Just checking

1. How does the theory of persistence of vision relate to animation?
2. Name three pioneers of animation and their key inventions.
3. What is CGI and where is it used?
4. Name three adverts which have involved animation that you have seen within the last week.
5. What is tweening?
6. What is a frame and what is a key frame?
7. Name five tools you might find in the toolbox of an animation program.
8. What are the key differences between a bitmap and a vector?
9. What is storyboarding and why is it important?
10. Why are log sheets and bar sheets used?

edexcel

Assignment tips

- When you are designing and making your animations, you need to achieve a balance between creating something that looks interesting and retelling a well-told story. Think of computer games you may have played where the graphics were really good but the storyline was poor, or vice versa. A good animator considers both visuals and story.
- Always remember the audience when creating your animations. If you put text on the screen, make sure it is on long enough for the user to read it. Remember that you know what is happening but your audience will be seeing it for the first time. Do not rush your animation. Perhaps ask a friend to watch it and see if it runs at an appropriate speed.
- Be careful with your timescales and make sure your designs are achievable within the deadline you have been set.

Credit value: 10

42 Spreadsheet modelling 102

Spreadsheet modelling is essential for many businesses and organisations, as spreadsheets are used for many of their activities, such as credit control, sales forecasting and stock analysis.

Spreadsheet software can support organisations, helping them to keep track of numerical information and analyse it quickly and more easily than paper records. The inbuilt functionality helps users to understand the data without the need for specialist mathematical skills.

Utilities such as ordering, sorting and filtering will show the same data in different ways. Charts and graphs help to display information more visually. Complex calculations can be carried out using library functions or users can choose to create their own formulae.

Spreadsheets can be set up as reusable templates that produce immediate results when data is input, such as payroll or invoice templates. Spreadsheet software can be customised with buttons and macros. For example, features are available, that restrict user access to whole workbooks, spreadsheets or parts of spreadsheets.

As an IT practitioner, you need to be able both to use spreadsheet software competently and to support users as part of a technical or help desk role.

Learning outcomes

After completing this unit, you should:

1. understand how spreadsheets can be used to solve complex problems
2. be able to develop complex spreadsheet models
3. be able to automate and customise spreadsheet models
4. be able to test and document spreadsheet models.

Assessment and grading criteria

This table shows you what you must do in order to achieve a pass, merit or distinction grade, and where you can find activities in this book to help you.

To achieve a **pass** grade the evidence must show that you are able to:	To achieve a **merit** grade the evidence must show that, in addition to the pass criteria, you are able to:	To achieve a **distinction** grade the evidence must show that, in addition to the pass and merit criteria, you are able to:
P1 explain how spreadsheets can be used to solve complex problems **See Assessment activity 42.1, page 283**		D1 discuss how organisations can use interpretation methods to analyse data **See Assessment activity 42.1, page 283**
P2 develop a complex spreadsheet model to meet particular needs **See Assessment activity 42.2, page 299**	M1 refine a complex spreadsheet model by changing rules and values **See Assessment activity 42.2, page 299**	
P3 use formulae, features and functions to process information **See Assessment activity 42.2, page 299**		
P4 use appropriate tools to present data **See Assessment activity 42.2, page 299**	M2 analyse and interpret data from a spreadsheet model **See Assessment activity 42.2, page 299**	
P5 customise the spreadsheet model to meet a given requirement **See Assessment activity 42.3, page 306**		
P6 use automated features in the spreadsheet model to meet a given requirement **See Assessment activity 42.3, page 306**	M3 compare different automation methods **See Assessment activity 42.3, page 306**	
P7 test a spreadsheet model to ensure that it is fit for purpose **See Assessment activity 42.4, page 310**		D2 evaluate a spreadsheet model incorporating feedback from others and make recommendations for improvements **See Assessment activity 42.4, page 310**
P8 export the contents of the spreadsheet model to an alternative format **See Assessment activity 42.4, page 310**		
P9 produce user documentation for a spreadsheet model **See Assessment activity 42.4, page 310**	M4 produce technical documentation for a spreadsheet model **See Assessment activity 42.4, page 310**	

How you will be assessed

This unit will be assessed by a number of internal assignments that will be designed and marked by the staff at your centre. It may be subject to sampling by your centre's External Verifier as part of Edexcel's ongoing quality assurance procedures. The assignments will be designed to allow you to show your understanding of the unit outcomes. These relate to what you should be able to do after completing this unit.

Your tutor will tell you precisely what form your assessment will take, but it could be in the form of:

- output from practical exercises such as printouts of worksheets, charts and graphs
- test plans providing evidence of the testing you have carried out to check accuracy of calculations
- observation and witness statements, eg of your converting files from one format to another
- user documentation and technical documentation.

Kevin, BTEC National IT learner

I know how to use spreadsheets for simple tasks – like recording a measurement over a period of 30 days – and feel confident about getting the software to add up a column of numbers or produce a graph from the data.

I'm also happy with structuring a spreadsheet, including formatting certain cells, rows or columns to make the data more accessible, but I want to progress further.

In the past, the scenarios have been scaled down – Mickey Mouse situations – and not overly realistic. I'm looking forward to solving some real problems using real data and developing real spreadsheet models.

Also, up until now, I've never felt motivated to explore some of the complex facilities that spreadsheet software offers the user – like pivot tables – and this challenge excites me. I have dabbled with what-if scenarios but not really got the hang of them. I'm hoping I'll be able to crack this, this time around.

In particular, I'm looking forward to automating a spreadsheet – lots of buttons for the user to press – and getting to grips with macros and Visual Basic so I can show how good I am at using this type of software.

Over to you

- **How confident are you in using spreadsheet software?**
- **Have you ever tackled some of the more complicated aspects – like pivot tables or automating a spreadsheet?**
- **What is it that you are most looking forward to in this unit?**

1 Understand how spreadsheets can be used to solve complex problems

Start up

Where does the time go?

We have 24 hours in every day and seven days in a week, but where does the time go?

- Think about how you might use a spreadsheet to record how you spend your time each day for one week. Think about how you might want to enter starting and finishing times and how your spreadsheet will process that data so that total time spent on each activity can be calculated.
- Think also about what results you might want to see and how you might display these and design the spreadsheet model using appropriate column and row titles.
- Think about how you might extend this model so that you could compare your use of time with that of others in your group.
- Share your ideas with others in your group.

1.1 Uses of spreadsheets

Any problem involving a lot of calculations and analysis of numerical data is ideally suited to being modelled using spreadsheet software. So, it is commonplace for the accounting and finance departments of an organisation to use a series of worksheets within a spreadsheet file to record the transactions made by that organisation. In the past, you needed special training to understand the accounts. Nowadays, users can benefit from the inbuilt functionality of spreadsheet software – it helps them to understand the data without needing specialist mathematical skills. Data can also be presented in graphical form at the press of a button.

For most organisations, worksheets have replaced manual pages in ledgers, where income and expenditure were organised into rows and columns. The basic design of a worksheet echoes the two-dimensional table of rows and columns.

- The rows of a worksheet are numbered 1, 2, 3, ...
- The columns of a worksheet are lettered A, B, C, ...

Each cell has a cell reference based on its row number and column letter: A7, B2, etc. In its simplest form, each cell can then contain one of four types of data:

- text – including titles, headings and labels, as well as names, addresses and telephone numbers
- numeric data – any type of number – can be formatted as currency, percentage or date, for example
- **formulae** – involving single operators, relative cell references and simple **functions**
- left blank – useful for creating white space on a worksheet, which makes the rest of the data easier to read and understand.

Key terms

Formula – (plural 'formulae') an expression written in terms of cell references and operators, which specifies a calculation that is to be done. The result of the calculation appears in the cell in which the formula is stored.

Function – a command that results in a value being returned.

Range – defines a rectangular shape within a worksheet, for example the range A3:B7 includes columns A and B, and rows 3 to 7.

Having thought through how you want to design your spreadsheet model, so that you know what data you plan to put in and where, you can physically create the spreadsheet model using spreadsheet software. For each worksheet, this involves entering a title, column headings and row labels. You then enter text, numeric data and formulae, and format all these cells appropriately.

If the spreadsheet model does not quite fit the purpose intended, you may need to refine it.

- You can change the 'shape' – or design – of the spreadsheet by inserting or deleting rows and columns, or adding additional worksheets.
- You can change the values held within particular cells or the rules – the formulae that act on the data in those cells.

Did you know?

To change the contents of a cell, the cell has to be selected first to make it the active cell (as specified in the Name Box) before you can overwrite its contents. If you only want to make a minor change, you can do so in the Formula Bar.

Manipulating complex data

While spreadsheet software is perfect for simple calculations, taking the tedium of some tasks away, it is also an excellent tool for manipulating complex data.

- Additional worksheets may be created and links formed between them (see page 284).

Complex formulae (see page 285) can be set up to perform more sophisticated calculations that might be needed for a statistical analysis.

Presentation to requirements

The spreadsheet data will be visible on-screen, but may also be needed in hard copy form. With a worksheet, controlling the pagination is not as straightforward as in some other applications. If there are too many columns to fit across a single page, even in landscape orientation, your printout will present only a **range** of cells on each page, and it might prove difficult to see how it all fits together (see Figure 42.1).

Activity: Setting a print area

1. Use the Help feature to discover how to set the print area on a particular worksheet. Select a range of cells that you want to print and set the print area for these cells.
2. Use View / Page Break Review to see what the worksheet will look like, printed out with your current settings for page size, orientation and margins.
3. Experiment with changing column widths, orientation and margins to fit more (or less) onto any page.

Supporting decision making

Spreadsheet software offers functions that can be used to support decision making, providing timely and accurate information in a variety of situations.

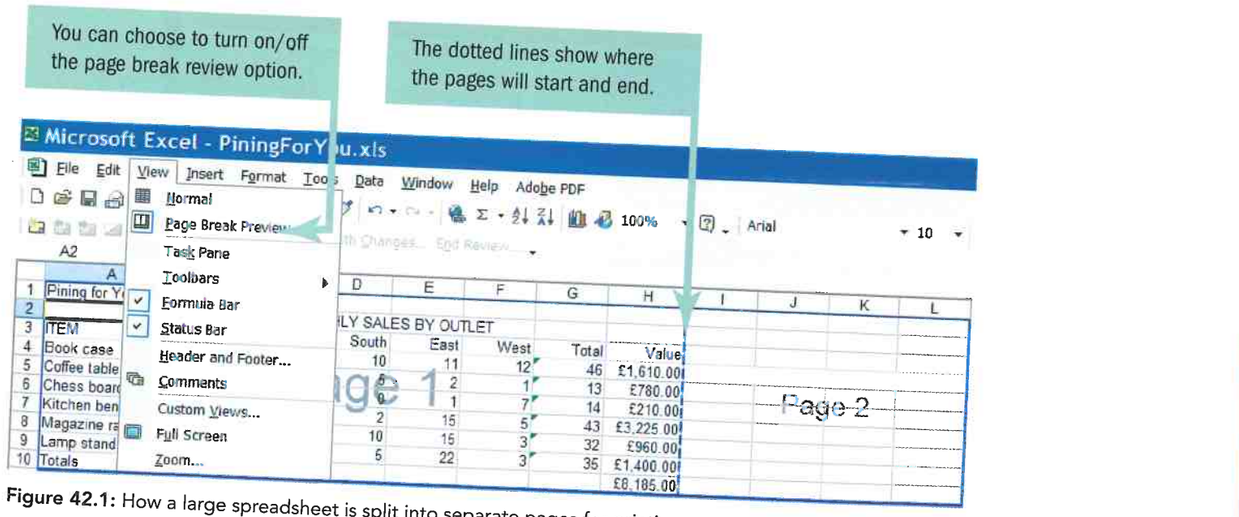


Figure 42.1: How a large spreadsheet is split into separate pages for printing

- **Analysis of data**: This is more easily achieved when data is summarised in some way or is presented graphically. This is especially true for large amounts of data when it is necessary to rely on **representative values** (like averages) and there is too much data to spot a trend among thousands of individual data results.
- **Goal seeking**: If you know the result that you want from a formula, but are not sure what input value the formula needs to get that result, using the Goal Seek feature does the job for you.
- **Scenarios**: If you create and save different groups of values as scenarios on a worksheet, you will then be able to switch between these scenarios to view the different results.
- **Regression**: This is a form of statistical analysis used for forecasting. It is time consuming to perform manually but easier if you use a spreadsheet to do all the calculations for you.
- **Data mining tools**: These help the user to derive patterns and trends that exist in complex data. For example, all credit card transactions are stored by the various credit card agencies and the data is analysed to spot possible fraudulent activity.

1.2 Complex problems

Essentially, spreadsheets are models that simulate a real-life situation. Spreadsheet models can be used to solve a number of problems, such as cash flow forecasting, budget control, sales forecasting, payroll projections, statistical analysis and trend analysis.

For example, in one spreadsheet model, the rows could be used to list the variables that relate to a situation, and the columns could reflect the passing of time (see Figure 42.2). The cells will be allocated to contain relevant data and to show the results of any calculations. Some values are fixed, whereas others will change. Some values will depend on other values within the spreadsheet.

The formulae that are used reflect current thinking on the 'rules' that apply in real life. For some formulae, there is no debate. For example, the cost of a product including VAT can be calculated with a degree of certainty. However, the effect on future sales of a price increase might be based on past experience but is, at best, an educated guess.

Having set up a model, it can then be used to simulate a situation and to forecast what might happen, given certain circumstances.

