**

10. Use the **TAB** key on your keyboard

    Your selection will be moved to the **Table_array** field

11. Select cells **A2**

12. Use the **CTRL – SHIFT -** → keyboard shortcut

13   Use the **CTRL – SHIFT - ↓** keyboard shortcut

Note the structured reference used here. We are using tables in this example because amongst many good reasons, structured references are innately absolute

14   Hit **TAB** on your keyboard to move your selection to the **Col_index_num** field

15   Type **2**
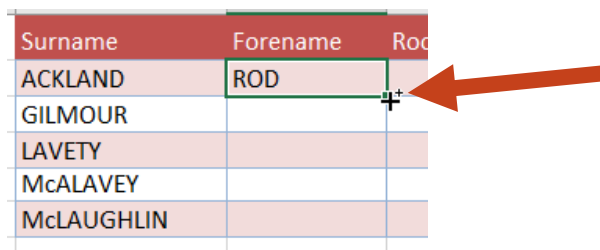
16   Hit **TAB** on your keyboard to move your selection to the **Range_lookup** field

17   Type **false**

Typing false changes the behaviour of the function to use exact match lookups
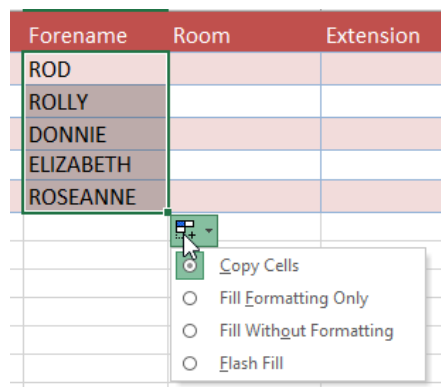
18   Click the **OK button** or **ENTER** on your keyboard

19   Double click the Autofill control on the bottom left of the selected cell

Surname	Forename	Ro
ACKLAND	ROD	
GILMOUR		
LAVETY		
McALAVEY		
McLAUGHLIN		

20   Use the smart tag that appears to select **Fill Without Formatting**

Forename	Room	Extension
ROD		
ROLLY		
DONNIE		
ELIZABETH		
ROSEANNE		

○ Copy Cells
○ Fill Formatting Only
○ Fill Without Formatting
○ Flash Fill

21   If you have time, repeat the process for the **Room** and **Extension** columns

c.   Closest Match Lookups

🔧 Task: Using VLOOKUP for closest match lookups

1   With the **1-Lookup Functions** worksheet still open

2   Select the **Closest Match** worksheet tab

3   Take a moment to familiarise yourself with the worksheet

There is a table here named **tbl_grade_lookup**

4   Use the sort and filter tool to change the sort order to Smallest and Largest on the Score column
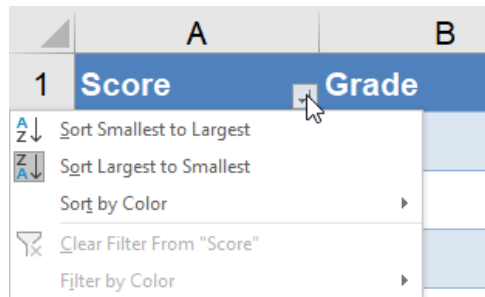
It is important that the column is sorted in this way when you are performing a closest match lookup!

5   Select cell **F2**

6   Select the Insert Function (fx) tool from the formula bar
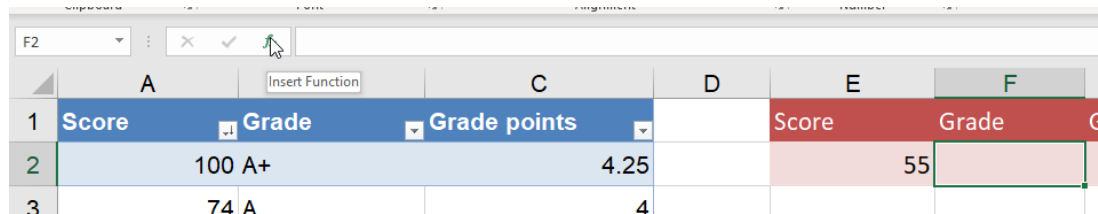
7   Select **VLOOKUP** from the **Select a function** control
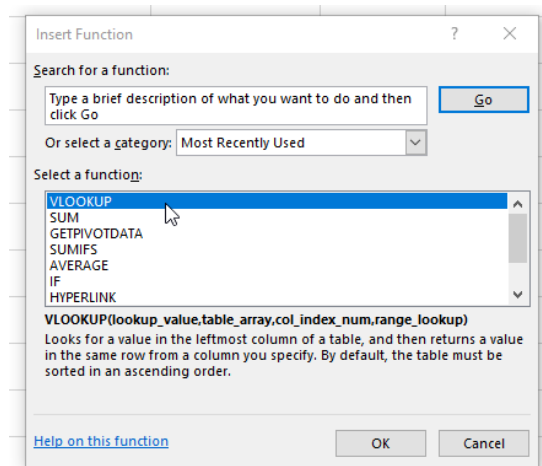
The list you see is the most recently used functions

