CHAPTER 3

LOGICAL FUNCTIONS

InFocus

Logical functions are used in spreadsheets to test whether a situation is true or false. Depending on the result of that test, you can then elect to do one thing or another.

These decisions can be used to display information, perform different calculations, or to perform further tests.

In this session you will:

- ✓ gain an understanding of logical functions
- ✓ learn how to display text using the **IF** function
- ✓ learn how to use **IF** to calculate values
- ✓ learn how to nest *IF* functions
- ✓ learn how to use *IFERROR*
- ✓ learn how to use TRUE and FALSE
- ✓ learn how to use the **AND** function
- ✓ learn how to use the **OR** function
- ✓ learn how to use the **NOT** function.

UNDERSTANDING LOGICAL FUNCTIONS

Logical functions provide decision-making tools for information in a spreadsheet. They allow you to look at the contents of a cell, or to perform a calculation, and then test that result against a

required figure or value. You can then use the IF logical function to determine which calculation to perform or action to take depending on the outcome of the test. Here are some examples.

1 The IF Function

The *IF* function is the key logical function used for decision making. It takes the format:

=IF(condition, true, false)

For example, you could use the following formula:

=IF(B2 > 400, "High", "Low") where,

B2 > 400 is the *condition* being tested

(this could be translated as "Is the value in cell B2 greater than 400?")

"High" is the text to display if B2 is greater than 400 (the result of the test is yes or TRUE)

"Low" is the text to display if B2 is less than or equal to 400 (the result of the test is **no** or **FALSE**)

2 The AND Function

The *AND* function is used to compare more than one condition. It returns TRUE only if <u>all</u> of the conditions are met, and takes the format:

=AND(condition1, condition2,...)

For example, you could use the following formula:

=AND(B2 > 400, C2 < 300) where,

B2 > 400 is the first condition being tested

C2 < 300 is the second condition being tested

This will only return the result *TRUE* if the value in cell B2 is greater than 400 <u>and</u> the value in cell C2 is less than 300. In all other situations, the result will be *FALSE*.

3 The OR Function

The *OR* function is also used to compare more than one condition. It returns TRUE if <u>any</u> of the conditions are met, and takes the format:

=OR(condition1, condition2,...)

For example, you could use the following formula:

=OR(B2 > 400, C2 < 300) where,

B2 > 400 is the first condition being tested

C2 < 300 is the second condition being tested

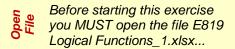
This will return the result TRUE if either the value in cell B2 is greater than 400 $\underline{\textit{or}}$ the value in cell C2 is less than 300. The result will be FALSE only if neither of the conditions is met.

USING IF TO DISPLAY TEXT

The *IF* function can be used to display different information depending on the outcome of the condition test. The resulting text will appear in the cell where the formula containing the *IF* function

resides. In this example, the *IF* function is used to indicate where figures in a neighbouring column meet or exceed a specified target. This makes identifying successful sales people far easier.

Try This Yourself:



- Click on the *IF Function*worksheet tab, then click on *D7* to select the cell
- Type =IF(C7>\$E\$2,"Exceeded Target","Below Target")
- Press Enter to complete the formula
- Click on **D7** then double-click on the fill handle to copy the formula down the column

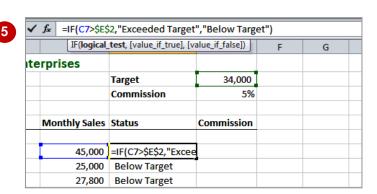
Notice that the result for Jerry Hancock is Below Target even though she achieved 34,000? Let's modify the formula...

- 5 Click on **D7**, then click in the **Formula bar** immediately to the right of >
- Type = then press Enter
- Repeat step 4 to copy the formula down the column



	Target	34,000		
	Commission	5%		
Monthly Sales	Status	Commission		
45,000	=IF(C7>\$E\$2,"Excee	ded Target","	Below Tar	get")
25,000	-			
27,800				
34,000				





For Your Reference...

IF(logical test, value_if_true, value_if_false)
This function performs the test then if the requi

This function performs the *test*, then if the result is true, uses the entry in the position *true*. If the result is not true, the entry for *false* is used.

Handy to Know...