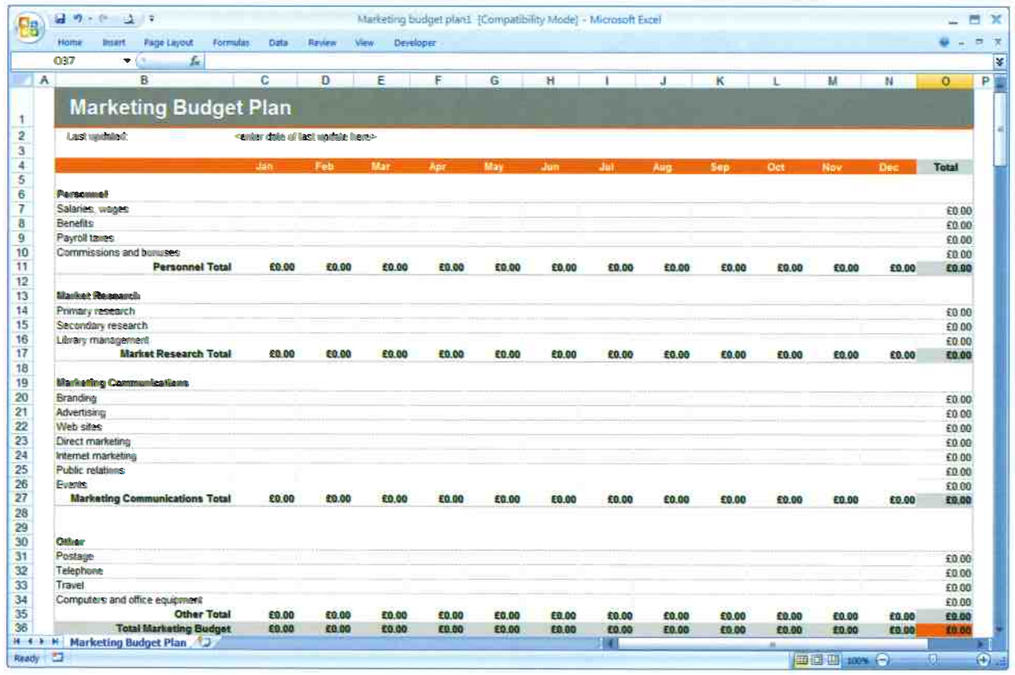


Figure 42.2: Marketing budget plan

Cash flow forecasting

Forecasting is inherently difficult. How can you possibly tell what is going to happen in the future? The answer is: you can't. But you can make an educated guess if you have sufficient information about how things have worked out in the past, and you have the tools to process this data. You can take measurements today and, if you have a formula that you think will work, you can calculate the values for tomorrow, the day after and so on. Then, as time passes, you can check the accuracy of your forecasts and amend your model – the formulae that you used – until they more accurately forecast the future.

A spreadsheet is particularly useful for forecasting because it will do all the calculations for you. Each new row (or column) can be used to represent the next day (or whatever time interval you choose for your model).

For cash flow forecasting, data that relates to past events will show what today's situation is: today's bank balance. This can be reconciled with bank statements and you can be sure it is accurate at a given date. Having sent out invoices, it would be reasonable to record these amounts as coming in against some future date. If known outgoings are also recorded – such as cheques already written but not yet showing on a bank statement, or regular payments that will happen at known times such as payroll payments or amounts due to the Inland Revenue or the VAT man – the net effect on today's balance can be projected forward. The cash flow forecast will then show on what date, for example, there won't be enough to meet an expense unless monies are received in good time from customers.

Accounts departments need cash flow forecasting data so that they can chase payments to avoid problems, and they may use this data to forestall outgoing payments if they know there is not enough money to honour a payment.

Budget control

Spending can't just happen; there ought to be plans made so that the expected revenue for a company can be used to fund all outgoings and still leave an amount – profit – with which to reward shareholders. Agreeing a budget together with targets for the sales force will provide a framework – a business plan – which can be checked before costs are incurred which might lead to bankruptcy.

If the budget is put into a spreadsheet, actual income and expenditure can be entered too, with any discrepancies being identified as soon as they happen. This knowledge of what is actually happening – against budget – provides budget control.

When a new year starts, the data from last year can also be used to inform the decision makers as to what can be achieved and where they perhaps ought to make changes.

What-if scenarios

A simple what-if might involve only changing one variable and seeing what happens to one other value in the spreadsheet. However, the more complex a scenario is the more realistic the model and the more useful the answer. Goal-seeking tools and scenario tools (page 280) make the more complex **what-if questions** easier to answer.

The underlying power of spreadsheet software lies in the facility to recalculate the contents of cells that hold formulae and to display the revised contents almost instantly. This means that you can answer what-if questions using a spreadsheet model.

Key terms

Representative values – single values that represent many items of data. They include mean, mode and median, as well as other statistical values.

Goal seeking – working from a known numerical goal back to whatever data entries are needed to achieve that goal.

Scenario – a set of values that you can substitute automatically on your worksheet.

Regression – type of analysis that estimates the relationship between variables so that a given variable can be predicted from one or more other variables.

Data mining tools – tools that involve the automatic collection of large amounts of data and then analysing the data for trends and patterns.

What-if questions – situations where the result depends on a number of input variables and you want to know the effect on the result if you were to change one or more of the input variables.

How to... Answer a what-if question

1. Set up the data in a spreadsheet to create a model of some real-life situation.
2. Identify the result cells, ie the cells that hold the data you are trying to maximise or minimise or that indicate you have met some criteria.
3. Identify the input data, ie the cells that hold data you might change.
4. Change the input data in some way and note any changes in the displayed output of the result cells.
5. If the new value made the situation better, can you make it better still? If it made it worse, undo the change and consider changing the data in the other direction.
6. Repeat steps 3-5 until you are as close to a solution as you want to be.

Sales forecasting

Sales forecasting goes hand in glove with budget control and cash flow forecasting and is an essential tool for all commercial organisations.

Sales forces need to be motivated and the management need to know what they can afford to give by way of salary and commission to reflect the revenue a salesperson brings to the organisation.

Sales projections also impact on production. If the sales force plans to sell one million new mobile phones, can production turn them out fast enough to meet this demand?

Payroll projections

The cost of a workforce is often the largest bill an organisation has to face. This cost will drop if employees resign, and rise if new staff are recruited. As employees progress they expect salary increases, either just by moving up a scale or through some promotion. As well as the salary paid to the employee, there are amounts to be paid to the Inland Revenue for National Insurance contributions and amounts to be set aside for pension provision.

Since these costs play a major role in the overall budget, projecting what the payroll bill will be in three months or six months or next year is important. Spreadsheets can be used to good effect for this forecasting task.

Statistical analysis

To make sense of a lot of numeric data, statistical analysis can provide insights into trends and arrive at representative values of the data.

To design spreadsheet models for statistical analysis requires considerable knowledge of statistics, and the formulae can be complex. However, using them, once the model has been set up, should be easy if the user interface has been well designed.

Trend analysis

If measuring some variable on a daily basis, such as your weight, there are bound to be variations, and it may be difficult to spot whether the overall trend is up or down. The same goes for numerical data such as the value of stocks and shares, and the various indices that the government uses to measure the economy.

What does help is to step back to look for a trend in the data. Spreadsheet software, as will be seen in Section 1.3 (page 283) is perfect for trend analysis.

Activity: What if?

1. The Social Committee of the Ria View Theatre Club are making plans for their Christmas party. There are known overheads of £50 for publicity, £125 for hall hire, £450 for the band. Set up a what-if scenario to work out the break-even point for this event if the tickets are priced at £7.50. How many tickets have to be sold to break even? If the tickets are £10 each, how many fewer tickets have to be sold to break even on the event?
2. The Committee want to know what is the lowest break-even price they should charge if they expect to sell 75 tickets. Use goal-seeking tools to find the answer to their question. And find out what profit they'd make if 100 tickets were sold.
3. The Committee are also thinking ahead to next year's event and may want to change the venue (resulting in the price being something between £100 and £200) and the band (costing between £250 and £500). If they fix the ticket price at £10, what effect does this have on potential profits?

1.3 Interpretation

Once all the data is in your spreadsheet, how can you interpret it? Two interpretation methods are discussed here – comparison of totals and trend analysis – but what other ways might you use?

Comparisons of totals

To compare totals, you must first calculate them.

- The SUM function will add the values in consecutive cells of a row or column.
- The SUMIF function could be used to include in the total only those values that meet some criteria.

You can then see which is the highest total and which is the lowest total.

- The MAX function returns the maximum value in a range of cells.
- The MIN function returns the minimum function.

You could work out the difference between the highest and lowest values, which might give a measure of range.

- The formula =MAX(A1:A10)-MIN(A1:A10) will return the range (difference between the lowest and highest values).

Activity: LARGE and SMALL

1. Find out what the LARGE and SMALL functions do.
2. Investigate some other functions. Choose ones that you have never used before.

Trend analysis

Some variables change over time and it helps to see what the trend is. It's not important whether the values go up and down on a day-to-day basis. What's the trend (say) over a week, over a month or over the years?

The easiest way of illustrating a trend is to turn the data into a chart or graph (see page 303) and the most appropriate is a line graph, with the variable on the vertical axis and time on the horizontal axis.

Activity: Reading a trend graph

Using a set of data supplied by your tutor, generate a trend graph and make statements about what you read from the graph.

Assessment activity 42.1 P1 D1 BTEC

The Ria View Theatre Club organises 30-40 theatre trips per year for their 200+ members.

Subscriptions are paid annually and this income is expected to cover the cost of all expenses such as production of the programme which is mailed out every 2-3 months and postage.

For each event, the costs to the club are the ticket price to be paid to the theatre plus the coach hire. The theatre charges a set amount times the number of seats booked less maybe some discount if more than 20 seats are booked. Coaches are available with 20, 29 or 49 seats and are priced according to the size of the coach and the destination. Before each programme of forthcoming events can be published, the club has to set a price for the trip, low enough so as to encourage as many members as possible to book for an event and yet not so low as to make a huge loss. There is no need to make a profit on each event but the club cannot afford to make a loss over any three-month period.

The Treasurer of the Ria View Theatre Club has asked you:

1. to provide information as to how a spreadsheet could be used to solve complex problems such as setting the trip price **P1**
2. how tools to analyse data might be employed to provide summary information to members at the Annual General Meeting of members of the Ria View Theatre Club. **D1**

Grading tips

- Assume that the Treasurer is competent in using spreadsheets for normal calculations and purposes but has never set up a spreadsheet with more than one worksheet and has no experience of using more complex functions. **P1**
- Include examples of how the Treasurer might model the finances of the Ria View Theatre Club, how the data might be interpreted and how the summary information might be presented to members. **D1**

PLTS

Looking at how the Ria View Theatre Club could analyse their data best will show that you are an **effective participator**.

Functional skills

Depending on how you present the information to the Treasurer, you may use your **ICT** or **English** writing skills.

2 Be able to develop complex spreadsheet models

A complex problem tends to need a complex model to hold all the necessary data and provide the analysis that the problem requires before a solution can be found.

2.1 Complexity

Complexity in a spreadsheet model can arise from a combination of factors: multiple pages, complex formulae, large data sets and cell linkage between worksheets.

Making life simple for the user also requires a more complex spreadsheet model design: data entry forms, data validation and error trapping, using lookup tables and nested IF functions, designing templates and setting up cell protection.

Multiple worksheets (with links)

Rather than having a single worksheet, you may design a spreadsheet model to have several separate worksheets and there are a number of benefits of linked worksheets.

- You can streamline the development of large, complex models by breaking them down into a series of interdependent workbooks. You can then work on the model without opening all of the related sheets. Smaller workbooks are easier to change, they don't require as much memory and they are faster to open, save and calculate.
- You can link workbooks from several users or departments and then integrate relevant data into a summary workbook. When any of the data in the source workbooks is changed, the summary workbook changes automatically.
- You can enter all the data into one or more source workbooks and then create different views of this data by setting up a report workbook that contains links to only the relevant data. For security purposes, you may restrict access to the source data but provide open access to the reports for those who need to see this information.

So, depending on the purpose of your model, you may have one worksheet per month, one per employee or one per event. The first worksheet may summarise the data held in subsequent worksheets and that's where the answer to the problem may be displayed.

Case study: Knits4U (1)

Knits4U use different worksheets, within the same spreadsheet file, to hold data on their stock and their customers. Figure 42.3 shows the worksheet tabs with appropriate names.

List the worksheets the Ria View Theatre Club might need in their spreadsheet model. What names might they choose for their worksheet tabs?

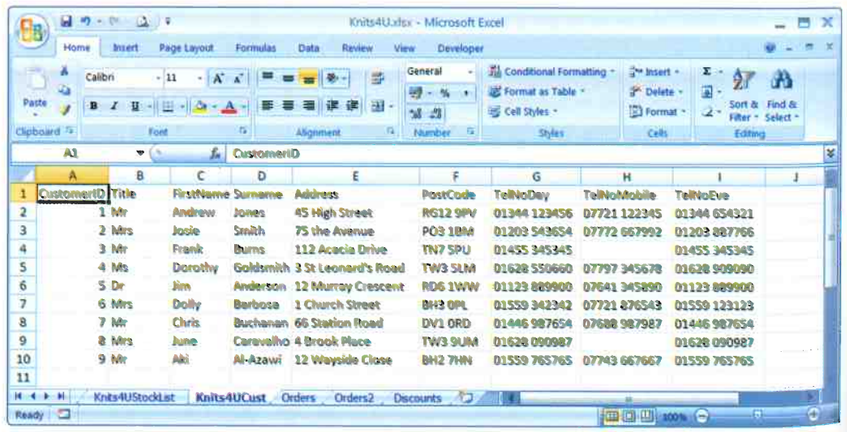


Figure 42.3: Named worksheet tabs

Each worksheet appears as a separate tab on the screen and the tabs can be labelled so you know what data is to be found where.

