Mastering Excel[®] Functions and Formulas

PARTICIPANT WORKBOOK



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Introduction

Learning to master Excel[®] provides essential skills that will aid your team's productivity and provide tools for effective communication of numbers. You can also use Excel[®] to track your compliance requirements.

When you understand how to collect and disseminate vast quantities of data with Excel[®], your value to your team grows in quantum leaps.

Properly configured and maintained, Excel[®] has the capacity to make you more productive and communicate more effectively because the data that you manage is essential to long-term corporate success.

In short, Excel[®] is an application used to manage and analyze vast quantities of data — numerical, categorical and ordinal.

SkillTip: Numerical data has meaning as a measurement and is quantitative. Categorical data identifies characteristics (qualitative). Ordinal data can be either numerical or categorical but has a special pattern — like dates or days of the week.

As you'll see in today's lesson, it's not data input (numerical, categorical or ordinal) — it's about the output your workbook provides and the knowledge it's able to transfer.

Speaking of knowledge transfer...we've got a lot to cover, so let's get started!

Course Overview

This multipart course is designed to provide compact explanations and relevant examples of the essential elements of mastering Microsoft Excel[®] — a program that enables an array of mathematical and analytical solutions from simple formulas to complex PivotTable reports that condense thousands of rows of data into meaningful information.

In this course, you'll go beyond basic "how-to" material and "step-by-step" instructions to best practices for designing professional-grade workbooks complete with numbers, text, formulas and functions.

Prerequisites

To fully benefit from this course, it's important for participants to:

- Be comfortable inputting data and writing simple formulas.
- Understand absolute and relative cell references.
- Be familiar with basic functions SUM, IF, AVERAGE.
- Have built basic PivotTable reports.

Learning objectives

At the end of this course, you'll be able to:

- Implement essential shortcuts, conditional formatting, functions and tables to build sheets quickly.
- Design and configure form controls to automate your workbook.
- Utilize data analysis and data mining tools.
- Develop effective charts and graphs.

Notes to readers

Throughout this workbook, you'll see study aids that will help you master Microsoft Excel®.

- SkillSteps: The fundamental steps to get to a feature
- SkillTips: Special guidelines for becoming a Power User
- Strategies: Techniques for mastering Microsoft Excel®

SkillTip: This workbook was written using Microsoft Excel[®] for Office 365 MSO Version 1904 Build 11601.20144 Click-to-Run Monthly Channel.

How to Write Formulas With Relative and Absolute Cell References

The heartbeat of Microsoft Excel[®] is the formula. A formula calculates values based upon parameters. By default, Excel[®] will recalculate formulas as soon as you complete them and press ENTER.

Formulas begin with an "=" symbol and are comprised of numbers, text or functions.

Examples of formulas:

- = 10 + 10 calculates the sum of two numbers
- =A1 + B1 calculates the sum of the values in two cells
- = C1 * .90 calculates the product of the value in a cell and .90
- =Sum(A1:A10) calculates the total of numbers in a range of cells

SkillTip: In general, don't put values into formulas. Put cell references. Formulas with values are more difficult to update and maintain than those with cell references.

Strategy: Typing is trouble. When you want to refer to a cell in a formula, select the cell with the mouse rather than try to type its address.

SkillTip: If you have an existing spreadsheet and wish to display the formulas, use the Show Formulas button in the Ribbon or press CTRL + `.

Often, you can write a single formula and then copy it to neighboring cells to save the time it would have taken you to rewrite the formula.

Copying formulas is not always as simple as it seems because sometimes reusing a formula may require relative cell references other times it might require absolute cell references.

Cell references

There are four types of cell references:

REFERENCE TYPE	EXAMPLE
Relative	A1
Absolute	\$A\$1
Mixed (Column fixed)	\$A1
Mixed (Row fixed)	A\$1

Use these different reference types in the appropriate scenarios.