8   Click **OK** or hit **ENTER** on your keyboard

9   In the **Lookup_value** field type **E2**

10   Hit **TAB** on your keyboard to move your selection to the **Table_array** field

11   Select Cell **A2**

12   Use the **CTRL – SHIFT -** → keyboard shortcut

13   Use the **CTRL – SHIFT - ↓** keyboard shortcut

14   Hit **TAB** on your keyboard to move your selection to the **Col_index_num** field

15   Type **2**

16   Click **OK** or hit **ENTER** on your keyboard

As closest matches are the default for the **VLOOKUP()** and **HLOOKUP()** functions, so we do not need to fill in the **Range_lookup** field this time

17   Select cell **G2**

18   Type the following formula:

=VLOOKUP(E2, tbl_grade_lookup, 3)

Use the autocomplete tool to help you (TAB)

19   Hit **ENTER** on your keyboard

d.   HLOOKUP()
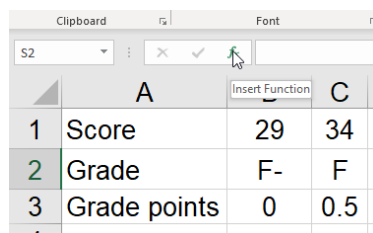
The HLOOKUP() function (H for horizontal) performs exactly the same task as VLOOKUP(), but with the look up values in the first row, and other values in subsequent rows.

⚙ Task: Using HLOOKUP() for Closest Match Functions

1   With the **1 – Lookup Functions.xlsx** sheet still open

2   Select the **HLOOKUP()** worksheet tab

3   Take a moment to examine the worksheet

Note: in this example we are not using data in Table form. So our referencing will using more traditional cell references

4   Select the **S2** cell reference

5   From the formula bar select the Insert Function (*fx*) command

6   In the dialogue box that appears, type **hlookup** in the **Search for a function:** box
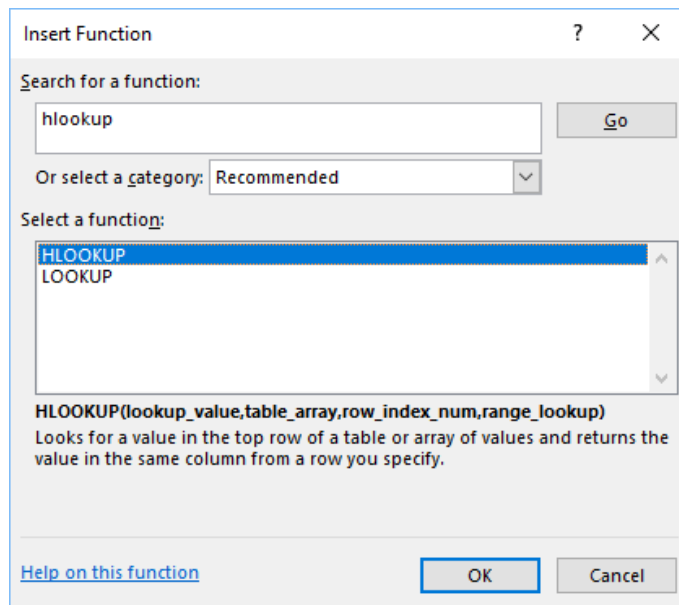
7   Click **GO**

8   Click **OK**

9   In the **Lookup_value** field, type **R2**

10   Use the **TAB** key on your keyboard

        Your selection will be moved to the **Table_array** field

11   Select cells **B1**

12   Use the **CTRL – SHIFT -** → keyboard shortcut

13   Use the **CTRL – SHIFT -** ↓ keyboard shortcut

        Note the structured reference used here. We are using tables in this example because amongst many good reasons, structured references are innately absolute

