

# Section 4

# Formulas

By the end of this Section you should be able to:

Create Simple Formulas

Understand Mathematical Operators

Use Brackets

Understand Relative Addressing

Select Cells with the Mouse to Create Formulas

Use AutoSum

Copy Formulas

## Exercise 24 - Introducing Formulas

### Guidelines:

A calculation in *Excel* is called a **Formula**. Formulas are used to calculate answers from numbers entered on the sheet, e.g. sales for the year, net profit in a month, overall profitability of the company, etc.

All formulas begin with an equals sign (=), followed by the calculation.

Formulas automatically calculate results from the data. Any changes in the data will cause the formulas to be recalculated automatically.

### Actions:

1. Open the workbook **Formulas**, created in **Exercise 21**. If you did not complete **Exercise 21**, create a new worksheet as shown below (leave cell **B6** empty for now) and then save it as **Formulas**.
2. To add the contents of **B4** and **B5**, make **B6** the active cell by clicking on it.
3. Do not add spaces and use the **+** symbol on the numeric keypad at the right of the keyboard to type in **=b4+b5 <Enter>**. The cells being selected in the formula are highlighted automatically when entered on the screen. This creates a formula to add the contents of cells **B4** and **B5**.

	A	B	C	D	E	F
1	Fred Bloggs					
2						
3	Number	Add	Subtract	Multiply	Divide	
4	First	6	7	3	12	
5	Second	3	4	5	4	
6	Result	=b4+b5				
7						

*Note:* When entering cell references, like **B4**, it does not matter if they are entered in capitals or not, as *Excel* converts them to uppercase.

4. Click back on cell **B6** and note the cell displays **9** and the **Formula Bar** displays **=B4+B5**, the formula.

	A	B	C	D	E	F
1	Fred Bloggs					
2						
3	Number	Add	Subtract	Multiply	Divide	
4	First	6	7	3	12	
5	Second	3	4	5	4	
6	Result	9				
7						

5. Leave the workbook **Formulas** open.

## Exercise 25 - Mathematical Operators

### Guidelines:

The basic mathematical operators are add, subtract, multiply and divide. You have already used the operator **+**; the others are introduced here. The symbols on a keyboard are slightly different to those used normally and are:

- + Add**
- Subtract**
- \* Multiply**
- / Divide**

These symbols appear twice, one set placed around the main keyboard and the other set on the numeric keypad (right side). The keypad is easier to use because the keys are closer together and the **<Shift>** key is not used.

Other mathematical operations are used via **Functions** These are not covered in this guide.

### Actions:

- With the workbook **Formulas** open, click on cell **C6**.

*Note: To use the numeric keypad for number entries, the **Num Lock** light on the keyboard must be on. If not, press **<Num Lock>**.*

- Enter the formula to subtract the two numbers above **=c4-c5**. Complete the entry by pressing the right arrow key. The answer is displayed as **3**.
- In cell **D6**, enter the formula to multiply the two numbers above **=d4\*d5**. Complete the entry by pressing the right arrow key. The answer is displayed as **15**.
- In cell **E6**, enter the formula to divide the two numbers above **=e4/e5**. Complete the entry by pressing the right arrow key. The answer is displayed as **3**.

	A	B	C	D	E	F	G
1	Fred Bloggs						
2							
3	Number	Add	Subtract	Multiply	Divide		
4	First	6	7	3	12		
5	Second	3	4	5	4		
6	Result	9	3	15	3		
7							

- Leave the workbook open for the next exercise.

## Exercise 26 - Brackets

### Guidelines:

When more than one operator is used in one formula, then the order becomes important, e.g. **D23+E17/E19**. *Excel* performs calculations in this order: **B**rackets over **D**ivision, **M**ultiplication, **A**ddition and finally **S**ubtraction (the **BODMAS** theory). Brackets are added to force *Excel* to perform calculations in a different order to normal, i.e. calculations within brackets are done first.

### Actions:

1. Open **Formulas** if not already open from previous exercise. Click on cell **C10** and enter the label **Item 1**.
2. Enter the labels in cells **B11** to **B14** below. Enter the numbers in cells **C11** to **C13** below.

