Advanced Formulas and Functions in Microsoft Excel

This document provides instructions for using some of the more complex formulas and functions in Microsoft Excel, as well as using absolute references in formulas.

Opening Comments

Formulas are equations that perform calculations on values. A formula starts with an equal sign (=) and follows the order of operations (parentheses, exponents, multiplication & division, addition & subtraction).

For example, the following formula multiplies 2 by 3 and then adds 5 to the result.

=5+2*3

A **function** is a preset formula. Like formulas, functions begin with an equal sign (**=**) followed by the function's name and its arguments. The function name tells Excel what calculation to perform. The arguments are contained inside round brackets.

For example, the most used function in Excel is the SUM function, which is used to add together the data in selected cells. The SUM function is written as -

=SUM(A1:A6)

Here the function adds the contents of the cell range A1 to A6.

Formulas and functions can be entered directly into a cell or into the Formula Bar.
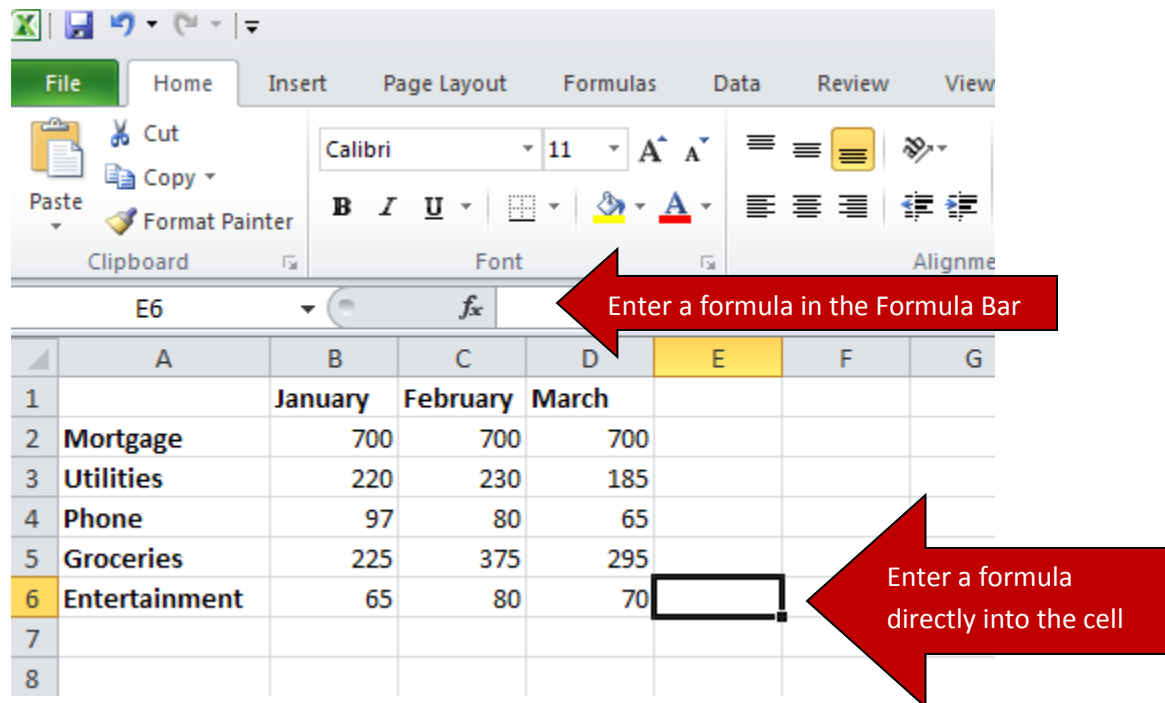
Formulas That Span Multiple Worksheets [3-D References]

There are often times when we want to create formulas that apply to data on multiple worksheets. For example, if each department in an organization has its own worksheet, it might be helpful to have a worksheet that totals or averages the budgets for the entire organization.

A reference that refers to the same cell on multiple sheets is called a 3-D reference. A 3-D reference is a useful and convenient way to reference several worksheets that follow the same pattern where cells on each worksheet contain the same type of data.

