# Section 3

# Formulas

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

Create Simple Formulas
Understand Mathematical Operators
Use Brackets
Calculate Percentages
Select Cells with the Mouse to Create Formulas
Understand Ranges
Use AutoSum
Copy and Paste Formulas
Use the Fill Handle
Check Formulas for Errors

# Exercise 12 - Introducing Formulas

***Guidelines:***

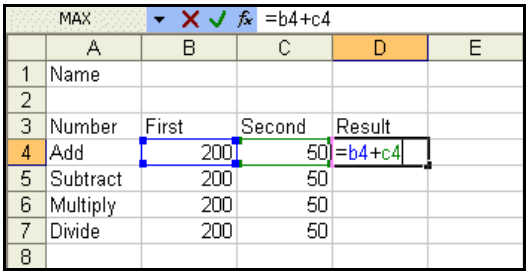
A calculation in *Excel* is called a **Formula**. Formulas are used to calculate answers from numbers entered on the sheet, e.g. add a column of numbers, total sales for the year, calculate net profit in a month, etc. Formulas automatically calculate results from the data. The original data can be changed, but the formula will automatically recalculate. This allows results to be projected from different data, but using the same formula. All formulas begin with an equals sign (=), followed by the calculation. Cell references are used in formulas in *Excel*.

***Actions:***

1. The workbook **Calculations** was created in Exercise 7. If you have not completed Exercise 7, create the layout shown below, placing your own name in cell **A1** and leaving cell **D4** empty for the moment.

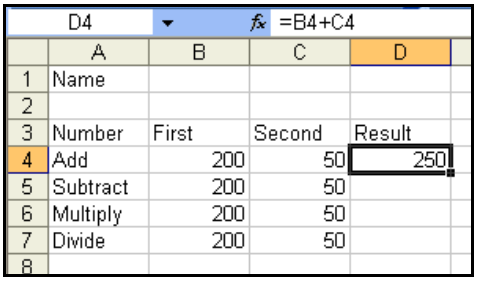
2. The contents of cells **B4** and **C4** are to be added together. Click on cell **D4** to make it the active cell. Type **=b4+c4**, without leaving spaces (the **+** symbol on the numeric keypad at the right of the keyboard may be used for the add sign).

*Note: To use the numeric keypad for number entries, the **Num Lock** light must be on. If it is not on, press the **<Num Lock>** key. When entering cell references, like **B4**, it does not matter if they are entered in capitals or not, as Excel converts them to uppercase.*




3. Complete the formula in **D4** by pressing <**Enter**>.

4. Click back on cell **D4** and notice that the answer to the calculation, **250**, is displayed in the cell, while the actual cell contents **=B4+C4** are displayed on the **Formula Bar**.




5. Save the workbook as **Calculations2** and leave it open.

# Exercise 13 - Mathematical Operators

***Guidelines:***

The basic mathematical operators are add, subtract, multiply and divide. The symbols on a keyboard are slightly different to those used normally and are:

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

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

Other mathematical operations are used via **Functions**, covered in a later Section.

***Actions:***

1. The workbook **Calculations2** should still be open from the previous exercise. If not, open it.

2. The number in cell **C5** is to be subtracted from the number in cell **B5**. Make cell **D5** the active cell and enter the formula **=b5-c5**. Complete the entry by pressing <**Enter**>. Cell **D5** should display the answer **150**.

3. Cell **D6** will be used to multiply together the contents of cells **B6** and **C6**. Enter the formula **=b6*c6** into cell **D6**. The answer should be **10000**.

4. Cell **D7** will be used to divide the contents of cell **B7** by the contents of cell **C7**. Make cell **D7** the active cell and enter the formula **=b7/c7**. Cell **D7** should display the answer **4**.

D8 fx

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | Name | | | | |
| 2 | | | | | |
| 3 | Number | First | Second | Result | |
| 4 | Add | 200 | 50 | 250 | |
| 5 | Subtract | 200 | 50 | 150 | |
| 6 | Multiply | 200 | 50 | 10000 | |
| 7 | Divide | 200 | 50 | 4 | |
| 8 | | | | | |
| 9 | | | | | |

5. Save the workbook and close it.

# Exercise 14 - Brackets

***Guidelines:***

When more than one operator is used in a single 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). So in this example **E17** would be divided by **E19** then added to **D23**. Brackets are added to force *Excel* to perform calculations in a different order.

