

Microsoft Excel 2010 – Level 1

7 – Formula referencing



FORMULA REFERENCING



InFocus

Formulas provide the key to working successfully with Microsoft Excel. When you create a formula you write it using **cell references** rather than actual hard-coded values – this is how spreadsheeting works.

It is important to fully understand and comprehend this concept to be able to exploit the full potential of Microsoft Excel. There are indeed also some potential traps that you can fall into with cell referencing if you don't take enough care.

In this booklet you will:

- ✓ gain an understanding of relative and absolute cell addressing in formulas
- ✓ learn how to confidently create relative formulas in a worksheet
- ✓ learn how to identify potential problems with relative formulas
- ✓ learn how to create absolute references in a formula
- ✓ learn how to create mixed references

ABSOLUTE VERSUS RELATIVE REFERENCING

Excel is a calculation tool and as such is geared around the concept of formulas. Formulas are entered into a worksheet using **cell references** rather than actual values. Each time a formula is entered

using cell referencing, a shape is created and it is this shape which determines where Excel goes to pick up values for use in the calculation.

1 Understanding Formula Shapes

When you create a formula you don't enter numbers into the formula – you enter **cell references**. This creates a great time advantage when you need to duplicate that formula in other cells. Formulas are merely **shapes** that reference cells in specific locations in the worksheet or workbook. In the example below, say you have a formula in cell **E5** that is written as **=D5*C5**. To Excel this is interpreted as a shape that says "from my current position (**E5**) go left one cell (**D5**), take the value there and multiply it by the value two cells left (**C5**)". This becomes the formula shape – *left one multiply by left two*.

When this formula, or shape, is then copied or filled to adjacent cells it is the **shape** that is copied and the cell references within those copied formulas change **relative** to the shape (which doesn't change). For example, if you copy **=D5*C5** from **E5** to **E6** the formula in **E6** changes to **=D6*C6** – but the shape is still – *left one multiply by left two*.

This is called **relative referencing** – because the cell address changes relative to the current location.

MIN					
A	B	C	D	E	
1 Alpheus Global Enterprises					
2 Weekly Payroll					
3					
4	First Name	Last Name	Hours	Rate	Gross Pay
5	Angelo	Marcuzzo	43	35.60	=D5*C5
6	Riley	Griffin	35	32.10	1123.50
7	Celeste	O'Connor	28	12.50	350.00
8	Alex	Barnard	15.5	32.40	502.20
9	Tammy	Huber	22.5	10.25	230.63
10	Ishara	Tringali	40	10.25	410.00
11					
12	Totals		4140		4147.13
13					

MIN					
A	B	C	D	E	
1 Alpheus Global Enterprises					
2 Weekly Payroll					
3					
4	First Name	Last Name	Hours	Rate	Gross Pay
5	Angelo	Marcuzzo	43	35.60	1530.80
6	Riley	Griffin	35	32.10	=D6*C6
7	Celeste	O'Connor	28	12.50	350.00
8	Alex	Barnard	15.5	32.40	502.20
9	Tammy	Huber	22.5	10.25	230.63
10	Ishara	Tringali	40	10.25	410.00
11					
12	Totals		4140		4147.13
13					

2 Absolute Referencing

There will be times however when one or more cell references in a formula are always required to be located in a **specific** cell, row, or column. In the example below, sales tax of 10% is located in cell **B4** and must always be referenced from **B4**. The sales tax for the dining table is calculated using the formula **=B8*B4** while the sales tax for the sofa is calculated using the formula **=B9*B4**. These are different **shapes** and if you were to copy the formula from **C8** (**=B8*B4**) to **C9** it would copy the shape and the formula would be **=B9*B5** – which is wrong.

MIN					
A	B	C	D	E	F
1 Alpheus Global Enterprises					
2 Price List					
3					
4	Sales Tax	10%			
5					
6		Price	Tax	Price	
7		Ex Tax		Inc Tax	
8	Dining Table	1,255.50	=B8*B4	1,381.05	
9	Sofa	2,788.90	278.89	3,067.79	
10	Credenza	355.50	35.55	391.05	
11					

MIN					
A	B	C	D	E	F
1 Alpheus Global Enterprises					
2 Price List					
3					
4	Sales Tax	10%			
5					
6		Price	Tax	Price	
7		Ex Tax		Inc Tax	
8	Dining Table	1,255.50	125.55	1,381.05	
9	Sofa	2,788.90	=B9*B4	3,067.79	
10	Credenza	355.50	35.55	391.05	
11					

When dealing with cells in formulas that must be referenced from the same location, you must fix these cell references by making them **absolute**. This is done by placing a **\$** sign in front of either or both the row and column co-ordinate of the cell depending on which of these has to remain fixed (e.g. **\$B\$4**, **\$B4**, or **B\$4**). In the example above, both row and column co-ordinates need to be fixed and the formula in **C8** should be written as **=B8*\$B\$4** before it can be copied to adjacent cells.

