

EXCEL 2013

Applying Advanced Functions

In this lesson, you will use advanced functions and what-if analyses to facilitate decision making. Complex worksheets for decision making often require advanced functions based on the values in other cells. With the criteria IF function, you can sum, average, or count values when specific criteria are satisfied. You can use logical functions to specify various criteria in formulas. The PMT function can determine the monthly payment for a business loan, while the FV function can determine the future value of investments.

CASE STUDY: ANALYZING A FUNDRAISING CAMPAIGN

Green Clean works in conjunction with an environmental charity to raise funds to support environmental responsibility. You have been asked to track the fundraising efforts of the charity. Additionally, this charity plans to expand its operations to a new facility and has asked Green Clean to help secure the necessary funding. You will set up an Excel worksheet that calculates the loan repayment schedule for this facility using the PMT function and input variables.

LEARNING OBJECTIVES

After studying this lesson, you will be able to:

- Build formulas with criteria IF functions and logical functions
- Use the PMT and FV functions to analyze loans and investments

LESSON TIMING

- Concepts/Develop Your Skills: 1 hr 30 min
- Concepts Review: 15 min
- Total: 1 hr 45 min

Creating Formulas Using Criteria IF Functions

Excel provides functions that average, count, or sum cells that meet one or more criteria. Because Excel performs the necessary calculations instantaneously, the possibility of making an error when using these functions is small. Only cells meeting all criteria are averaged, counted, or summed.

Function Syntax

Criteria IF functions all utilize a combination of the same arguments.

FUNCTION ARGUMENTS	
Argument	Description
Range	The cells to be compared with the criteria
Criteria	Enclosed in quotation (") marks, the comparison value, text, or expression using a comparison operator, such as =, >, <, >=, <=, or <> (not equal to)
Sum range	(Optional) The potential cells to be summed. If this is omitted, the range will be summed.
Average range	(Optional) The potential cells to be averaged. If this is omitted, the range will be averaged.

The IF functions have the following structure, or syntax.

FUNCTION SYNTAX	
Function	Description
SUMIF	SUMIF(range,criteria,[sum range])
AVERAGEIF	AVERAGEIF(range,criteria,[average range])
COUNTIF	COUNTIF(range,criteria)
SUMIFS	SUMIFS(sum range,range1,criteria1,range2,criteria2)
AVERAGEIFS	AVERAGEIFS(average range,range1,criteria1,range2,criteria2)
COUNTIFS	COUNTIFS(range1,criteria1,range2,criteria2)

How the SUMIF Function Works

In the formula `=SUMIF(C5:C12,">=30000",C5:C12)`, the range to be evaluated is C5:C12. The criterion used to determine if a cell in the range should be summed is the second argument, greater than or equal to 30,000. The third argument, sum range, represents the cells that Excel will add together. In this formula, it's the same C5:C12 range.

Note that if the sum range is not specified in a SUMIF formula, the range will be used to evaluate criteria and to calculate the result. Therefore, the sum range could have been excluded from the above formula with the same result.

How the AVERAGEIF Function Works

In the formula `=AVERAGEIF(C5:C12,">=30000",C5:C12)`, the range to be evaluated is C5:C12. The criterion used to determine if a cell in the range should be averaged is the second argument, greater than or equal to 30,000. The third argument, average range, represents the cells that Excel will average. In this formula, it is again the same C5:C12 range.

How the COUNTIF Function Works

In the formula `=COUNTIF(C5:C12,">=30000")`, the range to be evaluated is C5:C12. The criterion used to determine if a cell in the range should be counted is the second argument, greater than or equal to 30,000. The COUNTIF function does not include a third argument.

How the COUNTIFS Function Works

The formula `=COUNTIFS(F5:F12,"Yes",G5:G12,"Yes")` examines the ranges F5:F12 and G5:G12 for the word "Yes." Cells are counted only when the word "Yes" appears in both columns within the same row.