	A	B	C	D	E	F
1	Fred Bloggs					
2						
3	Number	Add	Subtract	Multiply	Divide	
4	First	6	7	3	12	
5	Second	3	4	5	4	
6	Result	9	3	15	3	
7						
8						
9						
10			Item 1			
11		Sell Price	10			
12		Buy Price	6			
13		Sold	3			
14		Profit				
15						

3. To calculate the profit, click on cell **C14** and type the formula **=c11-c12\*c13**.
4. Press **<Enter>** to complete the formula. The answer given is **-8** (this is because the multiplication is carried out before the subtraction: the **BODMAS** theory).
5. Click on cell **C14** and this time add brackets around the subtraction (the old formula is replaced by the new). Type **=(c11-c12)\*c13 <Enter>**.
6. Check that the answer displayed is now **12**. Profit per item **10-6**, which is **4** multiplied by the number sold, **3**, giving the total profit of **12**. The answer is now correct.
7. Leave the workbook open for the next exercise.

## Exercise 27 - Selecting Cells with the Mouse

### Guidelines:

When entering formulas that involve the use of cell references, e.g. =E6+F6 typing errors can be made. The mouse can be used to enter the cell references. This is also called **Pointing**. The mouse pointer is moved to the required cell and clicked.

### Actions:

1. If the workbook **Formulas** is not open then open it.
2. Move to cell **D10** and add another label **Item 2**.
3. In **D11** add another **Sell Price** of **8**.
4. In cell **D12** enter a **Buy Price** of **5**, and in cell **D13** enter the number **Sold** as **10**.
5. In cell **D14** enter the formula to calculate the **Profit**, using the mouse to enter the cell references. Type **=**( to start the formula and instead of typing **d11**, point and click on **D11** with the mouse.

	A	B	C	D	E	F
1	Fred Bloggs					
2						
3	Number	Add	Subtract	Multiply	Divide	
4	First	6	7	3	12	
5	Second	3	4	5	4	
6	Result	9	3	15	3	
7						
8						
9						
10			Item 1	Item 2		
11		Sell Price	10	8		
12		Buy Price	6	5		
13		Sold	3	10		
14		Profit	12	=D11		
15						

6. Press the - key, then click on cell **D12**. Press ) then \* followed by a click on cell **D13** and then press <Enter>. The cell will display the result, **30**.

D14		= (D11-D12)*D13				
	A	B	C	D	E	
9						
10			Item 1	Item 2		
11		Sell Price	10	8		
12		Buy Price	6	5		
13		Sold	3	10		
14		Profit	12	30		
15						

The **Formula Bar** shows the formula and the cell shows the answer



7. Save the workbook using the same filename, **Formulas**, then close it.

## Exercise 28 - AutoSum


### Guidelines:

The most common formula is addition. This calculation has been simplified by the creation of a **Function** called **Sum**. Functions are pre-calculated formulas. There is a button on the toolbar called **AutoSum** that creates the **Sum** function automatically.

### Actions:

1. Open the workbook **Equipment Sales** created earlier, or the supplied workbook **Computer Sales**.
2. Click in cell **B7**. The three cells above need to be added together to find the total. Add them using the mouse to select each of the cells. The formula is **=B4+B5+B6**. The answer should be **21**.
3. As more and more numbers are added this method becomes unworkable. There is a function: **SUM** that adds a group of cells. This is so widely used that there is a button on the toolbar to perform it automatically.
4. Select cell **C7** and click on the **AutoSum** button,  (if this is not displayed then click  to display more buttons).

	A	B	C	D	E	F
1	Computer Equipment Sales					
2						
3	Sales	PC's	Printers	Scanners	Total Units	
4	John	9	3	2		
5	Natalie	5	5	4		
6	Asif	7	2	5		
7	Total	21	=SUM(C4:C6)			
8			SUM(number1, [number2], ...)			
9						

5. The program looks for numbers to add. **AutoSum** tries above first, if there are no numbers above it looks left. **AutoSum** finds the 3 numbers and adds them. Press **<Enter>** to complete the function and display the answer **10** in cell **C7**.
6. Click in cell **E4** and click the **AutoSum** button, , which is now displayed on the toolbar. There are no numbers above so **AutoSum** looks left and sums the 3 cells **B4**, **C4** and **D4**. Press **<Enter>**. The answer is **14**.

**Note:** **AutoSum** only works without any help when numbers have already been entered into the worksheet. If **AutoSum** has numbers in both directions it will sum upwards by default.

7. The other formulas are created later by copying. Close the workbook and select **Yes** to save the changes, using the same workbook name.