				Taxrate	~	10%
Item	Price	Тах	total	Ţ		
Shoes	\$100.00	\$10.00	\$110.00			
Socks	\$10.00	\$1,00	\$11.00			
Pants	\$50.00	\$5.00	\$55.00			
Jewelry	\$200.00	\$20.00	\$220.00			
Hat	\$10.00	\$1.00	\$11.00			

SkillTip: While editing a formula, you can modify a cell address from one reference type to another by pressing F4. (On Excel® for Mac, it's Command + T.)

Relative cell references

If the formula is written with relative cell references, the cell references will update to reflect the new cell to which they've been copied.

To copy a formula from one cell to another:

- Use Copy and Paste
- Use the Fill handle
- Home > Editing > Fill

In all instances, your objective is to type as little as possible.

Absolute references

Sometimes you don't want a cell reference to change when you copy a formula. You need the cell addresses to use absolute references.

Cell references with dollar symbols before the column letter and row number are absolute and will not update when a formula is copied.

New Topic: Modern Excel[®], Dynamic Arrays and Spill Ranges

Modern Excel[®] or Dynamic-Array Excel[®] are terms that are being used to describe the newest versions of Excel[®] because they support Dynamic Arrays.

What are Dynamic Arrays?

They are a new calculation engine that support simpler formulas that "spill" to remaining cells.

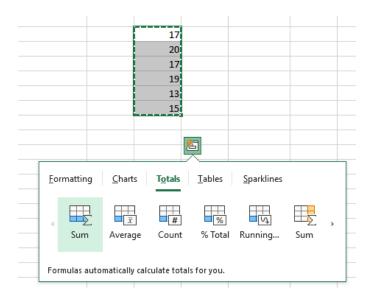
For example, if you wanted to create a sum from two columns, you could write a single formula in a cell that would "spill" to the remaining rows.

Item	Price	Tax	total
Shoes	\$100.00	\$10.00	=D4:D8+E4:E8
Socks	\$10.00	\$1.00	\$11.00
Pants	\$50.00	\$5.00	\$55.00
Jewelry	\$200.00	\$20.00	\$220.00
Hat	\$10.00	\$1.00	\$11.00

New Topic: Quick Analysis for Formulas and Crosstab Formulas

Quick analysis

The Quick Analysis Tool (CTRL + Q) provides an easy method to create calculations. The tool gives you some standard calculations you can apply to a range of cells.



Other quick methods to build a formula (ALT + =)

In addition to Quick Analysis, you can also build formulas with shortcuts like ALT + =.

In the example, we'll build a crosstab report with subtotals at the end of each row and at the bottom of each column.

	Jan	Feb	Mar	Apr	May		In Balance?
ltem 1	10	10	10	10	10	50	TRUE
Item 2	10	10	10	10	10	50	
Item 3	10	10	10	10	10	50	
Item 4	10	10	10	10	10	50	
Item 5	10	10	10	10	10	50	
Item 6	10	10	10	10	10	50	
Item 7	10	10	10	10	10	50	
Item 8	10	10	10	10	10	50	
	80	80	80	80	80	400	
					checksum	400	

Best practices when building a quick crosstab report

It's not a great idea to daisy-chain formulas together. It's best to calculate totals directly from the source numbers, not from subtotals.

When you crate a checksum calculation to compare your indirect calculation with a direct one, you can build a logical formula with the "=" key that return TRUE if the numbers match and FALSE if they don't.

The Basics of Functions

Excel® provides 248 functions divided into 14 categories that are available via the Formulas tab on the Ribbon.

Function are built-in formulas that carry out set calculations and require you to provide arguments. Arguments are any input you give to a function (as in a range of cells.) Arguments are always surrounded by parenthesis and individual arguments are separated by commas.

Functions can be inserted into a formula by typing their name. However, you'll have to know the name of the function or research the appropriate one.

Here are some examples of functions:

- **SUM:** to calculate a total
- NETWORKDAYS: to calculate number of workdays between two dates
- PMT: to calculate a loan payment
- VLOOKUP: to look up a value in a list
- **CONCATENATE:** to combine text values
- IF: to return a value if true and another if false
- **RANDBETWEEN:** returns a random number between two numbers
- **CELL:** returns information including the name of the current file

To learn the names of functions, you can use the Insert Function button on the Formulas tab and search for the function that matches your need.