If you only want text to appear if the result is true, you can enter "" (two double quotes) in the position for false. For example, =IF(C7>=\$E\$2, "Exceeded Target","") will only display text if the target was met or exceeded.

USING IF TO CALCULATE VALUES

One of the most common uses of the *IF function* is to perform numerical computations based on the outcome of the condition test. This is achieved by putting formulas that would normally

be used to *calculate values* in place of the *true* and *false* components in the function. You can also use this structure to show a specific value according to the result of the condition test.

Try This Yourself:

Same File Continue using the previous file with this exercise, or open the file E819 Logical Functions_2.xlsx...

- 1 Click on cell E7
- Type =IF(C7>=\$E\$2,(C7\$E\$2)*\$E\$3,0)
- Press Enter to complete the formula
- Click on **E7** and double-click on the fill handle to copy the formula down

Due to the formatting of the Commission column, instead of a 0, the dash symbol appears where no commission is to be paid

В	С	D	E	F	G
ilobal Ent	erprises				
nissions		Target	34,000		
		Commission	5%		
	Monthly Sales	Status	Commission		
Costas	45,000	Exceeded Target	=IF(C7>=\$E\$2	,(C7-\$E\$2)	*\$E\$3,0)
Daniels	25,000	Below Target			
Grayson	27,800	Below Target			
Hancock	34,000	Exceeded Target			
Houson	18,350	Below Target			
Kai	12,500	Below Target			
Maunga	75,880	Exceeded Target			
Nguyen	43,778	Exceeded Target			
Rualowy	23,400	Below Target			



В	С	D	Е	F	G
Slobal Ente	erprises				
nissions		Target	34,000		
		Commission	5%		
	Monthly Sales	Status	Commission		
Costas	45,000	Exceeded Target	550		
Daniels	25,000	Below Target	-		
Grayson	27,800	Below Target	-		
Hancock	34,000	Exceeded Target	-		
Houson	18,350	Below Target	-		
Kai	12,500	Below Target	-		
Maunga	75,880	Exceeded Target	2,094		
Nguyen	43,778	Exceeded Target	489		
Rualowy	23,400	Below Target	-		
				軒	



For Your Reference...

IF(test, true-calculation, false-calculation)

This function performs the *test*, then if the result is true, performs the calculation in the position *true*. If the result is not true, the entry for *false* is used.

Handy to Know...

When you work with values, rather than text, it is better to use 0 (zero) than to use ""
 where there is no calculation to perform. This means that all of the results will be values, rather than a mixture of text and values, and the cell formatting can be used to control the way the values are displayed.

NESTING IF FUNCTIONS

If you need to make more than one decision before calculating an answer, you can nest or embed an *IF* function inside an *IF* function. For example, you can use an *IF* function in place of

the *true* component of the *IF* function. If the result of the first condition test is true, the second condition will be tested. This structure provides for three alternative outcomes instead of two.

Try This Yourself:

Continue using the previous file with this exercise, or open the file E819 Logical Functions_3.xlsx...

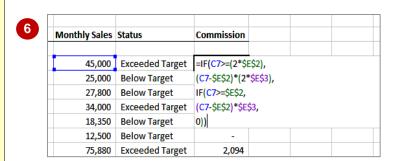
- Double-click on **E7** to open the formula for editing
- Click after the first equal sign and type IF(C7>=(2*\$E\$2), then press Alt + Enter to create a new line
- Type (C7-\$E\$2)*(2*\$E\$3), then press Alt + Enter to create a new line
- Click immediately after the first comma on this line and press
- Click immediately after the first comma on this line and press

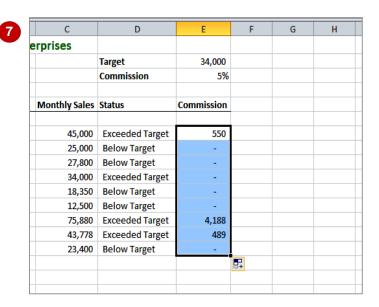
Your formula is now divided into components. Let's complete the formula...

