INFORMATION SYSTEMS SERVICES

Writing Formulae with Microsoft Excel 2002

A Tutorial for Excel 2002 for Windows

Contents

Format Conventions

In this document the following format conventions are used:

Menu items are given in a bold, Arial font.	**Windows Applications**
Keys that you press are enclosed in angle brackets.	**<Enter>**

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1.0 Introduction

1.1 About Spreadsheet Software

Before spreadsheets became such widespread computer tools, calculations were done either by hand or by writing programs with a programming language. This was time-consuming and frequently led to errors in the calculations.

Spreadsheets very quickly took over the tasks from the hand calculation method and, as time has gone on, they have taken on more and more of the calculations that used to require programming languages.

The power of a spreadsheet lies in its ability to have formulae in cells. These formulae can consist of numbers and simple arithmetic operators, mathematical, statistical and financial functions and cell references. The result of a calculation in one cell can be used in a further calculation. The concept is simple, but it means that spreadsheets can perform very complicated analyses.

This set of exercises is designed to introduce you to the way Excel uses formulae and functions. The document is not intended to give you a comprehensive list of all the functions that Excel can perform as that can be obtained from the on-line Help system. However, once you have completed these exercises you should be able to use other Excel functions.

1.2 Prerequisites

It is assumed that you already know how to open, close, save and print an Excel spreadsheet and that you know how to enter data, edit data and create simple formulae. If you are new to Excel it will be necessary for you to read and work through the following document before attempting these exercises:

Getting Started with Microsoft Excel 2002   (BEG 40)

If you wish to investigate some of the other facilities in Excel then the following documents are also available:

Formatting Data in Microsoft Excel 2002   (TUT 48)

Using Charts with Microsoft Excel 2002   (TUT 49)

Data Manipulation with Microsoft Excel 2002   (TUT 130)

Before you begin, download the zip file for use with this document.

Open a web browser such as Internet Explorer and go to URL:

www.leeds.ac.uk/iss/documentation/tut/examples/index.html
Scroll down to Writing Formulae with Microsoft Excel 2002 and right-click on the file TUT47.xls. Select **Save Link As**…(**Save Target As**… in Internet Explorer). When the **Save As** dialog box appears, select a suitable directory and click **Save**.

Task 1 Using Series

It is often necessary to create a regular, repeating series. Being able to do this automatically can save a lot of time. Excel has some built-in series, e.g. days of the week and weeks of the year. In addition to using these series, Excel can be made to continue a pattern set by the user. The exercises in this section will illustrate the various methods.

Activity 1.1   Run Excel **(Start > Microsoft office XP > Excel**) and open the file that you have just saved – TUT47.xls. Click on Sheet 2, to start with a completely blank worksheet.
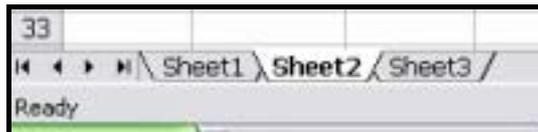

Figure 1   The Worksheet Labels

Select cell A1 using the mouse. Type **Jan** and then press **<Enter>**. The word Jan should appear in cell A1. Select cell A1 again and point the mouse at the fill handle (as you do this the cursor will take the shape of a cross hair). Drag the mouse down the column to cell A12 and then release it. Cells A1:A12 will now contain the months Jan to Dec.
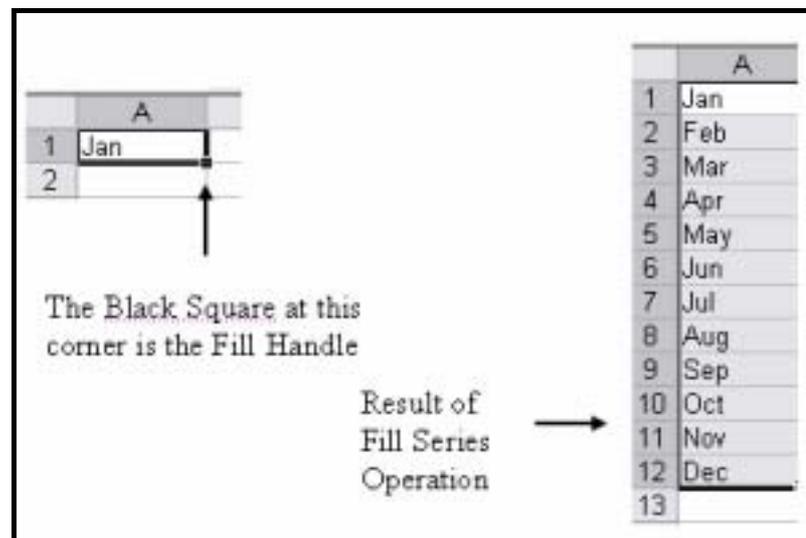
Figure 2   Fill Series Operation