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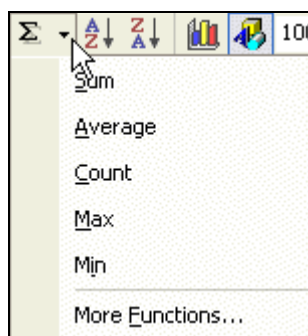
## Exercise 29 - Average Function

### Guidelines:

**Average** is another basic function that adds a list of numbers and then divides by the number of numbers. The average of **10** and **20** is **15**, the sum (30) divided by how many numbers (2).

### Actions:

1. Start a new workbook and enter a column of **4** numbers, starting in **B3**.
2. To average the numbers in cell **B7**, type **=Average(B3:B6)**. Press **<Enter>**, the result is displayed.
3. Delete the contents of cell **B7** and repeat the function by typing **=Average(** and then select the range by clicking and dragging **B3:B6**. Finish the formula by typing **)** and then pressing **<Enter>**.
4. The **Average** function can also be generated automatically, similar to **Sum**. Delete the contents of cell **B7**. With cell **B7** active, click the drop arrow next to the **AutoSum** button.

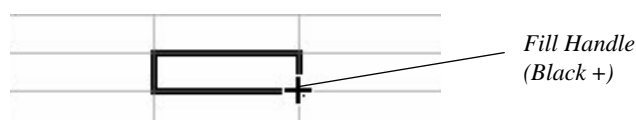


5. Select **Average**. The function is entered, check that the correct range is highlighted (**B3:B6**) and then press **<Enter>** to complete the function.
6. The average of the 4 numbers is displayed. To see the effect change one of the original numbers. The average changes automatically.
7. Enter **10**, **20**, **30** and **40** as the 4 numbers. The average should be displayed as **25**.
8. Close the workbook without saving.

## Exercise 30 - Using the Fill Handle to Copy

### Guidelines:

A group of cells or a range can be quickly filled with data by using the **Fill Handle**, at the bottom right corner of the active cell.

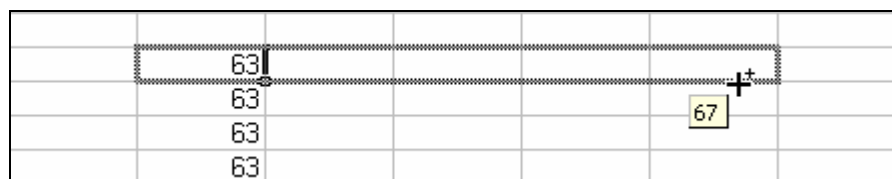


It is only possible to drag in one direction, i.e. along a row or down a column.

An extra feature of dragging the **Fill Handle** is the ability to automatically fill ranges with titles such as months of the year, days of the week, any text ending with a number and dates.

### Actions:

1. On a new worksheet enter your first name in **B2**.
2. Select **B2** and move the mouse pointer to the **Fill Handle** of **B2**. Click and hold down the mouse button, then drag the mouse to the right along the row of cells to **G2**.
3. In **E4** enter **63**. Click and drag the **Fill Handle** of **E4** down to **E7**. The entry **63** is repeated.
4. Click the cell **E4**. Hold **<Ctrl>** while dragging the **Fill Handle** to cell **I4**.



*A ToolTip shows the extent of the range as a caption.*

5. Release the mouse button, before releasing **<Ctrl>**. Holding **Ctrl** while dragging has caused the range to be filled with a series of numbers rather than the same number repeated. This method is very useful for quickly numbering cells, especially rows.

*Note: When using the **Fill Handle**, with or without the **Ctrl** key, a **Smart Tag** is displayed at the end of the new range. Clicking on the **Smart Tag** will display options to either **Copy Cells** or **Fill Series**. This can be used to override the default action. The **ToolTip** for the **Smart Tag** is **Auto Fill Options**.*

6. Close the workbook without saving.

## Exercise 31 - Copying Formulas

### Guidelines:

The copying of formulas can be carried out in precisely the same way as labels. If the user wishes to use the same formula in another position, e.g. to total the next column of figures, then the references of the columns within the formula will require adjustment.

By default *Excel* will carry out this adjustment automatically. This is because cell addresses are held as **Relative Addresses** (this is covered in the next exercise).

### Actions:

1. Open the workbook **Equipment Sales** (created earlier and saved last in **Exercise 28**).

			Labels				
							Formula
	Labels			Numbers			
		Formula					

*Note:* When creating a typical **Spreadsheet Model**, only the formulas to the right of the first row and at the bottom of the first column are created. The **Fill Handle** is then used to copy each of the formulas to adjacent cells (the grand total, bottom right, can be either the sum of the rows or of the columns).