Labelling the worksheets in this way – and choosing sensible names – becomes more important when you need to use data from one worksheet in a formula on another worksheet. This is called cell linkage (see below).

Complex formulae

Formulae (see page 278) are the 'equations' that perform calculations on values in your worksheet.

- A formula can be as simple as `=A5*17.5` or `=SUM(A1:A20)` and involve only one operation (*) or function (SUM).
- A formula can be as complex as `=(-B7-SQRT(B7*B7-4*A7*C7))/(2*A7)` which provides one of the roots of a quadratic equation with relevant values in A7, B7 and C7.

For the purposes of this unit, just two or more steps in a formula make it complex.

Case study: Knits4U (2)

Knits4U use complex formulae within their spreadsheet file. Figure 42.4 shows one example which calculates the price excluding VAT.

Give two examples of complex formulae that might be found in Ria View Theatre Club's spreadsheet model.

Large data sets

Processing a large data set might involve using a number of large and cumbersome worksheets. The reader will need help in interpreting this data.

- Using named ranges (page 295) within worksheets is one way of making formulae that rely on large amounts of data easier to understand.
- Summarising the data (page 300) and presenting the summary information on a single overview worksheet will help the reader to see the data more clearly.
- A summary could be in the form of a single representative value or graphical representation of the data (page 303).

Cell linkage

When data for a single spreadsheet model is held in a number of worksheets, it's inevitable that a formula in one worksheet will require data from a cell, or range of cells, in another worksheet.

Fortunately, there is a facility to link cells between worksheets which allows the user to create such complex formulae. Within the formula, a name preceded by an exclamation mark (!) indicates that the row and column numbers are on that (named) worksheet rather than within the worksheet where the formula is to be found.

Changes on one worksheet can then have an effect on the data on another worksheet, if the relevant cells are linked.

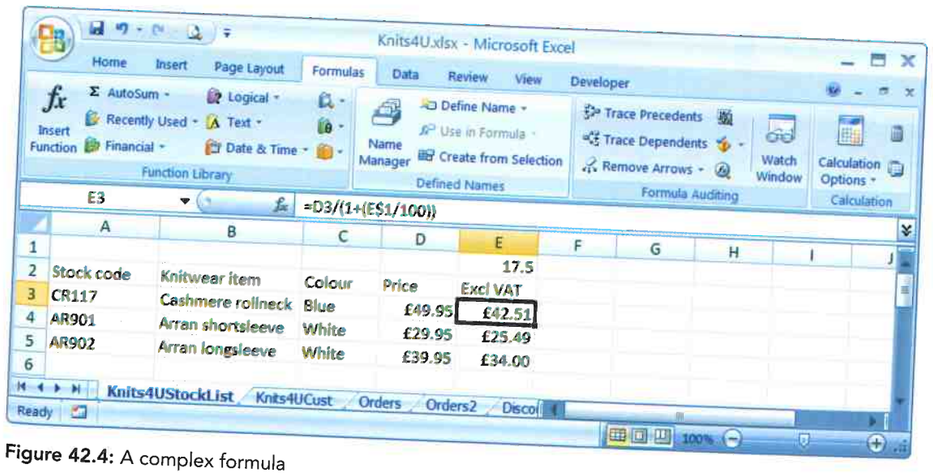


Figure 42.4: A complex formula

Did you know?

If you don't name your worksheet tabs, the formula will refer to the sheet by number: Sheet1 or Sheet2 say. It's far more user friendly to name the worksheets (see page 284).

Did you know?

The formulae with links to other workbooks are displayed in two ways, depending on whether the source workbook (the workbook that supplies data to a formula) is open or closed.

- When the source is open, the link will appear as, eg

  `=SUM([Turnover.xls]Annual!C12:C23)`

- When the source is not open, the link includes the entire path, eg

  `=SUM('C:\Accounts\[Turnover.xls]Annual'!C12:C23)`

Excel® provides options for controlling the updating of the links. All linked objects are updated automatically every time you open a file and at any time that the original data file changes while your file is open. When you open a workbook, a start-up prompt automatically asks if you want to update the links – it makes sense to do so at this time. You can also manually update the links if you wish.

Case study: Knits4U (3)

Knits4U use formulae which link cells between worksheets in their spreadsheet file. Figure 42.5 shows one example.

Look at your list of worksheets the Ria View Theatre Club might need in their spreadsheet model. How might these worksheets be linked?

Data entry forms

Spreadsheets can be used to record historical data but they become far more useful if they can be programmed to accept current data and to show the effect of inputting this new data.

Data entry forms may be designed as part of a user-friendly interface, providing a safe way for users to input such data to the model without risk to the design. They can include **form controls** such as **list boxes** and **drop-down menus** which force users to enter valid data.

In Excel®, the controls you need to create your own form are available on the Developer tab (see Figure 42.6).

The first forms that you might design are those which will serve as a **menu system** for the user.

A complex spreadsheet model can be set up to allow a number of tasks to be performed such as 'add new stock item', 'delete stock item', 'record stock order', 'record delivery of stock', 'record sale of stock' and so on. When a user opens the spreadsheet application, being presented with the various choices – in the form of a menu – serves to guide the user to the appropriate data within the spreadsheet. From

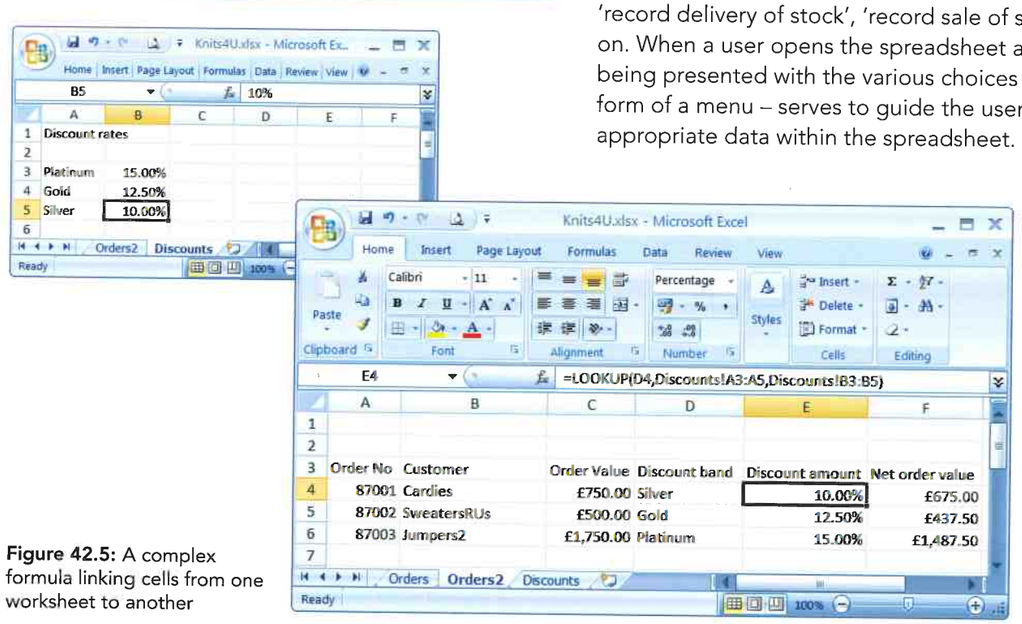


Figure 42.5: A complex formula linking cells from one worksheet to another

one STOCK menu (offering SALES, PURCHASES, REPORTS and EXIT), a user may then be presented with a second menu within the menu system with more choices to make, such as which REPORT is wanted today.

Controls can also respond to events, such as mouse clicks, by running **VBA** code (see page 306).

Key terms

Form controls – the original controls (label, group box, button, check box, option button, list box, combo box, scroll bar, spin button) that were provided with early versions of Excel ®.For more recently introduced controls, see ActiveX® Controls on page 306.

List box – displays one or more items of text from which a user can choose. The user might highlight the item or click on a radio button to indicate a choice.

Drop-down menu – for a particular data entry field, a list of valid entries that is compiled from cells elsewhere in the workbook, used to make data entry easier, or to limit entries to certain items that you define.

Menu system – a user interface device that presents the user with a window of buttons, each one leading – via a mouse click – to another lower level menu or the data required.

VBA – stands for Visual Basic for Applications. It is a macro-language version of Microsoft® Visual Basic used to program Microsoft® Windows®-based applications.

Did you know?

A combo box is like a list box except the user has to click on a down arrow to reveal the list of options. It's therefore more compact on the screen.

Activity: The Developer tab

1. Check that you know how to reveal the Developer tab within Excel®.
2. Explore the form controls (label, group box, button, check box, option button, list box, combo box, scroll bar, spin button) and create one or more sample forms to illustrate each example of form control.
3. Create a menu system for Ria View Theatre Club with options such as create a new venue, add a new event at a venue, book a coach for an event, take a booking for an event.

Data validation

It is important that the data that goes into a worksheet is accurate. Otherwise, the information gleaned from that worksheet is compromised.

Data validation begins when you first design your spreadsheet model and decide what data goes where, in which cell and on which worksheet. Excel® provides a wide range of validation options that can be applied to a cell or range of cells. You may:

- set upper and lower limits for numeric data entries (eg a month number must be between 1 and 12)
- compare the entry against items in a list (eg to make sure there is a stock item with that particular code)
- specify a time range and/or a date range (eg to make sure that the age of a person is within a sensible range)

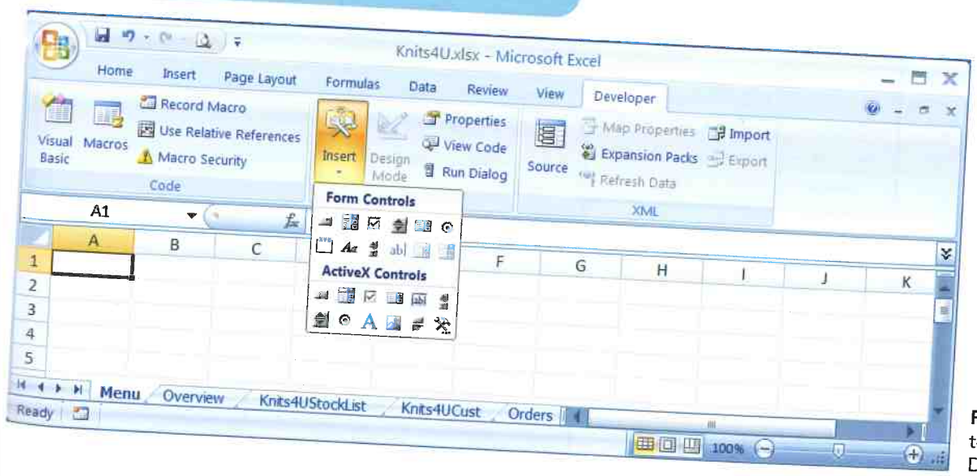


Figure 42.6: Forms toolbar from the Developer tab

- limit the number of characters accepted in a text string to prevent strings that are too long ruining a layout elsewhere on your spreadsheet
- calculate what is allowed, according to the contents of another cell – for example, if the cell contains an amount of credit available, then a loan for anything higher than that should be rejected
- use a formula to calculate what is allowed – in the Formula box (see Figure 42.7), the formula will have a `TRUE` (valid) or `FALSE` (invalid) value according to the data that is entered.

For some data, it may be necessary to insist that an entry is made before the entire form is accepted. For example, if an entry is zero, you may insist that the user enters the number 0, rather than just leave the entry blank.

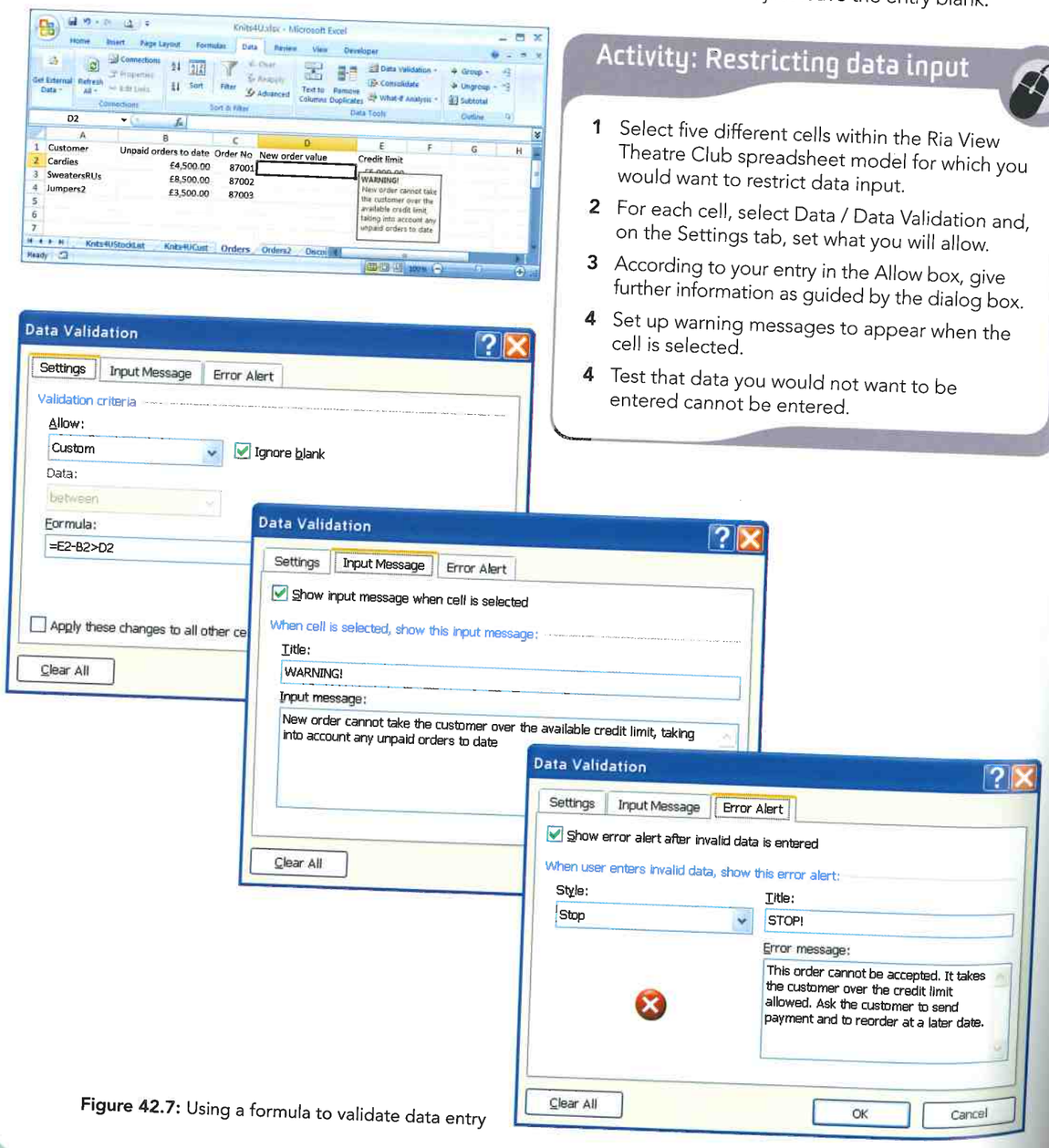


Figure 42.7: Using a formula to validate data entry

Activity: Restricting data input

1. Select five different cells within the Ria View Theatre Club spreadsheet model for which you would want to restrict data input.
2. For each cell, select Data / Data Validation and, on the Settings tab, set what you will allow.
3. According to your entry in the Allow box, give further information as guided by the dialog box.
4. Set up warning messages to appear when the cell is selected.
4. Test that data you would not want to be entered cannot be entered.