Insert Function			?	×		
Search for a function:						
Type a brief descript click Go	ion of what you want	to do and then		<u>G</u> o		
Or select a <u>c</u> ategory:	Most Recently Used	~				
Select a function:						
DAYS360 PRODUCT ROUNDDOWN WORKDAY MATCH TEXT TODAY DAYS360(start_date, Returns the number (twelve 30-day month	of days between two o	lates based on a 36	50-day	year		
Help on this function		ОК	C	ancel		

How to calculate days to go with NETWORKDAYS

Do you need to calculate the number of working days until a deadline? Consider NETWORKDAYS.

Function Arguments				?	\times
NETWORKDAYS					
Start_date	TODAY	<u>↑</u>	=	Volatile	
End_date	G7	Ť	=	43845	
Holidays	\$0\$6:\$0\$13	1	=	{43824;0;43831;43830;0;0;0;0;0}	
Returns the number of whol				· Volatile epresents the start date.]
Formula result = Volatile					
Help on this function				OK Car	ncel

Why you should build formulas with cell references, rather than fixed values: CONVERT

It's always easier, as depicted above, to update a worksheet when formulas refer to cells (with relative and absolute cell references) rather than values. In the above example, you can switch column calculations by swapping labels, not swapping columns.

Use CONVERT as an example to understand this principle.

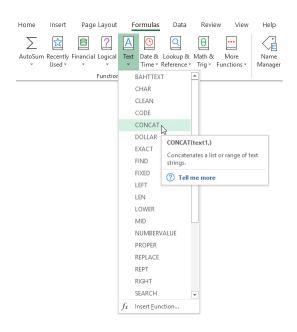
m	ft	yd	in	mi
100	=CONVER	(\$N5,	\$ <mark>N\$4,</mark> O\$4)	
200	CONVERT(num	er, from_uni	t, to_unit)	
300				
400				
500				
600				
700				
800				
500 600 700				

As mentioned earlier, try to avoid formulas daisy-chained to other formulas.

The Wonderful SUMPRODUCT Function That Combines Two Other Functions

Function Arguments		?	×
SUMPRODUCT			
Array1	D4:D8 = {100;10;50;300;15}		
Array2	E4:E8 主 = {1;4;1;1;1}		
Array3	主 = array		
Returns the sum of the	= 505 products of corresponding ranges or arrays.		
	Array1: array1, array2, are 2 to 255 arrays for which you want t then add components. All arrays must have the same di		
Formula result = 505			
Help on this function	ОК	Car	ncel

Text functions



Some of the most common and valuable text functions include:

- UPPER RIGHT
- LOWER
 MID
- PROPER
 CONCAT
- LEFT

You can use text functions to create calculations based on cells that contain text, change their appearance or truncate their content.

Input: Mary Jones

UP	PER	LOV	VER	PRO	PER	TRIM	TRIM AND PROPER
MARY	JONES	mary	jones	Mary	Jones	Mary Jones	Mary Jones

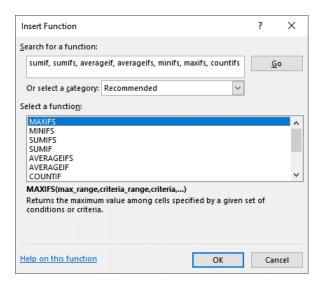
Flash Fill can make text functions obsolete

First	Last	LCFN	
Sheila	Smith	Smith, Sheila	
Mary	Jones	Jones, Mary	II -
Alan	Brown	Brown, Alan	5 Undo Flash Fill
Doug	Sampson	Sampson, Doug	 Accept suggestions
Chad	Brayman	Brayman, Chad	
Bill	Keegan	Keegan, Bill	Select all 0 <u>b</u> lank cells
Doris	Roberts	Roberts, Doris	Select all 6 <u>c</u> hanged cells

Use the new TEXTJOIN to generate a list of emails

John.Smith@gmail.com Paul.Jones@infotech.com Mary.Rogers@Yahoo.com Dan.Brown@DanBrown.com Pat.Johnson@Hotmail.com Lynn.Johnson@aol.com Sheila.Carson@abc.com

The IFs functions



The family of IF functions is based on combinations of values and conditions.