2. Select cell **C7**. Notice the formula bar shows the calculation was made using **=SUM(C4:C6)**. This formula is to be copied to cell **D7**.
3. Click and drag the fill handle of cell **C7** to **D7**.

continued over

**Exercise 31 - Continued**

	A	B	C	D	E	F
1	Computer Equipment Sales					
2						
3	Sales	PC's	Printers	Scanners	Total Units	
4	John	9	3	2		
5	Natalie	5	5	4		
6	Asif	7	2	5		
7	Total	21	10	11		
8						
9						

4. Examine the formula in **D7**. It now shows **=SUM(D4:D6)**.

*Note: The **Smart Tag** for the copy action is shown to the right of cell **D7**.*

5. The formula in **E4** is to be copied using the same process to **E5**, **E6** and **E7**. Click and drag the fill handle from **E4** to **E7**. The completed spreadsheet should now appear as below.

	A	B	C	D	E	F
1	Computer Equipment Sales					
2						
3	Sales	PC's	Printers	Scanners	Total Units	
4	John	9	3	2	14	
5	Natalie	5	5	4	14	
6	Asif	7	2	5	14	
7	Total	21	10	11	42	
8						
9						

6. Save the workbook using the name **Results** and then close it.



## Exercise 32 - Relative Addressing

### Guidelines:

As a formula is copied across a range of cells, the formulas change automatically. The calculation is performed on cells in the positions relative to those copied, e.g. **B2+B3** becomes **C2+C3** then **D2+D3**, as the formula is copied from column **B** to column **C** to column **D**.

The formulas can be copied to any cells in any position on a worksheet.

### Actions:

1. Start a new workbook.
2. In cell **B2** enter **7** and in **B3** enter **8**. In cell **B4** create a formula **=B2+B3** to add the two numbers.
3. Click on cell **B4** and click the **Copy** button, . Move to cell **D8** and click **Paste** button, , to copy the formula.

*Note: A **Paste Options Smart Tag** is displayed after each paste action. This allows formatting options to be specified.*

4. The formula is copied and adds the cells relative to the formula, i.e. the two cells directly above, which are empty at present. Enter **5** and **3** into cells **D6** and **D7**.

	A	B	C	D	E
1					
2		7			
3		8			
4		15			
5					
6				5	
7				3	
8				8	
9					

*Note: All formulas copied are relative whether using **Copy** or the **Fill Handle**.*

5. Click on cell **B4** and drag its **Fill Handle** across three columns. The results are displayed as **0**, because there is no data above the formulas yet.
6. Examine the formulas in cells **C4**, **D4** and **E4**.
7. Enter numbers into the two cells above the three formulas to test and see if they work.
8. Close the workbook without saving.

## Exercise 33 - Revision

1. Open the file **Fruit** created in **Exercise 22**. If you did not complete **Exercise 22**, create a new workbook as below and save it as **Fruit**.
2. This is a worksheet produced by a person who sells a limited number of fruits from a barrow in the High Street. The numbers are boxes of fruit sold per month.

	A	B	C	D	E
1					
2					
3	Fruit	Apples	Pears	Oranges	Total
4	Jan	36	38	26	
5	Feb	40	26	37	
6	Mar	53	23	84	
7	Total				
8					

3. Use the **AutoSum** button to calculate the total boxes of **Apples** sold in cell **B7**.
4. Calculate the total boxes of fruit sold during **January** in cell **E4**.
5. Find out how many boxes of fruit were sold in **February** and **March** by completing cells **E5**, and **E6** using the **Fill Handle**.
6. Similarly, copy the formula from **B7** to **C7**, **D7** and finally **E7**.
7. How many boxes of fruit were sold in the first three months of the year?
8. Save the file as **Fruit2** and close the worksheet.

*Note: The answers are listed in the **Answer Section** at the end of the guide.*

## Exercise 34 - Revision

1. Open the workbook **Population**. This workbook lists all the major countries of the world showing their land size and population.
2. You are required to sum each of the four main regions of the world. Sum the population of **Europe** in cell **D22** (the range **D4:D21**) using **AutoSum**.
3. Sum the other three regions: **Asia** in cell **D38**, **America** in **D52** and **Australasia** in cell **D60**.
4. Type your name in cell **A1**.
5. Save the workbook as **Population2** and then close it.

*Note: The answers are listed in the **Answer Section** at the end of the guide.*