14   Hit the **F4** key on your keyboard

        This will convert your **Table_array** refence from relative to absolute

15   Hit **TAB** on your keyboard to move your selection to the **Row_index_num** field

16   Type **2**

17   Click **OK** or hit **ENTER** on your keyboard

18   Autofill your answer by double clicking the Autofill handle (bottom right of the **S2** cell)

2   INDEX/MATCH

As well as the VLOOKUP() and HLOOKUP() functions are some related functions index and match. Although they are functions that have uses in their own rights, you will often find INDEX() and MATCH() functions used together in a nested formula.

a.   MATCH()

The purpose of the Match function is to return the position of a sought after value within an either horizontal or vertical array. It's syntax is as follows:

=MATCH (lookup_value, lookup_array, [match_type])

lookup_value - The value you are looking for in the lookup_array. This can be a value or a cell reference to a cell containing that value

lookup_array - A range of cells or an array reference, e.g. B2:B100

match_type - [optional] 1 = exact or next smallest (default), 0 = exact match, -1 = exact or next largest.

As you can see, there is one more match type than you get when you use the VLOOKUP() function. Other things to note:

- If there are duplicates in your array, MATCH returns the first match it finds from the top
- Like a closest match lookup, If match_type is -1 or 1, the lookup_array must be sorted.
- You can use wildcards (such as * or ?) providing you are doing an exact match lookup.
- /MATCH is not case-sensitive.
- MATCH returns the #N/A error if no match is found.

⚒ Task: Using the MATCH() Function

1   Open the **2 – Index Match Functions.xlsx** practice file

2   Click the **Exact Match** Worksheet

3   Take a moment to familiarise yourself with the sheet layout

4   Select cell G2

5   Press the **Insert Function** button in the formula bar
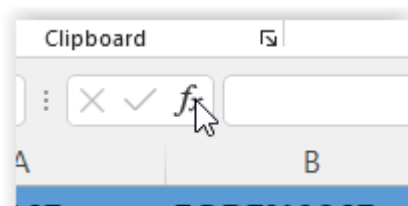
6   Search for the **Match** function and click **OK** when you find it.

7   For the **Lookup_value** click cell **F2**

8   For the **Lookup_array,** select cells **A2 to A64**

       Note the structured reference!

9   For the **Match_type** enter **0** (zero)

10   Click **OK**

11   **Notice the results you get**

As you can see the Match function returns an index number that represents the position in the lookup array that your Lookup value matches. In itself, it is not especially valuable, but when we use it within other functions it can tell us very useful things.
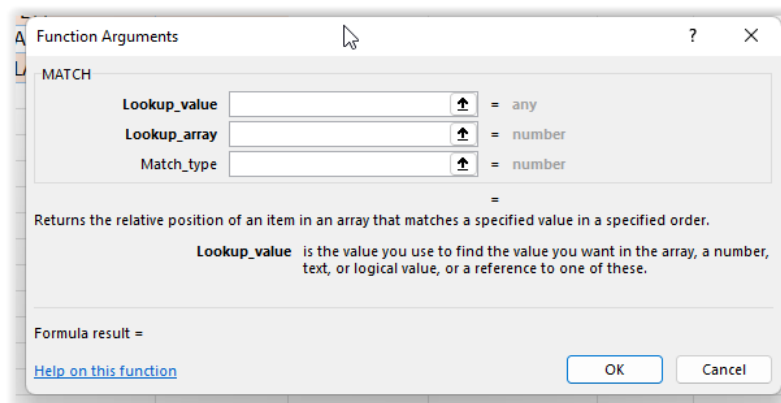
b.   INDEX()

The purpose of the INDEX() function is to return the value found within an array at a numerical positon. It's syntax is as follows:

INDEX(array, row_num, [column_num])

Array - A range of cells or an array constant.

row_num -Selects the row in array from which to return a value. If row_num is omitted, column_num is required.

column_num   Optional. Selects the column in array from which to return a value. If column_num is omitted, row_num is required.

