IF & VLOOKUP Function

If Function
An IF function is used to make logical comparisons between values, returning a value of either True or False. The if function will carry out a specific operation, based on a true or a false value.

Simply put, the if function is:

```
IF(Comparison, if true then perform this action, otherwise do something else).
```

The syntax for an if function is: `=IF(logical_test, value_if_true, value_if_false)

- **Logical test**: any value or expression that can return a TRUE or FALSE
- **Value_if_true**: The value to be returned, or operation to be performed, if the condition is TRUE.
  - This can be an operation, a function, a number, or text.
    - If the value returned is text, the “text” must be in double quotes.
- **Value_if_false**: The value to be returned, or operation to be performed, if the condition is FALSE.
  - This can be an operation, a function, a number, or text.
    - If the value returned is text, the “text” must be in double quotes.

Comparison Operators

- `=` - equal to
- `>` - greater than
- `<` - less than
- `>=` - greater than or equal to
- `<=` - less than or equal to
- `<>` - not equal to

Best practices with IF Functions
Generally, it is not good practice to manually type values directly into functions in Excel. The main reason for this is if a change has to be made to a value in the IF function, the values must be changed in the function and then the function will need to be copied to all other functions that are associated with it.

It is best to put the values being used in an IF function into their own individual cell, and then reference that cell within the IF function. If a value has to change, the value is changed in the referenced cell’s location and all functions related to that function are now updated immediately.
Enter an IF function

IF functions may be entered by:

- Choosing the IF function from the Formulas tab, which will use the Insert Function option.
  - This option is recommended when first using functions, as it is an easy to learn about the arguments for a function.
- Typing directly into a cell
- Typing into the formula bar

Formulas tab

To enter an IF function, place the cursor in the cell that will contain the function and then navigate to the Formulas tab. On the Formulas tab, functions are separated into categories. Click on a Logical category dropdown and then select the IF option.

Another option to insert an IF function is to use the Insert function button from the Formulas tab.

The insert function option allows users to search for a description of what they want to do instead of having to know the name of a function. To insert an IF function, type if in the search textbox and then hit the Go button to populate the results.

Select IF name from the Select a function box. On the bottom of the Insert Function, excel will display the function and its arguments, along with a description of the function. To choose a function, double click on the function name, or select the function and then click the OK button.
After selecting the IF function, from either the Logical category dropdown or the Insert Function option, Excel will display the Function Arguments window. Each argument of the IF function will display as a separate entry on the window. Click on the textbox next to each argument to display a description of the data needed for the argument.

To enter the data for an argument, manually type in the data into the textbox, or select the corresponding cell within the sheet.

When all required arguments are entered, click on the OK button to complete the function.

**In a cell or the formula bar**

To enter an IF function into a cell or the formula bar, start the function by typing an equal (=) sign, followed by the text, if. As the name of a function is typed, Excel will list all functions that match the text being typed under the cell, or formula bar, containing the function.

To view a description of any of the suggested functions, use the arrow keys on the keyboard to highlight the function, or single click on the function name with the mouse. To select a function, use the arrow keys to highlight the function and then hit the tab key, or double click on the function name.

When the IF function is selected, the name of the function will be in all caps followed by an open parentheses. Under the IF function name will be a display of the arguments for the function.

When all of the required arguments, logical_test[value_if_true], and [value_if_false], are entered into the function, enter a closed parentheses and then by hitting the Enter key.

**Tip:** The closed parenthesis is not required to be entered to complete a function. Simply hit the Enter key and Excel will add the closed parenthesis to complete the function.
Cell References
There are a couple of options when copying and pasting a function. Before being able to copy and paste a function, users must understand how cell references work.

Relative Cell Reference
By default, Excel uses relative cell referencing, which means the cell references change in relation to a function’s new location as the function is copied or moved.