RELATIVE FORMULAS



Most of the formulas that you enter into a worksheet, unless you are dealing with quite complex mathematical modelling, will be **relative formulas** where the cell references will be able to change when the

formulas are copied to other locations. This is particularly true of columnar worksheets where there is a series of columns that all have the same shape and structure.

Try This Yourself:

Open
File

Before starting this exercise you **MUST** open the file *E811 Absolute_1.xlsx...*

- 1 Click on **B9** to make it the active cell
- 2 Click on the **Sum** command  in the **Editing** group on the **Home** tab of the **Ribbon** to commence a formula in the cell
- 3 Press **Enter** to complete the formula
- 4 Click on **B9** again, and drag the small square handle (the **fill handle**) at the bottom right corner of the cell to **E9**
This will copy the formula shape from B9 to E9...
- 5 Click in cell **F6** to make it the active cell
- 6 Click on the **Sum** command  in the **Editing** group to commence a formula in this cell
- 7 Press **Enter** to complete the formula
- 8 Click on **F6** again, and drag the **fill handle** to **F9**
This will copy the formula shape from F6 to F9

2

	A	B	C	D	E	F
1	Alpheius Global Enterprises					
2	Revenue					
3						
4		Auckland	Dublin	Melbourne	New York	Total
5						
6	January	1,050,254	1,547,000	1,488,369	1,523,124	
7	February	1,524,294	1,685,548	1,599,854	1,789,552	
8	March	3,521,487	2,985,448	2,741,221	2,521,447	
9	1st Quarter	=SUM(B6:B8)				
10						

4

	A	B	C	D	E	F
1	Alpheius Global Enterprises					
2	Revenue					
3						
4		Auckland	Dublin	Melbourne	New York	Total
5						
6	January	1,050,254	1,547,000	1,488,369	1,523,124	
7	February	1,524,294	1,685,548	1,599,854	1,789,552	
8	March	3,521,487	2,985,448	2,741,221	2,521,447	
9	1st Quarter	6,096,035	6,217,996	5,829,444	5,834,123	
10						

6

	B	C	D	E	F	G	H
Global Enterprises							
	Auckland	Dublin	Melbourne	New York	Total		
	1,050,254	1,547,000	1,488,369	1,523,124	=SUM(B6:E6)		
	1,524,294	1,685,548	1,599,854	1,789,552			
	3,521,487	2,985,448	2,741,221	2,521,447			
	6,096,035	6,217,996	5,829,444	5,834,123			

8

	A	B	C	D	E	F
1	Alpheius Global Enterprises					
2	Revenue					
3						
4		Auckland	Dublin	Melbourne	New York	Total
5						
6	January	1,050,254	1,547,000	1,488,369	1,523,124	5,608,747
7	February	1,524,294	1,685,548	1,599,854	1,789,552	6,599,248
8	March	3,521,487	2,985,448	2,741,221	2,521,447	11,769,603
9	1st Quarter	6,096,035	6,217,996	5,829,444	5,834,123	23,977,598
10						

For Your Reference...

To **create** a **relative formula**:

1. Click on the cell in which you want the formula
2. Type or enter the formula and ensure that the formula contains references to other cells

Handy to Know...

- The formulas that we created above copied successfully and correctly because the same formula shape is used in each of the cells in which the formula was copied – this is the real benefit of relative formulas.

PROBLEMS WITH RELATIVE FORMULAS

Copying formulas can present problems when the **shape** of the formula varies from cell to cell. This can occur when one or more values in a formula must be located in a specific cell, row, or column – that is,

the formula must include an **absolute** cell reference. In this exercise you will see some strange values when you copy a formula to other cells using the default copying method.

Try This Yourself:

Open File

Before starting this exercise you **MUST** open the file E811 Absolute_2.xlsx...

1

Click on **C11** where we need to calculate the product's surcharge

2

Type **=B11*B5**

Notice the shape of the formula, as indicated by the highlighted cells...

3

Press **Enter** to complete the formula

Okay, now we can copy (or perhaps fill, as the destination cells are adjacent) to the other cells...