To create a 3-D reference,

1. Click the cell where you want to enter the function.
2. Type **=** (equal sign), enter the name of the function, and then type an opening parenthesis.
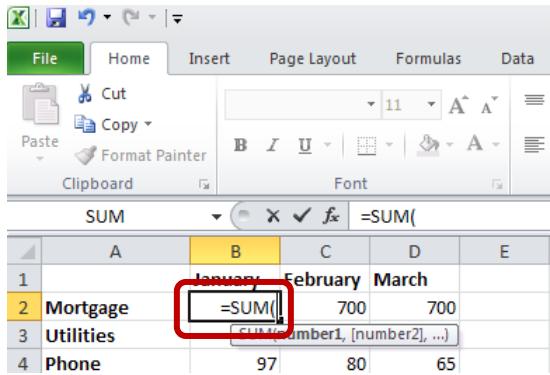
3. Click the tab for the first worksheet that you want to reference.
4. Hold down **Shift** and click the tab for the last worksheet that you want to reference.
5. Select the cell or range of cells that you want to reference.
6. Complete the formula, and then press **Enter**.
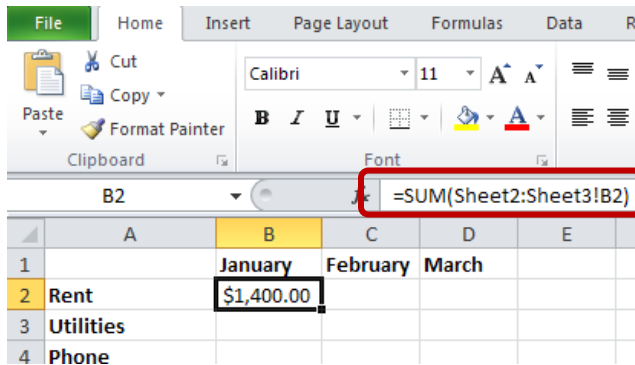
This formula says 'Add the values in cell B2 on each worksheet from Sheet 2 through Sheet 3.

Intro to the VLOOKUP Function

The VLOOKUP function searches for a value in the first column of a table array and returns a value in the same row from another column in the table array. The V in VLOOKUP stands for


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"Vertical". Use VLOOKUP when your comparison values are located in a column to the left of the data that you want to find.

1. Begin by preparing the lookup table.
    a. The first column must be in alphabetical or numeric order.
    b. Name the data range. This will make writing the formula easier.
        i. To name a range, select the cells.
        ii. Then click the **Name** box and type the name of the range.
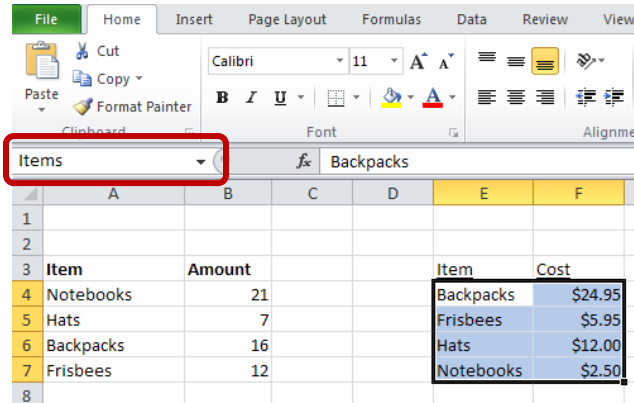

2. The VLOOKUP formula has 4 components:
    a. Lookup_value: The value to search in the first column of the table array.
    b. Table_array: Two or more columns of data. The values in the first column of table_array are the values searched by lookup_value.
    c. Col_index_num: The column number in table_array from which the matching value must be returned. A col_index_num of 1 returns the value in the first column in table_array; a col_index_num of 2 returns the value in the second column in table_array, and so on.
    d. Range_lookup: A logical value that specifies whether you want VLOOKUP to find an exact match or an approximate match. If TRUE or omitted, an approximate match is returned. In other words, if an exact match is not found, the next largest value that is less than lookup_value is returned. If FALSE, VLOOKUP will find an exact match. If one is not found, the error value #N/A is returned.
3. Enter the formula: =VLOOKUP(A4,Items,2) * B4
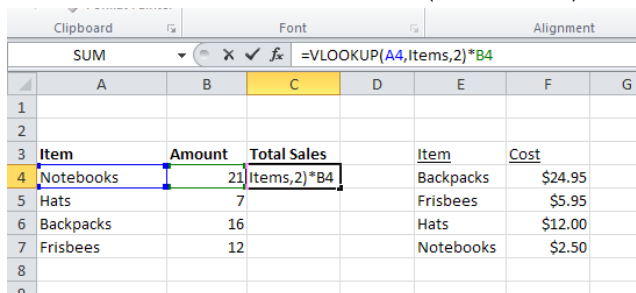
   a. A4 is the look up value.
    b. Items is the name of the table.

c. The column number from which the matching value should be returned is 2.
d. We want to multiply the resulting value by the number of items sold, which is B4.
e. We omitted the optional range_lookup since our values all match.