☞ TASK: Using the INDEX() Function

With the **2- Index Functions.xlsx** file still open

1   Select the **Index()** worksheet tab

2   Take a moment to understand the worksheet layout, note cells **F2:F6** have index numbers in them

3   Select cell **G2**

4   Click the **Insert function** command from the formula ribbon

5   Search for the **Index** function and click **OK**
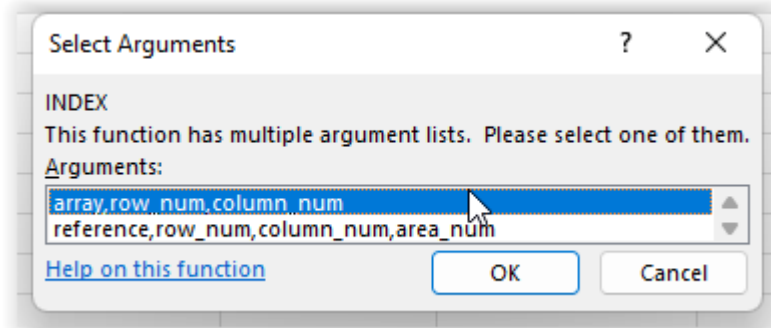
6   Make sure the first row is selected in the options and click **OK**
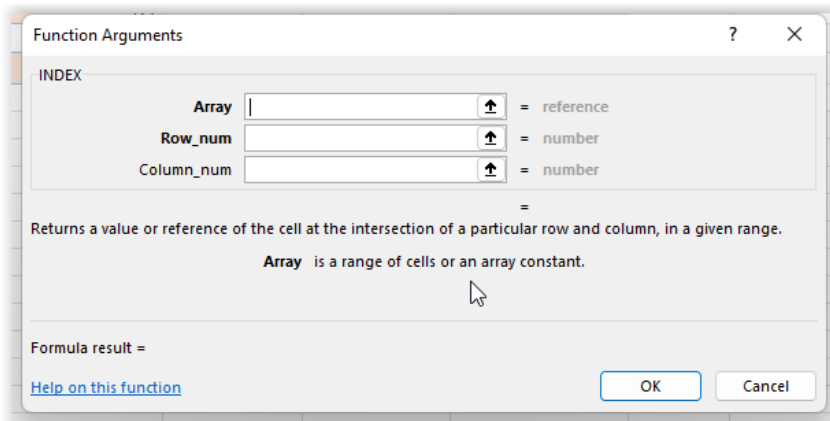
7   For the **Array,** select cells **B2:B64**

8   For the **Row_num** select cell **F2**

9   Click **OK**

10   Autofill your answers

11   If you have time complete the Room and Extension columns

Note how Index will find the values at your index positions in the array.

c.   INDEX()/MATCH() functions

As mentioned before, while index and Match functions can be used individually it is often and probably more common to see the two functions used together in a nested configuration. The reason this works is that the result of the MATCH() function is a row or column number which happens to be one of the arguments required within the INDEX() function. Together this produces a formula that replicates the function of the VLOOKUP() or HLOOKUP() functions but with some additional benefits, namely:

- A VLOOKUP() function requires the lookup column that contains values you are searching for to be organised on the leftmost column of the array. Answers can only be returned from columns to the right of this column. Using an INDEX()/MATCH() formula allows your answer columns to be placed to either the left or right of the lookup column. This is far more flexible!
- The same is true when you replace a HLOOKUP function with an INDEX()/MATCH() function
- Because a MATCH() function has three match_type arguments rather than the two of either VLOOKUP() or HLOOKUP() functions, this gives you a little more flexibility in terms of the search order when performing closest match lookups.

⚙ Perform an Index/Match Formula

With the **2 – Index Match Functions.xlsx** file still open

1   Select the **INDEX – MATCH EXACT** worksheet tab

2   Select cell **G2**

3   Click the **Insert Function** command in the formula bar

4   Search for **Index** and click **OK**

5   Select the first row of options and click **OK**

6   For the **Array**, Select **B2:B64**

7   Click into the **Row_num** box

8   From the reference control, click the drop down arrow
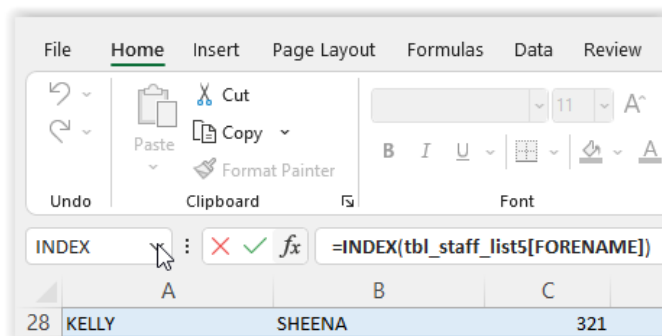
9   From the List of functions that appears, select **Match**

10   For the **Lookup_value** enter **F2**

11   for the **Lookup_array** enter **A2:A64**

12   for the **Match_type,** enter 0 (zero)

13   Click **OK**

14   Autofill the rest of the column

15   If you have time, apply this formula to the other columns of the table

3 XLOOKUP

Why use XLOOKUP?