***Actions:***

1. Start a new blank workbook and create the spreadsheet layout shown below.

| | A | B | C |
|---|---|---|---|
| 1 | Profit | | |
| 2 | | | |
| 3 | | Product 1 | |
| 4 | Sold at | 15 | |
| 5 | Bought at | 10 | |
| 6 | Number | 20 | |
| 7 | Profit | | |
| 8 | | | |

2. The profit per unit is calculated by subtracting the **Bought at** price from the **Sold at** price. The overall profit per product may then be calculated by multiplying the profit per item by the number of units sold. Make cell **B7** the active cell and enter the formula **=b4-b5*b6**.

3. Press <**Enter**> and the answer is displayed as **-185**, a loss! This is because *Excel* follows the BODMAS theory and carries out the multiplication (**10*20=200**) before the subtraction (**15-200=negative 185**).

4. To correct the situation delete the contents of cell **B7** and re-enter the formula as **=(b4-b5)*b6** <**Enter**>.

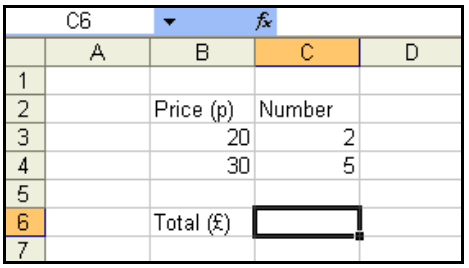
5. Notice how the brackets ensure that the subtraction (**15-10**) is carried out first and then the multiplication (**5*20**), so that the correct answer of **100** is displayed.

6. Save the workbook as **Brackets** and leave it open.

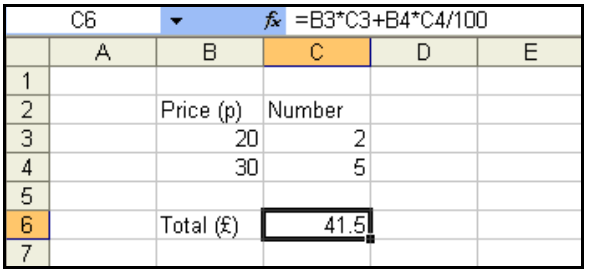
continued over

# Exercise 14 - Continued

7. Click the **Sheet2** tab. Enter the following data, starting at cell **B2**.



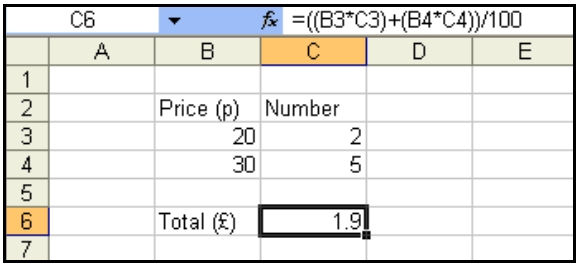

8. In cell **C6**, the total income will be calculated by multiplying the **Price** by **Number** e.g. **20** by **2** and **30** by **5** and then adding these together, then dividing by **100** to give the price in **pounds**. Enter the formula **=B3*C3+B4*C4/100**.




9. The answer is **£41.50**, which is not correct. Brackets must be used to make sure *Excel* performs the calculations in the right order, e.g. the multiplication's first, the addition second and the division last.

10. Click on cell **C6** and press the <**Delete**> key.

11. Now enter the correct formula, **=((B3*C3)+(B4*C4))/100** (Brackets are always used in matching pairs).




*Note: When brackets appear inside other brackets, the inside brackets are always calculated first. In the example, the two multiplications are calculated first, then added together and finally the division is performed.*

12. Save the workbook and leave it open for the next exercise.

# Exercise 15 - Selecting Cells with the Mouse

***Guidelines:***

When entering formulas that involve the use of cell references, e.g. **=E6+F6** or even **=GZ1207+GZ1208** 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. The workbook **Brackets** should still be open from the previous exercise. If not, open it. Click the **Sheet1** tab.
2. Make cell **C3** active and enter the label **Product 2**.
3. In cell **C4** enter a **Sold at** price of **20**.
4. In cell **C5** enter a **Bought at** price of **10**.
5. In cell **C6** enter the **Number** value of **15**
6. Make cell **C7** active and begin a formula by typing **=(** then instead of typing the cell reference, click on cell **C4** to enter the reference into the formula.