	A	B	C	D	E	F	G
		Nov.	Nov.	Dec.	Dec.	Achieved	Achieved
4	Team Leader	Goal	Raised	Goal	Raised	Nov. Goal?	Dec. Goal?
5	Abbott	\$25,000	\$24,500	\$25,000	\$31,810		Yes
6	Debowski	\$90,000	\$92,200	\$100,000	\$95,350	Yes	
7	Faber	\$40,000	\$44,475	\$60,000	\$52,500	Yes	
8	Lemus	\$80,000	\$79,620	\$100,000	\$110,350		Yes
9	Martinez	\$70,000	\$52,170	\$70,000	\$66,000		
10	Nguyen	\$25,000	\$25,250	\$45,000	\$48,000	Yes	Yes
11	Park	\$25,000	\$27,570	\$30,000	\$31,680	Yes	Yes
12	Weinstein	\$50,000	\$45,650	\$70,000	\$67,000		
13						Count	2

Cells that satisfy the
formula's COUNTIFS criteria

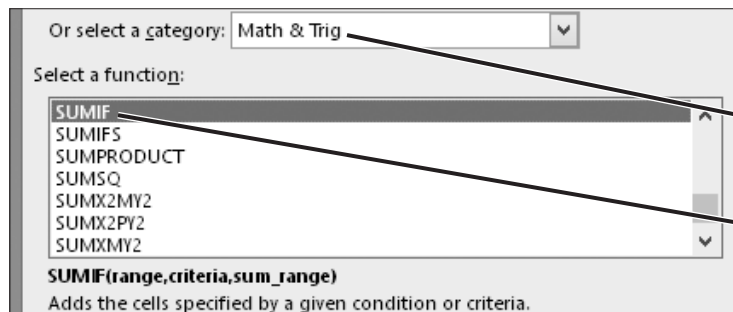
DEVELOP YOUR SKILLS EX03-D01

Create a SUMIF Function

1. Open **EX03-D01-Awards** from the **EX2013 Lesson 03** folder and save it as **EX03-D01-Awards- [FirstInitialLastName]**.
2. Display the **November** worksheet and enter **Raised at Least \$30,000** in cell **A13**.
3. Use **Format Painter** to copy the number format from cell **C12** to cell **C13** and then format the range **A13:C13** as bold.
4. Widen column **A** to fit the text in cell **A13**.

5. Select **cell C13**.

6. Follow these steps to find the SUMIF function:



A Click the **Insert Function** button.

B Choose **Math & Trig**.

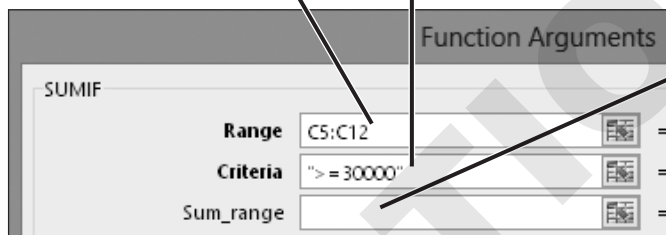
C Scroll down to double-click the **SUMIF** function.

7. If necessary, move the **Function Arguments** dialog box out of the way of **column C** by dragging its title bar.

8. Follow these steps to specify the SUMIF function arguments:

A Select the **range C5:C12** in the worksheet.

B Click in the **Criteria** box and type **>=30000**. Excel will add the quotation marks.



C Leave the **Sum_Range** box empty because the cells are the same as the range.

D Click **OK**.

9. Review the completed formula.

10. Save the file and leave it open; you will modify it throughout this lesson.

Using Logical Functions in Formulas

Excel provides several logical functions that allow you to customize criteria when comparing data. The IF function provides the basis for many of the formulas used for decision-making. You can use the AND, OR, and NOT functions in IF formulas to specify one or more criteria to be checked. AND requires that all conditions be met, while OR is satisfied if any one of the conditions is met. Excel displays *TRUE* or performs the specified action when the criteria are met. Excel displays *FALSE* or performs a different specified action when the criteria are not met.