Activity 1.2   Enter the word **Monday** in cell B1. Point to the fill handle and when the cursor shape changes to a cross hair, drag the mouse down to cell B7 and release it. The cells will be filled with the days of the week.

Activity 1.3 It may be desirable to produce a list of weekdays only and Excel has such a list. Enter **Monday** in cell C1 and repeat activity 1.2. This time note that at the bottom right of the cell C7 is a symbol. Click on this to see a **Fill Series** menu, and choose **Fill Weekdays**.
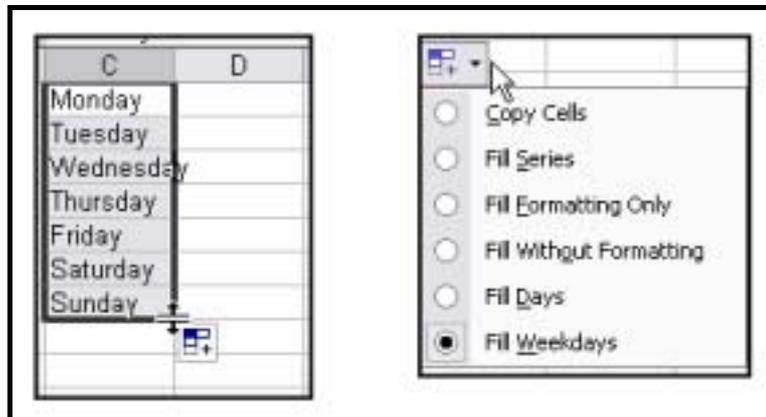
Figure 3   The Fill-Series Menu

Activity 1.4 Excel will also recognize a mixture of text and numbers as a potential series. In cell D1 type **Semester 1**. Use the fill series handle and drag the mouse to cell D3. Note that Excel has extended the series to Semester 3.

Activity 1.5 Excel can create a series from two cells that contain the first two (numeric or date) terms. It may be useful to have a list of dates a week apart. In E1 type **1/9/04** and in E2 type **8/9/04**. Highlight both cells together and drag the fill handle down to E5.
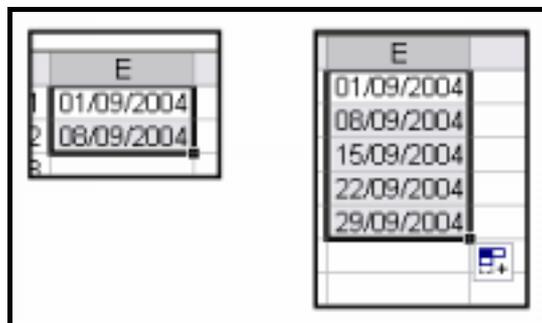
Figure 4   User-Defined Date Series

Activity 1.6 Return to Sheet 1. In cell A5 type **Jan**, in cell A10 type **Feb** and in cell A15 type **Mar**. In B5 type **Week1** and then drag the fill handle to B8 to complete the series. Copy the contents of cells B5:B8 into cells B10:B13 and B15:B18.