| | A | B | C | D |
|---|---|---|---|---|
| 1 | Profit | | | |
| 2 | | | | |
| 3 | | Product 1 | Product 2 | |
| 4 | Sold at | 15 | 20 | |
| 5 | Bought at | 10 | 10 | |
| 6 | Number | 20 | 15 | |
| 7 | Profit | 100 | =(C4 | |
| 8 | | | | |

7. Use the keyboard to enter a **-** sign and then click on cell **C5**. Type **)*** and then click on cell **C6**. Press <**Enter**> to complete the formula and confirm that **C7** displays the correct result of **150**.

C7 fx =(C4-C5)*C6

| | A | B | C | D |
|---|---|---|---|---|
| 1 | Profit | | | |
| 2 | | | | |
| 3 | | Product 1 | Product 2 | |
| 4 | Sold at | 15 | 20 | |
| 5 | Bought at | 10 | 10 | |
| 6 | Number | 20 | 15 | |
| 7 | Profit | 100 | 150 | |
| 8 | | | | |

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

8. Save the workbook and close it.

# Exercise 16 - Percentages

***Guidelines:***

Percentages are displayed with a percentage symbol, e.g. 25%. A percentage is a fraction or decimal displayed differently. Percent means per hundred. 20% is 20/100 as a fraction or 0.2 as a decimal.

There is a **Percent Style** button,  , that changes a decimal to a percentage.

***Actions:***

1. Start a new workbook and create the following worksheet.

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | | 1st | 2nd | Percentage | |
| 3 | | 15 | 25 | | |
| 4 | | | | | |

2. To display the first number as a percentage of the second in **D3**, enter the formula **=B3/C3** using any method.

3. To format the answer as a percentage, click the **Percent Style** button,  (this displays whole number percentage).

4. Change the second number to **27** and press <**Enter**>, notice that the percentage value changes automatically.

5. To display percentage with two decimal places, make the active cell **D3** and select **Format** | **Cells** to display the **Format Cells** dialog box. Make sure the **Number** tab is selected and change the **Decimal places** box to **2**. Click **OK** to display the worksheet.

6. Add the following data starting at cell **B5**.

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | | 1st | 2nd | Percentage | |
| 3 | | 15 | 27 | 55.56% | |
| 4 | | | | | |
| 5 | | Number | Percent | Answer | |
| 6 | | 20 | 50% | | |
| 7 | | | | | |

*Note: To enter **50%** in cell **C6**, type **50** followed by <**Shift 5**>, or enter **0.5** and use the **Percent Style** button.*

7. To find 50 percent of 20, in cell **D6** enter the formula **=B6*C6**. The answer is **10** (half of 20 is 10).

8. Enter **86** in **B6** and **45%** in **C6**. Press <**Enter**> to display the answer, **38.7**.

9. Close the workbook without saving.

# Exercise 17 - Ranges

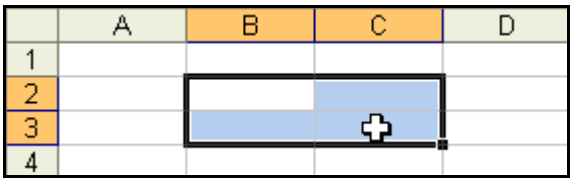
***Guidelines:***

A **Range** is a rectangular collection of cells. Just as single cells are identified by a cell reference, ranges are identified by the cells of their outer limits, e.g. the four cells **B2, B3, C2** and **C3** is the range **B2:C3**.

Ranges are selected by pressing the mouse button and holding it down, then dragging to highlight a range of cells (called **click and drag**). Entire rows or columns can be selected by clicking the row or column headings. By clicking and dragging the row or column headings, groups of rows or columns can be selected.

***Actions:***

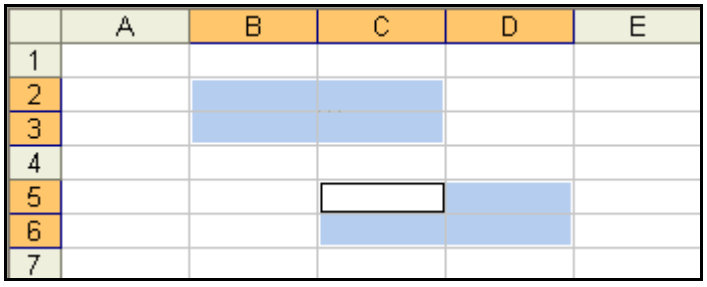
1. On a new worksheet, point and click on cell **B2** and with the mouse button held down, drag down and to the right so that a range of four cells is highlighted, as shown below.




