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RELEVANT TO MA1 AND MA2

Getting to grips with spreadsheets

The use of spreadsheets appears in the syllabus of both MA1 and MA2. This article provides explanations and examples that can supplement the study text materials and is therefore helpful for exam purposes. It also provides guidance on the practical application of Excel in a working environment.

There are a number of different versions of Excel currently being used by organisations and individuals and the detailed steps for performing certain operations can vary between versions. However, while the steps on how to use a feature can vary, the functionality of the feature will generally remain the same. There is, therefore, more emphasis in this article on the purpose and application of the various features, highlighting alternative approaches, any common errors in usage of certain features, or where the use of a feature may have unexpected results.

It is assumed that students do have a working knowledge of Excel and, therefore, detailed step-by-step menu selections are not provided for every feature used. Many of the features discussed can be accessed in a variety of ways such as through the toolbar menus or icons, keyboard shortcuts or the pop-up menus that appear when right-clicking the mouse. Specifically, it is assumed that students know the basics of how to enter data, write a simple formula, use some of the most common cell formatting features and copy and paste.

Throughout the article there are opportunities to practise the spreadsheet features. It is intended that students will follow these steps and create the simple spreadsheets shown in the practice exercises.

It may be useful to open a blank Excel workbook while reading this article and creating a folder that can be used to store any practice exercises you create.

Spreadsheet design

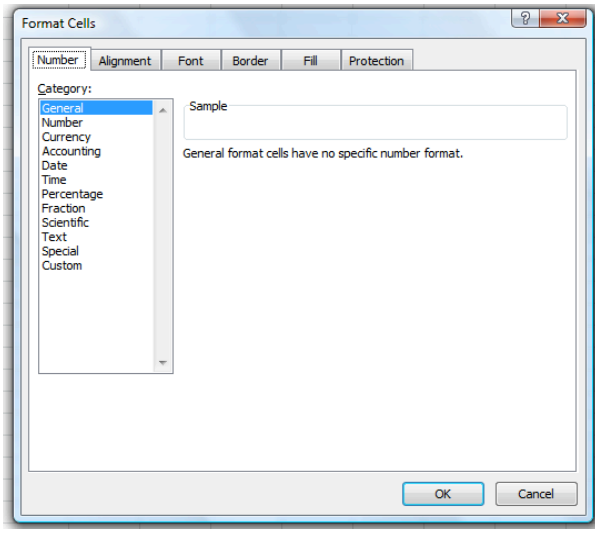
Before creating a spreadsheet, it is a good idea to take a few minutes to think and plan the design or layout. What do you want the spreadsheet to do? Will it be used to perform calculations for a single use purpose or will it be reused on a regular basis with updated information being added? Who will use the spreadsheet? Just the person creating it, or will it be distributed to others in the organisation? Will others who may use it be confident or beginner users of Excel? Should all the data be on one worksheet or should it be split onto multiple sheets? These issues may affect how you design your spreadsheet and

some of these will be addressed in this article, but this theme will develop during future articles.

Format Cells, Number

Figure 1 shows the ***Format Cells, Number*** dialog box. There are various ways to use the number formatting features that do not require the use of this dialog box, such as toolbar icons, but these can differ from one version to another, whereas the dialog box is common to all versions. Also, a number of the shortcuts are only useful for the most common types of formatting and, if anything out of the ordinary is required, the dialog box is usually where we will go for a little more customisation.

Figure 1



The automatic, or default, format setting for all cells on a worksheet is usually the *General* format.

This means that if a value is typed as '20.557', it will appear as '20.557' with all three decimals showing. If it is typed as 20.5, then only that one decimal will appear. Values, therefore, appear with the number of decimals that have been typed and values that are the result of a formula will appear with the maximum number of decimals that can be shown within the existing column width. If the formula results in a value with more decimals than can be displayed, the cell may be filled with the symbol '#########', indicating that the column is not wide enough to display the entire value.

Note that some versions of Excel will automatically change the column widths or the format of a cell to accommodate the data that has been entered. Sometimes this works well and provides the results the user wants, but other times it does not. By understanding how to use Excel's features, the user has the choice to accept Excel's automatic settings or to make adjustments – thereby giving the user control over how data is displayed.