IF, AND, OR, and NOT Function Syntax

The logical functions (IF, AND, OR, and NOT) have the following structure.

LOGICAL FUNCTION SYNTAX	
Function	Syntax
IF	IF(logical test,value if true,value if false)
AND	AND(condition1,condition2,...)
OR	OR(condition1,condition2,...)
NOT	NOT(condition)

The following table outlines the arguments of logical functions.

LOGICAL FUNCTION ARGUMENTS	
Argument	Description
Logical test	The condition being checked using a comparison operator, such as =, >, <, >=, <=, or <> (not equal to)
Value if true	The value, text in quotation (") marks, or calculation returned if the logical test result is found to be true
Value if false	The value, text in quotation (") marks, or calculation returned if the logical test result is found to be false
Condition	A logical expression to be evaluated as true or false; one of multiple expressions evaluated by an AND function or an OR function

How Logical Functions Work Together

The formula `=IF(AND(B5>=25000,B5<=50000),D5,"")` is used to explain the function results shown in the following illustration.

		Logical test		Result if true	
				Result if false	
				Formula results	
F5					
	A	B	C	D	E
			Amount	Over	
			Raised	(Under)	
				Goal	
4	Team Leader	Goal			
5	Abbott	\$25,000	\$24,500	(\$500)	
6	Debowski	\$90,000	\$92,200	\$2,200	

In this formula Excel looks to cell B5 to determine the result to display. If cell B5 is greater than or equal to \$25,000, and is also less than or equal to \$50,000, then the contents of cell D5 will display. If the conditions for cell B5 are not met, then a blank space (expressed as quotation, quotation) will appear in the destination cell. This is seen when copying the formula to cell F6, as shown above.

Alternatively, the logical test $NOT(L5=M5)$ could be used in an IF formula to ensure that two values are not identical. If the value in L5 is not equal to the value in M5, the value-if-true action is performed; if the values are equal, the value-if-false action is performed.

IFERROR Function Syntax

The IFERROR function checks a formula for an error. The structure of the formula is *IFERROR(value,value if error)*.

The value represents the formula being checked for an error, while the value if error represents either the value, text in quotation marks, or calculation returned if the formula result is found to be an error. Excel checks formulas and returns the following error types.

ERROR TYPES		
Error Type	Description	Common Cause
#DIV/0!	Value is divided by 0	Divisor cell referenced in the formula contains 0 or is empty
#N/A	Value not available	Cell referenced in the formula is empty
#NAME?	Text in a formula is not recognized	Misspelled or nonexistent range name in formula
#NULL!	Nonadjacent areas referenced in a formula	The existence of a space character instead of punctuation, such as a comma (,)
#NUM!	Invalid numeric value in a formula or function	Nonnumeric text in a function that requires a numeric argument
#REF!	Invalid cell reference	The deletion of cell(s) referenced in the formula
#VALUE!	Incorrect data type used in a formula	Cell referenced in the formula contains text rather than a value

How the IFERROR Function Works

Adding the IFERROR function to a formula allows you to display a descriptive message rather than the error type.

✓	<i>fx</i>	=C5-B5			
B	C	D	E		
	Amount	Over (Under)			
Goal	Raised	Goal			
\$25,000	Raised	#VALUE!			

The defined error message, enclosed in quotation marks, appears in the active cell.

Text cannot be subtracted in a formula, so the error type is shown in the active cell.

✓	<i>fx</i>	=IFERROR(C5-B5, "Check Data")			
B	C	D	E		
	Amount	Over (Under)			
Goal	Raised	Goal			
\$25,000	Raised	Check Data			

DEVELOP YOUR SKILLS EX03-D02

Use Logical Functions

1. Save your file as **EX03-D02-Awards-[FirstInitialLastName]**.
2. On the **November** worksheet, select **cell F5** and choose **Formulas→Function Library→Logical→IF**.
3. If necessary, move the **Function Arguments** dialog box out of the way so you can see **columns B–D**.
4. Follow these steps to enter the IF function arguments:

A Type **AND (B5>=25000, B5<=50000)**.