2.0 Formulae

Formulae have three basic components:

- Values include numbers, text and dates

- Cell references (a cell is the intersection of a row and column)

- Operators

  o Subtraction   the minus sign   **-**

  o Negation   the minus sign   **-**

  o Addition   the plus sign   **+**

  o Multiplication   the asterisk   **∗**

  o Division   the forward slash   **/**

  o Exponentiation   the caret   **^**

A formula in Excel must be preceded by an equals sign   **=**

2.1 Functions

The real power of Excel is seen in its range of predefined functions. These are grouped into the following types:

- Financial

- Date & Time

- Mathematical and Trigonometrical

- Statistical

- Lookup & Reference

- Database

- Text

- Logical

- Information.

The components of a function are:

- The equals sign

- The name of the function e.g. SUM or AVERAGE

- The arguments (these are enclosed in parentheses, and if there is more than one argument, they are separated by commas) e.g.
  =SUM(A1:A5)
  =SUM(A1:A5,B1:B5)

2.2 Layers

Spreadsheets contain two layers – the stored layer and the displayed layer.

The stored layer contains just what you type in. All numbers are stored in the same way, text is stored as simple ASCII characters and formulae are stored exactly as they are typed in. The formula bar will always show what is in the stored layer.

The displayed layer is what you see on the worksheet. It shows the result of a formula. The displayed layer can also include formatting features for numeric data, such as the number of decimal places or currency symbol. Text formatting includes font size, style and colour.

By default the worksheet shows you what is in the displayed layer. To change this display to show the stored layer, select **Tools > Options**, choose the **View Tab** and check the **Formulas** box.
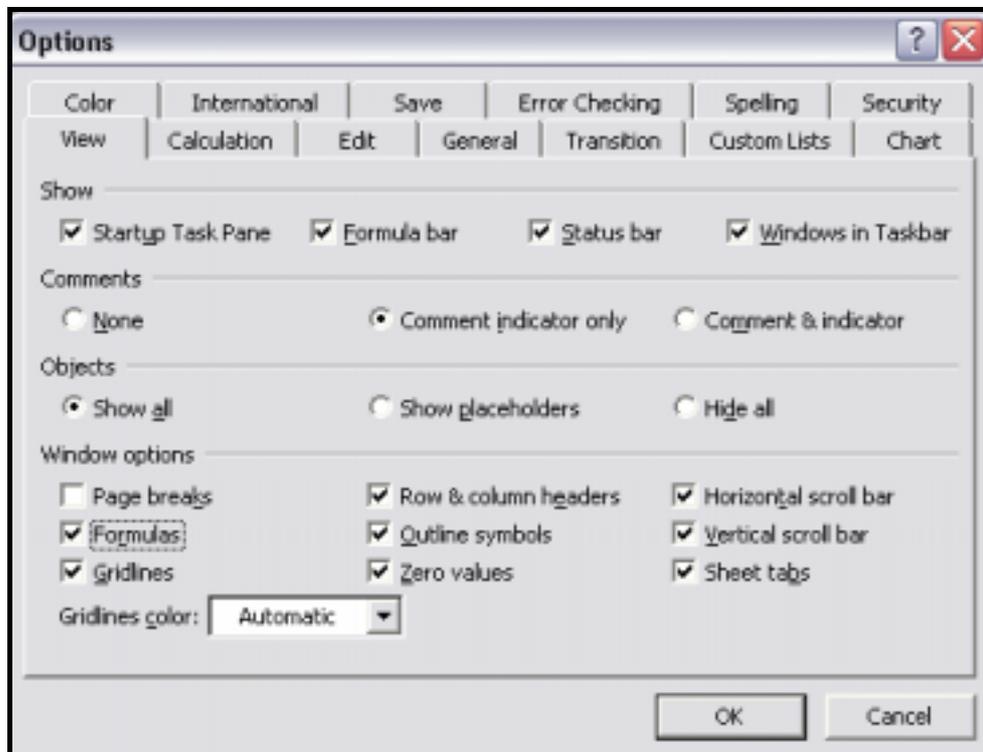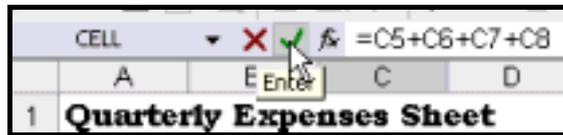