4. Copy the formula for the rest of the items.
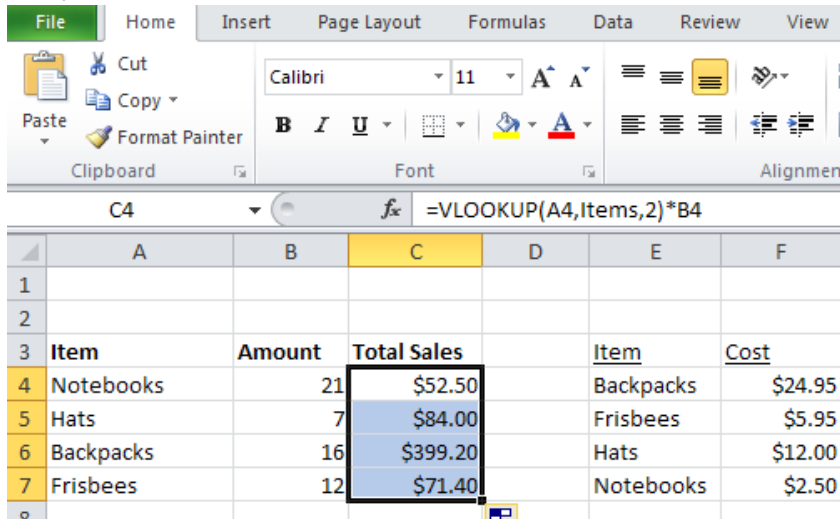
Intro to the HLOOKUP Function

The HLOOKUP function searches for a value in the top row of a table array, and then returns a value in the same column from a row you specify in the table array. The H in HLOOKUP stands for "Horizontal." Use HLOOKUP when your comparison values are located in a row across the top of a table of data, and you want to look down a specified number of rows.

1. Begin by preparing the lookup table.
   a. The first row must be in alphabetical or numeric order.
   b. Name the data range. This will make writing the formula easier.
      i. To name a range, select the cells.
      ii. Then click the **Name** box and type the name of the range.

These amounts are in numeric order.
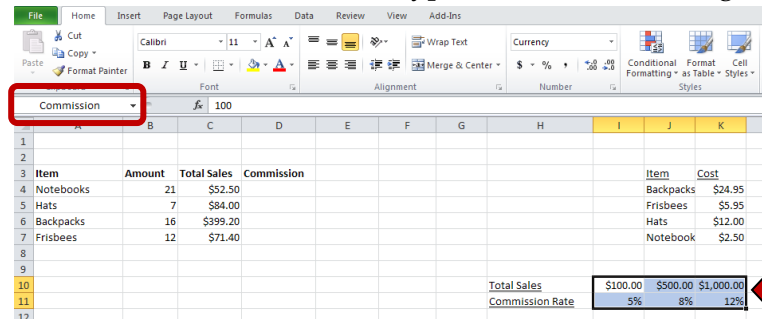
2. The HLOOKUP formula has 4 components:
   a. Lookup_value: The value to be found in the first row of the table array.

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b. Table_array: The table of data in which data is looked up. The values in the first column of table_array are the values searched by lookup_value.

c. Row_index_num: The row number in table_array from which the matching value must be returned. A row_index_num of 1 returns the value in the first row in table_array; a row_index_num of 2 returns the value in the second row in table_array, and so on.

d. Range_lookup: A logical value that specifies whether you want HLOOKUP to find an exact match or an approximate match. If TRUE or omitted, an approximate match is returned. In other words, if an exact match is not found, the next largest value that is less than lookup_value is returned. If FALSE, HLOOKUP will find an exact match. If one is not found, the error value #N/A is returned.