B Select **cell D5** in the worksheet.

C Type **""** (open and close parentheses with no space).

5. Click **OK**.
6. Use **AutoFill** to copy the formula in cell F5 to the **range F6:F12**.
7. Save and then close the file.

Using Flash Fill and the CONCATENATE Function

A new feature in Excel 2013 is Flash Fill, which allows you to quickly create modified versions of text entries with similar characteristics. CONCATENATE is a function that can be used to combine multiple text entries within a single cell.

FROM THE RIBBON

Data→Data Tools→Flash Fill

Flash Fill

You may find it useful to modify text within a worksheet so that portions of the text are copied to a new column. For example, when email addresses are listed within a column, you can use Flash Fill to insert the account name (text before the @) in an adjacent column. You need only type the account name for the first row (when using the Flash Fill button on the Ribbon) or the first two rows (when using Excel's automatic suggestions for filled data), after which Excel completes all remaining cells.

Original data

	A	B
1	William@Pasadena.com	William
2	Joseph@SaltLakeCity.com	Joseph
3	Suzanne@Duluth.com	Suzanne
4	Tyler@Honolulu.com	Tyler
5	Stacey@Phoenix.com	Stacey

Flash Fill's automatic suggestions, based on data typed in the two cells above

Flash Fill Ribbon button

Flash Fill Options button

B	C
William	
Joseph	
Suzanne	
Tyler	
Stacey	

Flash Fill can also be used to combine text from multiple columns (for example, combining first, middle, and last names from multiple columns into one column) and to modify text (for example, adding dashes to a list of phone numbers to modify them from #####-#### to ###-###-####).

CONCATENATE Function

Similar to Flash Fill, the CONCATENATE function can combine existing text within a single cell. While it is appropriate to use Flash Fill when you are combining multiple columns of data, the CONCATENATE function is a better option when combining text entries from non-adjacent locations within a worksheet. The syntax of the CONCATENATE function is *CONCATENATE(text1,[text2],...)*.

	A	B	C
1	Text 1	Text 2	Formula Result
2	New	York	New York

The CONCATENATE function: =CONCATENATE(A2," ",B2)

DEVELOP YOUR SKILLS EX03-D03

Modify Text Using Flash Fill and CONCATENATE

1. Open **EX03-D03-DataCleanUp** from the **EX2013 Lesson 03** folder and save it as **EX03-D03-DataCleanUp- [FirstInitialLastName]**.
2. Type **Howard** in cell **C5**.
3. Select cell **C6** and then choose **Data→Data Tools→Flash Fill**.
4. Repeat the above steps to display **First Names** within column **D**.

5. Follow these steps to use the CONCATENATE function:

A Select **cell G5** and choose **Formulas→Function Library→Text Function** → **Concatenate**.

B If necessary, drag the **Function Arguments** dialog box below **row 5**.

C Select **cell B5** in the **Text1** box.

D Select **cell I5** in the **Text2** box.

E Click **OK**.

6. Copy the formula from **cell G5** to the **range G6:G8**.

7. Widen **column G** to display all the data.

8. Save and close the file.

Creating Financial Functions

Excel provides a wide variety of financial functions that calculate important financial numbers. For example, Excel has basic financial functions for determining monthly payments on loans and the future value of investments.

PMT and FV Functions

The PMT function calculates the required payment for a loan when you specify the loan amount, interest rate, and number of payments you will make. The FV function calculates the future value of an investment when you specify the payment amount, interest rate, and number of payment periods.

Financial Function Syntax

You may enter financial functions using the Insert Function dialog box or by typing them. You may use the actual values or cell references in the formulas. Keep in mind that using the cell reference offers more flexibility and is, therefore, preferable.