For example; Excel reads the formula in cell C1 as “add the number in the cell located two columns to the left to the number in the cell located one column to the left”. When the formula, which appears as =A1+B1, is copied to the cell below, it performs the calculation using the same pattern, but updates the formula to reflect the appropriate cell addresses, =A2+B2.

Absolute cell reference
An absolute reference is a reference to a particular cell, or range of cells, that never updates as the function is copied to a new location. Absolute references may consist of an individual cell that never updates, or to keep a row or a column constant as the function is copied to a new location. A dollar sign ($) in front of the Column letter and Row number indicates an absolute reference to a cell.

To create an absolute cell reference, navigate into the formula in the Formula bar and click on the cell reference to be absolute referenced. Press the F4 key on the keyboard to add an absolute reference to the cell reference, which will be indicated by a dollar sign ($) in front of the column letter and the row number, $B$12.

To cycle through all Absolute reference options, press the F4 key while the cell reference is highlighted.

1. The first time the F4 key is pressed, an absolute reference to an individual cell is made.

   ![Cell reference 1](image1)

2. The second time F4 is pressed, the reference will be to the row only, meaning the row number is held constant, but the column letter can update.

   ![Cell reference 2](image2)

3. The third time F4 is pressed, the reference will be to the column only, meaning the column letter is held constant, but the row number can update.

   ![Cell reference 3](image3)

4. The fourth time F4 is pressed, the reference will return to a relative cell reference.

   ![Cell reference 4](image4)

Tip: The F4 key may also be pressed immediately after clicking on a cell within a function, instead of having to go back into the function to update it.
AND & OR Functions
The And & Or functions are great functions to use within an if function because they will return a value of either True or False, which is what the logical_test portion of an IF function argument requires.

The And and Or functions will allow for multiple logical expressions to be created within the argument of the function, instead of just a single option when using an IF function.

And Function
The And function will return a True value if every one of the logical expressions is true.

The syntax is; =AND(logical1,[logical2],...)

OR Function
The OR function will return a True value as long as one of the logical expressions is true.

The syntax is; =OR(logical1,[logical2],...)

Nesting an AND or OR function in an If function
The easiest to incorporate an AND or OR function into an if function is to first create the AND or the OR function. When the AND or OR function is complete, place the function into the logical_test argument portion of an IF function.

The steps below will walk through the process of creating an AND function within an IF function. To have an OR function in the IF function, follow the same steps, but enter OR instead of AND.

Navigate to the cell that will contain the IF function. We will start by creating the AND function, so type in an equal sign, followed by AND. Select the AND function by double clicking on it, or using the arrow keys to select the function and then hit the tab key.

Type in the first logical expression (remember to use absolute references if necessary) and then hit the comma key to navigate to the second logical expression.

Continue this pattern until every logical expression has been entered into the argument. When the AND function is complete, complete the function by entering in a closed bracket ).

Navigate to the front of the AND of OR function and place the cursor after the equal sign.

Tip: This may also be done in the formula bar, as it may be easier to access the first portion of the function in the formula bar instead of in a cell.
Start typing if in the cell and Excel will populate a list of functions underneath the cell. Either double click on the If function, or use the arrow keys to highlight IF and then hit the tab key.

Excel will now display the arguments for the IF function underneath the cell, or the formula bar. The logical_test argument is bolded because that is the first argument in the function.

Since the logical test is complete with an AND or OR function, move the cursor to the far right of the AND function, and then type in a comma.

In the value_if_true argument, enter what should happen if the logical_test value returns TRUE and then type a comma to get to the last portion of the IF function, the value_if_false.

In the value_if_false argument, enter what should happen if the logical_test value returns FALSE and then type in a closed bracket to complete the function.

**Note:** Users may hit the Enter key instead of typing in the closed parenthesis to complete the function, which may populate an error.

This error is just notifying the user that the last closed bracket is missing. By accepting this error, Excel will insert the closed bracket to complete the function.
Nested IF function

A nested IF function, which is an IF function contained within an IF function, is an easy way to test for multiple conditions.