2. Release the mouse button. Notice that the first cell in the range contains the cell reference (is white) and the other cells are highlighted in blue.

3. Click anywhere on the worksheet to remove the selected range.

4. More than one range can be selected by pressing <**Ctrl**> whilst clicking and dragging. Select the range **B2:C3** again. Press and hold down the **<Ctrl>** key. Click and drag the range **C5:D6**. Release the **<Ctrl>** key. There should now be two separate ranges highlighted.




5. Click anywhere on the worksheet to remove the selected ranges.

6. Click on the **B** in the column heading. Column **B** is now highlighted. Click anywhere to deselect it.

**continued over**

## Exercise 17 - Continued

7. Click and drag in the row heading, from **5** to **7**. The three rows are selected. Click anywhere on the worksheet to remove the selection.
8. When selecting a range the mouse control has to be very precise. Sometimes the range is not exactly the right one, it may be 1 row or column short. Click and drag the range **C3:G7**.
9. The range can be extended by holding down the <**Shift**> key and clicking on a cell to extend the range. Hold <**Shift**> and click on cell **G9**. The range is extended.
10. Click anywhere on the worksheet to remove the selection.
11. A range can be selected without dragging using the above method. Click on cell **B2**, hold <**Shift**> and click on cell **G12**, to select the range **B2:G12**.

*Note: If the range is larger than the screen, stay in the grey areas next to the worksheet if dragging, as the selection process is very fast if the pointer touches the edge of the screen.*

12. Select the range **C5:Z5** by dragging. Deselect the range.
13. Select the same range **C5:Z5** by clicking in cell **C5**, scrolling across to column **Z**, holding <**Shift**> and clicking in cell **Z5**.
14. Close the workbook without saving.

# Exercise 18 - AutoSum

***Guidelines:***

The most common formula is addition. This calculation has been simplified by the creation of a **Function** called **Sum**. Functions (covered in full in a later Section) are pre-calculated formulas. There is a button on the toolbar called **AutoSum**,  , that sums automatically.

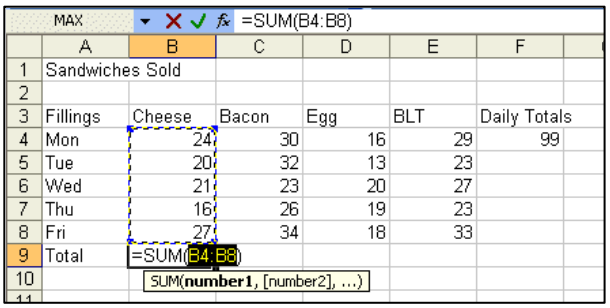
***Actions:***

1. Open the workbook **Sandwiches**. This should have been created in Exercises 3 and 4, if not go back to Exercise 4 and re-create the spreadsheet layout.

2. Click on cell **F4**. A formula needs to be entered here that will add up the contents of the four cells **B4**, **C4**, **D4** and **E4**. Using the mouse to select each of the cells, enter the formula **=B4+C4+D4+E4**.

3. This method of adding cell contents soon becomes unusable, as more numbers need to be added. To avoid the creation of long and unwieldy formulas, a function: **SUM** is available within *Excel* to add together the contents of a group of cells. A button is provided on the toolbar to perform this function automatically. Make cell **B9** the active cell.

4. Click the **AutoSum** button,  (if this is not displayed then click  to display more buttons).




5. **AutoSum** scans vertically upwards, searching for cells containing numbers. It identifies the numbers in cells **B4** to **B8** and uses those cell references to create the function =**SUM(B4:B8)**. Since this is the correct calculation, press <**Enter**> to accept the function and display the answer **108**.

6. Make cell **F4** active and click  to replace the existing formula. This time **AutoSum** scans vertically upwards but there are no numbers above so it scans left and identifies the range of cells from **B4** to **E4** inclusive. Press <**Enter**> to complete the function. The answer should be **99**, the same as displayed by the original formula.

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 totals will be created in a later Exercise (20). Save the workbook as **Sandwiches2** and close it.