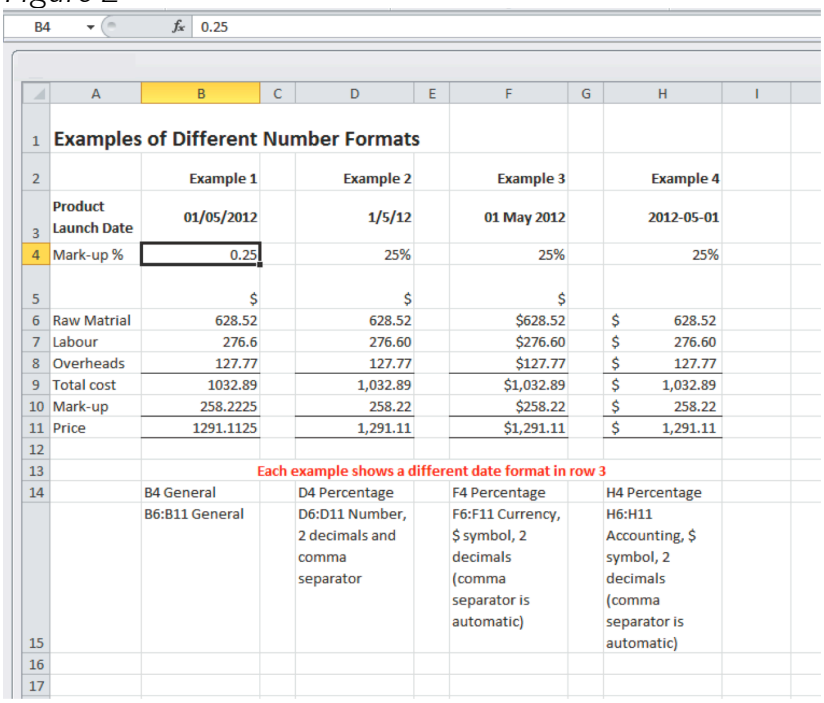
Usually, however, we want to restrict the number of decimal places that appear in a cell – often to two or three decimal places. The *Number*, *Currency*, *Accounting* and *Percentage* formats all have this option to allow the user to select the number of decimal places to be displayed in the cell.

Below is a brief summary of the most commonly used number formats:

General	Cells have no specific number format Values appear as they are typed in
Number	Used for general display of numbers Option to choose the number of decimal places displayed, whether to have a comma separator for thousands and how negative numbers are displayed
Currency	Used for general monetary values Allows for all the same options as the *Number* format but also allows a currency symbol to be selected, which will be displayed immediately to the left of the value in every cell
Accounting	Similar to the currency format, however the currency symbol will be shown close to the left boundary of the cell Currency symbols and decimal points will be lined up in a column
Date	Allows for a variety of different date formats using numbers only or with the month name as text
Percentage	Multiplies the cell value by 100 and displays a percentage sign

Figure 2 provides an example of the same data displayed using different number formats. The key word here is 'displayed'.