Error trapping

If you are using data entry forms, the design of the form – the order of fields to be completed – will guide the user through the correct order of entry but you may also need to provide prompts to remind the user what is expected. If a mistake is made – data which is considered to be invalid is input – it needs to be trapped and an error message displayed, explaining what is wrong and giving guidance so that the user might retry and enter the correct data.

Activity: Data validation and error

1. Select five different fields within the Ria View Theatre Club spreadsheet model that would give rise to a range of types of validation. Define the data validation that you would impose on data entry.
2. For each of the five fields, decide what warning and error message you would display if invalid data had been entered.

Lookup tables

A table can be used to store a range of values that apply according to some specified criteria. Rather than embed this data within formulae, the criteria and their matching values can be stored in a lookup table and then referred to using LOOKUP functions.

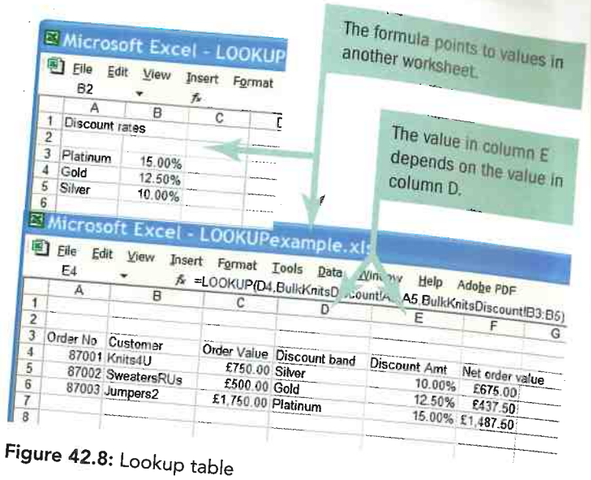


Figure 42.8: Lookup table

Case study: Knits4U (4)

Knits4U have differing discount rates according to the volume of business a customer places with them: Silver, Gold or Platinum. At a given time, these translate into percentages, eg 10%, 12.5% and 15% (see Figure 42.8).

Identify an application for lookup tables within the Ria View Theatre Club spreadsheet model. [Hint: consider their transport options.]

If, at a later date, the values need to be changed, they only need changing in the lookup table, not everywhere they are mentioned within a table. So, Knits4U can increase or decrease individual percentage discounts applicable to particular bands of customers.

Nested IF functions

An IF function sets a criterion (a condition being TRUE or FALSE) and, depending on the outcome (TRUE or FALSE), one of two values are returned. More complex problems can require nested IF functions, one within another, so that there are a greater number of values, any one of which might be returned.

The syntax for nesting the IF function is:

IF(condition1, value_if_true1, IF(condition2, value_if_true2, value_if_false2))

This would be equivalent to the following IF THEN ELSE statement:

IF condition1 THEN value_if_true1
ELSEIF condition2 THEN value_if_true2
ELSE value_if_false2
END IF

In this example there are three possible values: value_if_true1, value_if_true2 and value_if_false2. Note that the second and third options only apply if condition1 is FALSE.

Templates

Templates can be set up in many applications, and spreadsheet software is no exception. The benefits are the same: a model that you know works that you can apply to a new situation and time saved in laying out worksheets and setting up formulae.

Cell protection

Cells can be protected, either by hiding them from view or by locking them (see page 304) so that the user cannot gain access to them.

Activity: Spreadsheet complexity

1 Identify which of the complex features you might need to develop for the Ria View Theatre Club spreadsheet model. Make notes on where they might best be utilised.

2 Check that you are familiar with the processes involved, eg hiding cells or locking them, setting up a template or writing nested IF statements.

3 Prepare sample worksheets to demonstrate how these complex features work.

2.2 Formulae

The main benefit of a spreadsheet is that the software can do the calculations for you. Formulae are the 'equations' that perform calculations on values in your worksheet.

A formula starts with an equals sign (=) and is followed by the expression that describes the calculation you want to perform. Within the expression, you can use:

- numerical values, including decimal numbers with a decimal point and negative values indicated by a minus sign
- operators, + for addition, – for subtraction, * for multiplication and / for division, and logical operators (see page 291) such as AND, OR and NOT
- brackets, to indicate the order in which you want the calculation to be done – otherwise the evaluation is performed in accordance with the **BODMAS** principle
- functions such as SUM and logical functions such as SUMIF (page 292)
- cell references, relative and absolute as described next, to indicate what data, located in other cells, is to be used in the calculation for this cell.

Relative references and absolute references

When setting up a formula that includes a reference to another cell, you have two options: **relative** or **absolute cell referencing**. By default, new formulae use relative references.

Key terms

BODMAS – order of execution of evaluation: brackets, order (that means powers!), division and multiplication (working left to right) and addition and subtraction (working left to right).

Relative cell referencing – allows you to copy a formula across rows (or down columns) with any cell reference in the formula being changed automatically, relative to its original position.

Absolute cell referencing – allows you to copy or move a formula without the cell reference changing. By inserting a dollar symbol ($) before the letter and/or number of a cell reference you can make all or part of a cell reference absolute.

Case study: Knits4U (5)

Knits4U sells high-quality knitwear. Tourists may buy the jumpers without paying the VAT, provided the purchase is for export.

A stock list shows the price without VAT and, in a separate column, the price including VAT. The VAT rate is currently 17.5% but may change, and so absolute addressing (see Figure 42.9) is used for the VAT rate, rather than embedding the value in the formulae.

1 Experiment with the inclusion of the dollar symbol to check how necessary each one is, according to whether you replicate across rows or across columns.

2 Identify situations where you might need to use absolute addressing in the Ria View Theatre Club spreadsheet model.

If you don't use named ranges (page 295), the formula in cell E3 has to include absolute.

The dollar symbol before the row number means that the row number for E1 will remain the same when E2 is copied to E3 and E4, and so on. The reference to D3 will change relative to the row. So the formula in E4 is =+D4/(1+(E$1/100)).

Figure 42.9: Absolute addressing

Logical functions

A **function** is not the same as a formula; but it forms an important part of the formula.

Let's start with operators first which form the 'glue' in an expression, another building block of a formula.

- The usual **mathematical operators** (+, –, *, /) and many others, such as the percent sign (%) and the caret (^) for exponentiation, can be used within any expression for a formula to perform an arithmetical calculation.
- For decision-making purposes, there are also three **logical operators** AND, OR, NOT (see Table 42.1) and, instead of writing the operator between two expressions (such as A4+B7 or H9*17.5), the **arguments** appear within rounded brackets after the logical operator – and there can also be more than two of them. Notice also that, within the definitions for a function, triangular brackets (<>) are used to indicate the arguments of the function.

Key terms

Function – a command that results in a value being returned, such as SUM.

Mathematical operators – return the result of the calculation, eg 3+4 returns 7, 3*4 returns 12.

Logical operators – return a value of True or False, depending on the logical values in the argument.

Argument – a value or expression used within a function. It specifies what data is to be acted upon, the criteria that are to be applied or the resulting value that is required.

Logical functions – functions that return a value of True or False, depending on the conditions that you set up.

Logical operator	What it does	Syntax	Notes
AND	Returns TRUE if all arguments are TRUE. Returns FALSE if one or more argument is FALSE.	`AND(<logical1>,<logical2>,...)`	
OR	Returns TRUE if any argument is TRUE. Returns FALSE if all arguments are FALSE.	`OR(<logical1>,<logical2>,...)`	You can use an OR array formula to see if a value occurs in an array. (To enter an array formula, press CTRL+SHIFT+ENTER.)
NOT	Reverses the value of the argument.	`NOT(<logical>)`	If logical is FALSE, NOT returns TRUE; if logical is TRUE, NOT returns FALSE. NOT can be used when you want to make sure a value is not equal to one particular value.

Table 42.1: Logical operators

For the logical operators, the arguments should evaluate to logical values such as `TRUE` or `FALSE`, or the arguments could be arrays or references that contain logical values. If the array or reference argument contains text or empty cells, those values are ignored. If the specified range contains no logical values, the operator returns the error value: `#VALUE!`

Now, having covered operators in full – back to functions. We have straightforward functions like COUNT, SUM and AVERAGE (Table 42.2) and there are several options as to what you might use for the arguments:

- cell references (such as A5 and Overview!B7 or a named range)
- numbers
- strings
- expressions.

For example: `COUNT(40,60,70)` or `SUM(A1:A7)`

However, as well as the straightforward functions, you can incorporate logical functions (see Table 42.3) into expressions for your formula.

Function	Description
COUNT(<value1>, <value2>, ...)	Counts the number of cells that contain the value(s) listed
SUM(<cellref1>:<cellref2>)	Adds up the cells within the stated range
AVERAGE(<cellref1>,<cellref2>, ...)	Adds up the contents of the cells and divides by the number of cells listed

Table 42.2: Functions

Logical function	What it does	Syntax
IF	Checks the condition of the logical test and returns one of the two values accordingly.	`IF (<logical_test>,<value_if_true>,<value_if_ false>)`
SUMIF	Tests the cells in cellrange1 against the criteria, and sums the corresponding cells within cellrange2.	`SUMIF(<cellrange1>, "<criteria>",<cellrange2>)`

IS	Checks the type of value and returns TRUE or FALSE, depending on the outcome. For example, the ISBLANK function returns the logical value TRUE if value is a reference to an empty cell; otherwise it returns FALSE.	`ISBLANK(<value>)`
		`ISERR(<value>)`
		`ISERROR(<value>)`
		`ISLOGICAL(<value>)`
		`ISNA(<value>)`
		`ISNONTEXT(<value>)`
		`ISNUMBER(<value>)`
		`ISREF(<value>)`
		`ISTEXT(<value>)`

Table 42.3: Logical functions

Correct operators

The different sets of operators can only be used with the appropriate functions and cell references. What can be used is defined by the syntax of expressions and formulae and if you make a mistake the formula will be rejected when you try to enter it.

Activity: Logical operators and functions

1 Experiment with logical operators and logical functions. Check that you understand the results that you are getting from your formulae.

2 Review your Ria View spreadsheet model. Where have you used formulae? Have you used logical operators and logical functions? Extend your model to include more complex formulae.

2.3 Structure and fitness for purpose

A worksheet is essentially a set of cells arranged in rows and columns but, within that format, you can create a structure. You can also set up a number of worksheets and link these.

To make it crystal clear what the data in your spreadsheet represents, you should include a title (to describe the whole spreadsheet and individual worksheets), column headings (to describe the data in each column) and row labels (to describe the data in each row).

Your overall aim should be to create an organised spreadsheet that is fit for purpose. This means, for example, making sure the size of font is legible enough for the intended audience, and that the layout of the data is as straightforward as possible.

Formatting

Each cell in your spreadsheet needs to be formatted and the format that you apply should depend on the contents – the type of data the cell holds (see Figure 42.10).

- For cells that contain numeric data, you need to specify the type of number: integer (ie whole number), the number of decimal places, percentage, currency or date/time.
- For cells that contain text, you can set the font, style, size and alignment. You should aim for consistency, using a minimal number of different fonts and sparing use of colour and shading, italics and bold.
- For cells that contain a formula, the format will depend on the type of data that the formula creates – for formulae that display a number, you can set the format of the cell as for numeric data; for formulae that display text, you can set the format of the cell as for text data.