4

Click on **C11** again

5

Move the mouse pointer to the **fill handle** at the lower right corner of the cell and drag down to cell **C22**

Yuk! The results are meaningless!

2

4				
5	Head Office Surcharge	12%		
6				
7				
8		Nett of		Including
9	Product	Surcharge	Surcharge	Surcharge
10				
11	World Communicator 223	234.50	=B11*B5	
12	Planet Tamer 34e	344.55		
13	Master Communicator 10 Plus	1,245.50		

3

4				
5	Head Office Surcharge	12%		
6				
7				
8		Nett of		Including
9	Product	Surcharge	Surcharge	Surcharge
10				
11	World Communicator 223	234.50	28.14	
12	Planet Tamer 34e	344.55		
13	Master Communicator 10 Plus	1,245.50		

7				
8		Nett of		Including
9	Product	Surcharge	Surcharge	Surcharge
10				
11	World Communicator 223	234.50	28.14	
12	Planet Tamer 34e	344.55	0.00	
13	Master Communicator 10 Plus	1,245.50	0.00	
14	Master Communicator 20 Plus	13,455.00	#VALUE!	
15	Global Roamer 514	112.34	#VALUE!	
16	Global Roamer 515	135.60	0.00	
17	Global Roamer 516	166.70	39,091.15	
18	Global Roamer 517	198.00	68,220.90	
19	Sat-Direct 1460	566.80	705,949.40	
20	Sat-Direct 1560	655.34	8,817,599.70	
21	Sat-Direct 1660	788.90	88,625.03	
22	Sat-Direct 1760	1,255.00	170,178.00	
23				
24				

5

Handy to Know...

- So what has gone wrong with the formulas above? The whole problem hinges on the fact that each of the formulas in column **C** uses a different shape from the other formulas. For example, the first formula in **C11** is **=B11*B5**. The shape of this formula is one left, then six up and one left.
- The second formula in **C12** has become **=B12*B6** because it uses the same shape as the originating formula in **C11**. In reality the formula should be **=B12*B5**. All of the formulas above must reference the Head Office Surcharge of 12% which is in cell **B5** – that is, the cell reference must be **absolute**.

CREATING ABSOLUTE REFERENCES

There will be times when you need to create a formula which references cells that must remain the same even when it is copied around the worksheet. That is, you will need to make the cell references

absolute. A cell reference in a formula is made absolute by preceding its row coordinate or its column coordinate or both with a \$ sign.

Try This Yourself:

Same File

Continue using the previous file with this exercise, or open the file E811 Absolute_3.xlsx...

- 1 Click on cell **C11** then click on the **B5** reference of the formula in the **Formula bar** at the top of the screen
- 2 Press the **Absolute** key **F4** several times and notice how the reference cycles through various \$ sign configurations. Press the **Absolute** key **F4** until **B5** appears as **\$B\$5**
- 3 Press **Enter** to complete the editing
- 4 Click on **C11**, move the mouse pointer to the **fill handle** at the bottom right of the cell, and drag down to **C22** to fill the formulas down – successfully this time

1

	A	B	C	D
4				
5	Head Office Surcharge	12%		
6				
7				
8		Nett of		Including
9	Product	Surcharge	Surcharge	Surcharge
10				
11	World Communicator 223	234.50	=B11*B5	
12	Planet Tamer 34e	344.55	0.00	
13	Master Communicator 10 Plus	1,245.50	0.00	
14	Master Communicator 20 Plus	13,455.00	#VALUE!	

2

	A	B	C	D
4				
5	Head Office Surcharge	12%		
6				
7				
8		Nett of		Including
9	Product	Surcharge	Surcharge	Surcharge
10				
11	World Communicator 223	234.50	=B11*\$B\$5	
12	Planet Tamer 34e	344.55	0.00	
13	Master Communicator 10 Plus	1,245.50	0.00	
14	Master Communicator 20 Plus	13,455.00	#VALUE!	

4

		Nett of	Including
	Product	Surcharge	Surcharge
11	World Communicator 223	234.50	28.14
12	Planet Tamer 34e	344.55	41.35
13	Master Communicator 10 Plus	1,245.50	149.46
14	Master Communicator 20 Plus	13,455.00	1,614.60
15	Global Roamer 514	112.34	13.48
16	Global Roamer 515	135.60	16.27
17	Global Roamer 516	166.70	20.00
18	Global Roamer 517	198.00	23.76
19	Sat-Direct 1460	566.80	68.02
20	Sat-Direct 1560	655.34	78.64
21	Sat-Direct 1660	788.90	94.67
22	Sat-Direct 1760	1,255.00	150.60

For Your Reference...