# Exercise 19 - Copy and Paste

***Guidelines:***

Rather than repeatedly typing the same data into several cells, the data can be copied and then pasted.

The **Copy** command can be used to copy labels, values and formulas. The selected cells are placed in an area of *Windows* called the **Clipboard**, from which they can then be **Pasted** back into other locations.

***Actions:***

1. Start a new workbook.
2. Make the cell **B3** active and type **HELLO <Enter>**.
3. To copy this cell, click on cell **B3** and then click the **Copy** button,  .

*Note: An alternative method is to use **Edit | Copy** or the key press <**Ctrl C**>.*

4. The selected cell will now have a broken border (called a **Marquee**) and the message **Select destination and press ENTER or choose Paste** is displayed in the **Status Bar**.
5. Click on cell **B7** and press **<Enter>**. The contents of **B3** will now be pasted into **B7**. The contents of **B3** remain unchanged. Note that **B3** no longer has a broken border.
6. Enter **65** into cell **C6**, select the cell and click the **Copy** button,  .
7. Move to **B9** and click the **Paste** button,  . Note that **C6** still has a broken border, indicating that its contents can be pasted again if required.

*Note: A **Paste Options Smart Tag**,  , will be displayed next to the pasted range. Clicking on this tag would display a selection of options concerning the paste process. These are not covered in this guide.*

*Note: An alternative method is to use **Edit | Paste** or the key press <**Ctrl V**>.*

8. Move to **B10** and paste again.
9. Press <**Esc**> to end the pasting and remove the marquee around **C6**.
10. Close the workbook without saving the changes.

# Exercise 20 - Using the Fill Handle

***Guidelines:***

Ranges can be quickly filled with data by using the **Fill Handle**, which appears when the cursor is placed over the bottom right corner of the active cell. Cell contents can either be copied or used as the basis for a numeric series.


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 series such as months of the year, days of the week and dates.

***Actions:***

1. Open the workbook **Sandwiches2**.

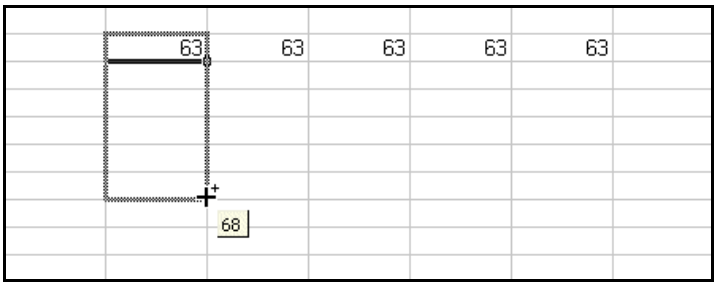
2. Click on the **Sheet2** tab to view a blank sheet within **Sandwiches2**.

3. Type your first name into cell **B2**.

4. Select **B2** again and move the mouse pointer to the **Fill Handle** of **B2**. Click and drag the cell along to **G2**.

5. In **E4** enter **63**. Click and drag the **Fill Handle** of **E4** across to **I4**. The entry **63** is repeated.

6. Click the cell **E4** again. Hold <**Ctrl**> while dragging the **Fill Handle** to cell **E9**.




7. Release the mouse button to fill the cells with increasing numbers. This method is very useful for quickly numbering cells, especially rows.

8. In **A10** enter **January**. Click and drag the fill handle of **A10** along to **H10**.

9. In **A13** enter **1st**.

10. Click and drag the fill handle of **A13** down to **A22**. This is very useful when creating calendars.

continued over

## Exercise 20 - Continued

11. Click the **Sheet1** tab to display the sandwich sales data.

12. Formulas can also be copied using the **Fill Handle**. The formulas in cells **B9** and **F4** can be copied in this way to save re-typing.