Styling

To make the title, column headings and row labels stand out, it is a good idea to style them differently. For example, to draw attention to the data in particular cells and to create interest in your layouts, you can use colour for the font and/or background shading. You

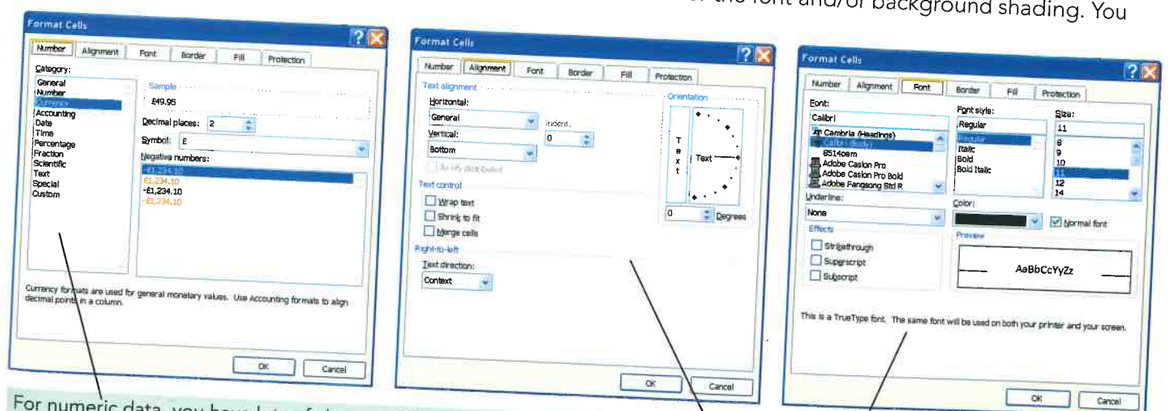


Figure 42.10: Formatting options

might also outline a cell or range of cells – a border draws the eye to the cells and creates a focal point of the screen (see Figure 42.11). Similarly, shading can be used to make some cells (such as headings) stand out.

Column alignment is also important.

- Text is usually aligned left, but might be centred if the text is a column heading or even right-aligned, as the title in Column E of the Knits4UStockList worksheet (see Figure 42.11).
- Numbers, including currency and percentages, are usually aligned on the decimal point, or where it would be if one were displayed.
- Dates could be left, right or centre-aligned.

The most important consideration when styling is to be consistent. If you use bold and centred for your column headings, make sure all column headings are bold and centred. Inconsistent styling results in a messy-looking spreadsheet display.

Activity: Formatting and styling

Consider what formatting and styling would be appropriate for the Ria View Theatre Club spreadsheet model. Produce some sample worksheets to demonstrate the formatting and styling that you would employ.

Context

A spreadsheet that is just rows and rows of numbers will not be fit for purpose if the reader cannot work out the context of the data. Appropriate column headings and row titles will assist the reader but each worksheet should also have an informative heading and the tabs should be renamed so that it is clear what data is stored on that particular worksheet.

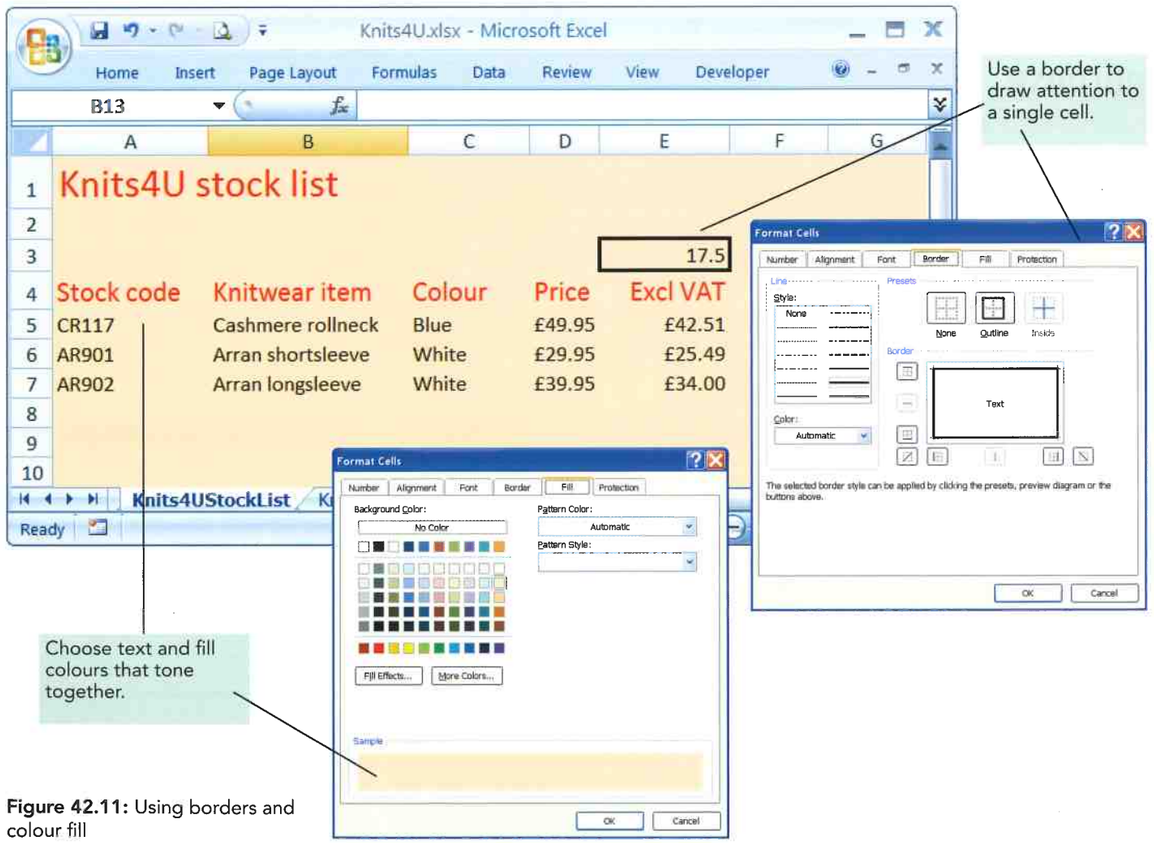


Figure 42.11: Using borders and colour fill

2.4 Features and functions

The more complex a spreadsheet becomes, the more likely it is that more than one user will need to have access to it – during development and/or during use. This section focuses on a range of features and functions that will be of particular use if more than one user is involved in the creation and/or editing of a workbook.

Named ranges

Each cell can be referred to by its column letter and row number, eg A7 or B9. A range of cells can also be referred to by the cell references, separated by a colon, eg A3:B7.

Cell references are fine and work well enough but named ranges provide a more meaningful way of referring to cells and ranges of cells within formulae (see Figure 42.12). You can even name non-adjacent cells as a named range if you wish, and you can also create 3D names that represent the same cell or range of cells across multiple worksheets.

Using named ranges is particularly important when a team of users are developing a complex spreadsheet, as it serves as documentation of the data.

Activity: Naming cells

1. Consider which cells in your Ria View Theatre Club spreadsheet model should be named.
2. Select the cell, range of cells or non-adjacent selections that you want to name. Click the Name box at the left end of the formula bar. In the Name box, type the name for the cells and press Enter.
3. Create a formula in some other cell, referring to the named cell or range of cells. Copy this formula down a column or across a row and check the effect of this.

File sharing

Sharing of files and data is possible, with restrictions. Having created a workbook that you want to make available for multi-user editing, you can enter any

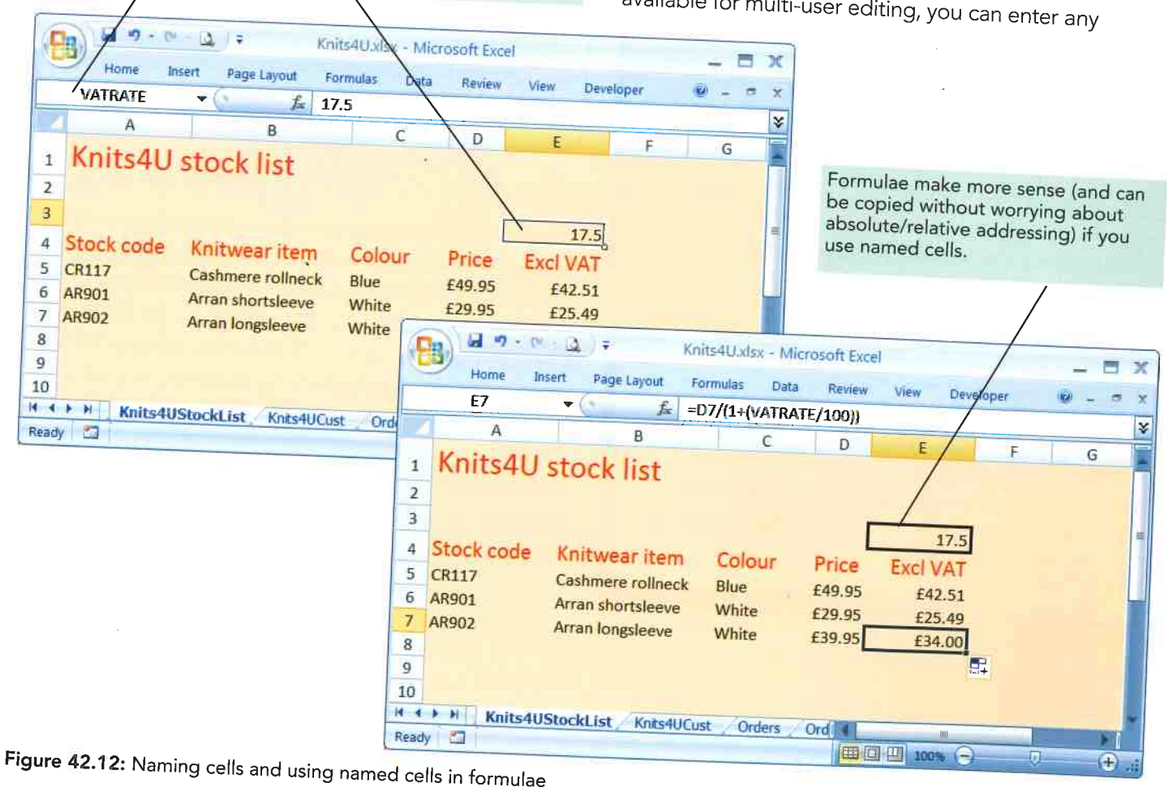


Figure 42.12: Naming cells and using named cells in formulae

data that you want to provide. Some features (such as merged cells, conditional formats and data validation) need to be incorporated prior to sharing because you cannot make changes to these features after you share the workbook.

Once you have set up the workbook for sharing, all users with access to the network will then have full access to the shared workbook, unless you use the Protect Sheet command (Tools / Protection / Protect Sheet) to restrict access.

Tracking changes

Track Changes is an option that logs any changes that are made to a shared workbook. Each user who has access to the file can view these changes. They can see when the change was made and who made the change. A user can then accept or reject the changes made.

Activity: Protecting your spreadsheet

1 Use the Help function provided with your spreadsheet software to find out how to protect or unprotect individual cells, row or columns of your spreadsheet and how you might prevent users from viewing certain rows or columns or certain formulae. Consider which cells, rows or columns of your Ria View spreadsheet model you need to protect, and apply that protection.

2 Find out how to prevent users from making changes to items that are part of a chart, such as the data series, axes and legends. Consider where you might include a chart in your Ria View spreadsheet model, include a chart and apply protection to it.

3 Find out how to control the size and position of the windows and prevent users from moving, resizing or closing the windows. Consider where you might want to exercise such window control within your Ria View spreadsheet model.

Security issues

Giving access to a workbook to other users introduces security issues.

- Who should have access?
- What level of access should they be given?
- What particular elements of the spreadsheet model need to be protected from change by other users?

Excel® offers a wide range of protection options.

User interface

The design of the user interface must take into account the needs of your intended user(s) and include appropriate user interface features such as data entry forms (page 286) and error trapping (page 289) via prompts and error messages.

Activity: Security and the user interface

1 Review the user interface for your Ria View spreadsheet model. Is it straightforward for a user to enter the data without error?

2 Produce some sample worksheets to demonstrate the error trapping techniques that you have employed.

Add-ins

Excel® offers many **add-in** programs (see Figure 42.13). Some are available when you install Excel® and others are available from the Microsoft® Office website.

The add-in is installed on your computer (as a .xla file) and then loaded into Excel®. Once loaded into Excel®, it becomes a feature and can be used like any other feature. Any commands that are associated with the add-in appear automatically on appropriate toolbars and menus.

Why not have all available add-ins present, all the time? The reason is that they take up space. So, to conserve memory and improve performance, it is wise to unload add-ins that you don't use or use only rarely. Unloading an add-in removes its features and commands from Excel® (although the add-in program remains on your computer so you can easily reload it when you next need it).

Key term

Add-in – installed functionality that adds custom commands and new features to an application such as Excel®.

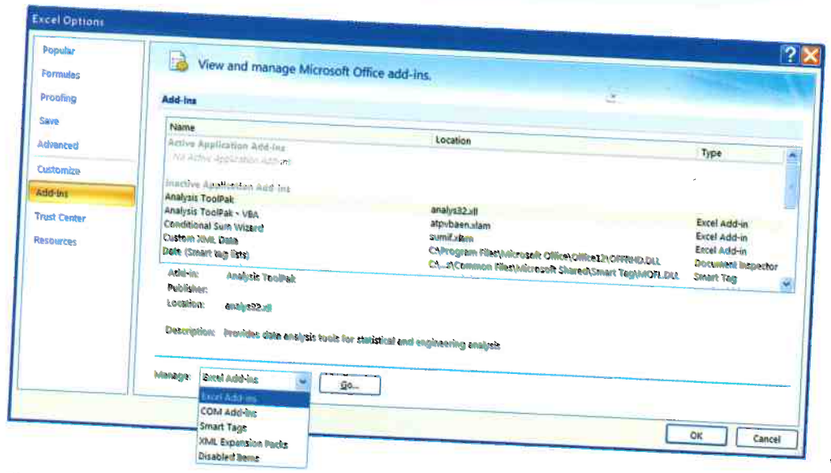


Figure 42.13: Excel® add-ins

Built-in functions

Excel® provides many built-in functions and these can be sub-grouped by type, for example: cell functions (such as SUM; see Table 42.2 on page 292) and logical functions (such as SUMIF; see Table 42.3 on page 292), LOOKUP functions (see below), text functions (see Table 42.4) or statistical functions (such as AVERAGE; see Table 42.5 on page 298).