Figure 2



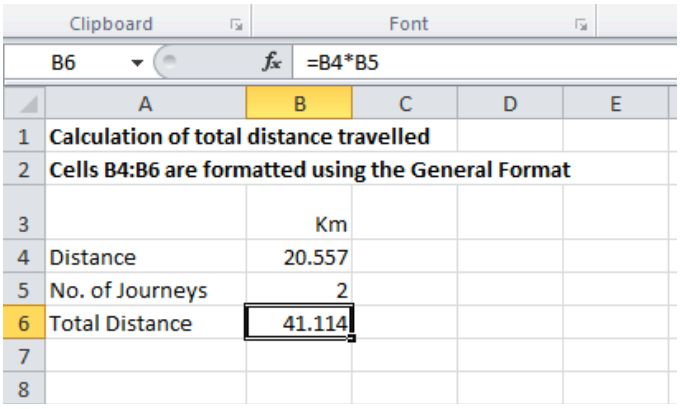
B4 | fx 0.25

	A	B	C	D	E	F	G	H	I
1	**Examples of Different Number Formats**								
2		**Example 1**		**Example 2**		**Example 3**		**Example 4**	
3	**Product Launch Date**	**01/05/2012**		**1/5/12**		**01 May 2012**		**2012-05-01**	
4	Mark-up %	0.25		25%		25%		25%	
5		$		$		$			
6	Raw Matrial	628.52		628.52		$628.52		$ 628.52	
7	Labour	276.6		276.60		$276.60		$ 276.60	
8	Overheads	127.77		127.77		$127.77		$ 127.77	
9	Total cost	1032.89		1,032.89		$1,032.89		$ 1,032.89	
10	Mark-up	258.2225		258.22		$258.22		$ 258.22	
11	Price	1291.1125		1,291.11		$1,291.11		$ 1,291.11	
12									
13		Each example shows a different date format in row 3							
14		B4 General		D4 Percentage		F4 Percentage		H4 Percentage	
15		B6:B11 General		D6:D11 Number, 2 decimals and comma separator		F6:F11 Currency, $ symbol, 2 decimals (comma separator is automatic)		H6:H11 Accounting, $ symbol, 2 decimals (comma separator is automatic)	
16									
17									

Rounding problems when using Format Cells, Number

It is important to understand that the *Format Cells, Number* feature gives the appearance of a rounded number on the screen and in any printed output, *but* the actual underlying content of the cell will still be the original value with all the decimal places originally entered or calculated as a result of a formula. This can create a potential problem that is best demonstrated with the use of a practical exercise.

Figure 3



Practice exercise 1a

Open a new blank workbook and create the simple worksheet as shown in Figure 3, adjusting the width of column A as necessary. Type the text as shown (note the text in cell B3 is right aligned). Type the values '20.557' in cell B4, '2' in cell B5 and the formula =B4*B5 in cell B6. The result of this formula in cell B6 is 41.114, which is the correct answer.

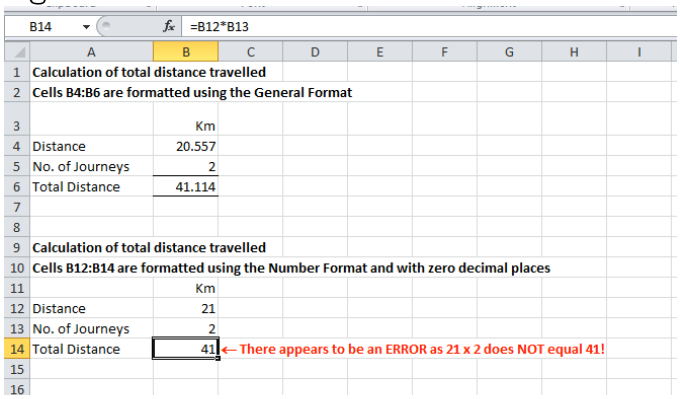
Save this new file (using *Save as*) with the filename 'Rounding Problems'.

Practice Exercise 1b

We will now amend this spreadsheet so that it will match that shown in Figure 4 by first copying the contents of cells A3:B6 into cell A11 (the copied data will now appear in cells A11:B14). Now, using the *Format Cells, Number* feature, format the cells B12 to B14 using the Number format and displaying zero decimal places.

Your spreadsheet should now match that shown in Figure 4.
(There is no need to type the annotation text which appears in red)

Figure 4



Save the updated version of this file using the same filename (using *Save*).
(Note that the formula in cell B14 appears to be correct, =B12*B13, but the answer '41' is incorrect, as 21 x 2 does not equal 41!)

This spreadsheet is calculating distance in kilometres, but it

could just as easily be a monetary amount in $ millions, and we would have just created a rounding error of $1m.

The error has arisen (yet note this is not an error that provides an on-screen error message) because cell B12 *displays* 21 as the rounded version of 20.557 but the cell still *contains* the value 20.557, which, when multiplied by 2, equals 41.114, which rounds down to 41.

Using the round function to solve the problem

A member of senior management reviewing a spreadsheet containing such an obvious arithmetic error could lose confidence in the data presented and may be concerned that there were other – perhaps less obvious – errors elsewhere in the spreadsheet.

To prevent this type of rounding error occurring, we can use the *Round* function. While the *Format Cells, Number* feature simply rounds the number displayed in the cell, the *Round* function actually changes the value contained in the cell to the rounded value.