Figure 5   The Options Dialog Box

Task 2   Simple Calculations

Activity 2.1   Click on Sheet 1. The aim is to calculate the sum of the values in the cells C5, C6, C7 and C8. Click in cell C9 and type an **=** sign. This tells Excel that what follows is a formula. Type **C5+C6+C7+C8** and then press **<Enter>** or click on the Confirm button (the green tick on the formula bar). The result will be 95.

Figure 6   The Confirm Button on the Formula Bar

Activity 2.2   Now select cell C5 and change the number to **20**. Press **<Enter>.** Immediately the result in cell C5 changes to 102 to reflect the change in data. When you have verified this, change the cell contents back to **13**.

Activity 2.3   The process of using formulae can be improved by making use of the built-in functions. Instead of referring to each cell as we did in previously, we can use the Excel **SUM** function. This requires as an argument the range of cells. In this case the range is C5:C8 so the formula we require is **=SUM(C5:C8).** Click in C9 and press the **<Delete>** key to remove the current formula and then type in the new one. The result will be 95 as expected.

Figure 7   The Formula Bar Showing the SUM Function

Activity 2.4   Delete the contents of C9 again. This time we will highlight the cells that are to be added. Click on the formula bar and type **=Sum(** Now drag the mouse over cells C5:C8 and note that Excel has entered the range for you. Type in a closing bracket **)** and then press **<Enter>**. The result will be the same.

Figure 8   Editing on the Formula Bar

Task 3 Copying Formulae

Activity 3.1   Now that we have created a formula to sum one column, we can copy the formula across to other cells in the same way that we continued a series in Task 1. Click on C9 again, and note that the formula bar shows the Excel function that was used in the calculation. Point to the bottom right-hand corner of the cell and make sure that the mouse pointer is in the shape of a cross hair. Drag the mouse across the row until the cell G9 and release it. Click on cell D9 and look at the formula bar. Note that the cell references have been translated and they now refer to column D. The entries in columns F and G will be zero as there are no numbers in the cells above them at the moment.

	D9 ▼	f_x =SUM(D5:D8)	
	A	B	C	D
1	**Quarterly Expenses Sheet**			
2				
3				
4	**Month**	**Week**	**Travel**	**Food**
5		Week 1	13	26
6		Week 2	26	25
7		Week 3	29	28
8		Week 4	27	25
9		Total	95	104

Figure 9   Formula Bar

Activity 3.2   Select the cell C14, type **=SUM(C10:C13)** and the press **<Enter>**. Use the same method as in the previous activity to copy the formula across to G14.

Activity 3.3   Repeat this process to insert the totals in cells C19:G19. The March figures should be as follows:

15	*Mar*	Week 1	25	24	19		
16		Week 2	28	28	25		
17		Week 3	28	29	19		
18		Week 4	40	16	16		
19		Total	121	97	79	0	0

Figure 10   Part-Completed Sheet

Task 4   Using Insert Function

Activity 4.1   Clicking the **Insert Function** button activates the function wizard, which provides a list of Excel functions and gives information about the arguments they require. Click in cell F5 and then click the **Insert Function** button. Select the category Math & Trig, and then scroll down the lower window until the **SUM** function becomes visible.
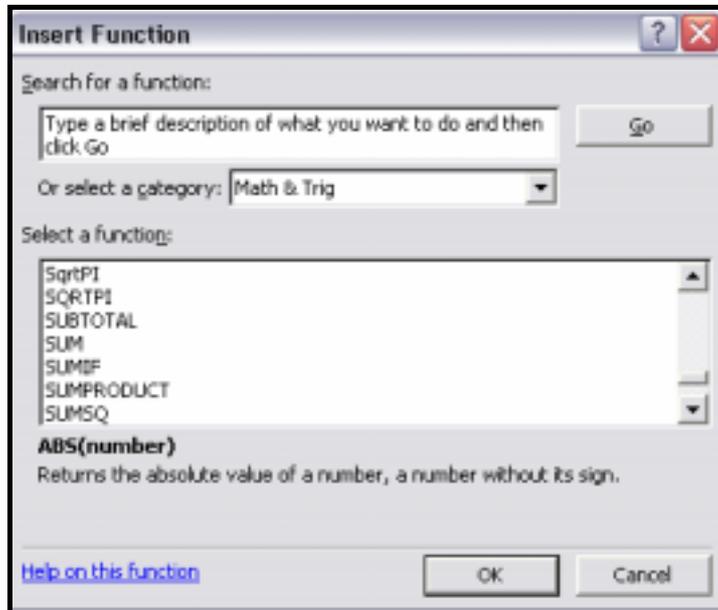