GENERIC FORMAT FOR PMT AND FV FUNCTIONS	
Function	Syntax
PMT (Payment)	PMT(rate,periods,loan amount,[future value],[type])
FV (Future Value)	FV(rate,periods,payment,[present value],[type])

The PMT and FV functions can be used when the payment amount remains constant, such as with most car loans and fixed-rate mortgages.

PMT AND FV FUNCTION ARGUMENTS	
Argument	Description
Periods	The number of payments (typically made monthly) for a loan or number of deposits for an investment
Rate	The interest rate for each period of the loan/investment. Although loans are quoted as annual rates, payments are usually made monthly. Therefore, divide the interest rate by 12 in the formula. For example, a 7 percent annual rate would be expressed as 7%/12.
Payment	The amount invested in each period. It's always the same for each period.
Loan amount	The amount borrowed
Present value (optional)	The starting balance of an investment; not required if the starting balance is zero
Future value (optional)	The balance you wish to have at the end of an investment; not required if the balance will be zero
Type (optional)	Indicates when payments are due. You are not required to enter the default argument 0 (zero) if payments are made at the end of the period. Enter 1 if payments are due at the beginning of the period.

Converting Negative Numbers to Positive

Excel treats payments as money you owe, so the PMT and FV functions display the result as a negative number. Placing a minus (–) sign before the cell reference or function name (=-PMT) in the formula changes the result to a positive number, which may be more easily understood by the user.

DEVELOP YOUR SKILLS EX03-D04

Use the PMT and FV Functions

1. Open **EX03-D04-Fundraising** from the **EX2013 Lesson 03** folder and save it as **EX03 - D04-Fundraising- [FirstInitialLastName]**.
2. In the **Loan** worksheet, type **=B3 - B13** in **cell B6**, **6%** in **cell B7**, and **60** in **cell B8**.
3. In **cell B9**, type **= -PMT (B7/12 , B8 , B6)**.
4. Format **cell B9** in **Accounting** format with **two decimal places**.
5. Enter the formula **=B9*B8** in **cell B14**; enter the formula **=B14 - B6** in **cell B10**.
6. In **cell B15**, enter the formula **=B13+B14**.
7. In the **Investment** worksheet, enter **0** in **cell B5**, **2.5%** in **cell B7**, and **36** in **cell B8**.
8. In **cell B6**, enter the formula **=B3/B8**.
9. Select **cell B9**.

10. Follow these steps to choose the FV function:

A Click the **Insert Function** button beside the Formula Bar.

B Choose **Financial** from the Or Select a Category list.

C Scroll down the Select a Function list and choose **FV**.

D Click **OK**.

11. Follow these steps to specify the function arguments:

A If necessary, drag the **Function Arguments** dialog box off the range A1:B9.

B Select cell **B7** in the worksheet and type **/12**.

C Select cell **B8** in the worksheet.

D Type a minus (-) sign and click cell **B6**.

E Skip the last two arguments and click **OK**.

12. In cell **E5**, enter the formula **=E3 * 25%**.

13. Copy the range **B6:B9** to the range **E6:E9**.

14. Select cell **E6**, click in the **Formula Bar**, and edit the formula to **=(E3 - E5) / E8**.

15. Select cell **E9** and click **Insert Function**

16. Follow these steps to enter optional arguments:

The image shows the 'Function Arguments' dialog box for the FV function in Excel. The arguments are as follows:

Argument	Value	Result
Rate	E7/12	= 0.002083333
Nper	E8	= 36
Pmt	-E6	= -6250
Pv	-E5	= -75000
Type	1	= 1
		= 314721.4387

A Type **-E5** in the **Pv** text box.

B Type **1** in the **Type** text box.

C Click **OK**.

17. Change the number of months in **cells B8 and E8** to **24**.

18. Save and close the file.

Concepts Review

To check your knowledge of the key concepts introduced in this lesson, complete the Concepts Review quiz on the student resource center.