3. Enter the formula: =HLOOKUP(C9,Commission,2) * C9
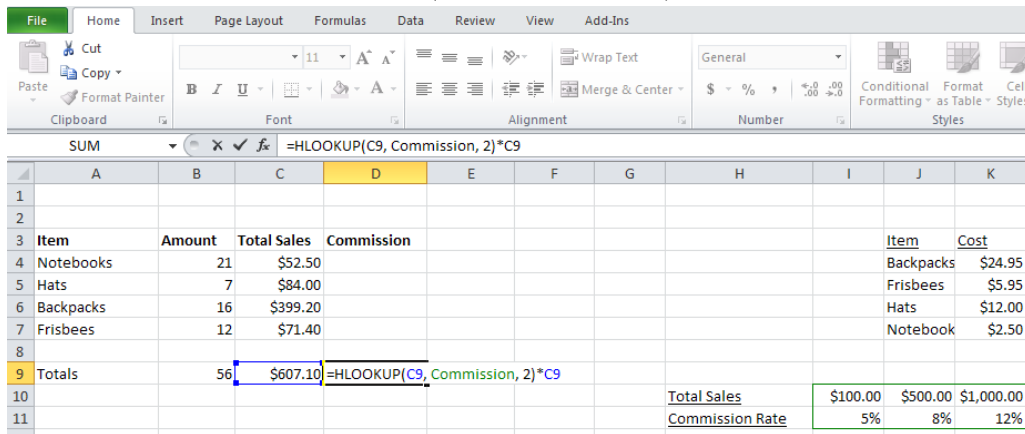
a. C9 is the look up value.
b. Commission is the name of the table.
c. The row number from which the matching value should be returned is 2.
d. We want to multiply the resulting value by the total sales, which is C9.
e. We omitted the range_lookup because we want to find an approximate match.

Intro to the PMT Function

The PMT function calculates the payment for a loan based on constant payments and a constant interest rate.

The PMT function has 3 required components and 2 optional components:

Rate: The interest rate for the loan.
Nper: The total number of payments for the loan.
**Pv:** The present value, or the total amount that a series of future payments is worth now; also known as the principal.

Fv: (Optional) The future value, or a cash balance you want to attain after the last payment is made. If fv is omitted, it is assumed to be 0 (zero), that is, the future value of a loan is 0.

Type: (Optional) The number 0 (zero) or 1 and indicates when payments are due. If the Type value is 0 or omitted, then the payment is due at the end of the period. If the Type value is 1, then the payment is due at the beginning of the period.
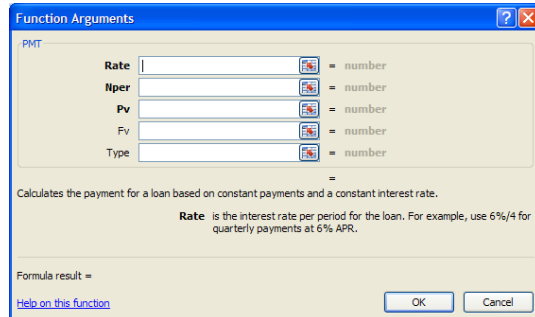
We will use the Insert Function wizard for this example.

1. Click on the **Insert Function** button.
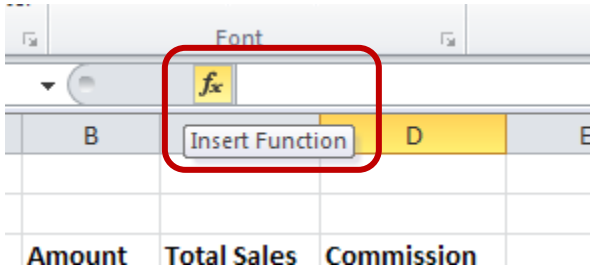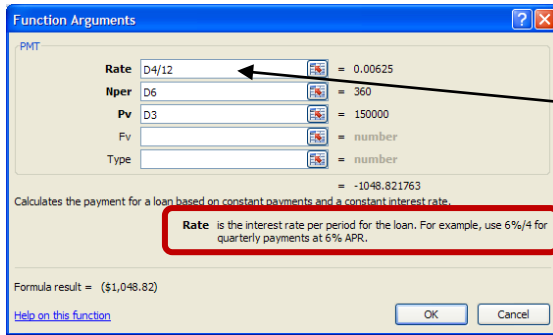