The list of IF functions includes:

• IF	AVERAGEIF	COUNTIFS
• SUMIF	AVERAGEIFS	MAXIFS
SUMIFS	COUNTIF	• MINIFS

They often make it easy to create crosstab reports when using mixed cell references.

The formulas perform calculations conditionally — based on whether a condition is TRUE or FALSE.

Rep	Item	Units
Dave	Product 2	13
Dave	Product 1	3
Matt	Product 1	5
Matt	Product 2	11
Sheila	Product 1	14
Chuck	Product 2	9
Chuck	Product 1	4
Dave	Product 2	14
Matt	Product 2	20
Matt	Product 2	8
Sheila	Product 2	6
Ryan	Product 2	12
Dave	Product 2	8
Chuck	Product 2	17

Product 1 Product 2									
Dave	•	3	35						
Matt		5	39						
Sheila		14	6						
Chuck		4	26						
Ryan		0	12						

=\$UMIFS(\$D\$4:\$D\$18,\$B\$4:\$B\$18,\$F6,\$C\$4:\$C\$18,G\$5)

COUNTIFS, SUMIFS, AVERAGEIFS

When you need to calculate sum or count combinations of entries — like names and regions, use the COUNTIFS function or the SUMIFS function.

Like CONVERT, they can be written with cell references to the top row and the left-most column to calculate the values that meet those two criteria.

Rather than write elaborate formulas, you can build a single multipurpose formula that can be copied to a crosssection of cells.

SkillSteps: The arguments for COUNTIFS look like: =COUNTIFS (criteria_range1, criteria1, [criteria_range2, criteria2] ...)

For example, if you need to count the number of employees broken down by department and region, you could write a formula like: =COUNTIFS(\$C:\$C,\$K4,\$B:\$B,L\$3).

If you wanted to total the amount of salary paid to employees broken down by department and region, you could write a formula like: =SUMIFS(\$G:\$G,\$C:\$C,\$K11,\$B:\$B,L\$10).

COUNTIFS	North	South	East	٧	Vest	Central			
Manufacturing	7	,	6	6	7	15			
Sales	8	3	9	8	11	10			
R & D	7	7	5	6	5	11			
	=COUNTIFS(\$C:\$C,\$K4,\$B:\$B,L\$3)								

SUMIFS	North	South	East	West	Central						
Manufacturing	291735	179279	207115	299023	568192						
Sales	389275	344242	348519	568344	444235						
R & D	291614	161998	313071	165643	611037						
	=SUMIF	=SUMIFS(\$G:\$G,\$C:\$C,\$K11,\$B:\$B,L\$10)									

SkillSteps: The arguments for SUMIFS look like:

=SUMIFS (sum_range, criteria_range1, criteria1, [criteria_range2, criteria2], ...)

SkillTip: When using sheets with only raw data, you can select the entire columns as criteria ranges, rather than selecting only certain rows.

In addition to these functions, Excel® provides a powerful tool that consolidates large data sets.

How to Use VLOOKUP, INDEX and MATCH

The purpose of VLOOKUP is to match a value in a remote column and return a "looked up" value. For example, "look up an employee ID number and return their first and last name."

VLOOKUP requires four arguments of information:

- 1. What are you looking up?
- 2. Where are you looking the value up?
- 3. Which column of the lookup range contains the resulting value?
- 4. Do you want to allow approximate matches?

The drawbacks to VLOOKUP:

- The value you are returning MUST be in a column to the right of the lookup value.
- The lookup value must be in the first column of the lookup range.
- The formula must contain the entire lookup range (and if the range is many columns wide, this is a large amount of data to store in every cell using the same VLOOKUP formula).
- The solution to this inefficiency is to divide up the pieces of VLOOKUP into INDEX and MATCH.
 - INDEX defines the range of cells with the results you need.
 - MATCH identifies the row number from the INDEX range that you specifically need.