To make a **cell reference absolute**:

1. Press **F4** to insert \$ before the row and column references, or type \$ before each

To **remove absolute references**:

1. Press **F4** until all \$ are removed, or delete the \$ from the formula

Handy to Know...

- To make a **row** reference absolute, press **F4** twice to insert \$ before the row reference only. To make a **column** reference absolute, press **F4** three times to insert \$ before the column reference only.

CREATING MIXED REFERENCES

Sometimes problems with formulas are more subtle. This often occurs when the cell reference only needs part of its coordinates locked in place. In this exercise we will use a formula to create

three price lists. Because we will copy the formula both across columns and down rows, we will need to apply only **partial absolute to the cell references** used in the formulas.

Try This Yourself:

Open File

Before starting this exercise you **MUST** open the file **E811 Absolute_4.xlsx...**

- 1 Click on **E11** and type **=D11-(D11*E9)** and press **Enter**
- 2 Use the mouse pointer to fill down to **E22** then across to **G22** – we've got problems!
- 3 Click on **E11** then click on the first **D11** reference in the formula in the **Formula bar**
- 4 Press **F4** three times until the reference appears as **\$D11**
- 5 Click on the second **D11** reference in the formula bar and press **F4** three times until the reference appears as **\$D11**
- 6 Click on the **E9** reference in the formula bar, press **F4** twice until the reference appears as **E\$9** then press **Enter**
- 7 Click on **E11** then use the mouse pointer to fill down to **E22** and across to **G22**

2

Volume Discounts			
Including	1 - 5	6 - 9	10+
Surcharge	5.0%	12.0%	15.0%
262.64	249.51	219.57	186.63
385.90	385.90	385.90	385.90
1,394.96	-346,658.72	#####	#####
15,069.60	#####	#####	#####
125.82	#####	#####	#####
151.87	#####	#####	#####
186.70	#####	#####	#####
221.76	#####	#####	#####
634.82	#####	#####	#####
733.98	#####	#####	#####
883.57	#####	#####	#####
1,405.60	#####	#####	#####

4

Volume Discounts			
Including	1 - 5	6 - 9	10+
Surcharge	5.0%	12.0%	15.0%
262.64	=D11-(D11	219.57	186.63
385.90	385.90	385.90	385.90

6

Volume Discounts			
Including	1 - 5	6 - 9	10+
Surcharge	5.0%	12.0%	15.0%
262.64	=D11-(\$D11	219.57	186.63
385.90	385.90	385.90	385.90

Handy to Know...

- In this scenario we created a formula to calculate a discounted product price. As we copy the formula to the right it picks up the wrong original product price. Then, as we copy the formula down it may, depending upon which column it is in, pick up the correct product price, but it then doesn't pick up the correct discount percentage. So, as we copy the formula across we need to ensure that the column coordinate pointing to the original product price is locked, but that the row is free to change as we copy down: **=D11-(\$D11*E9)**. However, the discount percentage is always in row 9. Therefore the formula needs to be further modified: **=D11-(\$D11*E\$9)**.

CONCLUDING REMARKS

Congratulations!

You have now completed the **Formula referencing** booklet. This booklet was designed to get you to the point where you can competently perform a variety of operations as listed in the objectives on page 2.

We have tried to build up your skills and knowledge by having you work through specific tasks. The step by step approach will serve as a reference for you when you need to repeat a task.

Where To From Here...

The following is a little advice about what to do next:

- Spend some time playing with what you have learnt. You should reinforce the skills that you have acquired and use some of the application's commands. This will test just how much of the concepts and features have stuck! Don't try a big task just yet if you can avoid it - small is a good way to start.
- Some aspects of the course may now be a little vague. Go over some of the points that you may be unclear about. Use the examples and exercises in these notes and have another go - these step-by-step notes were designed to help you in the classroom and in the work place!

Here are a few techniques and strategies that we've found handy for learning more about technology:

- visit CLD's e-learning zone on the Intranet
- read computer magazines - there are often useful articles about specific techniques
- if you have the skills and facilities, browse the Internet, specifically the technical pages of the application that you have just learnt
- take an interest in what your work colleagues have done and how they did it - we don't suggest that you plagiarise but you can certainly learn from the techniques of others
- if your software came with a manual (which is rare nowadays) spend a bit of time each day reading a few pages. Then try the techniques out straight away - over a period of time you'll learn a lot this way
- and of course, there are also more courses and booklets for you to work through
- finally, don't forget to contact CLD's IT Training Helpdesk on **01243-752100**