

Exercise 11: Logical Functions

After completing this exercise you will:

- better understanding of the structure of IF functions and their arguments;
- be able to insert and use IF statements for 'decision making' in Excel.
- Use the AND and OR functions to make decisions based on more than one variable

Decision Making Using IF Statements

In constructing worksheet formulas it may be necessary to instruct the program to select an appropriate value from a number of choices. The formula, in effect, makes a decision based on the rules you have built into the IF statement. The IF function requires three arguments:

=IF(Logical Expression, Action If True , Action If False)

Logical formula are true and false statements concerning values in other cells. The formula specifies a logical test to perform (**Logical Expression**) and then performs an action, **Action if True** or **Action if False**, depending on whether the logical expression is true or false.

For example, Bacchus may have to pay overdraft charges if its bank balance exceeds an agreed overdraft limit. In this case the formula must compare Bacchus's current bank balance with the agreed overdraft limit (say -£5,000). If the balance exceeds -£5,000 it must calculate overdraft charges (say at 2% per month), If the balance is within the agreed limit it returns zero. This would require the following formula: =ABS(IF(Balance>-5000,0,Balance*2%)) To better understand IF statements you need to get as much practice as you can in using them:

1. Open your itcExs.xls workbook and insert a new worksheet called Ex-11.
2. Enter the values 35 and 55 in B2 and B3;
3. Enter the formula =IF(B2=B3,"OK","PROBLEM") in cell C2. This returns "OK" if B2=B3, otherwise it returns "PROBLEM". Change the values in B2 and B3 so you are clear about how the function works;
4. Move to cell C3 and enter the formula =IF(B2<50,B2*5.25%,B2*15%). This returns a value of B2 x 5.25% if the value in B2 is less than 50, otherwise it returns a value of B2 x 15%. Again, adjust the values in B2 so that you are clear about what's going on;
5. Enter the following values in cells D2:D4, then enter IF Statements in cells F2:F5 which return:

	D	E	F
2	25	25	Hello if D2 equals E2, otherwise it returns Goodbye
3	25	23	Arsenal if D3 equals E3, otherwise it returns Spurs
4	45	35	Labour Government if D4 is greater than E4, otherwise it returns Conservative Government.

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Change the values in cells D2:E5 to make sure you understand how the IF Statement operates.

Decision Making Using Nested IF Statements

The IF function can also be 'nested'. This allows multiple conditions to be set up by placing a second IF function inside the first.

For example, if the rate at which Bacchus's current account accrues interest is dependent on its credit balance then you will have to devise a formula containing nested IF statements:

=IF(Balance<5000,0,IF(Balance<20000,Balance*0.0025,Balance*0.0055))

This says that if the account balance (Balance) is:

- less than £5,000 you receive zero interest;
- greater than £5,000 and less than £20,000 you receive monthly interest of 0.25% x the account balance;
- greater than £20,000 you receive monthly interest of 0.55% x the account balance.
-

Enter the following values into cells D6:D9. Then enter IF Statements in cells F6:F9 which return:

	D	E	F
6	55	53	JACKPOT!!!! if D5 is greater than 90; Win if E5 is greater than D5; otherwise Sorry You Loose.
7	7500		1. Zero if Balance is less than £1,000 2. Calculates Interest at 3.5% if Balance is between £1,000 and £5,000; 3. Calculates interest at 5.75% if Balance is over £5,000. (Note: Set Name of cell in which you entered 7500 = Balance)
8	-6520		Overdraft charge of 2% If Overdraft falls below -£3,000, otherwise it returns zero. (Note: Set Name of cell in which you entered -6520 = Overdraft).
9	2525		1. Zero if Balance is less than £500 2. Calculates Interest at 2.55% if Current_Balance is between £500 and £2,500; 3. Calculates interest at 5.15% if Current_Balance is between £2,500 and £5,000; 4. Calculates interest at 6.50% if Current_Balance is greater than £5,000 (Note: Set Name of cell in which you entered 2525 = Current_Balance)

Change the values in cells D6:D9 to see if your IF statements are working correctly.