Table 1 provides a summary of the output of the *Round* function, which can be added at the beginning or anywhere within a formula:

Table 1

If cell G18 contained the value 15,623.763 and the formula below were typed into cell H18, then cell H18 would actually *contain* the following:	
Formula in cell H18	**Value actually contained in cell H18**
= Round(G18,2)	15,623.76
= Round(G18,1)	15,623.8
= Round(G18,0)	15,624
= Round(G18,-1)	15,620
= Round(G18,-2)	15,600
= Round(G18,-3)	16,000

Practice exercise 1c

Using the same file created earlier, 'Rounding Problems', we will use the *Round* function to deal with this problem. The formula in cell B14 as shown in Figure 4 can be rewritten in such a way that it does not simply take the unrounded value that is actually contained in cell B12 and multiply it by the value in cell B13, but rather takes the rounded value of cell B12. We will assume for the purposes of this demonstration that any value in cell B13 (the number of

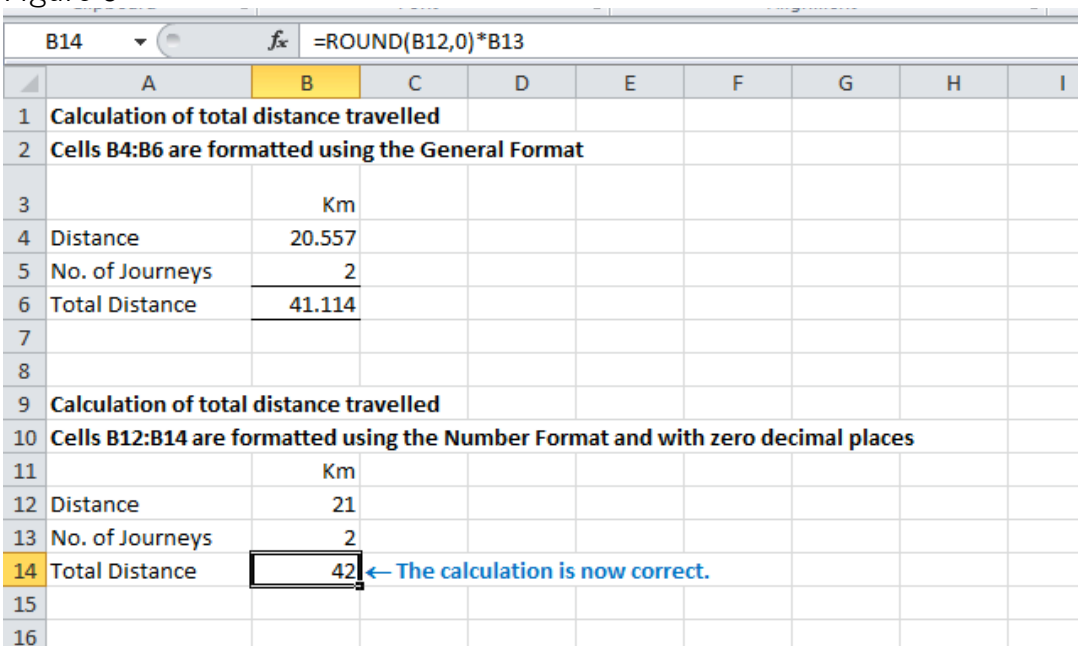
journeys) will always be a whole number and therefore cell B13 will not require to be rounded.

The formula in cell B14 would therefore be:
=Round(B12,0)*B13

We should now replace the existing formula in cell B14 with this new formula which can be done in a variety of ways. You may choose to simply go to cell B14 and type the new formula directly into the cell to replace it, or alternatively you may choose to go to cell B14 and edit the existing formula adding the *Round* function to the formula. You may edit the formula by clicking into the formula bar and editing the formula there, or by hitting the F2 button (the Edit function key) and then editing the formula directly in the cell. Remember that the positions of the brackets and the comma in the formula are important for the correct operation of this formula.

Your spreadsheet should now match that shown in Figure 5 which is the amended version of the worksheet where cell B14 displays the correct total for the rounded data displayed.
(There is no need to type the annotation text which appears in blue)

Figure 5



Remember to save your file again.

The zero after the comma in the formula relates to the number of decimal places the value will be rounded to. So '2' would be two decimal places, '–1' would be used to round a number to round 10s, and '–2' would be used to round to hundreds, and so on as shown earlier in Table 1.

This formula will result in what appears to be the more 'correct' result in cell B14, irrespective of the number of decimal places in the number typed in cell B12.

The format command will ensure that the value *displayed* in the cell is the rounded value to zero decimal places and the '=Round' function will ensure that the actual value *contained* within the cell has been rounded to zero decimal places.