LOOKUP function

The LOOKUP function – to be used with a lookup table – has two syntax forms: vector and array. The vector form of LOOKUP looks in a vector for a value and returns a value from the same position in a second vector.

The array form of LOOKUP looks in the first row or column of an array for the specified value and returns a value from the same position in the last row or column of the array.

The LOOKUP function is useful when:

- you have a table of values that may change at some later date, and which you therefore do not want to embed within a formula
- the value you want depends on the contents of a cell, and this also varies.

The values that you want to look up might be in the same worksheet or in a completely different worksheet within the same spreadsheet.

Text functions

Text functions act on the textual content of cells and can be used, for example, to change the case of text.

Table 42.4 shows how the text string 'jenny Lawson' (in cell A1) is displayed according to the text function that is used in another cell (A2).

In A1	Text function in A2	Result displayed in A2
jenny Lawson	=UPPER(A1)	JENNY LAWSON
	=LOWER(A1)	jenny lawson
	=PROPER(A1)	Jenny Lawson

Table 42.4: Example text functions

If you are not sure which function you need, Excel® provides help. Select Formulas / Insert Function and type a brief description or look through the lists of functions available.

Statistical functions

The usual mathematical operators (+, −, *, /) and many others, such as the percent sign (%) and the caret (^) for exponentiation, can be used within any expression for a formula to perform an arithmetical calculation.

In addition, Excel® offers many statistical functions some of which are listed in Table 42.5.

Statistical function	What it does	Syntax
AVERAGE	Returns the average of its arguments	`=AVERAGE(number1,[number2],...)`
COUNT	Counts how many numbers are in the list of arguments	`=COUNT(value1,[value2],...)`
FORECAST	Returns a value along a linear trend	`FORECAST(x,known_y,known_x)` Where x = the data point for which you want to predict a value, known_y = the dependent array or range of data and known_x = the independent array or range of data.
INTERCEPT	Returns the intercept of the linear regression line	`INTERCEPT(known_y,known_x)`
MEDIAN	Returns the median of the given numbers	`MEDIAN(number1,number2,...)`
SLOPE	Returns the slope of the linear regression line	`SLOPE(known_y,known_x)`
STDEV	Estimates standard deviation based on a sample	`STDEV(number1,number2,...)`
TREND	Returns values along a linear trend	`TREND(known_y,known_x,new_x,const)`

Table 42.5: Statistical functions

Finding data

The Find&Select function within Excel® is more powerful than that offered in, for example, Word®. Instead of simply searching on a match of a string of text, you can search for cells which contain a formula, for those that have comments attached or those for which validation has been specified.

Activity: Functions

1. Find out which add-ins are available and experiment with installing an add-in and using it.
2. Review your understanding of the built-in functions, in particular the LOOKUP function, some text functions and some statistical functions.
3. Consider how you might use built-in functions within your Ria View spreadsheet model. Prepare sample worksheets to show what your built-in functions do.

2.5 Refine

Having designed a spreadsheet model, the final stage is to consider refinements.

Improving efficiency

Efficiency could be improved by including **shortcuts** or aiding navigation.

Users of Microsoft® software have the option to set up a Quick Access Toolbar and to include the most frequently used commands on that toolbar, such as Save and Print. This saves the user clicking several times on various drop-down menus to achieve a particular outcome. If a shortcut saves just one click whenever the user wants to do something, over time the user will work more quickly.

Similarly, by grouping commands in a way that makes sense to the user's needs, such aids to navigation improve efficiency.

Key term

Shortcut – an icon which, when double clicked, opens an application

Formatting

While you may have already decided on the formatting of data within cells, what have you decided about the formatting of output?

- What fonts will you use for reports?
- What page orientation provides the best view for the reader?
- What headers and footers will you include on reports?
- How much of the spreadsheet is to be printed, ie what is the print area?
- Have you made good use of colour?
- Have you considered conditional formatting so, for example, 'bad' news appears in red?

Assessment activity 42.2

P2 P3 P4 M1 M2 BTEC

1. Develop a complex spreadsheet model to meet the needs of the Ria View Theatre Club (or some other organisation) P2. This will involve the use of formulae, features and functions to process information P3 and refining the complex spreadsheet model by changing rules and values. M1
2. Use appropriate tools to present data from your chosen spreadsheet model (or another that your tutor gives to you) P4 and analyse and interpret data from the spreadsheet model. M2

Grading tips

- Make sure that your spreadsheet model meets the 'complex' criteria and exhibits some aspects of complexity such as multiple worksheets (with links), complex formulae (for example at least two-step process), large data sets, cells linkage, data entry forms (for example menu systems, list boxes, drop-down boxes, event controls), data validation, error trapping, lookup tables, nested IF functions, templates and cell protection. P2
- Check that you have incorporated some of the required range: relative references, absolute references, logical functions (eg, IF, AND, OR, NOT, SUMIF) correct operators, named ranges, file sharing, track changes, security issues, user interface, add-ins, built-in functions, for example cell functions, LOOKUP functions, text functions, statistical functions and finding data. P3
- You will create charts and graphs from numeric data sets. This can be either the same data used in different graphical images or a number of different charts or graphs created from different data. Make sure your charts and graphs are fit for purpose, ie are of the appropriate type according to the type of data being presented, that they include appropriate titles, labels and axis scales and that you choose suitable colouration. P4
- Think about refinements such as introducing shortcuts or other methods to aid navigation, and improving the presentation by applying different styles and formatting techniques – all of which should make the spreadsheet model more presentable and user friendly. M1
- You might use sub-totals or pivot tables, data sorting and data comparison techniques (trends for example) to interpret a complex spreadsheet model. M2

PLTS

When you are identifying questions and creating a spreadsheet to resolve a problem using formulae and functions, you are demonstrating your skills as an **independent enquirer**.

When you are generating ideas and exploring possibilities to customise part of a spreadsheet to meet a given need, you are demonstrating your skills as a **creative thinker**.

Functional skills

When you are developing a complex spreadsheet model to meet particular needs, you are demonstrating that you can select, interact with and use **ICT** systems safely and securely for a complex task in no-routine and unfamiliar contexts.

When you are using formulae, features and functions to process information, you are demonstrating that you can enter, develop and refine information using appropriate software to meet the requirements of a complex task.

When you are using appropriate tools to present data, you are demonstrating that you can combine and present information in ways that are fit for purpose and audience.

3 Be able to automate and customise spreadsheet models

One of the main advantages of spreadsheet software is that it can be customised to meet the needs of the intended user as closely as possible and parts can also be automated.

3.1 Sorting and summarising data

Sorting will show the same data in different ways, enabling easy analysis and interpretation of the data within a spreadsheet model.

It is possible to sort the data in one column of a spreadsheet while leaving the rest of the data in place. However, if each row represents a record and each column a field, then sorting in this way destroys the integrity of the data. So, if the cells contain material that needs to be kept together in rows (or columns, depending on your design), it is important to expand the selection.

Sorting allows you to identify the smallest and largest items (at the start and end) and, provided some sensible ordering has been used, when it is graphed sorted data may indicate a trend.

Use of sub-totals

Faced with a lot of data, statisticians tend to try to find representative data, such as an average, which can be used to describe all the data using just one item of data. Such single numbers can give a lot of information to the reader.

Another type of single number that can inform the reader is the **sub-total**.

When presented with the sales figures (say) for every day in the year, it can become difficult to spot a trend. However, if the data is summed so that sub-totals of sales (for example weekly, monthly, for particular days of the week or according to lines of stock) are presented within the spreadsheet model, a trend can be established.

Case study: Knits4U (6)

The revenue figures for sales of particular garments are presented to the management every month so that the most popular stock lines can be identified and any lines for which sales have dropped to an unacceptably low figure are reviewed. Questions are asked:

- Is the style now so out of date that the line should be discontinued?
- Might sales increase if a different range of colours – but in the same style – were offered?
- If stock remains, should it be offered at a reduced price in the next brochure mailing?

1 Review your Ria View spreadsheet model. Where might you include sub-totals?

2 Having included sub-totals, what questions might be raised from the additional information provided by these sub-totals?

Pivot tables

A **pivot table** report is most useful when you want to analyse related totals. Each row and column (or field) in your source data becomes a pivot table field that summarises multiple rows of information as shown in Figure 42.14.

Key terms

Sorting – rearranges the data (eg in one column of a spreadsheet) into a sequence such as alphabetical or numerical, ascending or descending.

Sub-total – the sum of some data, which together with other sub-totals makes a grand total.

Pivot table – an interactive table that combines and compares data. The rows and columns can be rotated (pivoted on a cell) to produce different summaries of the source data.

Filtering – extracting data according to some criteria, eg all the data relating to one particular sales person or product.

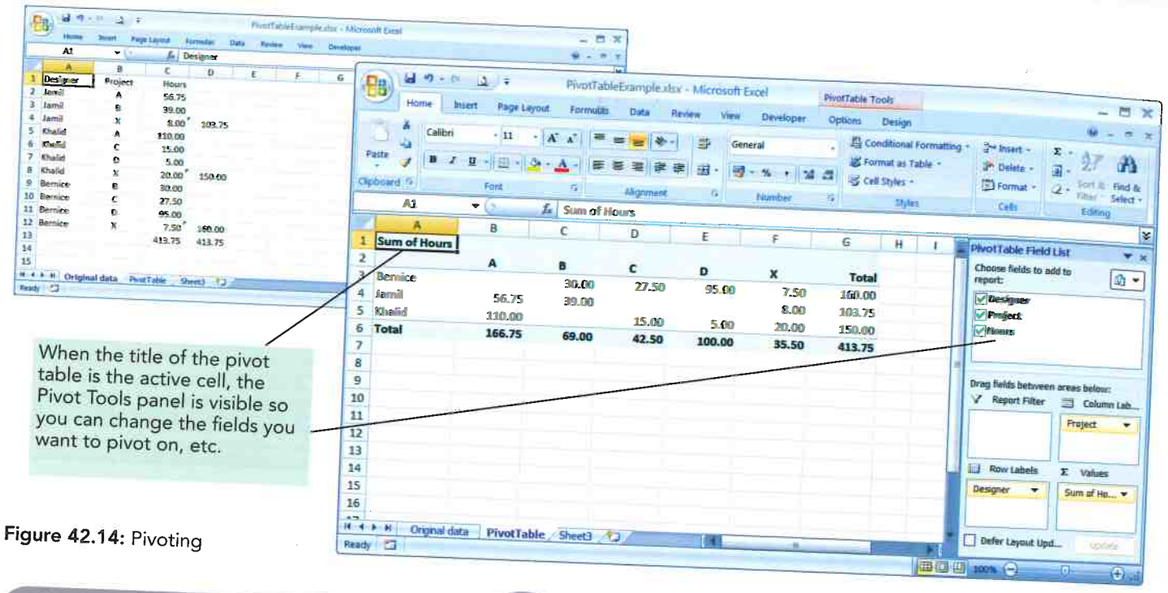


Figure 42.14: Pivoting

Activity: Pivot tables

1 Choose a spreadsheet that has six or more columns/fields and at least ten rows of data and choose fields on which you might pivot the data.

2 Experiment with creating pivot tables – but use separate worksheets so that you also demonstrate your skills in linking data between worksheets.

Activity: Sorting on multiple fields

1 Choose a spreadsheet that has six or more columns/fields and at least ten rows of data.

2 Decide on three 'important' fields and experiment with sorting the data according to these three fields.

3 Compare the results which you get by changing which field is sorted first, second and third.

Sorting data on multiple fields

Having learnt how to sort on one field, for more complex data you might need to sort on multiple fields. The order in which you sort the fields can affect the outcome though.

Filtering data sets

Filtering is one way of finding a subset of data from a list. It focuses on one aspect of the data and allows the user to ignore data which does not meet some criteria. The filter can therefore be used to extract information to meet a specific user need (see Figure 42.15).

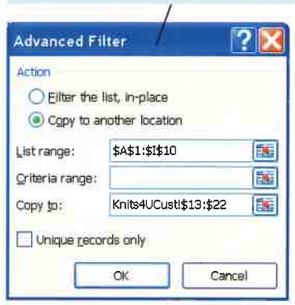
The filtered list displays only those rows of the list that match the criteria that you specify for a particular column. None of the data is lost – it is just hidden from view while the filter is on. To remove the effect of filtering, deselect Data / Filter.

3.2 Tools

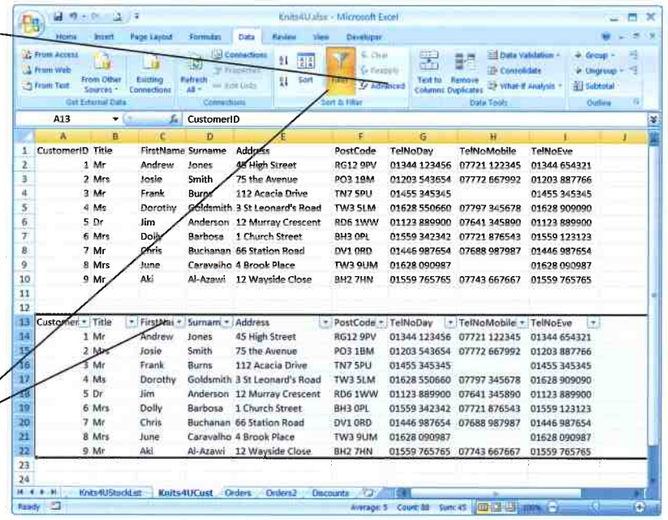
Numeric data is harder to interpret than graphical representations of the same data. Statisticians rely on graphical representation of data because the shape of a graph can say a lot about the general trend of the data.