Figure 11 Insert Function Dialog Box

Activity 4.2   Click on the **SUM** function and then click **<OK>** to proceed to the next step. If the range C5:E5 has not been entered automatically by Excel, type it into the Number 1 Box and click **<OK>**. (If we wanted to sum two ranges that were not contiguous, we could enter the cell references for the second block into the **Number 2** box. As we did this, a further box would be added to the list, ready to accept the references for the third block.)
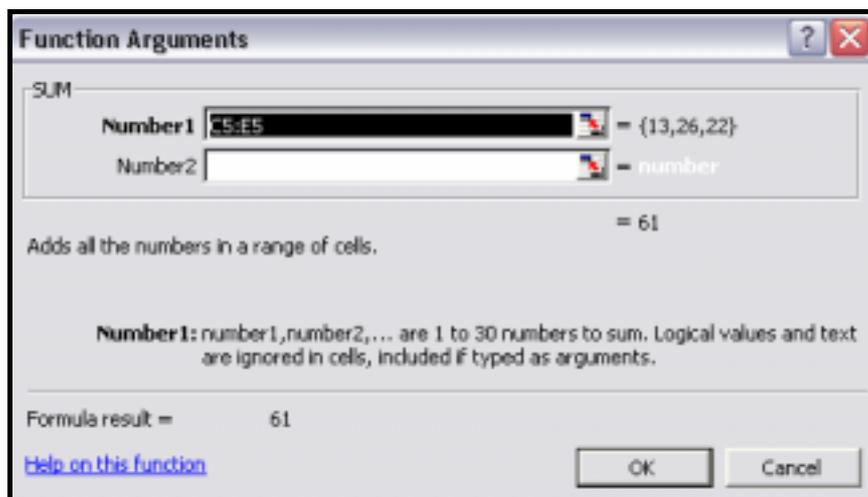

Figure 12   SUM Function Arguments Dialog Box

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Activity 4.3   Point to the bottom right corner of the cell, and when the cursor shape changes to a cross hair, drag the mouse down to cell F9. (An even quicker way to do this is to double-click the mouse when it is in this position.)

Activity 4.4   Repeat this process to enter the remaining data in column F.

2.3 Relative and Absolute Cell Addressing

In Task 3 we copied a formula to other cells, and the cell addresses that we used in the original formula were translated automatically to give the correct results. This is called relative cell addressing. Sometimes, however, this is not the way we want Excel to work. We may want some of the cells to remain static, or absolute, while others translate in the usual way. This task will illustrate the need for absolute cell addressing.

Task 5   Using Absolute Cell Addressing

Activity 5.1   Click on sheet 3 in cell I2. We wish to calculate the percentage that the sales figures in January contribute to the total sales for the first quarter. To do this, enter the formula as shown:

G	H	I
Month	**Sales**	**Percentage**
Jan	500	=H2/H5*100
Feb	550	
Mar	400	
Total	1450	

Figure 13   Percentage Calculation (Relative Cell Addressing)

Activity 5.2   Copy the formula down to cells I3 and I4 in the usual way. The result will be a series of error messages which warn of division by zero.