The 'Round' function may not always give the 'best' answer

Looking back at Figures 4 and 5, we can see that the formula in cell B6 provides the most accurate answer using the distance to three decimal places, providing a total distance travelled of 41.114km. The formula that appears in cell B14 in Figure 4 results in a figure of 41km, while the amended formula using the *Round* function in cell B14 in Figure 5 results in a figure of 42km.

We are faced with a dilemma as to which formula in cell B14 provides the 'best' answer. 41km is actually closer to the accurate answer to three decimal places, but as the distance per journey is being displayed as a rounded number, this results in an apparent incorrect calculation, as shown in Figure 4. In fact, 42km, as shown in Figure 5, is further away from the accurate number but does provide the correct answer for the data displayed.

The most important issue is to be aware of rounding when creating a spreadsheet. If a decision is made to reduce the number of decimal places and this results in totals not calculating correctly, then it should be noted on the spreadsheet that this apparent error is caused by rounding. If the *Round* function is used to solve the problem, then it should be noted that the calculations are based on already rounded figures. There are a variety of solutions to the issue of using rounded numbers and the purpose of Practice Exercise 1 is to highlight the problems and some of the solutions.

Formulae using absolute and relative cell addresses

To appreciate the difference between an absolute and relative cell address in a formula, it will be helpful to consider how Excel interprets a cell address in a formula. Looking again at Figure 4, the formula in cell B6 appears as =B4*B5. Excel, however, interprets this formula not as the absolute cell addresses B4 and B5 but as cell positions that are *relative* to the position of the formula cell. So Excel interprets the formula in cell B6 as: 'Take the contents of the cell that is two rows above the current cell position and multiply this by the contents of the cell that is one row above the current cell position.'

It is this relative interpretation of cell addresses that allows us to use the *Copy* feature to copy formulae so effectively.

The formula in cell B6 was copied into B14 and the formula performed the same job as it had done in B6, multiplying the two cells directly above.

However, while there are many situations where this is exactly how we want Excel to perform when a formula is copied, there are other situations when we want to write a formula that uses data contained in a particular cell, and no matter where we copy that formula to in the worksheet, we want the formula to always use the contents of that particular cell, which Excel refers to as the 'absolute' cell. To do this, we change the cell address used in the formula from a relative cell address to an absolute cell address.

Figure 6 shows a simple spreadsheet that has been created to calculate the total pay for a team of salesmen who earn a base salary plus an additional 10% commission on total sales (combined sales in their home/domestic market and the overseas/export market).

There is no need to create the worksheet shown in Figure 6 as it is for demonstration purposes.

Figure 6

F5 =(C5+D5)*E5

	A	B	C	D	E	F	G	H	I
1	**Sales Team Salaries**								
2			Sales	Sales					
3		Base Salary	Home	Overseas	Commission	Commission	Total pay		
4		$	$	$	%	$	$		
5	Salesman 1	5,000	54,650	16,560	10%	7,121	12,121		
6	Salesman 2	6,000	44,870	12,200	10%	5,707	11,707		
7	Salesman 3	5,500	38,270	21,500	10%	5,977	11,477		
8	Salesman 4	8,000	17,660	15,750	10%	3,341	11,341		
9	Salesman 5	4,500	27,390	32,540	10%	5,993	10,493		
10									
11									

The formula in cell F5, which can be seen in the formula bar, =(C5+D5)*E5, uses relative cell addresses, and so this formula could be copied into cells F6 to F9 and still perform the same function.

Do remember the importance of brackets in this type of formula as we want to first add together the two sales amounts and then multiply those total sales by the commission rate of 10%. If the brackets were not included in the formula, the amount appearing in the cell would be 56,306 because without the brackets Excel will perform the multiplication first, so multiplying the overseas sales figure by 10% and then adding this to the total home sales figure. This would be the normal arithmetic order for carrying out such a calculation, so we

use brackets to ensure that the addition of the two sales figures is performed first.

Notice, however, that all the salesmen earn the same commission percentage. The design of the spreadsheet could therefore be changed so that only one cell contained the figure for the commission percentage rate and this single cell (or absolute cell) could be used in the commission calculation for all the salesmen.

To make a cell address absolute in a formula, the $ symbol is used as a code. So a cell address J22 for example would become $J$22. This means that if the $J$22 appears in a formula, and that formula is copied to any other cell on the worksheet, the formula will always use the data contained in cell J22. (Note that the $ symbol is simply used as a code – it has no currency significance).