13. With the active cell as **B9**, drag the **Fill Handle** across to **F9**.

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 1 | Sandwiches Sold | | | | | | |
| 2 | | | | | | | |
| 3 | Fillings | Cheese | Bacon | Egg | BLT | Daily Totals | |
| 4 | Mon | 24 | 30 | 16 | 29 | 99 | |
| 5 | Tue | 20 | 32 | 13 | 23 | | |
| 6 | Wed | 21 | 23 | 20 | 27 | | |
| 7 | Thu | 16 | 26 | 19 | 23 | | |
| 8 | Fri | 27 | 34 | 18 | 33 | | |
| 9 | Total | 108 | 145 | 86 | 135 | 99 | |
| 10 | | | | | | | |
| 11 | | | | | | | |

*Note: **E9** will show the sum of column **E** and **F9** will show the sum of column **F** although column **F** is incomplete at the moment.*

*Note: The **AutoFill Options Smart Tag**,  , appears which allows different formatting to be selected. Performing any other unrelated action removes it.*

14. Click in cell **E9** and check the **Formula Bar** to see that the formula has been updated automatically to sum column **E** instead of column **B**.

15. To complete column **F** make the active cell **F4** and drag the fill handle down to **F8**. The completed spreadsheet should look the same as below.

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | Sandwiches Sold | | | | | |
| 2 | | | | | | |
| 3 | Fillings | Cheese | Bacon | Egg | BLT | Daily Totals |
| 4 | Mon | 24 | 30 | 16 | 29 | 99 |
| 5 | Tue | 20 | 32 | 13 | 23 | 88 |
| 6 | Wed | 21 | 23 | 20 | 27 | 91 |
| 7 | Thu | 16 | 26 | 19 | 23 | 84 |
| 8 | Fri | 27 | 34 | 18 | 33 | 112 |
| 9 | Total | 108 | 145 | 86 | 135 | 474 |
| 10 | | | | | | |

16. Save the workbook using the same file name.

17. Leave the workbook open for the next exercise.

# Exercise 21 - Checking Formulas

***Guidelines:***

Spreadsheets are of little use if the formulas within them contain errors. All formulas should be checked to make sure that they are accurate.

***Actions:***

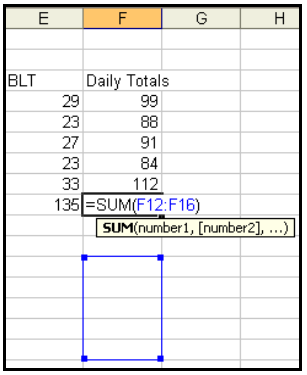
1. The workbook **Sandwiches2** should still be open from the previous exercise. If not, open it.

2. To check the formula in cell **F4**, click on the cell and check the formula in the **Formula Bar**, it should be **=SUM(B4:E4)**.

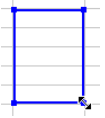
3. A much better way to check a formula is to double click on the required cell. Double click on cell **F4**. The formula is displayed in the cell with colour coding to show which cells are used.

4. After checking, press <**Enter**> or <**Esc**> to finish the editing.

5. Double click on cell **F9**. The range is shown in blue. Click and drag the blue range border down to start at row **12**, which moves the range being calculated in **F9**.




6. As well as moving the range it can be adjusted by moving the mouse pointer over one of the corner arrows and clicking and dragging the border.



7. Click and drag the border up one cell, using one of the right corners, so the range only includes three cells.

8. Move the range back to the correct position starting on row **4** (it will be two rows short). Press <**Enter**> to complete the formula.

9. Double click on cell **F9** and adjust the range to include **F7** and **F8** as before.

10. Save the changes using the same name and close **Sandwiches2**.

# Exercise 22 - Revision

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

1. Start a new workbook.

2. The illustration below shows the number of high-tech components produced in a week by the different plants of a precision engineering company. Create the following worksheet.

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | Week ending: 9th January 2004 | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | Production | Northern | Southern | Eastern | Western | Total |
| 5 | Wottnots | 25078 | 23512 | 25385 | 24765 | |
| 6 | Thingmies | 16362 | 16391 | 17425 | 16987 | |
| 7 | Widgets | 11234 | 10959 | 12001 | 11678 | |
| 8 | Doodahs | 8950 | 9006 | 7123 | 9218 | |
| 9 | Total | | | | | |
| 10 | | | | | | |

3. In cell **F5**, use **AutoSum** to work out the total number of **Wottnotts** produced across the four plants.

4. In cell **B9**, calculate the total output of the **Northern** plant for the week.

5. Use the **Fill Handle** to replicate the formula in **F5** down to **F8**.

6. Copy the formula in **B9** across to **F9**.

7. What was the total production of the **Southern** plant in that week?

8. How many **Doodahs** did the four plants produce between them during the week?

9. What was the total output for all four plants?

10. Save the workbook as **Engineering** and close it.