- 6 Press and to move to the end of the formula, and type)
- Press Enter, click on E7 then double-click on the fill handle to copy the formula down the column



Monthly Sales	Status	Commission			
45,000	Exceeded Target	=IF(C7>=(2*\$	E\$2),		
25,000	Below Target	IF(C7>=\$E\$2,(C7-\$E\$2)*	\$E\$3 ,0)	
27,800	Below Target	IF(logical_tes	t, [value_if_	true], [value	_if_false])
34,000	Exceeded Target	-			
18,350	Below Target	_			





For Your Reference...

IF(test, true-calculation, false-calculation)

This function performs the *test*, then if the result is true, performs the calculation in the position *true*. If the result is not true, the entry for *false* is used. You can substitute an entire *IF* function for the *true* and/or the *false* calculations.

Handy to Know...

- When you create nested formulas, Excel will colour-code the paired brackets to make it easier to see what you are doing. The outside brackets are coloured black.
- You can nest any function within another function, but plan carefully.

USING IFERROR

IFERROR is used to trap errors that may occur as the result of a calculation and then display alternative text or values. For example, if you divide a number by zero, Excel will normally

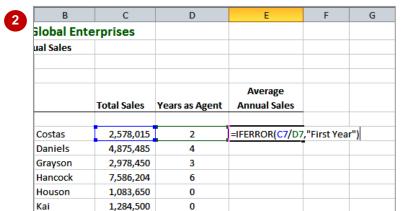
return the message **#DIV/0!** which can be a bit alarming for novice users. **IFERROR** tests a calculation to see if it works and, if so, performs the calculation. If not, it displays an alternative.

Try This Yourself:

Same File Continue using the previous file with this exercise, or open the file E819 Logical Functions_4.xlsx...

- Click on the *IFERROR Function* worksheet tab
 and click on *E7*
- Type the following
 =IFERROR(C7/D7, "First
 Year")
- ? Press Enter
- Click on **E7** and double-click on the fill handle to copy the formula down the column

Instead of giving an error where the divisor is zero, Excel displays the text "First Year" in the cell



8

5

3



Maunga

Nguyen

Rualowy

7,658,900

4,357,859

2,487,652

	Total Sales	Years as Agent	Average Annual Sales	
Costas	2,578,015	2	1,289,008	
Daniels	4,875,485	4	1,218,871	
Grayson	2,978,450	3	992,817	
Hancock	7,586,204	6	1,264,367	
Houson	1,083,650	0	First Year	
Kai	1,284,500	0	First Year	
Maunga	7,658,900	8	957,363	
Nguyen	4,357,859	5	871,572	
Rualowy	2,487,652	3	829,217	
				=

For Your Reference...

IFERROR(calculation, error_value)

This function performs the *calculation* and if there are no errors, displays the result of the calculation. If an error does occur, it displays the *error value*.

Handy to Know...

 In this example we've used text as the entry to be displayed if an error is located, but you could just as easily display nothing using "" (two double quotes) or perform an alternative calculation.

USING TRUE AND FALSE

TRUE and **FALSE** are logical values. The result of a logical test is either true or false and Excel allows you to enter these values in cells or test for them in functions. TRUE and FALSE can be

entered as *values*, which are TRUE and FALSE, or as *formulas* with no parameters, which are =TRUE() and =FALSE(). The value TRUE and the formula =TRUE() are treated as identical by Excel.

Try This Yourself:

Same File Continue using the previous file with this exercise, or open the file E819 Logical Functions_5.xlsx...

- Click on the **AND Function** worksheet tab and click on cell **D7**
- Type the TRUE and FALSE entries in the column as shown
- Click on *E7* and type =IF(C7>=\$E\$2, IF(D7=TRUE, (C7-\$E\$2)*\$E\$3,0),0)
- 1 Press Enter
- 5 Click on D7 and double-click on the fill handle to copy the formula down the column



2	Agency Con	nmissions		Target	34,000	
3				Commission	5%	
4						
5	Agent		Monthly Sales	On Staff	Commission	
6						
7	Janet	Costas	45,000	TRUE		
8	Mark	Daniels	25,000	TRUE		
9	Maureen	Grayson	27,800	FALSE		
10	Jerry	Hancock	34,000	FALSE		
11	Brian	Houson	18,350	FALSE		
12	Helen	Kai	12,500	TRUE		
13	Norris	Maunga	75,880	TRUE		
14	Alex	Nguyen	43,778	FALSE		
15	Kate	Rualowy	23,400	FALSE		
16						
17						