Practice exercise 2a

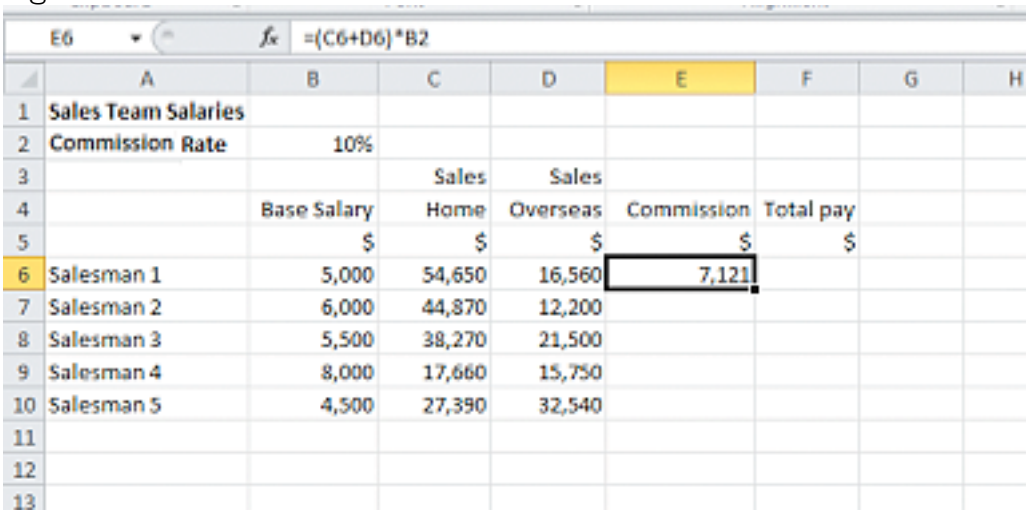
We will now create a slightly amended version of the Sales Team Salaries worksheet as shown in Figure 7.

Open a new blank workbook and enter the text and values as shown in Figure 7. Notice that the value in cell B2 is displayed as 10% and that the values in cells B6 through D10 are displayed with comma separators and zero decimal places. Note also that you should adjust column widths and use the appropriate text alignment to match those shown in Figure 7.

Type the formula as shown in the formula bar into cell E6:
=(C6+D6)*B2

Use *Save as* to save the file using the filename 'Sales Team Salaries 1'.

Figure 7



	A	B	C	D	E	F	G	H
1	**Sales Team Salaries**							
2	**Commission Rate**	10%						
3			Sales	Sales				
4		Base Salary	Home	Overseas	Commission	Total pay		
5		$	$	$	$	$		
6	Salesman 1	5,000	54,650	16,560	7,121			
7	Salesman 2	6,000	44,870	12,200				
8	Salesman 3	5,500	38,270	21,500				
9	Salesman 4	8,000	17,660	15,750				
10	Salesman 5	4,500	27,390	32,540				
11								
12								
13								

If you now copy this formula down into cells E7:E10, the data appearing in Column E should match that shown in Figure 8. Clearly, there is an error. Copying this formula into cells E8 and E9 results in an error code appearing in the cell, #VALUE!. This error code is caused by the formula attempting to multiply the total sales by cells that contain text, cells B4 and B5 respectively. Cells E7 and E10 result in incorrect values as the formula substitutes cells B3 (which is an empty cell) and B6 (which contains the value 5,000) for the commission rate.

Figure 8

E6 =(C6+D6)*B2

	A	B	C	D	E	F	G	H
1	**Sales Team Salaries**							
2	**Commission Rate**	10%						
3			Sales	Sales				
4		Base Salary	Home	Overseas	Commission	Total pay		
5		$	$	$	$	$		
6	Salesman 1	5,000	54,650	16,560	7,121			
7	Salesman 2	6,000	44,870	12,200	0			
8	Salesman 3	5,500	38,270	21,500	#VALUE!			
9	Salesman 4	8,000	17,660	15,750	#VALUE!			
10	Salesman 5	4,500	27,390	32,540	299,650,000			
11								

Practice exercise 2b

We will now correct the formula in cell E6 so that it refers to the *absolute* cell address B2 by adding the $ code, so that the formula shows $B$2. This amended formula can then be copied into then cells below.