G	H	I
Month	**Sales**	**Percentage**
Jan	500	34.4827586
Feb	550	#DIV/0!
Mar	400	#DIV/0!
Total	1450	#DIV/0!

Figure 14   Error Messages

Activity 5.3   Click in the cell I3 to see the cause of the problem. The formula here is H3/H6*100. The cell address H5 has been translated, but H6 is an empty cell (treated as zero). This is not the calculation that we intended. Although the reference H2 should be relative, to work out the other percentages we must continue to use the divisor 1450 in H5. To make this cell address absolute it is necessary to write it as H5. Edit the formula in I2 to **=H2/H5*100** and copy the formula down. The answer will now be correct.

G	H	I
Month	**Sales**	**Percentage**
Jan	500	34.4827586
Feb	550	37.9310345
Mar	400	27.5862069
Total	1450	100

Figure 15   Correct Result

Activity 5.4   Return to sheet 1 and enter the formulae to calculate the totals including VAT.

Task 6 Statistical Functions

Activity 6.1 Click in cell C13 on sheet 3 and then click on the **Insert Function** button on the formula bar. From the dialog box select the category **Statistical**, click on the function **AVERAGE** and then click **<OK>**.
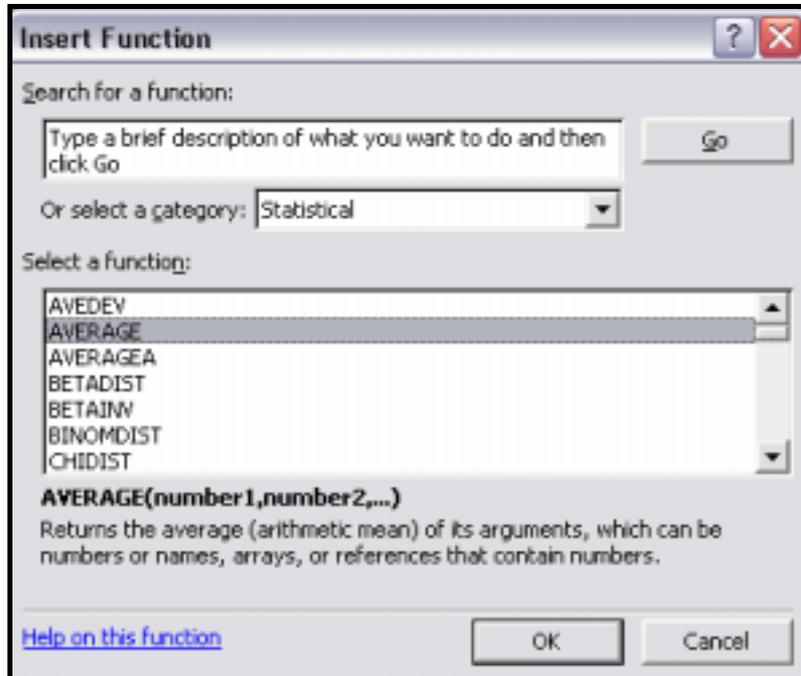

Figure 16 Insert Function (Statistical)