		Target	34,000				
		Commission	5%				
Monthi	y Sales	On Staff	Commission				
	45,000	TRUE	=IF(C7>=\$E\$2	IF(D7=TRU	IE <mark>,(C7-\$</mark> E\$2)*\$E\$3,0),(0)
	25,000	TRUE					
	27,800	FALSE					
	34,000	FALSE					



	Target Commission	34,000 5%			
Monthly Sales		Commission			
45,000	TRUE	550			
25,000	TRUE	-			
27,800	FALSE	-			
34,000	FALSE	-			
18,350	FALSE	-			
12,500	TRUE	-			
75,880	TRUE	2,094			
43,778	FALSE	-			
23,400	FALSE	-			
			-		

For Your Reference...

TRUE

The logical value TRUE

FALSE

The logical value FALSE

Handy to Know...

TRUE is used really just to make formulas more readable. You could also write the above formula as =IF(C7>=\$E\$2.IF(D7,(C7-\$E\$2)*\$E\$3,0),0). Here the =TRUE in the second IF statement is left out because Excel automatically reads the IF expression as "if D7 is true, then...".

USING AND

The **AND** function is used to compare the results of more than one condition test. It ensures that a calculation will not be performed unless all of the specified conditions are met. In other words, the

first and second and third (and so on) conditions must all be true before **AND** returns the value **true**. This is ideal to use with the IF function to test for a collection of conditions.

Try This Yourself:

Continue using the previous file with this exercise, or open the file E819 Logical Functions_6.xlsx...

Click on the **AND Function** worksheet, then click on **E7** and type:

=AND(C7>=\$E\$2,D7=TRUE)

7 Press Enter

The result will be TRUE, because both conditions are satisfied. Now to add the IF function...

- Double-click on **E7** then click after the first equal sign and type **IF(**
- Press End to move to the end of the formula and type, then press Alt + Enter to create a new line
- Type (C7-\$E\$2)*\$E\$3,0)
- 6 Press Enter
- Click on *E7* then double-click on the fill handle to copy the formula down the column

The result is the same, it's just a different way of testing the values

Blobal En	terprises				
nissions		Target	34,000		
		Commission	5%		
	Monthly Sales	On Staff	Commission		
	•				
Costas	45,000	TRUE	=AND(C7>=\$E	\$2,D7=TRI	JE)
Daniels	25,000	TRUE	-		
Grayson	27,800	FALSE	-		
Hancock	34,000	FALSE	-		
Houson	18,350	FALSE	_		

terprises					
	Target	34,000			
	Commission	5%			
Monthly Sales	On Staff	Commission			
45,000	TRUE	=IF(AND(C7>: (C7-\$E\$2)*\$E	=\$E\$2,D7=1	ΓRUE),	
25,000	TRUE	(C7-\$E\$2)*\$E	\$3,0)		
27,800	FALSE	-			
34,000	FALSE	_			
18,350	FALSE	_			

For Your Reference...

AND(logical1, logical2,...)

This function tests the logical value of each entry e.g. *logical1*. If they are all true, it will return the value *TRUE*. If any one of them is false, the function will return *FALSE*.

Handy to Know...

 A condition in an AND function can simply be a reference to a cell holding a logical value (that is, TRUE or FALSE). For example, =AND(B2,C2) will return the value FALSE if B2 and/or C2 contain the text FALSE.

USING OR

The **OR** function is used to compare the results of more than one condition test. It will return the value **TRUE** if any of the condition tests return the value **TRUE**. It will only return the value

FALSE if all of the condition tests return **FALSE**. The **OR** function is often used in conjunction with the **IF** function to test a collection of conditions, and is easier to work with than nested **IF** functions.

Try This Yourself:

Continue using the previous file with this exercise, or open the file E819 Logical Functions_7.xlsx...

- Click on the **OR Function** worksheet tab and click on **E7**
- Type =OR(D7="Gold",D7="Silver ")
- ? Press Enter

The result will be TRUE, because both conditions are satisfied. Now to add the IF function...