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AND() logical function

This function returns the value TRUE if all of its arguments are true, otherwise it returns the value FALSE.

The syntax is:

`=AND(condition1,condition2...)`

Up to 30 conditions can be tested.

The AND() function can be used in conjunction with the IF() function to return a value based on more than one variable.

For example, there are two possible grades for a module - P (pass) and F (fail). To pass a student must have a mark ≥ 50 for each paper.

To test this enter the following data into columns H, I and J of your worksheet. Then enter the following function into column K: `=IF(AND(B2 \geq 50,C2 \geq 50),"P","F")`

(Note the way in which the brackets are used.)

	H	I	J	K
1	Student	Paper 1	Paper 2	Grade
2	Austin	51	95	P
3	Bennett	48	75	F
4	Brannan	92	35	F

The AND() function is used to test whether both marks are > 50 . If both marks are ≥ 50 the return value of the AND() will be TRUE and the IF() function's value_if_true will appear in the cell. Otherwise the return value of the AND() will be FALSE and the IF()'s value_if_false will appear in the cell.

Try changing the marks that the students have been awarded for each paper to make sure you understand how this works.

OR() logical function

This function returns TRUE if one or more of its arguments is true, otherwise it returns FALSE.

The **syntax** is: `=OR(condition1,condition2...)`

Again, up to 30 conditions can be tested.

You will now change the function you entered in column K above to satisfy the condition that a pass is awarded if the mark in either paper is ≥ 50 .

The function is written as the example above, substituting OR for AND:

`=IF(OR(B2 \geq 50,C2 \geq 50),"P","F")`

	H	I	J	K
1	Student	Paper 1	Paper 2	Grade
2	Austin	51	95	P
3	Bennett	48	75	P
4	Brannan	92	35	P

Again, try changing the marks that the students have been awarded for each paper to make sure you understand how this works.

Now try modifying the functions you entered above to include a mark of D for distinction when a student's mark is ≥ 80 . You will need to use nested IF functions as well as AND/OR to do this.

Error Checking Using IF Statements

To ensure that worksheet values and calculations are accurate it is good worksheet practice to build in a systematic means of error checking. Most of the financial worksheets that you have built during the course comprise a table of values in a row and column matrix, with a total at the end of a row and column. The table may also include a grand total that is the sum of all rows, which should equal the sum of the column totals.

Consider, for example, Bacchus's Wines Sales for the First Quarter of 1998. In the absence of any errors the grand total in cell F30 should be the same as the SUM(C30:E30) and SUM(F26:F29) = 1,075.

	A	B	C	D	E	F
23						
24		Bacchus Wines - First Quarter Sales (1998)				
25		Wine	Jan-98	Feb-98	Mar-98	Q1-98
26		Red	75	125	100	300
27		White	150	175	125	450
28		Rose	35	115	50	200
29		Sparkling	20	80	25	125
30		Total	280	495	300	1,075
31						

However, an error in either of these totals may mean that the grand total in cell F30 is incorrect. To eliminate the risk of this error you can make use of an IF Statement to construct the following error checking formula: =IF (SUM(C30:E30)=SUM(F26:F29), SUM(C30:E30), "Error")

This formula states that:

1. if the two sums are the same, then the former will appear as the grand total;
2. if the two sums are different, then cell P30 will display ERROR, as shown below, indicating the presence of a problem in your worksheet (though not its location).

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	A	B	C	D	E	F
23						
24	Bacchus Wines - First Quarter Sales (1998)					
25	Wine	Jan-98	Feb-98	Mar-98	Q1-98	
26	Red	75	125	100	300	
27	White	150	175	125	450	
28	Rose	35	115	50	200	
29	Sparkling	20	80	25	125	
30	Total	205	495	300	Error	
31						