2. Select the **Financial** category and scroll to the **PMT** function. Click **OK**.
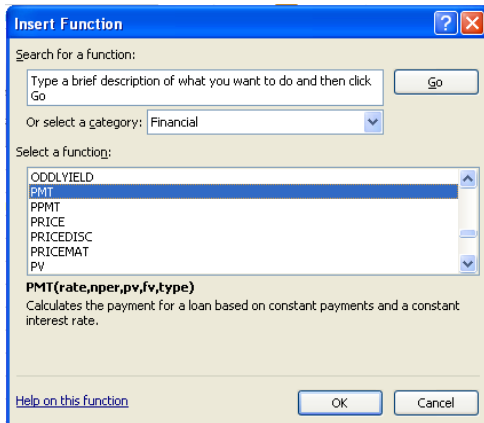
3. This brings up a **Function Arguments** dialog box, which is a helpful tool when completing the components of a complex formula. Notice that a description is provided for each component.
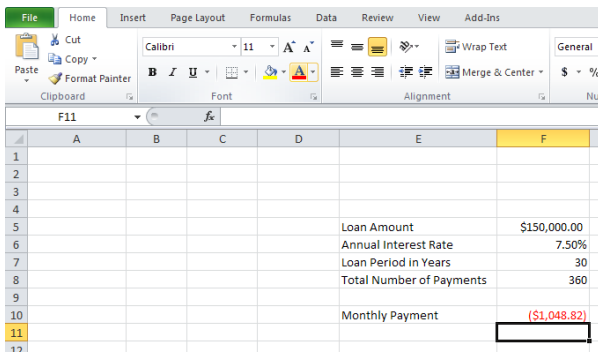
4. Either enter the appropriate cell reference or click in the appropriate cell for each required component.

Notice that we divided the rate by 12, since there will be 12 payments each year. This would have been easy to forget without the helpful description provided.

5. The result is shown in red because Excel recognizes it as an outgoing payment, which is a debit.

6. Notice how easy this formula makes it for us to quickly determine how much we can spend on a house and/or what our target interest rate might be.
7. **Tip:** To find the total amount paid over the duration of the loan, multiply the returned PMT value by Nper.

Absolute References

Often, when we create a formula once, we want to apply it to a series of rows or columns. For example, if we apply a SUM formula to the total sales for January, we probably want to apply the same formula to the total sales for the other months. To do so, we use AutoFill to copy the formula to the other months. Excel automatically adjusts the references in the pasted formula to refer to different cells relative to the position of the formula. For example, if we copy the formula one column to the right, then Excel knows to add the cells that are one column to the right of the original formula. We call these relative references - references to cells or ranges are based on their position relative to the cell that contains the formula.

However, there are times when we want to use absolute references.

1. In this example, each salesperson has a goal to increase their first quarter sales by 8% for the second quarter.

2. To determine the target sales goal, a formula was entered to multiply the first quarter sales by 8% and then add that amount to the first quarter sales:

3. The formula works perfectly for the first salesperson. But look what happens when the formula is copied down.

4. Let's look at the formula. Notice the problem is that the reference for the rate needs to stay fixed. In other words, it needs to an absolute reference.

5. Excel uses dollar signs ($) to indicate absolute references. The $ can be included in the formula by using the **F4** button or by typing it directly.
   a. Go back to the original formula.
   b. Click between the E and the 2.
   c. Press the **F4** button.

SUM	▾	⊙	✕ ✓ ƒ𝑥	=B2*E2+B2

◢	A	B	C
1	Salesperson	1st Qtr. Sales	Target 2nd Qtr. Sales
2	Baker	$456.00	=B2*E2+B2
3	Connor	$500.00	
4	Watson	$197.00	
5	Walters	$350.00	
6	Wilson	$248.00	

   d. This tells Excel that as the formula is copied, the E2 reference should stay constant.
   e. Copy the revised formula down to see the results.

C8	▾	⊙	ƒ𝑥	

◢	A	B	C
1	Salesperson	1st Qtr. Sales	Target 2nd Qtr. Sales
2	Baker	$456.00	$492.48
3	Connor	$500.00	$540.00
4	Watson	$197.00	$212.76
5	Walters	$350.00	$378.00
6	Wilson	$248.00	$267.84
7			