Activity 6.2 At the next dialog box, use the mouse to highlight the cells that contain the marks for maths and then click **<OK>**. The result will appear in C13.
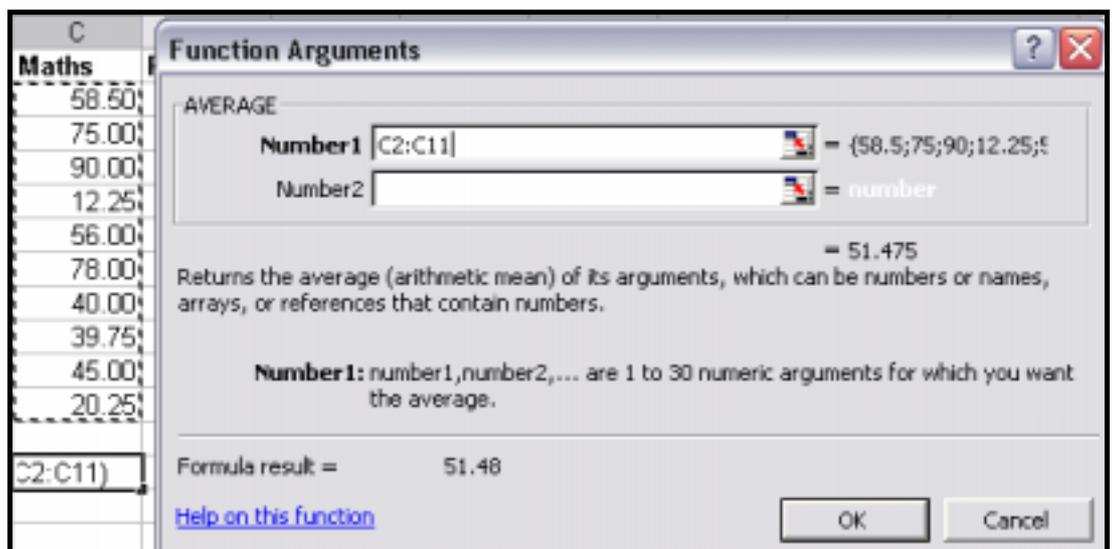

Figure 17 Completed Dialog Box

Activity 6.3   Copy the formula across to insert the average marks for physics and chemistry.

Activity 6.4   The range of marks is required for each subject. Excel does not have a RANGE function, so it will be necessary to calculate the maximum and minimum marks and then subtract one from the other to give the range. In the statistical category you will find functions called MAX and MIN. First enter the formulae to get these results for maths and then copy the formulae across to insert the results for the other two subjects. The results are shown below:

Average		51.48	57.35	59.48
Min		12.25	25.00	40.00
Max		90.00	92.00	70.00
Range		77.75	67.00	30.00

Figure 18   Exam Results

The formulae are shown below.

	A	B	C	D	E
1	Name	Initial	Maths	Physics	Chemistry
2	Smith	A	58.5	55	60
3	Jones	B	75	80.5	70
4	Webb	B	90	92	68
5	Grant	N	12.25	25	64.25
6	White	T	56	60.2	40
7	Mather	H	78	80	65
8	Mazey	W	40	45.25	60.5
9	Bowden	E	39.75	50	65
10	Weir	DR	45	50.5	62
11	Collier	C	20.25	35	40
12					
13	Average		=AVERAGE(C2:C11)	=AVERAGE(D2:D11)	=AVERAGE(E2:E11)
14	Min		=MIN(C2:C11)	=MIN(D2:D11)	=MIN(E2:E11)
15	Max		=MAX(C2:C11)	=MAX(D2:D11)	=MAX(E2:E11)
16	Range		=C15-C14	=D15-D14	=E15-E14

Figure 19   Formulae for Exam Results

Task 7   Ranges

It can be useful to give a name to an array of cells. Once this has been done, the name of the array can be used in the formula instead of the cell references.

Activity 7.1   On sheet 3, delete the average marks for the three subjects. We will now give names to the blocks of cells.