Here is an example of using VLOOKUP and then delivering the same results with INDEX and MATCH.

0.....i

Item	tall	grande	venti	trenta
Valencia Orange	3.	29 3.59	3.89	4.29
Very Berry Hibiscus	3.	29 3.5	3.89	4.29
Cool Lime	3.	29 3.59	3.89	4.29
Iced Coffee	2.	99 3.29	3.59	3.89
Shaken Sweet Tea	2.	99 3.29	3.59	3.79
Shaken Iced Tea	2.	99 3.29	3.59	3.79

Item	tall	grand	le ver	nti	trenta
Valencia Orange	3.2	29	3.59	3.89	4.29
Very Berry Hibiscus	3.2	29	3.59	3.89	4.29
Cool Lime	3.2	29	3.59	3.89	4.29
Iced Coffee	2.9	99	3.29	3.59	3.89
Shaken Sweet Tea	2.9	99	3.29	3.59	3.79
Shaken Iced Tea	2.9	99	3.29	3.59	3.79

Item	tall		grande	venti	trenta					
Cool Lime	•	3.29	3.59	3.89	4.29					
=INDEX(F:F,MATCH(\$L4,\$E:\$E,0))										

SkillTip: As data in a workbook grows, the usage of VLOOKUP can slow down the workbook. If this is the case, consider replacing VLOOKUPs with INDEX and MATCH.

SkillTip: The consolidation feature matches column and row headers from the supporting sheets to generate the results. Your ranges need to have consistent headings for this to work.

Once you've successfully combined the data, Excel® displays the results in an outline format.

1 2		Α	В	С	D	E	F	G	Н	I	J	K	L	М	N
	1			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
+	5	Alan		\$203.00	\$122.00	\$158.00	\$216.00	\$152.00	\$97.00	\$208.00	\$179.00	\$148.00	\$197.00	\$224.00	\$105.00
+	9	Bob		\$165.00	\$94.00	\$229.00	\$168.00	\$198.00	\$126.00	\$218.00	\$141.00	\$216.00	\$52.00	\$134.00	\$146.00
+	13	Cathy		\$159.00	\$129.00	\$103.00	\$135.00	\$95.00	\$210.00	\$173.00	\$158.00	\$184.00	\$90.00	\$191.00	\$184.00
+	17	David		\$131.00	\$162.00	\$108.00	\$186.00	\$132.00	\$181.00	\$138.00	\$168.00	\$213.00	\$209.00	\$248.00	\$173.00
+	21	Ed		\$166.00	\$161.00	\$200.00	\$84.00	\$164.00	\$212.00	\$152.00	\$233.00	\$181.00	\$137.00	\$162.00	\$194.00
+	25	Fred		\$143.00	\$124.00	\$124.00	\$192.00	\$121.00	\$111.00	\$148.00	\$223.00	\$230.00	\$221.00	\$196.00	\$198.00
+	29	George		\$162.00	\$167.00	\$212.00	\$148.00	\$203.00	\$126.00	\$146.00	\$83.00	\$219.00	\$165.00	\$197.00	\$93.00
+	33	Henry		\$130.00	\$177.00	\$67.00	\$212.00	\$210.00	\$152.00	\$116.00	\$180.00	\$264.00	\$125.00	\$135.00	\$153.00
+	37	Ira		\$174.00	\$125.00	\$225.00	\$109.00	\$188.00	\$189.00	\$188.00	\$188.00	\$69.00	\$207.00	\$147.00	\$204.00
+	41	Jack		\$164.00	\$211.00	\$212.00	\$195.00	\$242.00	\$104.00	\$205.00	\$91.00	\$115.00	\$103.00	\$176.00	\$151.00
+	45	Ken		\$255.00	\$234.00	\$129.00	\$141.00	\$122.00	\$175.00	\$278.00	\$188.00	\$170.00	\$148.00	\$184.00	\$104.00
+	49	Lisa		\$99.00	\$194.00	\$173.00	\$108.00	\$207.00	\$115.00	\$126.00	\$139.00	\$181.00	\$138.00	\$224.00	\$74.00



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