The way a nested IF function works is a logical_test is tested, if that test returns a TRUE value, something will happen, but if it returns a FALSE value, another IF function will be used to determine if the logical_test fits into another qualifier.

An example of a nested IF function may look similar to this;
=IF(logical_test,value_if_true,IF(logical_test,value_if_true,value_if_false))

Note: Excel can nest up to 64 IF functions.

If comparing values on a scale, make sure the values are sorted in either increasing or decreasing order. If the scale is in Increasing order, the less than < sign will be used in the arguments and if the scale is in decreasing order, the greater than > sign will be used in the arguments.

Steps for a Nested IF function

To enter a nested IF function into a cell or the formula bar, start the function by typing an equal (=) sign, followed by the text, if. As the name of a function is typed, Excel will list all functions that match the text being typed under the cell, or formula bar, containing the function.

To select a function, use the arrow keys to highlight the function and then hit the tab key, or double click on the function name.

When the IF function is selected, the name of the function will be in all caps followed by an open parentheses. Under the IF function name will be a display of the arguments for the function.

Enter in the first logical test within the If function, then hit the comma key to get to the value_if_true.

In the value_if_true argument, enter what should happen if the logical_test value returns TRUE and then type a comma to get to the last portion of the IF function, the value_if_false.
In the value_if_false, a new IF function will be started. To start a new IF function, type “if” within the value_if_false portion of the argument. Excel will populate the if function underneath the cell that is being typed in. Select the if function, just as if this was a brand new IF function that was being started, by double clicking on the If, or by highlighting it and then hitting the tab key.

When the IF function is selected, the argument underneath the cell changes from being the value_if_false portion of the first IF function into the logical test of a new IF function.

It is best to ignore the data of the first IF function and work solely on the second IF function by working through the arguments.

In the second IF function’s logical_test, enter in the second comparison and then hit the comma key to get into the value_if_true.

In the value_if_true argument, enter what should happen if the second logical_test value returns TRUE and then type a comma to get to the last portion of the IF function, the value_if_false.

In this example, only IF functions are needed, so in the value_if_false of the second IF function, enter what should happen if the second logical_test value returns FALSE and then type in a closed parenthesis).

Note: If more logical tests were being compared, another IF function may be entered into the value_if_false portion of the second IF function, following the same steps that were taken above.

After the value_if_false portion is completed, Excel will display the value_if_false portion complete the second IF function by typing in a closed bracket).

When the closed bracket is typed, users will notice that the IF function argument below the cell will now display the value_if_false argument of the first IF function. Since the second IF function has completed the value_if_false portion of the first IF function the nested if is now complete. To complete the nested IF function, either type in another closed bracket ), or hit the Enter key.
Note: Users may also hit the Enter key after completing the second IF function. If this is done, Excel will populate a window indicating that there is a typo in the formula, meaning there aren’t any closed brackets to complete the function. To have Excel enter in the closed brackets, hit the Yes button.

Verify nested IF function
To verify the nested IF was entered in correctly, click on the cell containing the IF function and then hit the F2 key. This will display the function with colored cell references related to the cells on the worksheet.
VLOOKUP

The VLOOKUP function is used to search for a value in the left-hand column of a vertical array (table) of data. When the value is found, the VLOOKUP function will returns a value from another column in the same array (table).

The V in VLOOKUP stands for vertical, so the array (table) must be arranged vertically.

The syntax for VLOOKUP is; \(=\text{VLOOKUP}(\text{Lookup\_value}, \text{Table\_array}, \text{Col\_index\_num}, \text{Range\_lookup})\)

- **Lookup\_value** – This is the value that is being searched for in the Table\_Array.
- **Table\_array** – A table with two or more columns.