Activity 7.2   Highlight the cells for maths (C2:C11) and then from the menu select **Insert > Name > Define**. The dialog box that appears will show that Excel has assumed that you wish to name the range using the column heading. Since this assumption is correct, click on **<OK>**.
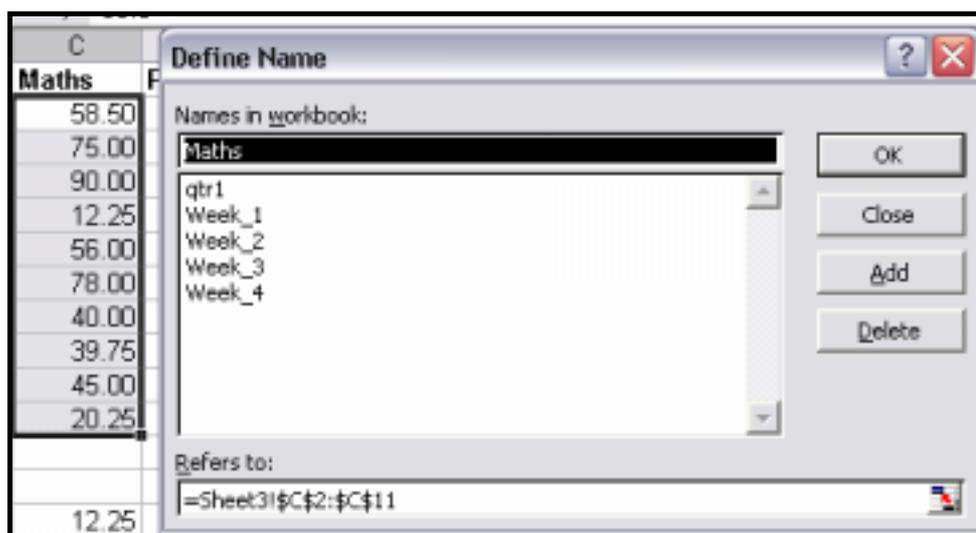

Figure 20   Define Name Dialog Box

Activity 7.3   Repeat this process to create names for the physics and chemistry results.

Activity 7.4   In cell C13 type the formula **= AVERAGE(maths)** and press **<Return>**. In D14 type the formula **= AVERAGE(physics)** and press **<Return>.** In E14 type the formula **= AVERAGE(chemistry)** and press **<Return>**. The results will be the same as the ones obtained earlier.

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Task 8   Using an Array Formula

Activity 8.1   On sheet 1, scroll down to the range A23:G27. This is a table identical to the three above, but this table will summarise the information from the other three tables. First give names to the ranges as follows:
Jan   C5:E9
Feb   C10:E14
Mar   C15:E19

Activity 8.2   An array formula is entered into one cell but displays its results in a range of cells. This range must be selected before the formula is entered. Select the range C23:E26 using the mouse. Note that the cell C23 is white on a black background because it is the active cell in selected range. Now type **=Jan+Feb+Mar**

Hold the **<Shift>** key and the **<Ctrl>** key down together, and press **<Enter>**. The highlighted range will fill with numbers. In the formula bar the formula should have curly brackets around it to indicate that it is an array formula.
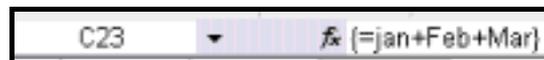
Figure 21   Array Formula

Move the active box around the range using the cursor keys. You will notice that the formula looks identical in every cell. In reality it is only stored in cell C23.

This formula has added the three ranges together cell by cell according to position. So, it has added:

C5+C10+C15 and displayed the result in C23
C6+C11+C16 and displayed the result in C24
D5+D10+D15 and displayed the result in D23

Note   Array formulae are necessary for certain functions that output a table of results. The advantages in using them for repetitive calculations in normal formulae are that they are quicker to type in, quicker to calculate and they take up less storage space.

Task 9   Finishing Excel

You should always quit any computer program when you have finished your session. Never switch off the computer without closing down Windows. Do not leave a computer whilst you are still logged on to it as others may use your account and could damage your files.

Activity 9.1   Select **File > Exit**. Excel will prompt you to save your document before it lets you quit. Click **<Yes>** to save the changes, **<No>** to quit without saving the changes, or **<Cancel>** to return to the spreadsheet.
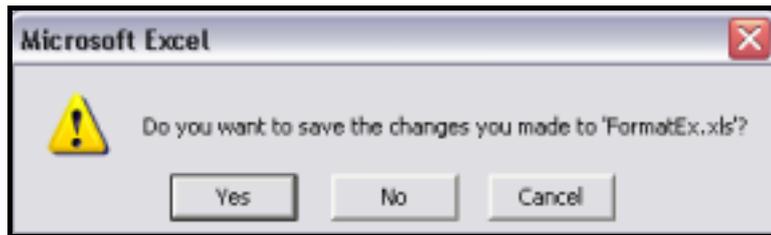

Figure 22   Quit Dialog Box

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