Click on to cell E6 and edit the formula either by hitting the F2 button and editing the formula directly in cell E6 or by clicking on to the formula bar and editing the formula there. Position the cursor somewhere on the cell reference B2 (before or after the letter B or after the number 2) and press the F4 function key (which is usually on the top row of the keyboard) once only. B2 will now show as $B$2 indicating that this cell reference will remain fixed even when the formula is copied. This has become an *absolute* cell reference rather that a *relative* cell reference in the formula. Hit 'enter' to accept this new formula. (Note that you can also simply type in the $ sign codes to make the cell reference B2 into the absolute $B$2 in the formula.)

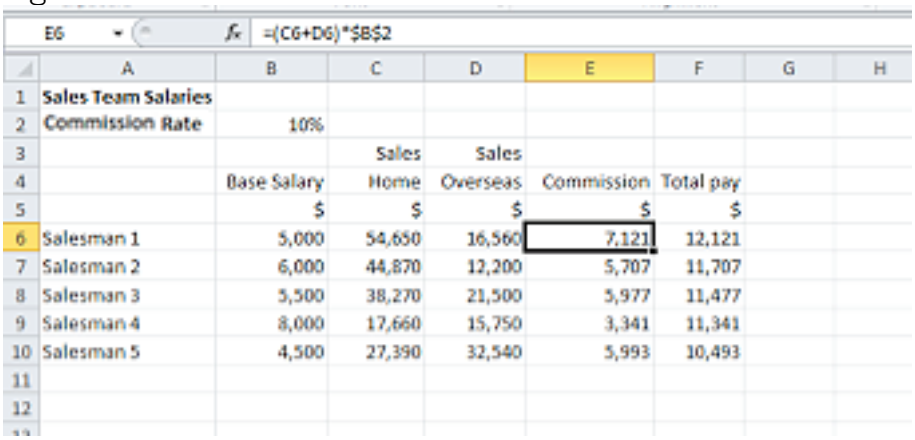
Copy this formula into cells E7:E10.

Note that when editing the formula, if we were to continue to press the F4 function key again the cell address will change to B$2, then $B2, then B2, before returning to $B$2 again. Where the $ code appears only once, then only the column *or* the row will be *absolute*, which may be required for some types of formula.

Finally you can enter the simple formula for total pay, which adds together the base salary plus the commission amount, into cell F6 and copy it into cells F7:F10. The formula for F6 will be =B6+E6.

Following some column width adjustment, number formatting and text alignment, your spreadsheet should match that shown in Figure 9. Remember to save the file.

Figure 9



E6 =(C6+D6)*$B$2

	A	B	C	D	E	F	G	H
1	Sales Team Salaries							
2	Commission Rate	10%						
3			Sales	Sales				
4		Base Salary	Home	Overseas	Commission	Total pay		
5		$	$	$	$	$		
6	Salesman 1	5,000	54,650	16,560	7,121	12,121		
7	Salesman 2	6,000	44,870	12,200	5,707	11,707		
8	Salesman 3	5,500	38,270	21,500	5,977	11,477		
9	Salesman 4	8,000	17,660	15,750	3,341	11,341		
10	Salesman 5	4,500	27,390	32,540	5,993	10,493		
11								
12								

Limiting the use of values within a formula

Taking another look at Figure 9, and specifically the formula that appears in cell E6, we could ask why it was necessary to link to cell B2 at all. Some users may have chosen to write the formula directly into cell E6 as =(C6+D6)*10%. This formula could be copied into cells E7:E10 and would provide the correct results.

It is true that this would provide the correct result, and we would therefore not need the details of the commission rate in Row 2. However, this would mean that we could not see what commission rate was being applied unless we clicked on one of the formula cells in Column E and reviewed the formula in the formula bar to find the rate. Also, in order to make any changes to the rate, we would have to edit the formula itself and copy it again.

We may want to give this spreadsheet to others in the organisation to use and we may not want them to go in and amend formulae in case they are less experienced and may make errors. There are features that allow cells to be locked so that users are prevented from making changes to the cells (these features will be discussed in a later article).

In the final version of the 'Sales Team Salaries 1' spreadsheet as shown in Figure 9, the user simply has to enter a new sales commission percentage in

one single cell, cell B2. This is much more effective than using the commission value itself within the formula.

Generally, where possible, it is advisable to limit the use of values in a formula, particularly where that value may be subject to change.

Using the 'If' function

The final feature we will consider in this article is the *If* function. This is used in a formula when we require the formula to perform one operation if a particular condition is met (the condition is *True*) or to perform an alternative operation if the condition is not met (the condition is *False*).