- Double-click on cell **E7** then click after the first equal sign and type **IF(**
- Press End to move to the end of the formula and type, then press Alt + Enter to create a new line
- Type (C7-\$E\$2)*\$E\$3,0)
- 7 Press Enter
- 8 Click on *E7*, then double-click on the fill handle to copy the formula down the column

		Agent	
	Monthly Sales	Classification	Commission
Costas	45,000	Gold	=OR(D7="Gold",D7="Silver")
Daniels	25,000	Bronze	
Grayson	27,800	Bronze	
Hancock	34,000	Silver	

			Agent	
		Monthly Sales	Classification	Commission
ı	Costas	45,000	Gold	TRUE
ı	Daniels	25,000	Bronze	
	Grayson	27,800	Bronze	
ı	Hancock	34,000	Silver	

6	Monthly Sales	Agent Classification	Commission		
	45,000	Gold	=IF(OR(D7="6"		
	25,000	Bronze	(C7-\$E\$2)*\$E		
	27,800	Bronze			
	34,000	Silver			

Monthly Sales	Agent Classification	Commission		
45,000	Gold	550		
25,000	Bronze	-		
27,800	Bronze	-		
34,000	Silver	-		
18,350	Bronze	-		
12,500	Bronze	-		
75,880	Gold	2,094		
43,778	Gold	489		
23,400	Silver	- 530		
			=	

For Your Reference...

OR(logical1, logical2,...)

This function tests the specified *logical* conditions or cell references. If any one of the conditions is true, it will return the value *TRUE*. If all of them are false, the function will return *FALSE*.

Handy to Know...

• If you want to pay commission to Gold and Silver agents *only* if they exceed the target, you can use the following formula:

=IF(AND(C7>=\$E\$2, OR(D7="Gold",D7=Silver")), (C7-\$E\$2)*\$E\$3,0).

USING NOT

Sometimes the best way to get the result you need is to exclude the values that you don't want, rather than testing for the values that you do. The **NOT** function is perfect for this situation,

returning the logical opposite of the condition test. If the condition test returns the value *TRUE*, the *NOT* function will return the value *FALSE*. This can also be used to great effect with the *IF* function.

Try This Yourself:

Same File Continue using the previous file with this exercise, or open the file E819 Logical Functions_8.xlsx...

- Click on the *OR Function*worksheet, double-click on cell *E7* then click before *OR*
- Press Del to remove the **OR** function until the formula reads
 - =IF("),C7-\$E\$2)*\$E\$3,0)
- Add the **NOT** function before the double quotes so that the formula reads

=IF(NOT(D7="Bronze"),(C7-\$E\$2)*\$E\$3,0)

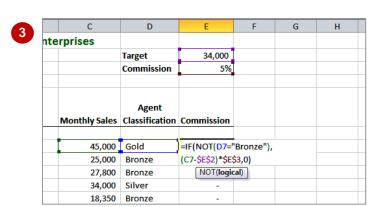
This excludes any of the Bronze sales agents, therefore selecting Silver and Gold...

- Press Enter
- Click on *E7*, then double-click on the fill handle to copy the formula down the column

The results are the same, we've just tested the contents of the cells in a slightly different way



	С	D	E	F	G	Н
ıtε	erprises					
		Target	34,000			
		Commission	5%			
	Monthly Sales	Agent Classification	Commission			
	45,000	Gold	-IE/"\			
	25,000	Bronze	=IF("), (C7-\$E\$2)*\$E	\$3,0)		
	27,800	Bronze	IF(logical_test, [value_if_true], [value_if_false])			
	34,000	Silver	-			
	18,350	Bronze	_			





Monthly Sales	Agent Classification	Commission		
45,000	Gold	550		
25,000	Bronze	-		
27,800	Bronze	-		
34,000	Silver	-		
18,350	Bronze	-		
12,500	Bronze	-		
75,880	Gold	2,094		
43,778	Gold	489		
23,400	Silver	- 530		
			F	

For Your Reference...

NOT(logical)

This function tests the specified *logical* condition or contents of a cell. If the condition is true, it will return the value *FALSE*. If the condition is false, the function will return *TRUE*.

Handy to Know...

 If you want to pay commission to Gold and Silver agents only if they exceed the target (to avoid paying negative commission), you can use:

=IF(AND(C7>=\$E\$2, NOT(D7="Bronze")),(C7-\$E\$2)*\$E\$3,0)