In 2019 Microsoft added several new functions designed to perform calculations on arrays. Amongst them was XLOOKUP which aims to replace VLOOKUP and HLOOKUP. It will also remove the need to use INDEX/MATCH nested formulas in most cases as well!

The syntax for XLOOKUP() is as follows:

XLOOKUP(lookup_value,lookup_array,return_array,[match_mode],[search_mode])

lookup_value - item used to find match in lookup_array

lookup_array - yields a relative position that can be used to retrieve item in return_array

return_array - contains items that you potentially want to lookup, must be same size as lookup_array

match_mode - Optional. Allows you to choose the match mode for instance if you wish to do a closest match lookup

search_mode – Optional. Decides the direction that the XLOOKUP() function searches in i.e. top to bottom.

Although the XLOOKUP() function at first glance looks to be more complicated than the VLOOKUP() or HLOOKUP() functions, in most calculations it is a simpler function to use:

- XLOOKUP simplifies things dramatically. You no longer have to use vector based arguments (col_index_num)
- XLOOKUP removes the need for your lookup table to be organised in a certain way. You no longer need to return answers from columns to the right (or below for HLOOKUP). Hence XLOOKUP can be used instead of INDEX/MATCH
- XLOOKUP has a 4th parameter to support value not found. In most cases, we have to nest our lookup formulas within IFERROR or IFNA formulas to remove the unsightly #N/A. XLOOKUP lets you tell what default output Excel should return if your value is not found.
- XLOOKUP expands on the types of searches you can perform with VLOOKUP to search in special situations. You can search from top or bottom, you can do wild card searches and faster options to search sorted lists.
- XLOOKUP returns reference as output, not the value. While this may not mean much to you now this means, you can combine XLOOKUP outputs in new exciting combinations with other formulas.

b. Basic Use – Exact Match Lookup

One of the big differences when performing exact match lookups using the XLOOKUP() function is that exact match lookups are now the default, which differs from VLOOKUP() which does closest match calculations instead.

⚲ Task: Using XLOOKUP() to perform exact match lookups

1   Open the 3 – **Xlookup Functions.xlsx** file

2   Select the **Exact Match** worksheet tab

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3   Select cell **G2**

4   Click the **Insert Function** command in the formula bar

5   Search for the **Xlookup** function and click **OK**

6   For the **Lookup_value**, input **F2**

7   For the **Lookup_array,** select cells **A2:A64**

8   For the **Return_array,** select cells **B2:B64**

9   For the **If_not_found,** input **"No Record"**

10   For the **Match_mode**, input 0 (exact match)

11   Click **OK**

12   Autofill the rest of the column

13   If you have time repeat the function for the Room and Extension columns

c.   Match_mode

Like the LOOKUP() function, XLOOKUP() also has an optional argument that adjusts the way that matches are made. If left empty this match_mode argument now performs an exact match lookup, however when filled in it offers a new improved method of performing closes matches.

When choosing your match_mode, you are now offered four different options (compared to the two of VLOOKUP()). These are:

0 - Exact Match – Default. This returns a match providing the strings or values match completely, it returns #N/A otherwise

-1 - Exact Match or Next Smaller – This returns an exact match when they exist or the closest match should they not. Very importantly, the lookup_array does not need to be sorted in ascending order

This is the equivalent to VLOOKUP() closest match in function

1 - Exact Match or Next Bigger - This returns and exact match when it exists or the next larger. Again the sorting order of the lookup_array is unemportant

2 – Wildcard character search - * = zero or more characters, ? = single character

🔧 Task: Use XLOOKUP() to Find the Last Grade Achieved

1   With the **3 – Xlookup Functions.xlsx** file still open

2   Select the **Closest Match Lookup** worksheet tab

3   Select cell **C3**

4   Click the **Insert Function** command in the formula bar

5   Search for **Xlookup** and click **OK**

6   For the **Lookup_value**, input **B2**

7   For the **Lookup_array,** select cells **C7:C13**

8   For the **Return_array,** select cells **A7:A13**

9   For the **If_not_found,** input nothing

10   For the **Match_mode**, input **-1** (next smaller)

11   Click **OK**

4   XMATCH()

Like XLOOKUP(), the XMATCH() function is new in 2019 and offers improved features compared to the older functions. XMATCH() performs a lookup and returns a position in a range. It is a more robust and flexible successor to the MATCH() function.