Fortunately, spreadsheet tools are available to present data graphically – as charts and graphs.

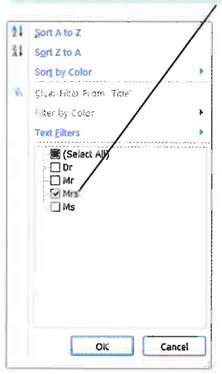
To show the before and after effects of filtering, the first step is to copy the original data from one place to another, using the Advanced Filter option on the Data menu.



Highlighting the copied data and clicking on the Filter button results in drop-down buttons appearing beside each field.



The drop-down menu for the Title field can then be completed to set the criteria for the filtering.



The net result is only those rows for which Title = Mrs.

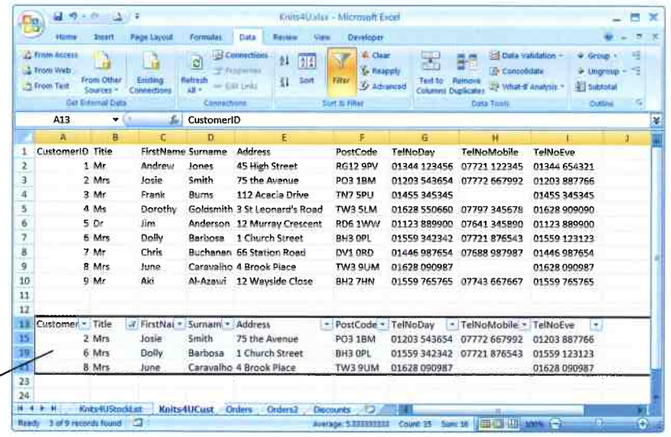


Figure 42.15: Filtering

Titles

Although the chart or graph may give an instant impression of the data used to generate it, the audience also need to know, in a condensed way, what data is being represented.

A title is therefore essential and should include a description (such as 'sales figures') and an indication of the date or time period to which the data relates (for example, 'for the year to 28 February 2011').

Labels

Within the chart or graph there will be axes that need careful labelling so that, for example, the axes scales are immediately clear to the reader. By clever choice of colours and annotation of any **legend**, you can also increase the accessibility of the chart or graph.

Select appropriate type

Excel® provides a wide range of graphical representations (see Figure 42.16) and wizards for each one to help you to enter all the relevant parameters.

It makes sense to use the wizard to set up a chart or graph and then fine tune it so it shows exactly what you want. However, to create output that suits the requirements of the user and/or the audience, you must take care to use the type of chart that matches the data: **categorical** or **ordinal**, **discrete** or **continuous**.

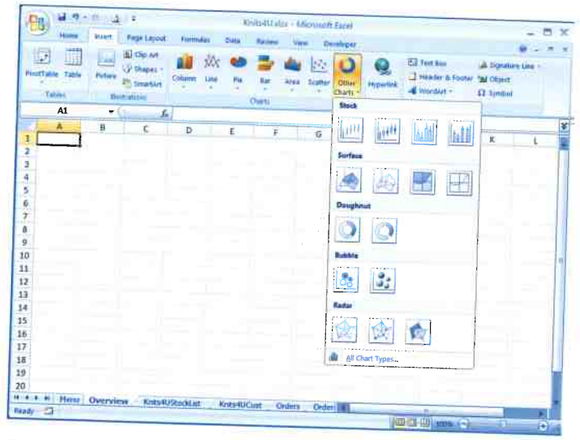


Figure 42.16: Graphical options available in Excel®

Key terms

Legend – (also called a key) an explanatory box that identifies the patterns or colours that are assigned to the data series or categories in a chart.

Categorical data – data that has separate categories, and that has no natural ordering.

Ordinal data – data that has a definite ordering, eg from smallest to largest, or oldest to newest.

Discrete data – data that takes values, but not the values between them. For example, shoes sizes are 4, 4½, 5, 5½, 6, 6½, 7 and so on. There is no shoe size between a 4 and a 4½.

Continuous data – data that can take a value anywhere on a number line. For example, time is a continuous variable, as are height, length and weight.

Here are some basic rules as to which charts suit which types of data.

- **Line graphs**: useful to display trends in continuous data. If a graph is used for discrete data (such as shoe sizes), the points should not really be joined, because the values between the discrete values are unachievable – but often the points are joined to show some trend.
- **Bar/column charts**: best for discrete ordinal data, such as shoe sizes. For discrete data, the bars should not touch. If a bar chart is used for continuous data, the bars should touch and the chart is then called a histogram.
- **Pie charts**: best for categorical data, such as colour of front door or make of car.
- **xy (scatter) graphs**: used to plot instances of a pair of variables such as height against weight of a class of learners. None of the points should be joined to any other but any cluster effects with points close to each other or lying along a general trend line show that there is some correlation between the two variables.

3.3 Presenting

This section focuses on two aspects of presentation: combining information and maintaining data.

Combining information

Often, a single source of data is not sufficient to inform the reader or to support an argument. Instead, you may need to bring together two or more sources of information. For example, you may show the results of a survey presented as the numerical data and totals, together with a pie chart of relevant results, to present the reader with the full picture. Such combining of information is an essential part of presenting complex data.

Maintaining data

Sometimes, it is not practical to keep large worksheet models together in the same workbook. Instead, you can set up several worksheets and link them.

For example: in a spreadsheet, one worksheet contains the current selling prices of products and another worksheet shows a forecast of turnover based on those prices. Unless suitable links are set up between the two worksheets, a change in the prices of products would mean that someone has to make a change to the data in the turnover worksheet too. Two sets of changes double the risk of input error and the time delay between the two entries means that the data is inconsistent for that period of time.

If, however, the data is held in a number of worksheets (or workbooks or software packages) that have been linked, any changes to one sheet will automatically impact on the data on other sheets. This will maintain the currency of all the data so you can be sure of an accurate and up-to-date forecast of turnover.

3.4 Analysing and interpreting data

Having presented the data in a more meaningful way (in a sensible order, with subtotals as appropriate), you can help your readers if you go one step further in analysing and interpreting the data for them.

- Converting data to charts or graphs instantly reveals trends in the data and is more meaningful to the reader (see above).
- With lists of data, techniques such as filtering and sorting (see page 301) serve to focus attention on relevant data and to present it in a sensible order to the reader.
- Trends are more easily noticed if data has been presented as a graph and trend analysis is then possible too (see page 303).
- Patterns in the data are also most easily spotted if the data is presented graphically.
- Data analysis is achievable using statistical formulae, calculating sub-totals (see page 300) and averages and so on.
- Results that you discover during the analysis stage need to be pulled together in the presentation so that the reader can see, at a glance, what the data tells you.
- Conclusions are also necessary to summarise what has been achieved, what the data proves or demonstrates and to draw to a close the report.

3.5 Customisation

oftware applications are designed to suit everyone nd yet every problem is different and every user as differing needs. So, tools are provided to low you to customise the spreadsheet model to lve the user's specific problem and to meet their rticular needs. In this section, we look at two oes of tools: those which allow you to apply some curity measures to restrict access and some others ich allow you to create a relevant user interface h appropriate validation and the best working vironment for the user.

estricting data entry

me cells on a worksheet – and perhaps entire rksheets – may contain material that you do not nt the end user to access and/or change. If that is the case, you might want to restrict data entry. There are two main methods open to you:

- **locking cells** so the user can view them but not change the contents of them
- **hiding cells** (also rows and columns) so that the user is not even aware they are there.

The method of locking cells involves unlocking the cells that you want them to be able to change and then protecting the whole sheet using a password.

Modifying toolbars and menus

The software that you use to develop a spreadsheet model provides all the tools that you need to change the structure of the worksheet, to format the data and to present the data graphically. These features appear in toolbars and menus.

The end user of your spreadsheet model does not need all these tools. Indeed, you may prefer to restrict the user's actions by reducing the number of features available within the software. For example, to prevent users from copying and filling data by dragging and dropping cells, clear the Enable fill handle and cell drag-and-drop check box (Excel® Options dialog box, Advanced options), and then protect the worksheet.

The Ribbon, which is part of the Microsoft® Office Fluent user interface, is designed to help users quickly find the commands needed to complete a task. Commands are organised in logical groups that are collected together under tabs. It is not possible to customise the Ribbon without using XML and programming code but you can customise the Quick Access Toolbar to add buttons that represent the commands that you frequently use.

Checking data

To make a spreadsheet robust, the designer needs to incorporate methods of data validation (see page 287) which will prevent the user entering data – or omitting to enter essential data – either of which could adversely impact on the design or content of the spreadsheet model.

Data validation establishes limits on data so that the user is limited to entering data within some range or matching an entry in a list. In Excel® this is accessed through the Excel® Options dialog box, Advanced options.

If you want to insist the user enters something into a cell, ie to reject handle blank (null) values, you need to clear the Ignore blank check box (see Figure 42.7 on page 288).

Did you know?

Data validation is designed to show messages and prevent invalid entries only when users type data directly in a cell. When data is copied or filled, the messages do not appear. So, for validation to work, you need to customise the menus to prevent Copy or Fill being used.

Error messages

Error messages should give sufficient information to guide the user towards entering correct data. Simply displaying 'INVALID DATA' will not be useful! Instead, explain what is expected and invite the user to try again. See, for example, Figure 42.7 on page 288.

Activity: Customisation

1 Identify cells within your Ria View spreadsheet model that ought to be locked and other cells that ought to be hidden from the user's view. Consider also whole rows and columns that should be protected.
2 Check that you are confident with locking and unlocking cells so as to protect your spreadsheet.
3 Decide what options you would not want the end user to have and disable these options.
4 Experiment with customising the Quick Access Toolbar.
5 Review the validation that you have put in place for the Ria View spreadsheet model. Is it robust enough?
6 Revise the Ria View spreadsheet model so that at least one data entry field requires data to be entered.
7 Review the error messages that you have incorporated within the Ria View spreadsheet model. Are they informative to guide the user towards entering correct data?

3.6 Automation

The end user of a spreadsheet may be proficient in using the software, but the more that you automate processes, the easier it should be for the user.

Macros

If a task is to be repeated, it can be automated with a **macro**.

When you record a macro, Excel® remembers data about each step you take (what menu options you choose, what values you select, and so on) and stores this information about the macro in a new module attached to your workbook. When you run the macro later, it plays back the commands – including any mistakes you might have made when recording it!

Within the user interface, you can automate procedures by providing buttons for the user to press. The event of a particular button being pressed then initiates the appropriate procedure.

For the procedure to happen when the user clicks on the button, you first have to create a macro and then assign the macro to the button. The same macro could be assigned to more than one button in your spreadsheet model, so if there are actions that are used frequently, plan your macros carefully.

Did you know?

Microsoft® Excel® provides safeguards that help to protect your computer against viruses that can be transmitted by macros. If you need to share macros, they can be certified with a digital signature so that other users can verify that each macro is from a trustworthy source.

Key terms

Locking cells – restricting access to a cell so that it can be viewed but not changed by particular users.

Hiding cells – a protection mechanism that prevents the user from seeing a cell. As long as there is no option to unhide it, the cell is protected. You can hide entire spreadsheets from the user.

Macro – a series of commands and functions that are stored in a Microsoft® Visual Basic module and can be run whenever the user needs to perform the task.

ActiveX® control

Within your spreadsheet design, you may decide to include command buttons (on a menu page), list boxes (as part of your validation) and dialog boxes (to communicate prompts and error messages to the user). These are all examples of ActiveX® controls – small program building blocks – which were designed so that applications could work over the Internet through web browsers. ActiveX® control can be written in Visual Basic® but Excel® provides some via the Toolbox.

Did you know?

ActiveX controls are similar to Java applets in that programmers designed both mechanisms so that web browsers could download and execute them. However, they differ in that Java applets can run on nearly any platform, while ActiveX components officially operate only with Microsoft®'s Internet Explorer® web browser and the Microsoft® Windows® operating system.

Control Toolbox

Every component on a form is a control and the Control Toolbox offers both ActiveX® controls and others which cannot be viewed using a browser. See Data entry forms on page 286.

Visual Basic®

After you have recorded a macro, you can use the Visual Basic® Editor to view the code you have generated and to correct errors or change what the macro does. The Visual Basic® Editor is designed to make writing and editing macro code easy – plenty of online help is provided so it is not necessary to learn how to program or use the Visual Basic® language to make simple changes to your macros.

Did you know?

As well as editing the macro code, the Visual Basic Editor also allows you to copy a macro – such as printing or formatting – from one module to another. You could even copy macros between different workbooks. If you need to, you can rename the modules that store the macros or rename your macros.

Assessment activity 42.3

P5 P6 M3 BTEC

1 You are to customise a spreadsheet model to a given requirement. Your tutor will guide you as to what spreadsheet model to customise and brief you on the requirements of the end user. P5

2 You are to use automated features in a spreadsheet model to meet a given requirement. Your tutor will guide you as to what spreadsheet model to automate and brief you on the requirements of the end user. P6

3 Your end user is pleased with what you have done to automate the spreadsheet model but would like to understand more about the methods of automation that you have used and those you chose not to use. Prepare a presentation for such an end user comparing the different automation methods. M3

Grading tips

- Examples of customisation include restricting data entry, for example hiding information, protecting worksheets and cells, modifying toolbars and menus, checking data, for example data validation, range checking, not NULL and display error messages. P5
- Develop the spreadsheet model further by implementing automated features, such as macros, ActiveX® control, Control Toolbox or Visual Basic®. P6
- In the presentation define and explain by examples a range of different automation methods, ie macros, ActiveX® control, Control Toolbox and Visual Basic®. M3

PLTS

When you are generating ideas and exploring possibilities to customise part of a spreadsheet to meet a given need, you are demonstrating your skills as a **creative thinker**.