There are several rules to remember about the table\_array.
1. The leftmost column must contain the value being searched for (Lookup\_value).
2. There leftmost column cannot have duplicate values.
3. This list must be sorted in ascending order based on the leftmost column if the range\_lookup is set to TRUE, or left blank.
4. The Table\_array must be absolute referenced within the VLOOKUP function

- **Col\_index\_num** – The column number in the table\_array which contains the value that is to be returned as a result.
- **Range\_lookup** (optional) – a logical value containing either True or False.
  - **TRUE**(or blank) - an approximate match is returned (if an exact match is not found, the next largest value within the Lookup\_Value is returned)
  - **FALSE** – an exact match must be found to return the value in the col\_index\_num

Create a Table\_array

Before using the VLOOKUP function, a Table\_array must be created that contains the searched for values (lookup\_value) in the leftmost column, as well a return value that will be populated when a value is found.

The lookup\_array must;
- Be arranged vertically
- Contain the searchable data in the leftmost column
- The leftmost column must be arranged in ascending order.
- Have the return value in a column, other than the leftmost column.
- Arranged in ascending or alphabetic order if looking for an approximate match. Meaning the Range\_lookup value is TRUE or blank.

To the right is an example of a lookup\_table. The lookup value, score, is in the leftmost column, arranged in ascending order. The return value is the letter grade, which is in column two.
Steps to create a VLOOKUP
When starting out, it is easiest to create a VLOOKUP from the Formulas tab using the Insert Function option.

Note: When the syntax for a VLOOKUP are learned, a VLOOKUP may be entered by typing an equal (=) sign in a cell followed by the text vlookup. Highlight the vlookup function and then hit tab to accept the function and provide the data for the first argument. Use the comma keys to navigate between the arguments, hitting the enter key when all arguments have been completed.

Place the cursor in the cell that is to hold the VLOOKUP function, which is also the cell that will display the value that will be populated from the table_array.

Navigate to the Formula tab and then click on the Insert Formula icon. The Insert Formula dialog will appear.

On the Insert Function dialog box, type “vlookup” in the search for a function textbox and then click the Go button.

Highlight VLOOKUP from the select a function area and then click the OK button.
Excel will populate the Function Arguments window with the VLOOKUP function. Every argument of the VLOOKUP function will be listed on the Function Argument window. To view a description of each argument, place the cursor in that argument’s textbox.

- **Lookup_value** – This is the value that is being searched for in the Table_Array.
- **Table_array** – A table with two or more columns.
  - The table_array must be absolute referenced.
    - This can be done by selecting the table_array and then hitting the F4 key once.
- **Col_index_num** – The column number in the table_array which contains the value that is to be returned as a result.
- **Range_lookup** (optional) – a logical value containing either True or False.
  - TRUE (or blank) - an approximate match is returned (if an exact match is not found, the next largest value within the Lookup_Value is returned)
  - FALSE – an exact match must be found to return the value in the col_index_num.

To enter the arguments, position the cursor in the argument textbox and then navigate to the corresponding worksheet containing the argument data and select the cell.
When selecting the range for the table_array, make sure to absolute reference the table by selecting the range and then hitting the F4 key.

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Letter Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00%</td>
<td>F</td>
</tr>
<tr>
<td>60.00%</td>
<td>D</td>
</tr>
<tr>
<td>70.00%</td>
<td>C</td>
</tr>
<tr>
<td>80.00%</td>
<td>B</td>
</tr>
<tr>
<td>90.00%</td>
<td>A</td>
</tr>
</tbody>
</table>

The col_index_num is the column number that contains the value that will populate in the cell that the VLOOKUP is being entered in.

The Range_lookup is either left blank (TRUE) or FALSE is entered. FALSE means the value being searched for must be an exact match to a value in the first column of the table_array.

When all arguments have been entered, click on the OK button.
Here is an example of a VLOOKUP pointing out the arguments of the VLOOKUP function.

This example is searching for score as a percent and displaying the corresponding letter grade. Since the scores do not have to be exact, the Range_lookup is left blank.