XMATCH() supports approximate and exact matching, reverse search, and wildcards (* ?) for partial matches.

XMATCH()

Syntax:

=XMATCH (lookup_value, lookup_array, return_array, [match_mode], [search_mode])

lookup_value - The lookup value.

lookup_array - The array or range to search.

return_array - The array or range to return.

match_mode - [optional] 0 = exact match (default), -1 = exact match or next smallest, 1 = exact match or next larger, 2 = wildcard match.

search_mode - [optional] 1 = search from first (default), -1 = search from last, 2 = binary search ascending, -2 = binary search descending.

Useful Shortcut keys

Using keyboard shortcuts can help you become more efficient when creating documents in Microsoft applications. Most keyboard shortcuts require you to use two or more keys at the same time. To use a keyboard shortcut first press and hold down the modifier key or keys (i.e. SHIFT, CTRL, ALT) and then press the corresponding standard key on your keyboard.

Function	Shortcut
Repeat the last command or action. For example, if the last thing you typed in a cell is "hello," or if you change the font color, clicking another cell and pressing F4 repeats that action in the new cell.	F4
Insert a new worksheet	Shift+F11
Undo an action	Ctrl+Z
Redo an action	Ctrl+Y
Switch to Print Preview	Ctrl+F2
Open the Help pane	F1
Go to the "Tell me what you want to do" box	Alt+Q
Check spelling	F7
Calculate all worksheets in all open workbooks	F9
Calculate active worksheets	Shift+F9
Turn key tips on or off	Alt or F10
Show or hide the ribbon	Ctrl+F1
Expand or collapse the formula bar	Ctrl+Shift+U
Minimize the workbook window	Ctrl+F9
Create a bar chart based on selected data (on a separate sheet)	F11
Create an embedded bar chart based on select data (same sheet)	Alt+F1
Search in a spreadsheet, or use Find and Replace	Ctrl+F
Switch between open workbooks	Ctrl+Tab
Insert a function	Shift+F3
Create, run, edit, or delete a macro	Alt+F8
Open the Microsoft Visual Basic For Applications Editor	Alt+F11
Move one cell to the left or right	Left/Right Arrow

Function	Shortcut
Move to the farthest cell left or right in the row	Ctrl+Left/Right Arrow
Move one cell up or down	Up/Down Arrow
Move to the top or bottom cell in the column	Ctrl+Up/Down Arrow
Go to the next cell	Tab
Go to the previous cell	Shift+Tab
Go to the most bottom right used cell	Ctrl+End
Go to any cell by pressing F5 and typing the cell coordinate or cell name.	F5
Go to the leftmost cell in the current row (or go to the beginning of the cell if editing a cell)	Home
Move to the beginning of a worksheet	Ctrl+Home
Move one screen up or down in a worksheet	Page Up/Down
Move one screen to the right or left in a worksheet	Alt+Page Up/Down
Move to the previous or next worksheet	Ctrl+Page Up/Down
Edit a cell	F2
Add or edit a cell comment	Shift+F2
Cut contents of a cell, selected data, or selected cell range	Ctrl+X
Copy contents of a cell, selected data, or selected cell range	Ctrl+C or Ctrl+Insert
Paste contents of a cell, selected data, or selected cell range	Ctrl+V or Shift+Insert
Open the Paste Special dialog box	Ctrl+Alt+V
Remove the contents of a cell, selected data, or selected cell range	Delete
Insert a hard return within a cell (while editing a cell)	Alt+Enter
Paste a cell name (if cells are named in the worksheet)	F3
Cancel an entry in a cell or the formula bar	Esc
Complete an entry in a cell or the formula bar	Enter
Add or remove bold to the contents of a cell, selected data, or selected cell range	Ctrl+B
Add or remove italics to the contents of a cell, selected data, or selected cell range	Ctrl+I

Function	Shortcut
Add or remove underline to the contents of a cell, selected data, or selected cell range	Ctrl+U
Apply outline border	Ctrl+Shift+&
Remove outline border	Ctrl+Shift+_ (Underline)
Hide the selected rows	Ctrl+9
Hide the selected columns	Ctrl+0
Open the Format Cells dialog box	Ctrl+1
Apply or remove strikethrough	Ctrl+5
Apply currency format	Ctrl+Shift+$
Apply percent format	Ctrl+Shift+%