Functional skills

When you are developing a complex spreadsheet model to meet particular needs, you are demonstrating that you can select, interact with and use **ICT** systems safely and securely for a complex task in non-routine and unfamiliar contexts.

4 Be able to test and document spreadsheet models

4.1 Test

A spreadsheet model is only useful if it meets the needs of the intended end user(s) – and works! Testing your spreadsheet model is therefore an essential part of the development process.

Your testing of the spreadsheet model

There is a lot to be considered during the process of testing your spreadsheet model.

- As a belt-and-braces check, you would be advised to perform manual calculations of all formulae in your spreadsheet model, paying special attention to those that involve functions.
- You should trial every data entry form, making sure that every field within that form has been set up with appropriate validation checks.
- You could build in **cross-cast checks** to help test the calculations within worksheets. For example, calculating the total sales for a team of salespeople over twelve months, with one calculation by month and another by salesperson; the two totals should tally.

Key term

Cross-cast check – doing a calculation in two different ways and checking that the two totals are the same.

- To make sure you have the correct outcomes in terms of layout and displayed values, check that your data is displayed at the appropriate level of detail: for example, to the nearest penny for currency or to the nearest £1000 for larger amounts of money.

Case study: Knits4U (7)

Apart from manually checking each calculation, or using a calculator, the developer of the Knits4U spreadsheet model built in checks to make sure the calculations are correct. Figure 42.14 on page 301 shows intermediate values in column D of the Original data worksheet, plus a total of those intermediate values in cell D13. This tallies with the value in cell C13.

1 In your Ria View spreadsheet model, identify at least one place where intermediate values might be displayed and where a cross cast could be used to verify calculations.

2 Consider situations that might cause the checking values not to match. Ask yourself: What could you do to prevent this happening?

- Last but not least, you must bear in mind that the spreadsheet model has been developed for an end user – a client with particular needs – and you must ask yourself whether your model meets the 'suitability for client' check.

User testing

Ideally you, the designer, will have created a sound spreadsheet model with correct calculations so that whatever data is entered, the correct results should be produced. Once the design is complete though, the user also needs to test that the results are as expected.

Test plans

Whether it's the designer or the end user who is testing a spreadsheet model, a test plan should be drawn up listing precisely what will be tested and then, during the testing, what happened (see Table 42.6).

WORKSHEET LEVEL TESTING	Date tested	Notes	Issues to be investigated further
Check layout and content of each worksheet Sheet 1 Sheet 2 ...			
Check formulae within each worksheet Sheet 1 Sheet 2 ...			
Check formulae that link worksheets Sheet 1 Sheet 2 ...			

MENU LEVEL TESTING	Date tested	Notes	Issues to be investigated further
Check layout and content of each menu Main menu New customer menu New product menu ...			
Check links from each menu Main menu New customer menu New product menu ...			
Check formulae that link worksheets Main menu New customer menu New product menu ...			

Table 42.6: Example test plan

The material put through the system should include normal data, **extreme data** and **erroneous data**, so that all situations are properly tested.

Key terms

Extreme data – data at the upper and lower acceptable limits.

Erroneous data – data that is not valid.

Activity: Testing

1. Identify the tests you should carry out on the Ria View spreadsheet model to make sure it works.
2. Invent examples of normal, extreme and erroneous data that can be used for testing purposes.
3. Carry out testing and record what happens on your test plan.

4.2 Feedback

Feedback on the success, or otherwise, of your spreadsheet model will help to inform future designs. Depending on the circumstances, there are various approaches to obtaining feedback:

- For a project with a large number of end users, you might conduct a survey. This could be online and the request to complete this survey might pop up when they start to use the application.
- The survey might be presented as a questionnaire, which the end user completes after using the application for a while.
- If there are not many end users, you might conduct one-on-one interviews or group interviews, possibly using the questions within your questionnaire as a prompt to the discussion.

Having gathered the feedback, the next stage is to analyse the results, take on board all criticisms of the developed spreadsheet model and then to make recommendations as to how – going forward – the model might be refined to better meet the needs of the end user. Such refinements take time, may delay the implementation of the spreadsheet system and may also involve additional costs to the end user. All this has to be negotiated and agreed before further development commences.

Activity: Feedback

Your tutor will supply you with a spreadsheet model and your task is to evaluate the spreadsheet and to give feedback.

With others in your group, collate this feedback, analyse the results and make recommendations as to how the spreadsheet model could be improved.

4.3 Alternative formats

Spreadsheets can be saved in a number of different formats, such as:

- xls (Excel® spreadsheet)
- csv (comma-separated variable)
- txt (text)
- xms (extended memory specification)
- html (hypertext markup language, as used for web pages).

CSV is one of the most useful formats – it can be read by many applications, so data created in one type of spreadsheet software can easily be exported to other programs.

Activity: Alternative formats

1. Experiment with exporting from Excel® to alternative formats and then retrieving the data from other applications.
2. Make notes on any limitations that you discover and share these with others in your class.

4.4 Documentation

As with all IT projects, documentation is essential so that those coming to the project after the designer has moved on can see what was done and why. If further development is to be undertaken, it can be done without upsetting what is already in place.

Documentation falls into two distinct types.

- **User documentation**: This provides instructions to those who have to use the system and may be provided in the form of a guide, which can be used for troubleshooting.
- **Technical documentation**: This focuses on the hardware and software resources and is written for the benefit of future IT professionals who might have to amend the spreadsheet model or develop it in some way.

With technical documentation particularly and user documentation to a lesser extent, there should be instructions as to how the systems can be worked, details of all calculations (the formulae and functions used within worksheets) and the validation procedures that have been put into place.

Assessment activity 42.4

P7 P8 P9 M4 D2

BTEC

1 Your tutor will provide you with a spreadsheet model that is to be tested to ensure it is fit for purpose. You will check the accuracy of the spreadsheet model and present your evidence in the form of a test plan. P7

2 Select a spreadsheet model – or use one provided by your tutor – and export the contents of the model to an alternative format. P8

3 Document your spreadsheet model by producing both user documentation and technical documentation. P9 M4

4 Your tutor will advise you which of your spreadsheet model designs you are to evaluate. You will incorporate feedback from others and make recommendations for improvements. D2

Grading tips

- Make sure the functionality works as required and that the calculations are accurate. Check the data validation, and that data has been displayed to appropriate levels of detail (for example, currency to two decimal places). Record what you tested and the results on your test plan. P7
- Your conversion to an alternative format could be evidenced through an observation and witness statement. You might, for example, convert to an alternative format and then import the converted file into some other relevant software. P8
- Your user documentation should include instructions on how to use the spreadsheet model, especially when navigating with user interfaces. Your technical documentation should include the required hardware and software resources, instructions and an explanation of calculations used in the spreadsheet model. P9 M4
- Reflect on your performance in building a spreadsheet model and what hurdles you have had to overcome to achieve the desired result. Did the spreadsheet model meet the given requirements? What did other people think of the spreadsheet model? Make sure your recommendations are sensible. D2

PLTS

When you are anticipating, taking and managing risks when testing a spreadsheet model, you are demonstrating your skills as a **self-manager**.

When you are inviting feedback from users when evaluating a spreadsheet model, you are demonstrating your skills as a **reflective learner**.

Functional skills

When you are evaluating a spreadsheet model, incorporating feedback from others and making recommendations for improvements, you are demonstrating that you can evaluate the selection, use and effectiveness of **ICT** tools and facilities used to present information.

WorkSpace

Khalid

Spreadsheet designer

Khalid works for Solutions UK Limited and his specialism is cost-benefit analysis, a relatively simple and widely used technique for deciding whether to make a change.

Part of Khalid's job is to identify the benefits of a course of action, add up the value of these benefits and subtract any costs associated with it. If the benefits outweigh the costs, the client is recommended to go ahead with the project. Simple!

Khalid knows that costs may be one-off or ongoing. Benefits, however, he realises are most often received over a period of time. So, in designing the spreadsheet model for a particular client, Khalid tries to build the effect of time into any analysis and he does this by calculating a payback period.

For most projects, the companies are willing to invest monies to get the project off the ground but will be looking for payback over a specified period of time – say, five years.

In its simplest form, the type of cost-benefit analysis that Khalid designs is carried out using only financial costs and financial benefits. For example, a simple cost-benefit analysis of a road scheme would measure the cost of building the road and subtract this from the economic benefit of improving transport links. It would not measure either the cost of environmental damage or the benefit of quicker and easier travel to work.

A more sophisticated approach to cost-benefit analysis – and one that Khalid aims to provide – is to try to put a financial value on these intangible costs and benefits. This can be highly subjective.

How do you put a price on the environmental importance of a copse that is home to butterflies but lies in the way of a planned motorway?

For the motorist, what value can be put on stress-free travel to work in the morning?

For those that live near the proposed route, what price do you put on air and noise pollution?

Think about it!

1 Identify a cost-benefit issue that is important to you.

2 List the costs and list the benefits. Try to put a value on each item.

3 Produce a simple spreadsheet model to show the payback period for your project.

Just checking

1. Explain the four main types of content that you may place in any one cell. What other content options does your spreadsheet software offer?
2. What is an active cell?
3. Explain these terms: categorical data, ordinal data, histogram, discrete, continuous.
4. Give two examples of spreadsheet models that forecast the future.
5. Why are spreadsheets useful for statistical analysis?
6. What is a representative value?
7. Explain these terms: ordering, sorting, filtering, hide, lock.
8. What is a pivot table? What does it mean to pivot a table?
9. Explain how you can protect the integrity of data during a sort.
10. What kind of data is best presented using a pie chart? Under what circumstances might you display data as a scatter graph?
11. What is a macro? How can macros be used to customise a spreadsheet solution?

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Assignment tips

- When looking at the kinds of problems spreadsheets are used to solve, focus on the simple tasks that can be done before thinking through the more complex options. Work from the bottom up.
- When developing your own complex spreadsheet model, don't forget to pay attention to the small details: the layout of a worksheet, the detailed validation of every data entry, the design of your charts and graphs.
- Aim for automation which saves the user time – rather than just demonstrating your skills in automating. Ditto for customisation. Ask yourself: What does the user really need?
- Be thorough in your testing and write down everything that you spot during the testing process. Systematic discovery of problems and then, later, systematic solving of the faults will result in a fully working system.

Glossary

8-bit – where a single byte is used for each item of data. A byte has 8 bits, each of which can be set to a one or zero. This gives 256 different combinations of bit patterns.

A

Absolute cell referencing – allows you to copy or move a formula without the cell reference changing. By inserting a dollar symbol ($) before the letter and/or number of a cell reference you can make all or part of a cell reference absolute.

Acessibility – the ease with which websites can be accessed by users, especially referring to those with particular technologies or special needs.

ActionScript – a language used in Flash animations, for example to create buttons.

Add-in – installed functionality that adds custom commands and new features to an application such as Excel.

Administrator account – a user account that has total access rights and permissions. This allows total unrestricted access to all hardware and software resources.

Argument – a value or expression used within a function. It specifies what data is to be acted upon, the criteria that are to be applied or the resulting value that is required.

Array – a collection of variables that have a single name.

Artifacts – unwanted visible elements in a picture or animation.

Asset – any type of object within a multimedia product, such as an image, movie clip or sound file.

Autocrop – a function that trims unwanted edges from an image or animation.

Auto-increment – means adding a value (normally one) automatically and is used to describe the process of automatically assigning a value to the primary key of a new record which is the last primary key plus one. It is used where no naturally occurring primary key is available.

B

Back-out procedure – restoring the system to the state it was in before the installation took place.

Back up – to copy computer work to another place so that it is kept safe in case of emergency such as file corruption, fire, flood or theft. Many users back up to CD-ROM, then store these somewhere secure, such as a fireproof safe or off-site in another location.

Bandwidth – the capacity a network connection can conduct at one time.

Bitmap format – saves the image as a map of pixels.

Bitmap graphics – also called raster graphics, they are made from lots of pixels, each with a colour.

Black box testing – focuses on the testing of functional requirements. The test designer develops a series of valid and invalid inputs and checks for each combination to see if the output is as expected.

Blu-ray discs – a form of DVD that can store more data than other discs and allows for more detailed games.

BODMAS – order of execution of evaluation: brackets, order (that means powers!), division and multiplication (working left to right), addition and subtraction (working left to right).

Body – the part of the code where all the elements that are visible on the web page are coded.

Bureau – an organisation that carries out services, such as printing, for other businesses or clients. A design studio may not have expensive specialist printing facilities, so sends work to a bureau to make use of their printing equipment.

Business case – a proposal stating the objectives, costs and benefits of a project.

C

Cache memory – very fast electronic memory between RAM and another device, used to make the system run faster.

Call – to access a function from wherever it is stored and execute it.

Categorical data – data that has separate categories, and that has no natural ordering.

CCD – stands for charge-coupled device. It is an image sensor used in digital cameras and other devices that converts the image to digital signals.

Cel – a piece of transparent film that can be drawn on then overlaid with other cels to create a composite image.

Certificate-based authentication – a method of coding information so the people at either end are identified by a digital certificate, coupled with a digital signature. These can confirm the identity of the sender or recipient.

CGI – stands for computer generated imagery and is where computers are used to create animation to be integrated into the live action in a movie.