Consider the amended 'Sales Team Salaries' spreadsheet shown in Figure 10. Salesmen are given an award if they reach or exceed the sales target set, which is based on overseas sales only.

Notice a new row has been inserted into the worksheet and details of the sales target have been entered. A new column for the performance award has also been added.

Figure 10

A3 — Overseas Sales Target

	A	B	C	D	E	F	G	H
1	Sales Team Salaries							
2	Commission Rate	10%						
3	Overseas Sales Target	$20,000						
4			Sales	Sales			Performance	
5		Base Salary	Home	Overseas	Commission	Total pay	Award	
6		$	$	$	$	$		
7	Salesman 1	5,000	54,650	16,560	7,121	12,121		
8	Salesman 2	6,000	44,870	12,200	5,707	11,707		
9	Salesman 3	5,500	38,270	21,500	5,977	11,477		
10	Salesman 4	8,000	17,660	15,750	3,341	11,341		
11	Salesman 5	4,500	27,390	32,540	5,993	10,493		
12								

The logic of the formula required, therefore, in cell G7 is as follows:
If the overseas sales equal or exceed $20,000 (or whatever the agreed target number is as entered in cell B3) then the word 'AWARD' should appear in cell G7, but otherwise the cell should contain the text N/A.

The formula should be written in such a way that it can be copied into cells G8:G11 and therefore will require the use of an absolute cell address in the formula.

Practice exercise 3a

Open the same 'Sales Team Salaries 1' file you saved earlier and save the file using the new name Sales Team Salaries 2, using the *Save as* feature.

Now amend the file so that it matches that shown in Figure 10 by inserting a blank row to insert the data regarding the sales target, and then add the 'Performance Award' heading into column G. Note that the $20,000 overseas sales target figure that now appears in cell B3 (after the new row has been inserted) has been formatted to show a $ symbol before the amount. Which number format has been used do you think? Currency or accounting? Try both to see which one matches the one shown.

Note also that you should adjust column widths and use the appropriate text alignment to match that shown in Figure 10.

Practice exercise 3b

The formula using the *If* function must now be written into cell G7. Taking the logic described above and converting that into the correct *If* function formula requires the formula to be written as follows:

=IF(D7>=$B$3,AWARD",“N/A”)
This follows the Excel If function logic of =IF(Condition,True,False)

In this particular application of the IF function, the operations to be carried out if the condition is met (is TRUE) or is not met (is FALSE) are in both cases to display text in the cell, the word “AWARD” or “N/A” as appropriate. In other applications of the IF function, the operations may be to insert a value or perhaps perform a calculation using a formula. Future articles will provide further examples of the IF function at work.

Enter the formula as shown above into cell G7 and copy it into cells G8:G11.

Figure 11

G7 =IF(D7>=$B$3,"AWARD","N/A")

	A	B	C	D	E	F	G	H
1	Sales Team Salaries							
2	Commission Rate	10%						
3	Overseas Sales Target	$20,000						
4			Sales	Sales			Performance	
5		Base Salary	Home	Overseas	Commission	Total pay	Award	
6		$	$	$	$	$		
7	Salesman 1	5,000	54,650	16,560	7,121	12,121	N/A	
8	Salesman 2	6,000	44,870	12,200	5,707	11,707	N/A	
9	Salesman 3	5,500	38,270	21,500	5,977	11,477	AWARD	
10	Salesman 4	8,000	17,660	15,750	3,341	11,341	N/A	
11	Salesman 5	4,500	27,390	32,540	5,993	10,493	AWARD	
12								

Your spreadsheet should now match that shown in Figure 11.
Save the file.

Notice that if the threshold for an award (the overseas sales target) changes, then a new figure would be entered into cell B3. Try changing the target to

$16,000. This would result in cell G7 showing that Salesman 1 was not entitled to an award.

Conclusion

The best way to become comfortable with the features of Excel is to practise using them. Therefore, it is recommended to create practice exercises for yourself and experiment with different features on these files.

You may have the opportunity to create spreadsheets in a work environment, or you can use spreadsheets for personal applications such as creating a personal or family budget or keeping track of your personal spending. You can also use any of the files that have been created as you worked through this article.

In future articles we will use some of these exercises to demonstrate additional features and also introduce some new practice exercises.

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